F - General info about maintenance, metallurgical-, heat-treatments, calculations, ect...of chains and sprockets

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Metallurgical and heat-treatment information about conveyor chains and sprockets

1. Chains (**)

- with your inquiry it is important to give the most possible information about the application of the chain you have to install. Such as product to convey, temperature, chain-speed, length of conveyor, bucket-elevator, pan-conveyor, scraper-conveyor, etc.
- with this information, we will be able to choose the adequate materials and heat-treatments for each part of the chain we will propose you.

- **engineered pin-bush-roller chain is mostly composed by 3 or 4 parts.**

1. the pin: can be made of several type of alloy steel such as: 20 Mn Cr 5 16 Mn Cr 4, 18 Ni Cr Mo 5, and some afterwards induction-hardened. This material is also recommended if breaking-load should be higher.
2. the bushing: can also be made in above mentioned materials and sometimes also in carbon-steel C15E case hardened (for normal use).
3. the roller: can be made of 9 S Mn Pb 36 steel case-hardened, in Ck45 trough-hardened and eventually in- and outside induction-hardened. Also here the rollers can be made of alloy steel, such as for the bushings.
4. side-bars are mostly made of Ck45 steel normalised at 600-700 N/mm² or with extra trough-hardening till 850-950 N/mm² to increase breaking-load. For some applications and depending heavy use, the side-bars can be made of Hardox 400 steel or Max-400 steel with high resistant properties such as resistance 1000-1250 N/mm² and hardness of 360-440 HBr. (carbon content is here only 25%).

- **concerning stainless-steel conveyor chains.**

1. pins: mostly made of Ferritic or Martinsitic stainless steel which can be trough-hardened or case-hardened. These are magnetic stainless steels such as X40 Cr 13 or X20 Cr 13. (AISI 440 or higher)
2. bush: is mostly made by Austenitic stainless steel such as AISI 304 and AISI 316 or AISI 316Ti.
3. roller-materials see material as for bush.
4. side-bars are mostly made of S.S. AISI 304 or AISI 316. For heat-resistant (till 1000-1100°C) stainless steels, please consult us.
5. stainless steel chains have a lower breaking-load in comparing with above steel chains.

(a) *all breaking-loads in this catalogue are only an indication as the breaking-load depends on the chosen materials and heat-treatments.*

- **drop-forged scraper-chains.**

1. these chain-links are mostly made of alloy steel like 20 Mn Cr 5, 18 Ni Cr Mo 5 (case hardened) and 42 Cr Mo 4 (thru-hardened). For normal use there is also available Ck15E steel (case-hardened) and Ck45V steel (trough hardened 850-950 N/mm²)
2. the pins are mostly made of 16 Mn Cr 5, 20 Mn Cr 5, 18 Ni Cr Mo 5, 42 Cr Mo 4 and lightly corrosion resistant AISI 420-430 steel.
3. the scraper-blades can be made of St.37, St.52 or Hardox 400 steel.

(a) *drop-forged chains can also be made of stainless-steel.*

2. Sprockets (**)

- sprockets are available in a lot of executions, sizes and shapes, depending the application. In bucket-elevators and heavy conveyors such as pan-conveyors, apron-feeders, etc., it is recommended to use sprockets with replaceable segments or teeth. These segments are made of Ck45 steel or 42 Cr Mo 4 alloy steel with induction-hardened teeth. Sometimes these segments can be made of Hardox 400 steel. The hubs are made of St.52 steel or Ck45 steel.
- for smaller conveyors or for transmission-use, sprockets in 1 single piece can be used.

3. About other chain-types

- **round-link steel chains, shackles and sprockets.**

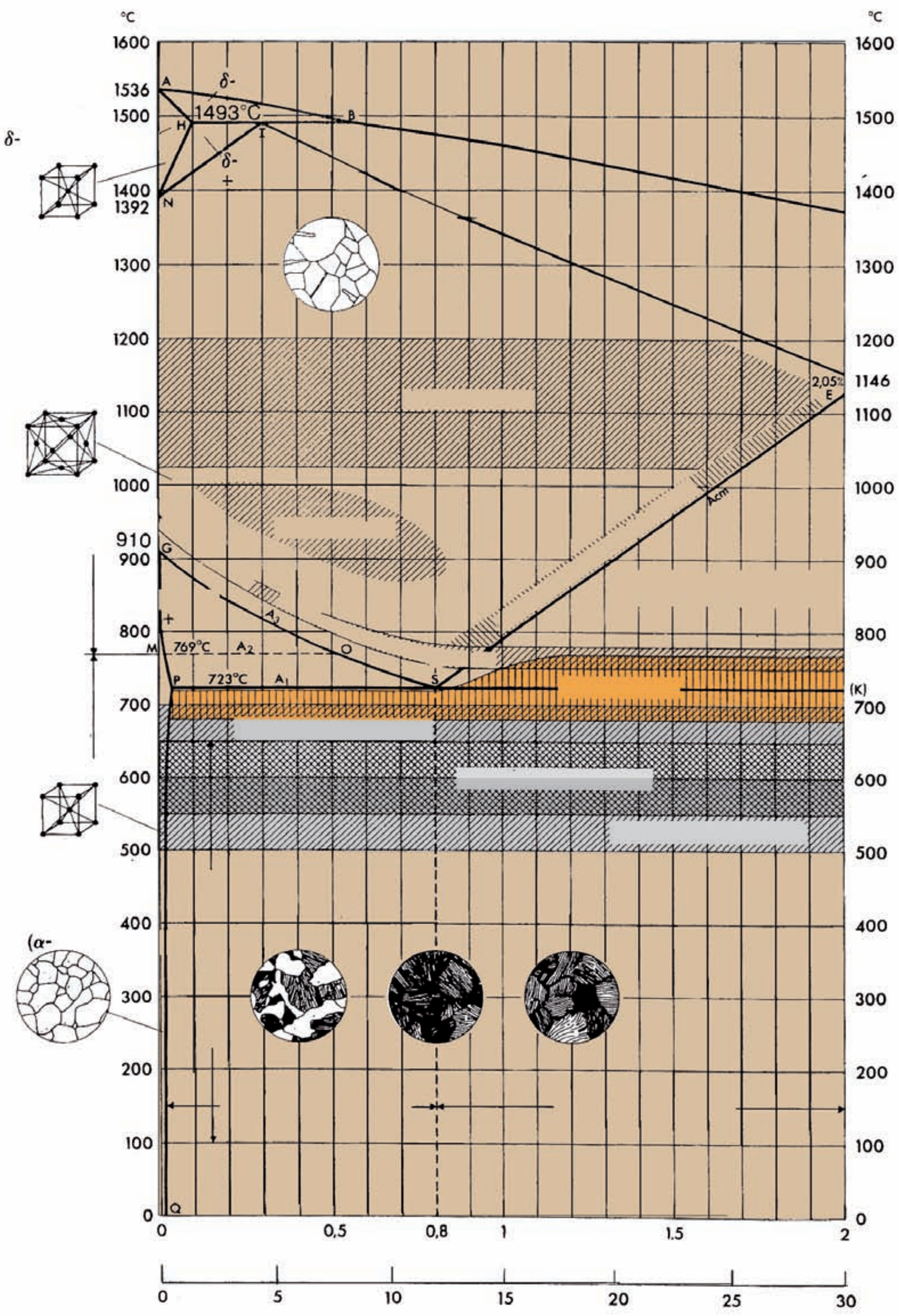
  For materials, heat-treatments and executions, please see chapter "round-link chains".

- **cast chains:**

  cast chains are only used for very typical applications and are mostly replaced by drop-forged chains. Anyway, we can supply cast drag-chains mostly made of 12-13% manganese steel (DIN 1.3401). Tolerances according DIN 1683 GTB 17.

(*) here-after you will find diagrams of some heat-treatments.
(**) for more information, please contact us.

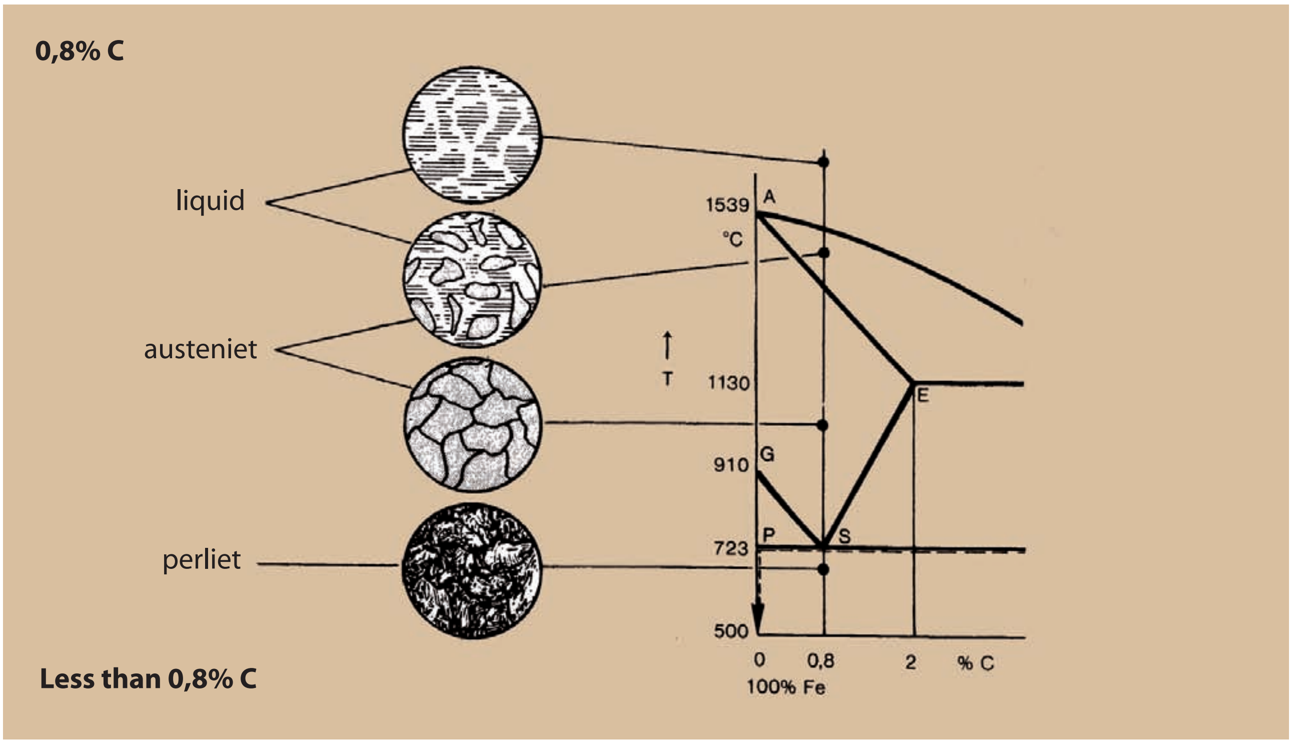
Ferro-coal content diagram (partly)

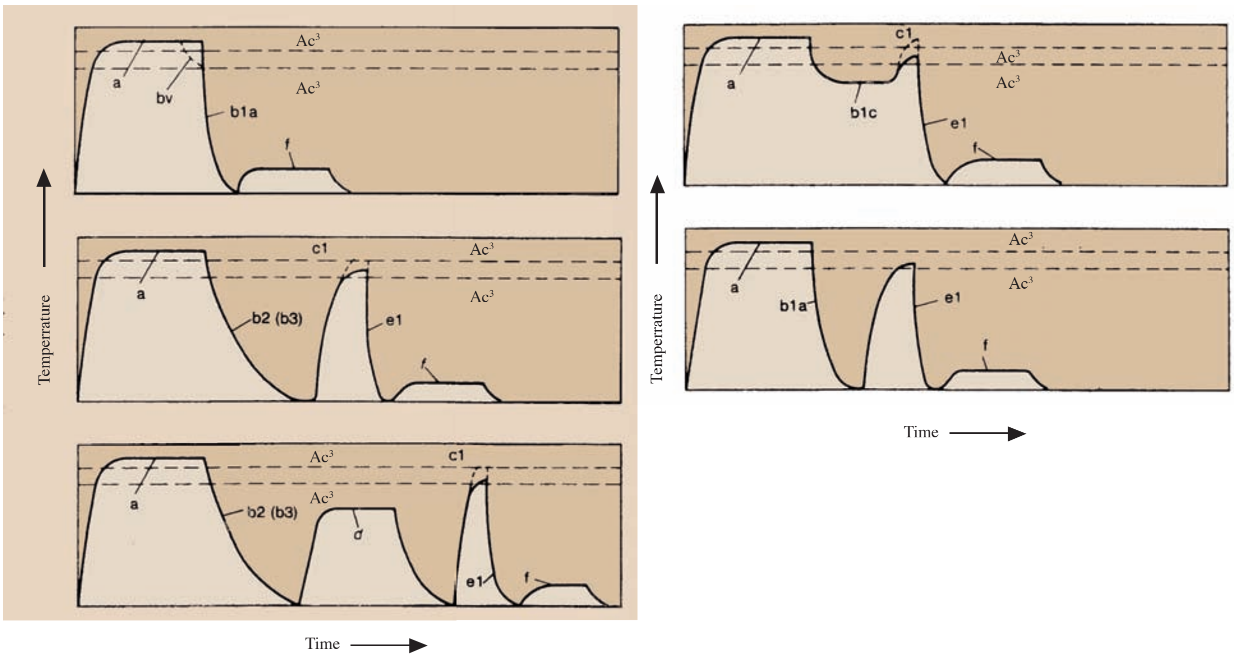


GENERAL INFO

Fe C diagram

Influence of carbon-content

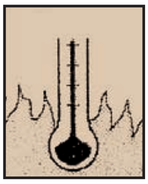




T.t. diagram acc. DIN17210

About the use of chains

For use at high temperature



In a high temperature atmosphere, or when high tempertaure articles are conveyed directly on the chain, or when the chain is heated by radiated heat, etc., chain strength is diminished. The service limit at high temperature does not depend on the temperature of the atmosphere, but on the temperature and material of the chain. When you use your chain at high temperature, pay attention to the following points:

1. High temperature brittleness and fracture by lowered hardness of heat treated material
2. Brittleness caused by carbide precipitation
3. Abnormal wear by scale
4. Fatigue fracture caused by repeated thermal shock (cooling and expansion)
5. Abnormal wear due to an increase in the coefficient of friction
6. Creep fracture
7. Fracture due to thermal fatigue of weld zone
8. Influence of thermal expansion
   a. Stiff links and rotation failure due to decreased clearance
   b. Fatigue fracture due to lowered fitting force
9. Lubrication failure and stiff links due to deterioration and carbonization of lubricating oil. Grease excellent in heat resistance include those based on silicon, graphite or molybdenum bisulfide.

For use at high temperature, high temperature bearings and stainless steel bearings are recommended.

For use at low temperature

When you use your conveyor chain at low temperature in a refrigerator or in a cold atmosphere etc., pay attention to the following points.

1. Low temperature brittleness
   In general, a material is embrittled at low temperature and shock resistance is lowered. This phenomenon is called low temperature brittleness, and the degree of emrittlement differs from material to material. The service limit of a conveyor chain depends on its specifications.

Versions different in material and heat treatment		Basic service limit temperature
Regular version	(J, A)	- 20°C
Wear resistance version	(P, C, D)	
Partial stainless steel version	(D1, D3, D5)	
Toughness version	(K, E)	- 40°C
Stainless steel version	(S4, S5, SH)	
Stainless steel version	(S3)	-100°C

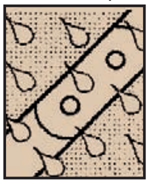
2. Influence of freezing
   If a conveyor chain is used at low temperature, water may penetrate and freeze in the clearance between a pin and a bushing, between a bushing and a roller or between an inner plate and an outer plate or frost may be deposited causing bending failure, roller rotation failure, seizing of chain by rail, etc. This permits an overload act on the chain and rive, diminishing the life of the chain.
   To prevent freezing, in general, it is recommended filling the clearances with a low temperature lubricant, to prevent water, frost, etc. from penetrating the respective portions of the chain. A silicon based grease is recommended.

For use in dusty environment

When you use your chain in a dusty environment of dirt, sand, dust, etc. periodically wash and grease the chain. For greasing, use a grease gun to alow the grease to sufficiently penetrate into the clearances between pins and bushings, between the bushings and rollers, and between outer plates and inner plates. Specifically when you use your chain in a highly abrasive environment, consider the following:

1. Select a conveyor which does not allow the conveyed abrasive articles to contact or coat the chain.
2. Select a chain size as large as possible, to reduce the face pressure of bearing portions between pins and bushings, etc.
3. Keep the chain speed as low as possible.
4. Make grease holes in the pins and bushings, and grease from grease nipples.
   (Pins and bushings are high in strength. So, for drilling them, please consult us.)
   For dusty environments and highly abrasive environments, high wear resistant bearings such as special chain bearings are available.

For use in an atmosphere exposed to plashes of water or sea water



In an atmosphere where rainwater or sea water is splashed on the chain, lowering of strength and brittleness by corrosion, bending failure and roller rotation failure due to sudden wear or rust, etc.
In this case, depending on the situation, adoption of a partial stainless steel version, stainless steel version or hi-guard version is recommended.
The hi-guard version used in an atmosphere exposed to splashes of rainwater or sea water is highly recommended. To use the chain in water, see the following "For use in water".

For use in water

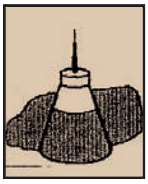
For use in water or sea water, in addition to the matters stated in the above "For use in an atmosphere exposed to the splashes of water or sea water", especially brittle fracture and corrosion must be considered. Outline includes "in-water used conveyor chains" water purification screen transfer chains, chains for rake use, sewage treatment chains, and BP type bush chains for water treatment drive units. It is recommended that you adopt a partial stainless steel version with specially coated plates or a stainless steel version. Furthermore, as corrosion resistant bearings which can be used in water, stainless steel bearings are available.

For use in an environment of acid, alkali, etc.

In an environment of acid, alkali, etc., in addition to the problems encountered in other corrosive environments, stress corrosion, hydrogen embrittlement, intergranular corrosion, etc. occur, and special care must be exercised. Section "5-4 Corrosion resistance against various substances" lists the corrosion resistance of chain materials to various substances. Please bear in mind that components made of 13C4 stainless steel may rust depending on conditions. * For use in a corrosive environment, please let us know the name and properties of conveyed object, service conditions (temperature, load, etc.), materials of parts used around the chain (rail, cover, members, tank, etc.)

GENERAL INFO

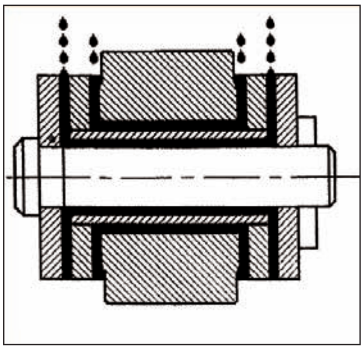
Lubrication



To extend the life of chain, periodical lubrication is important. Lubrication also reduces the required power. However, note that, under some service conditions, lubrication may adversely affect the chain, or be regulated by law, etc.

Lubricating oils and lubrication intervals

Temperature	-10°C~0°C (-14°F~32°F)	0°C~40°C (32°F~104°F)
SAE NO.	SAE 30	SAE 40

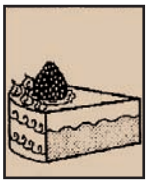


In general, the lubrication intervals are as follows.
Intervals: About once a week
Method: Coating or dripping

Lubrication intervals
Lubricating about once a week general, but depending on the conditions during operation and the state of lubricating oil, carry out lubrication as needed.
As a lubrication method, coating or drip lubrication is recommended.
As for the locations of lubrication, see the following illustration.
For effective lubrication, clean the chain before lubrication. In a special environment, adopt the lubrication method suitable for the respective conditions.

Automatic oiling (greasing) device
We have various automatic oiling (greasing) devices. If you use your chain in a place where lubrication is difficult or if you plan to automate oiling, please contact us.

When lubrication cannot be practiced



Lubrication is absolutely necessary for extending the life of the chain. However, under some conditions, lubrication may not be practical.
Avoid lubrication in the following cases:
1. The chain is embedded in the conveyed articles (granular material, powder, etc.)
2. When a granular material or powder is conveyed by a pan conveyor or apron conveyor, etc., it cannot be avoided that the granular material or powder will be deposited on the chain. Here, lubrication exerts an adverse influence.
3. The chain temperature becomes high.
4. When the chain cannot be lubricated, it is recommended that you use our resin bearings, oiless bearings or stainless bearings if food product conveyed.

For use with foods, etc.

When you use your chain for transport or driving in a food processing machine, especially when the food directly contacts the chain, stainless steel is required by FDA regulations.
A stainless steel version using 18-8 stainless steel (S3 version) is recommended. We also make a special type designed for "style" as well as function in food processing.

Calculation formula for horizontal, vertical and inclined conveyors

The maximum static tension acting on the chain can be calculated from the following formula.

Specifications of conveyor		SI unit	Gravitational unit
T	Maximum tension acting on the chain	kN	(kgf)
Q	Maximum conveyance capacity	t/h	(tf/h)
S	Conveyance speed	m/min	(m/min)
V	Vertical centre distance between sprocket shafts	m	(m)
H	Horizontal centre distance between sprocket shafts	m	(m)
L	Centre distance between sprocket shafts	m	(m)
M	Mass of operating section (mass of chain, slats, buckets, etc)	kg/m	(kgf/m)
f1	Coefficient of friction between chain and guide rail		
f2	Coefficient of friction between conveyed articles and bottom plate or side plate		
μ	Mechanical efficiency of transmission of drive		
kW	Required power	kW	(kW)
g	Gravitational acceleration 9.80665/S^2		
W	Total mass of conveyed articles on the conveyor (maximum value) kN	kg	(kgf)

Countable object: $W = \frac{L\ (m)}{\text{Intervals of conveyed object (m)}}$ X Mass per unit of conveyed article (kg)

(As unit symbols, a symbol of SI unit and asymbol of gravitational unit are stated together. Each parenthesized symbol is a Gravitational unit symbol. For the weight (kgf) and mass (kg), the same value is used.)

Layout of conveyor	Conveyance method	Type of conveyed object	SI unit	Gravitational unit
Horizontal conveyance	In the case of conveying articles on a conveyor *(slat conveyor, apron conveyor, etc.)*	Countable object	$T = (W + 2.1 \times M \times L) \times f_1 \times \frac{g}{1,000}$ $kW = \frac{T \times S}{52.2 \times \mu}$	$T = (W + 2.1 \times M \times L) \times f_1$ $kW = \frac{TXS}{5,320 \times \mu}$
		Bulk	$T = (16,7 \times \frac{Q}{S} + 2.1 \times M) \times L \times f_1 Xg) \times f_1 \times \frac{g}{1.000}$ $kW = \frac{T \times S}{52.2 \times \mu}$	$T = (16.7 \times \frac{Q}{S} + 2.1 \times M) \times L x f_1$ $kW = \frac{TXS}{5,320 \times \mu}$
	In the case of conveyance by scraping *(continuous flow conveyor, scraper conveyor, ect.)*	Bulk	$T = (16,7 \times \frac{Q}{S} \times f_2 + 2.1 \times M \times f_1) \times L \times \frac{g}{1.000}$ $kW = \frac{T \times S}{52.2 \times \mu}$	$T = (16,7 \times \frac{Q}{S} \times f_2 + 2.1 \times M \times f_1) \times L$ $kW = \frac{T \times S}{5,320 \times \mu}$
Vertical conveyance	In the case of conveying articles on a conveyor *(Bucket Elevator Tray Elevator.)*	Countable object	$T = (W + M \times L) \times \frac{g}{1,000}$ $kW = \frac{T \times S}{52.2 \times \mu}$	$T = W + M \times L$ $kW = \frac{TXS}{5,320 \times \mu}$
		Bulk	$T = (16,7 \times \frac{Q}{S} + M) \times (L + 2) \times \frac{g}{1.000}$ $kW = \frac{Q \times (L + 2)}{320 \times \mu}$	$T = (16.7 \times \frac{Q}{S} + M) \times (L + 2)$ $kW = \frac{Q \times (L + 2)}{320 \times \mu}$

GENERAL INFO

Coefficient of friction

Value of coefficient of friction f1

Table 1
Coefficient of friction with chain rollers on a guide rail.
Note 1. The value may depend on the ambient temperature etc.
Note 2. The listed values are at room temperature.

Roller diameter	With lubrication	Without lubrication
D < 50	0,15	0,20
50 ≤ D < 65	0,14	0,19
65 ≤ D < 75	0,13	0,18
75 ≤ D < 100	0,12	0,17
100 ≤ D	0,11	0,16
Without rollers (when bushings slide on a rail)	0,2 ~ 0,3	0,30 ~ 0,45
bearing built-in rollers	0,035 ~ 0,050	

Table 2
Coefficient of friction with chain plates sliding on a guide rail.

Temperature (°C)	With lubrication	Without lubrication
Room temperature ~ 400	0,20	0,30
400 ~ 600	0,30	0,35
600 ~ 800	0,35	0,40
800 ~ 1000		0,45

Value of coefficient of friction f2

Table 3
Coefficient of friction with conveyed materials and bottom and/or side wall
Note: Table 2 is changed by the condition of grading and/or humidity.

Conveyed object	f2
Coal	0,30 ~ 0,70
Coke	0,35 ~ 0,70
Ash	0,45 ~ 0,65
Sand	0,55 ~ 0,90
Sandstone	0,55 ~ 0,70
Ore	0,45 ~ 0,70
Cement	0,60 ~ 0,75
Cereal	0,35 ~0,45
Limestone	0,35 ~0,55

Safety factor and determination of chain size

Multiply the chain tension calculated in 5-1-2 by the safety factor to obtain the required strength of the chain for confirming whether it satisfies the tensile strength of the chain selected before. If the calculated strength does not satisfy chain tensile strength, select a chain larger in strength be one step or a heavy-duty chain, and re-calculate.

Chain size decision condition
Average tensile strength > Calculated chain tension x Ks x Ke

The service factor under good service conditions is 1.0, but depending on whether shock loads occur, service environment, lubrication condition, service time per day, etc., the corresponding value in the table given on the right is used as the service factor.

Reference: Good service conditions refer to the following conditions.
1. The load is almost constant and uniform.
2. At the time of loading and unloading, there are no shock loads.
3. Service environment is good. (Close to room temperature without wear and corrosion)
4. Lubrication is good with little wear.

Safety factor Ks depending on chain speed

Chain speed	Safety factor KS
30 m/min or less	7 or more
30 ~ 40 m/min	8 or more
40 ~ 50 m/min	9 or more
50 ~ 60 m/min	10 or more

Safety factor Ke

	Service factor Ke	
	Service time per day	
	10 hours or less	10 ~ 24 hours
Good	1.0	1.2
Fair	1.2	1.4
Bad	1.5 ~ 2.0	1.8 ~ 2.5

In any special environment (when the temperature of chain is higher than 200°C, when wet or abrasive or corrosive articles are conveyed, etc.), the environment must be carefully examined when determining chain size. In this case, please consult us.

GENERAL INFO

Chain determination about pressure in the articulations, resistance of the side-bars and bending coefficient of the chain-pins

A) Allowed pressure concerning bearing surface in the articulations:

Articulation-surface: $f = d1 \times b2$ cm²

Pressure in the articulation: $pr = \frac{Ff}{F}$ N/cm³

The value of the pressure in the articulations will be around 200 N/cm² for applications with hot product or important abrasiveness. It goes till 4000 N/cm² for easy and clean conveying conditions.

Standard indications are to consider:

Unhardened steel	> 1000 N/cm²
Normal steel hardened	ca. 2000 N/cm²
Hardened alloy steel	ca. 4000 N/cm²

Above element is very important to determine the chain-type and specially the life-time!

B) Resistant of the side-plates:

$$\frac{Ff}{2 \times (h-d) \times s} \qquad \frac{N}{mm^2}$$

C) bending-resistance of the pin:

Mb = W x Qb allowed N cm

For correct and regular charge this results in following formula:

$$\frac{Ff}{2} \times \frac{b^3}{2} = \frac{s}{2} - \frac{b3}{4} = \frac{\mu \times d^3}{32} \times Qb \text{ allowed}$$

This results in determining the pin diameter:

$$d = \sqrt[3]{\frac{1.27 \times Ff \times (b3 + 2s)}{Qb \text{ allowed}}} \text{ cmm}$$

Mb	= bending-factor in Ncm
Md	= rotation-moment in Nm
F	= chain resistance in N
Ff	= total charge of the chain in N
b3	= dimension between A link in mm
pr	= pressure in the articulation in N/cm2
f	= surface of the articulation in cm2
h	= side-bar height in mm
s	= thickness of the side-bar in mm
Q	= working load in kg/m
W	= resistance factor in cm3
Qb	= bending tension in N/mm2
W	= resistance (torque) moment in cm3
b1	= inner width between side-bars of inner link

Examples of calculation for selection

Selection case I

A case of calculation where a powder is horizontally scraped to be conveyed by a scraper conveyor is shown below.

Specifications

Conveyor type:	Scraper conveyor
Maximum conveyance capacity:	Q = 100 tons/h
Conveyance speed:	S = 20m/min
Horizontal center distance between sprocket shafts:	L = 30m
Scraper installation intervals:	600 mm
Mass of Scraper:	W1 = 30kg/m
Coefficient of friction between chain and guide rail:	f1 = 0,2
Coefficient of friction between conveyed articles and bottom plate or side plate:	f2 = 0,6
Number of chain rows:	2

Note) Mass of chain (W2) is supposed to 20 kg/m/strand because it is unknown value at the initial selection

Calculation

SI t uni

Maximum chain tension $T = (16{,}7 \times \frac{Q}{S} \times f_2 + 2.1 \times M \times f_1) \times L \times \frac{g}{1000}$

Required power $kW = \frac{TXS}{52.2X\eta}$

Gravitational t uni

Maximum chain tension T = (16,7 x x f2 + 2,1 x M x f1) x L

Required power $kW = \frac{TXS}{52.320X\eta}$

Substituting the values of the above specifications into these formulas:

$T = (16{,}7 \times \frac{100}{20} \times 0{,}6 + 2{,}1 \times 50 \times 0{,}2) \times 30 \times \frac{9.80665}{1000} = 21$ kN

$T = (16{,}7 \times \frac{100}{20} \times 0{,}6 + 2{,}1 \times 50 \times 0{,}2) \times 30 = 2{,}133$ kgf

The value of T obtained here is a tension acting on two chain strands. So, the chain tension per strand is T/2.
Since the conveyance speed(chain speed) is 20 m/min, the safety factor Ke is 1,5.
Furthermore, for an 8-hour operation per day and no lubrication, engendered by poor environment, the service factor Ke is 1,5.

Required chain tension $= \frac{21}{2} 7 \times 1{,}5 = 110$ kN

Required chain tension $= \frac{21}{2} \times 7 \times 1{,}5 = 11198$ kgf

Therefore, since the 15011G regular version among the regular conveyor chains satisfies the average tensile strength, it can tentatively selected. Then, with the mass of chain considered, accurate calculation is re-made.
The masses of chain components with A2 attachments for every four links are as follow:

Mass of chain proper: 7,9 kg/m
Mass of attachment: 0,24 kg/pc
Attachment installation intervals: 0,6m

Mass of chain $= 7{,}90 + \frac{0.24}{0.60} = 8{,}3$ kg/m/row

Mass of operation section M = 30 + 8,3 x 2 = 46,6 kg/m

Therefore, the maximum service chain tension is:

$T = (16{,}7 \times \frac{100}{20} \times 0{,}6 + 2{,}1 \times 46{,}6 \times 0{,}2) \times 30 \times \frac{9.80665}{1000} = 20{,}5$ kN

$T = (16{,}7 \times \frac{100}{20} \times 0{,}6 + 2{,}1 \times 46{,}6 \times 0{,}2) \times 30 = 2{,}090$ kgf

The chain tension per chain strand is:

$\frac{20.5}{2} \times 7 \times 1{,}5 = 108 \text{ kN} < 112 \text{ kN}$

$\frac{2{,}090}{2} \times 7 \times 1{,}5 = 10973{,}6 \text{ kgf} < 11500 \text{ kgf}$

Hence, the chain size to be selected is 15011G regular version.

Conveyor chain safety factor $Sf = \frac{112 X 2}{20.5} = 11$

Conveyor chain safety factor $Sf = \frac{11{,}500 X 2}{2{,}090} = 11$

Required power (when the mechanical efficiency of transmission of drive is 0,8) is:

$kW = \frac{20.5 X 20}{52.2 X 0.8} = 9{,}8$ kW

$kW = \frac{20.5 X 20}{5.320 X 0.8} = 9{,}8$ kW

GENERAL INFO

Examples of calculation for selection

Selection case II

A case where conveyor chain for bucket elevator conveying a powder vertically using buckets is described below.

Specifications

Conveyor type:	Guide discharge type bucket elevator
Maximum conveyance capacity:	Q = 250 tons/h
Conveyance speed:	S = 25m/min
Horizontal centre distance between sprocket shafts:	L = 20m
Mass of buckets:	W1 = 60kg/m
Mass of chain:	W2
	Since W2 is unknown in the initial state, it is assumed to be approximately 20 kg/m/row
Bucket installation intervals:	500 mm
Chain pitch:	250mm
Number of chain rows:	2
Coefficient of friction between chain and guide rail:	f1 = 0,2
Coefficient of friction between conveyed articles and bottom plate or side plate:	f2 = 0,6

Note) Mass of chain (W2) is supposed to 20 kg/m/strand because it is unknown value at the initial selection

SI t uni / **Gravitational t uni**

As a calculation formula, from the layour of conveyance, the formula for vertical conveyance of bulk.

SI unit: Maximum chain tension $T = (16{,}7 \times \frac{Q}{S} + M) \times (L+2) \times \frac{g}{1000}$

Gravitational unit: Maximum chain tension $T = (16{,}7 \times \frac{Q}{S} + M) \times (L+2)$

SI unit: **Required power kW** $= \frac{TX(L+2)}{52.2X\eta}$

Gravitational unit: **Required power kW** $= \frac{TX(L+2)}{5{,}320X\eta}$

Substituting the values of the above specifications into these formulas:

SI unit: $T = (16{,}7 \times \frac{250}{25} + 100) \times (20 + 2) \times \frac{9.80665}{1000} = 57{,}6$ kN

Gravitational unit: $T = (16{,}7 \times \frac{250}{25} + 100) \times (20 + 2) = 5874$ kgf

The value of T obtained here is a tension acting on two chain strands. So, the chain tension per strand is T/2. Since the conveyance speed(chain speed) is 25 m/min, the safety factor Ke is 7. Furthermore, for an 12-hour operation per day and no lubrication, engendered by poor environment, the service factor Ke is 1,8.

SI unit: **Required chain tension** $= \frac{57.6}{2} \times 7 \times 1{,}8 = 362{,}9$ kN

Gravitational unit: **Required chain tension** $= \frac{5{,}874}{2} \times 7 \times 1{,}8 = 37006$ kgf

Therefore, since the 250Z35GG among chains for NK Type Bucket Elevators satisfies the average tensile strength, it can be tentavively selected. Then, accurate calculation is re-made, also considering the mass of the chain. Since the mass of chain with G4 attachments every two links is 15 kg.

The masses of operation section is M = 60 + 15x2 = 90 kg/m

Therefore, the maximum service chain tension is:

SI unit: $T = (16{,}7 \times \frac{250}{25} + 90) \times (20+2) \times \frac{9.80665}{1000} = 55{,}4$ kN

Gravitational unit: $T = (16{,}7 \times \frac{250}{25} + 90) \times (20+2) = 5654$ kgf

The chain tension per chain strand is:

SI unit: $\frac{55.4}{2} \times 7 \times 1{,}8 = 349$ kN < 392 kN

Gravitational unit: $\frac{5{,}654}{2} \times 7 \times 1{,}8 = 35620$ kgf < 40000 kgf

Hence, the chain size to be selected is 250Z35G.

SI unit: Conveyor chain safety facto $Sf = \frac{392 \times 2}{55.4} = 14$

Gravitational unit: Conveyor chain safety facto $Sf = \frac{40{,}000 \times 2}{5{,}654} = 14$

Required power (when the mechanical efficiency of transmission of drive is 0,8) is:

SI unit: $kW = \frac{55.4 \times (20+2)}{52.2 \times 0.8} = 29{,}2$ kW

Gravitational unit: $kW = \frac{5{,}654 \times (20+2)}{5{,}320 \times 0.8} = 29{,}2$ kW

Particularity of conveyed articles and the recommended chains

The following table shows the chain versions for general conveyed objects. A powder or granular material of the same category may be different from the following table in physical properties, depending on the place of production, manufacturer, grain form, storage condition, supply condition, temperature, humidity, etc.. So, confirm the properties of each actual conveyed object, when selecting the conveyor type and chain.

	Conveyed articles	Apparent	specific	gravity	Wear	Corrosion	Adhesion	Bucket elevator	Continuous flow conveyor	Drag chain conveyor	Scraper conveyor	Pan conveyor	Recommended chain spec.
Metal, ore and dust	Iron ore powder	1.6	~	2.4	O			O	O	O		O	K
	Iron ore lumps	1.6	~	2.6	O			O	O	O		O	K
	Zinc ore	1.6	~	2.6	O			O	O			O	K
	Zinc dust	0.4	~	0.6				O	O			O	A
	Manganese ore (powder)	1.3	~	1.5	O			O	O			O	K
	Nickel ore (powder)	0.9	~	1.2	O			O	O			O	K
	Copper ore (powder)	1.0	~	1.9	O	O		O	O			O	K
	Iron sulfide ore (powder)	1.5	~	2.5	O	O	O	O	O			O	K
	Bauxite	0.9	~	1.3	O			O	O			O	K
	Alumina	0.4	~	1.0	O			O	O			O	K
	Titanium oxide (lumps) (powder)	0.6	~	1.0	O			O	O			O	K
	Sintered ore	1.6	~	1.8	O			O	O			O	K
	Spiled ore for re-sintering	1.6	~	1.8	O			O	O			O	K
	Iron ore pellets	1.6	~	2.1	O			O	O	O		O	K
	Slag	1.0	~	1.2	O			O	O	O		O	K
	Casting bed dust	1.0	~	1.5	O			O	O			O	K
	Sintered dust	0.6	~	1.5	O			O	O			O	K
	Klin exhaust gas dust	0.8	~	1.2	O			O	O			O	K
	Iron oxide dust	0.3	~	0.6	O			O	O			O	K
Coal	Coal (grains)	0.5	~	1.0		O		O	O	O	O	O	SH
	Coal (lumps)	0.6	~	0.7		O		O	O	O	O	O	SH
	Pulverized coal	0.5	~	0.8		O	O	O	O		O	O	SH
	coke	0.5	~	0.8	O			O	O			O	K
	Powdery coke	0.3	~	0.8	O		O	O	O			O	K
Waste	Fuel oil burned ash	0.6	~	1.0		O		O	O		O	O	D1
	Sludge burned ash	0.6	~	0.8				O	O		O	O	A
	Refuse burned ash	0.4	~	0.8				O	O		O	O	A
	Kitche refuse					O					O	O	D1
Cement and lime	Cement	0.8	~	1.2				O	O			O	A
	Blast furnace cement	0.8	~	1.2	O			O	O			O	K
	Cement raw material powder	0.8	~	1.0				O	O			O	A
	Cement clinker	1.2	~	1.6	O			O	O	O	O	O	K
	Cement Cottrel dust	0.7	~	1.0				O	O			O	A
	Clinker dust	0.6	~	1.2	O		O	O	O			O	K
	Limestone (lumps)	1.2	~	1.6	O			O	O	O	O	O	A
	Limestone (grains)	1.0	~	1.4				O	O		O	O	A
	Limestone (powder)	0.9	~	1.0				O	O			O	A
	Limestone dust	0.5	~	0.6				O	O			O	A
	Quick lime	0.7	~	1.2				O	O		O	O	A
	Slaked lime	0.4	~	0.7				O	O		O	O	A
Non-metal	Dolomite	1.5	~	1.8	O			O	O	O	O	O	K
	Calcium carbonate	0.5	~	1.4				O	O			O	A
	Silica sand	1.1	~	1.5	O			O	O			O	K
	Silica rock	1.0	~	1.5	O			O	O			O	K
	Clay (dry)	1.0	~	1.6	O		O	O	O	O	O	O	D2
	Clay dust	1.1	~	1.6	O		O	O	O			O	D2
	Fluorite	1.7	~	1.6				O	O		O	O	A
	Gypsum	0.6	~	0.9		O	O	O	O		O	O	D2
	Talc	0.5	~	0.7			O	O	O		O	O	A
	Feld spar	1.0	~	1.4	O			O	O		O	O	K

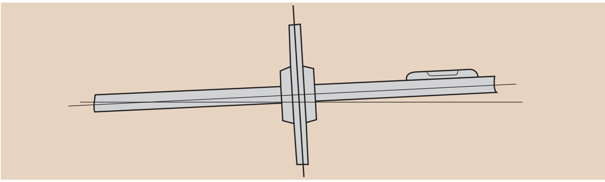
	Conveyed articles	Apparent	specific	gravity	Wear	Corrosion	Adhesion	Bucket elevator	Continuous flow conveyor	Drag chain conveyor	Scraper conveyor	Pan conveyor	Recommended chain spec.
Non-metal	Bentonite	0.6	~	0.8	O			O	O		O	O	A
	Fly ash	0.7	~	1.6	O			O	O			O	K
	Magnesia clinker	1.3	~	1.9	O			O	O	O	O	O	K
	Brick stone scraps	1.3	~	1.5	O			O	O	O		O	K
	Soda ash (dense)	0.9	~	1.1				O	O		O	O	A
	Soda ash (light)	0.3	~	0.6			O	O	O		O	O	A
	Casting sand	1.5	~	1.8	O		O	O	O	O	O	O	K
	Crushed stone and gravel	1.2	~	2.0	O			O				O	K
	Raw material of ferrite	0.7	~	0.9			O	O	O		O	O	A
	Porcelain clay	0.9	~	1.4	O			O	O		O	O	K
	Carbide	0.6	~	1.3				O	O		O	O	A
	Urea	0.5	~	0.8		O	O	O	O		O	O	S4
	Glauber's salt	0.6	~	0.9		O	O		O			O	S4
	Anhydrous sodium sulfate	1.1	~	1.3		O		O	O			O	S4
	Sulfur powder	0.8	~	1.0				O	O			O	A
	Cullet	1.3	~	1.7	O			O				O	K
	PVC powder	0.5	~	0.7				O	O			O	A
	Plastic powder	0.5	~	0.6				O	O			O	A
	Synthetic detergent	0.5	~	0.6			O	O	O		O	O	A
	Carbon black	0.1	~	0.4	O		O	O	O		O	O	K
	Fine powder carbon	0.2	~	0.3	O		O	O	O		O	O	K
	Rubber powder	0.3	~	0.4				O	O			O	A
	Wood chips	0.1	~	0.3				O	O		O	O	A
	Raw materials of agricultural chemicals	0.4	~	0.6	O	O	O	O	O			O	SH
	Phosphorus ore (powder)	0.9	~	1.5	O			O	O			O	K
	Phosphorus ore (lumps)	1.1	~	1.6	O			O	O			O	K
Fertilizer	Phosphorus sulfide (powder)	0.7	~	1.0				O	O		O	O	A
	Ammonium phosphate	0.9	~	1.2			O	O	O		O	O	A
	Ammonium chloride (powder)	0.5	~	0.7		O	O	O	O		O	O	A
	Ammonium chloride (grains)	0.6	~	0.9		O		O	O		O	O	A
	Ammonium sulfate	0.8	~	1.2		O	O	O	O		O	O	A
	Potassium sulfate	0.5	~	1.3		O	O	O			O	O	SH
	Potassium chloride	0.7	~	1.0		O	O	O			O	O	SH
	Lime nitrogen	0.8	~	1.3	O			O	O		O	O	SH
	Calcium superphosphate	0.8	~	1.0		O	O				O	O	SH
	Compound fertilizer	0.7	~	1.2		O	O	O	O		O	O	SH
	Fused phosphate	1.0	~	1.3	O			O	O		O	O	K
Cereal, food and feed	Rice	0.7	~	0.8				O	O		O	O	A
	Barley	0.6	~	0.7				O	O		O	O	A
	Wheat	0.7	~	0.8				O	O		O	O	A
	Wheat flour	0.4	~	0.7			O	O	O		O	O	A
	Soybean	0.7	~	0.8				O	O		O	O	A
	Corn	0.7	~	1.0				O	O		O	O	A
	Malt	0.9	~	1.0				O	O		O	O	A
	Starch	0.4	~	0.7			O	O	O		O	O	A
	Cane	0.2	~	0.3							O	O	A
	Bagasse	0.1	~	0.2			O				O	O	A
	Sugar	0.8	~	1.0			O	O	O		O	O	S4 S3
	Salt (dry)	0.9	~	1.3		O	O	O	O		O	O	A
	Mixed feed	0.4	~	0.6		O		O	O		O	O	A

Installation, adjustment and maintenance

Installation of sprockets

The installation accuracy of sprockets greatly affects the service life of equipment and conveyor chain. Even if they are accurately installed, vibration during operation, land subsidence, etc., may cause deviation. In such case, the teeth of sprockets are worn laterally or the conveyor chain is damaged. Misalignment, parallel measurement and other checks must be conducted from time to time.

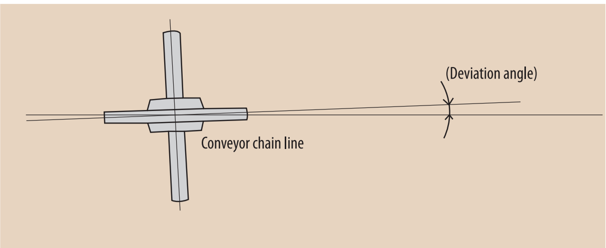
Parallel measurement



Adjust the parallel measurement as follows, using a level.

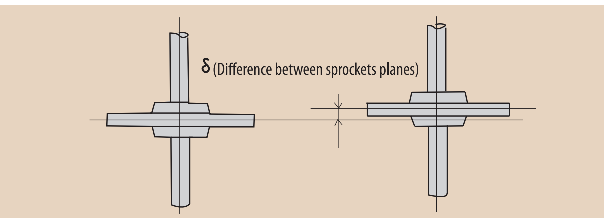
Flow conveyor:	Within ± 1.0 mm / 1m
Bucket conveyor:	Within ± 0.5 mm / 1m
Long pan conveyor:	Within ± 0.5 mm / 1m
Slat conveyor:	Within ± 0.5 mm / 1m

Deviation of sprocket theet line from conveyor chain line



Adjust to eliminate deviation from the conveyor chain line.

Difference between sprocket planes



Adjust to keep the driving and driven sprockets on the same plane as follows.

Flow conveyor:	Within ∂ = 1mm
Bucket conveyor:	Within ∂ = 2mm
Long pan conveyor:	Within ∂ = 1mm
Slat conveyor:	Within ∂ = 1mm

(within 3 mm in the case of heavy-duty type chain 120H and 120Z or larger)

Conveyor chain connection procedure

As the general connection procedure for conveyor chain, take steps 1 through 4 below. Disconnection is the reverse of connection.

1. Pull the pin at one end of the chain, and overlap the chain ends with the pin holes of the inner and outer plates kept coinciding with each other.
2. Insert the pin into the coinciding holes of the plates
3. Apply a hammer to the plate on the side opposite to driving side, and hit the head of the pin, to drive it in.)
4. Insert a T-pin into the pin hole, and bend it by a wrench, etc. to secure it in position

(Cautions)

1. Confirm the progression direction of the chain, the direction of attachments, etc., before work begins.
2. When driving in the pin, do not grind the pin for easier working. A ground pin will cause various troubles.
3. After completion of chain connection, confirm whether the chain can be bent smoothly.

GENERAL INFO

Tension adjustment of conveyor chain

An overly tight or overly sag conveyor chain cannot be smoothly operated. Especially, an overly sag chain rides over a sprocket and interferes with the rail etc. So, check and adjust proper timing.

Timing of adjustment

In the beginning of use, a chain causes initial elongation, and subsequently is elongated due to steady wear. Usually the components of a chain are hardened on the surface, and if the hardened layer is exhausted, elongation progresses rapidly. So, periodical checks are necessary.

Check frequency for daily 8-hour working

Within one week after start up of operation	Once daily
Within one month after start up of operation	Once weekly
After lapse of one month	Twice monthly

This table shows a general case. In the case of continuous operation, in the case of abrasive environment or in the case of corrosive environment, increase the check frequency.

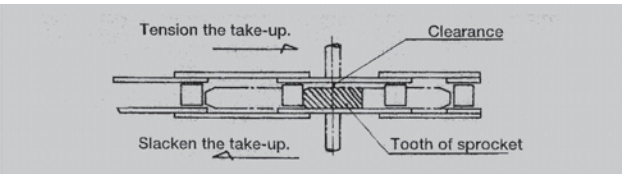
(Cautions)

• Also for a chain with tension automatically adjusted by counter weight take-up or spring take-up, confirm whether the tension device functions normally.

• When high temperature articles are conveyed, be sure to adjust the take-up since the chain expands or contracts remarkably when the conveyor is started or stopped.

Adjust take-up using two persons

The take-up adjustment must be performed equally on both sides. So, one person is required to check the tension of chain, while the other is required to check the tension of chain, while the other carries out adjustment. For adjustment, alternate tension on both sides little by little. If the chain is tensioned too tightly on one side only, an accident will be caused. Be sure to locate the chain at the centers of the teeth of the sprockets through adjustment. When the chain is not located at the centers of teeth, adjust according to the following procedure.



Tension on the side with a clearance between the sprocket and the chain, or slacken on the side with the sprocket kept in contact with the chain.

Shorten the chain early

The chain tension is adjusted by take-up. If elongation comes close to the limit of het adjustable range, shorten the chain early. An overly sag chain causes troubles through interference and contact.

Check point

The slackening of a chain occurs generally at one place. Therefore, confirm at first what point of the conveyor should be checked. Furthermore, exercise care to ensure safety at the site of checking, and improve imperfections for safe work conditions.

• In the case of a horizontal conveyor irrespective of top conveyance or bottom conveyance, the slackening is usually eliminated on the chain return side at a portion immediately after or downstream of the driving sprocket.

• In the case of a straight gradient conveyor, the point where the slackening is eliminated depends on the gradient angle and the kind of conveyor, and cannot be generally addressed. Confirm with reference to the instruction manual, etc.

• In the case of an L type or S type conveyor, slackening is eliminated at the bend case.

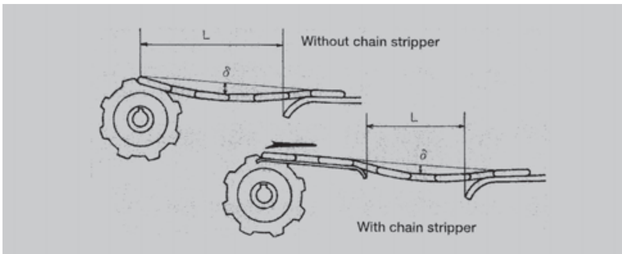
Tension adjusting degree

The degree of tension adjustment is determined with reference to the following conditions.

• The chain smoothly departs from the sprockets.

• Spaces are secured to keep the chain, attachments, pans, etc. from interfering with the rail and frames.

• A proper tension not causing surging is secured. For example, in the case of a horizontal continuous flow conveyor, adjust to achieve a sag depth of about ∂ = 1/10L ~1/20L.



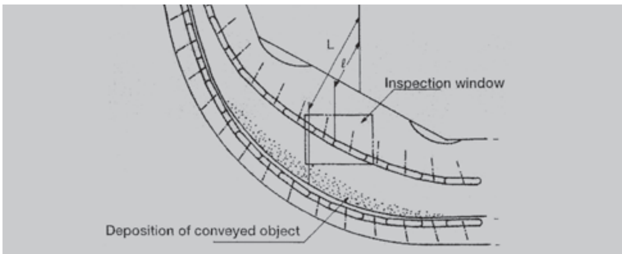
However, in the following cases, increase the adjusting frequency to achieve ∂ = 1/15L – 1/25L.

• Frequently starting and stopping of conveyor

• The conveyed articles are high in temperature

• The chain is heavy or large.

In the case of an L type continuous flow conveyor, adjust the tension to keep the chain directly visible from the inspection hole. The dimension is l 1/2L.



On the bottom of the case, the conveyed articles are often deposited. So, periodically clean the inside, to secure space for slackening of chain.

GENERAL INFO

How to calculate the pitch-circle diameter for toothed sprockets

FOR PIN-BUSH-ROLLER CONVEYOR CHAINS:

z = number of teeth
t = pitch
n = index

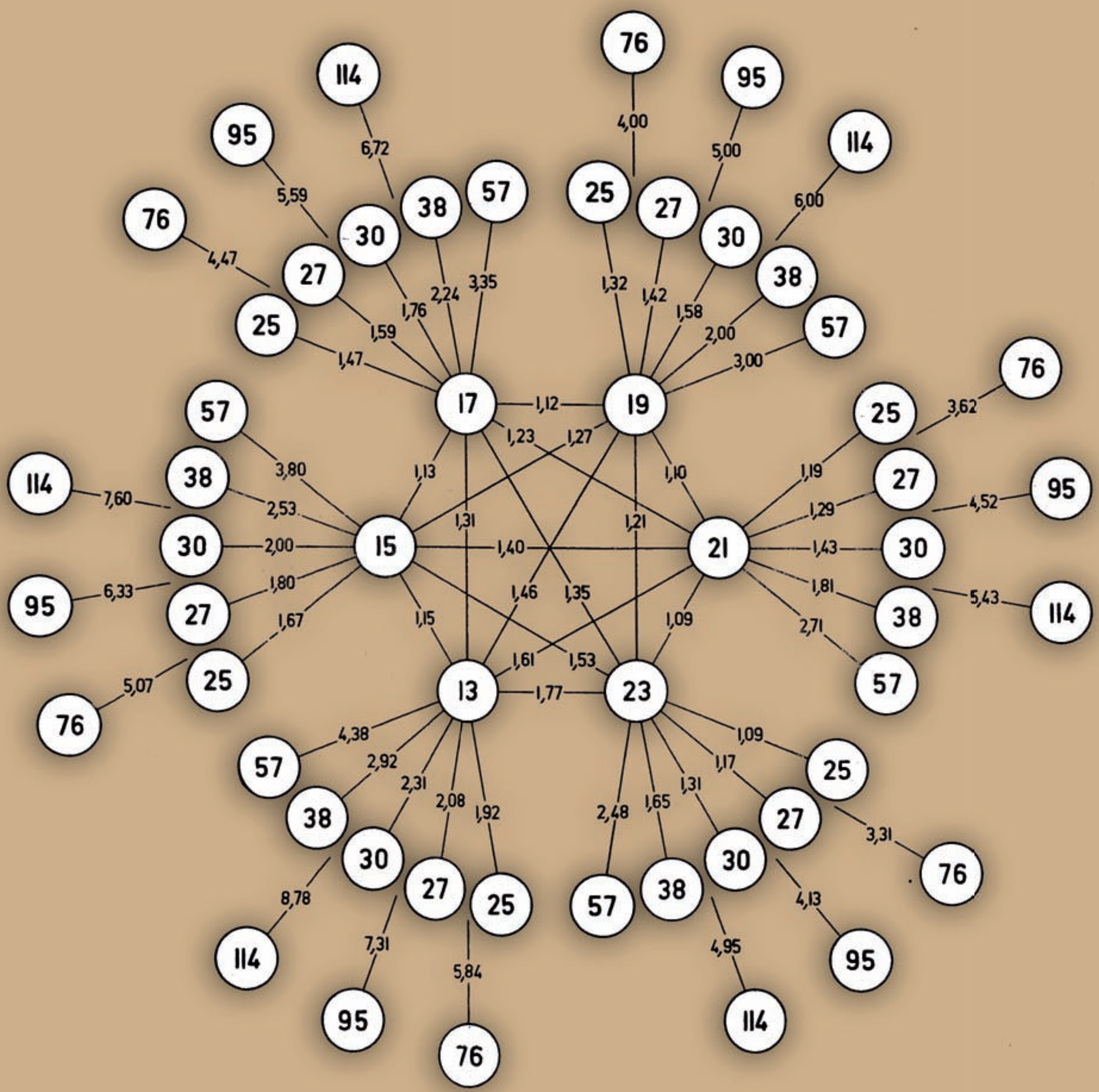
Formula: **P.c. Ø = t x n**
Example: **chain pitch 125 mm (t) – sprocket 12 teeth (z)**
(t) 125 x (n) 3,864 = 483 mm P.c. Ø

z	*n*	*z*	*n*	*z*	*n*	*z*	*n*	*z*	*n*	*z*	*n*	*z*	*n*
5	1,701	22	7,027	39	12,427	56	17,835	73	23,244	90	28,654	107	34,064
6	2,001	26	7,344	40	12,746	57	18,153	74	23,562	91	28,972	108	34,382
7	2,305	24	7,661	41	13,063	58	18,471	75	23,880	92	29,290	109	34,700
8	2,612	25	7,979	42	13,382	59	18,769	76	24,119	93	29,608	110	35,190
9	2,924	26	8,296	43	13,699	60	19,107	77	24,517	94	29,927	111	35,337
10	3,237	27	8,614	44	14,018	61	19,425	78	24,835	95	30,245	112	35,655
11	3,550	28	8,931	45	14,336	62	19,744	79	25,153	96	30,563	113	35,974
12	3,864	29	9,250	46	14,654	63	20,061	80	25,471	97	30,872	114	36,292
13	4,179	30	9,567	47	14,972	64	20,380	81	25,790	98	31,200	115	36,610
14	4,494	31	9,885	48	15,290	65	20,698	82	26,108	99	31,518	116	36,929
15	4,809	32	10,202	49	15,607	66	21,017	83	26,426	100	31,836	117	37,247
16	5,126	33	10,521	50	15,926	67	21,335	84	26,744	101	32,155	118	37,565
17	5,441	34	10,838	51	16,244	68	21,653	85	27,063	102	32,473	119	37,883
18	5,759	35	11,156	52	16,562	69	21,971	86	27,381	103	32,791	120	38,202
19	6,076	36	11,474	53	16,880	70	22,289	87	27,699	104	33,109	121	38,520
20	6,392	37	11,792	54	17,194	71	22,608	88	28,017	105	33,428	122	38,838
21	6,709	38	12,109	55	17,517	72	22,926	89	28,335	106	33,746	124	39,475

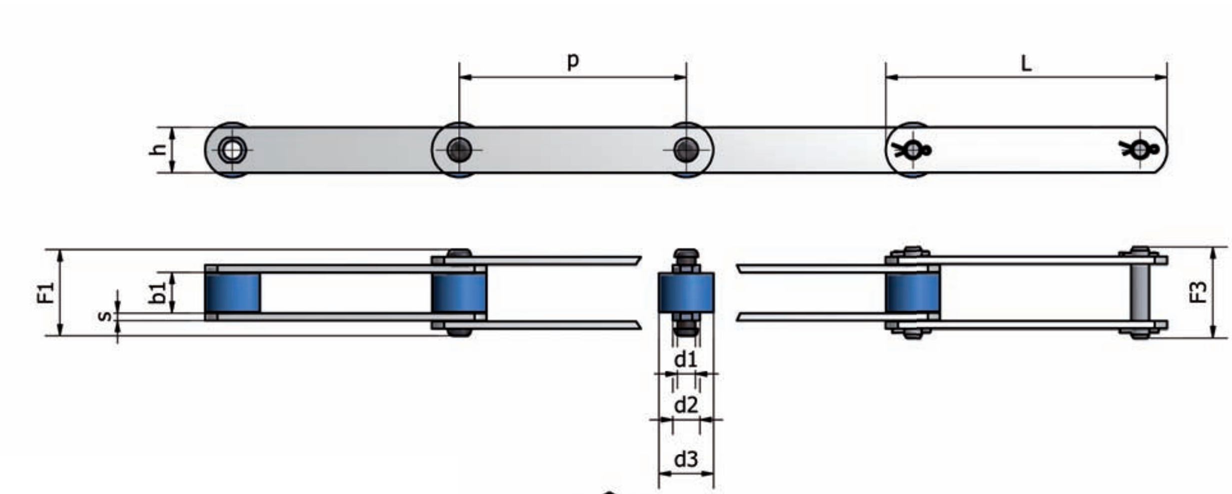
GENERAL INFO

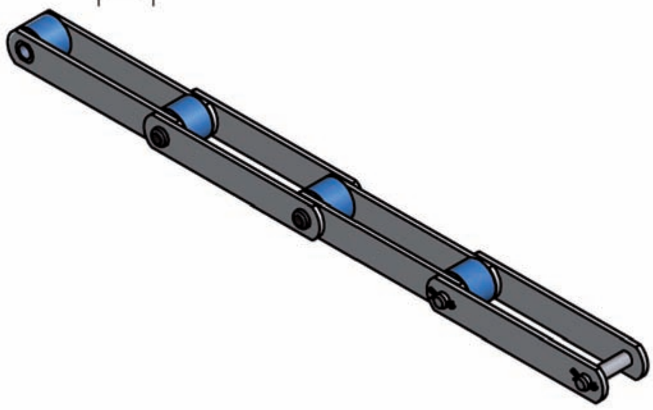
Standard ratios of different teeth numbers

Table



Approximative weight calculation of conveyor chains





A—SIDE-PLATES :

$$\frac{L \,.\, h \,.\, S \,.\, 8 \,.\left(\frac{1000}{P}\right).\, 2}{1000} = \text{Kg/m (*)}$$

(*) the rounded ends of the plates are not considered, but compensate the pin-ends coming out of the chain. For heavy chains with short pitch, this has to be calculated separately to obtain correct weight of the chain.

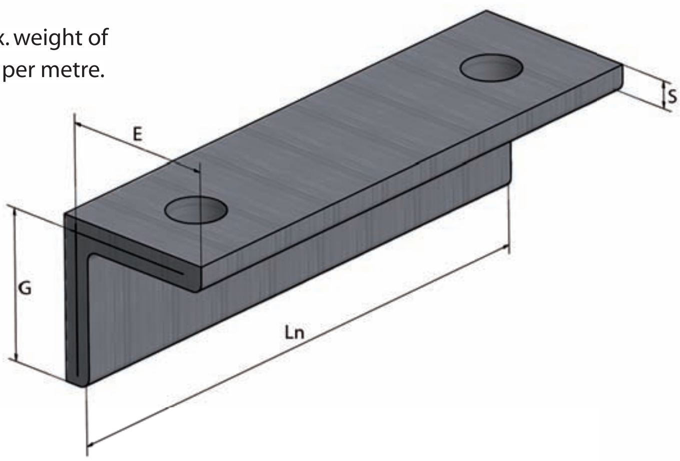
B—PIN, BUSH, ROLLER :

$$\frac{\pi \,.\left(d3\right)^2 .\, 8 \,.\left(\frac{1000}{P}\right)}{1000} = \text{Kg/m (*)}$$

TOTAL WEIGHT PER METRE : A + B

C – WEIGHT OF WELDED ANGLE ATTACHMENT:

$\frac{G + E \,.\, Ln \,.\, S \,.\, 8}{1000}$ x number of attachments per metre = total approx. weight of attachment per metre.



GENERAL INFO

Hardness comparison table & strenght

(for all non Austenitic steel types)

BRINEL			ROCKWELL		Vickers
3000 kg 10 mm ball	Diam. in mm	Strength kg/mm2	HRB	HRC	HV P=30 kg
80	6,50	28	36,4		80
85	6,30	30	42,4		85
90	6,15	32	47,4		90
95	6,00	33	52,0		95
100	5,88	35	56,4		100
105	5,75	37	60,0		105
110	5,62	39	63,4		110
115	5,52	40	66,4		115
120	5,42	42	69,4		120
125	5,33	43	72,0		125
130	5,22	45	74,4		130
135	5,13	47	76,4		135
140	5,05	48	78,4		140
145	4,96	50	80,4		145
150	4,88	51	82,2		150
155	4,81	53	83,8		155
160	4,74	55	85,4		160
165	4,67	56	86,4		165
170	4,60	58	88,2		170
175	4,54	60	89,6		175
180	4,48	62	90,8		180
185	4,42	63	91,8		185
190	4,37	65	93,0		190
195	4,32	67	94,0		195
200	4,26	68	95,0		200
205	4,22	70	95,8		205
210	4,17	72	96,6		210
215	4,11	73	97,6		215
220	4,07	75	98,2		220
225	4,03	77	99,0		225
230	3,99	78		19,2	230
235	3,95	80		20,2	235
240	3,91	82		21,2	240
245	3,87	84		22,1	245
250	3,83	85		23,0	250
255	3,80	87		23,8	255
260	3,76	89		24,6	260
265	3,73	90		25,4	265
270	3,70	92		26,2	270
275	3,66	94		26,9	275
280	3,63	96		27,6	280
285	3,60	97		28,3	285
290	3,57	99		29,0	290
295	3,54	101		29,6	295
300	3,51	103		30,3	300
310	3,45	106		31,5	310
320	3,40	110		32,7	320
330	3,35	113		33,8	330
340	3,30	117		34,9	340

BRINEL			ROCKWELL		
3000 kg 10 mm ball	Diam. in mm	Strength kg/mm2	HRB	HRC	Vickers HV P=30 kg
350	3,26	120		36,0	350
359	3,22	123		37,0	360
368	3,18	126		38,0	370
376	3,15	129		38,9	380
385	3,11	132		39,8	390
392	3,08	135		40,7	400
400	3,05	138		41,5	410
408	3,02	141		42,4	420
415	3,00	144		43,2	430
423	2,97	146		44,0	440
430	2,95	149		44,8	450
				45,5	460
				46,3	470
				47,0	480
				47,7	490
				48,3	500
				49,0	510
				49,7	520
				50,3	530
				50,9	540
				51,5	550
				52,1	560
				52,8	570
				53,3	580
				53,8	590
				54,4	600
				54,9	610
				55,4	620
				55,9	630
				56,4	640
				56,9	650
				57,4	660
				57,9	670
				58,4	680
				58,9	690
				59,3	700
				60,2	720
				61,1	740
				61,9	760
				62,8	780
				63,5	800
				64,3	820
				65,0	840
				65,0	860
				66,3	880
				66,9	900
				67,5	920
				68,0	940

Hardness comparison table

Rockwell HRC	Rockwell SUPERFICIAL 15 N	30 N	45 N	Shore
68	93,2	84,4	75,4	97
67	92,9	83,6	74,2	95
66	92,5	82,8	73,3	92
65	92,2	81,9	72,0	91
64	91,8	81,1	71,0	88
63	91,4	80,1	69,9	87
62	91,1	79,3	68,8	85
61	90,7	78,4	67,7	83
60	90,2	77,5	66,6	81
59	89,8	76,6	65,5	80
58	89,3	75,7	64,3	78
57	88,9	74,8	63,2	76
56	88,3	73,9	62,0	75
55	87,9	73,0	60,9	74
54	87,4	72,0	59,8	72
53	86,9	71,2	58,6	71
52	86,4	70,2	57,4	69
51	85,9	69,4	56,1	68
50	85,5	68,5	55,0	67
49	85,0	67,6	53,8	66
48	84,5	66,7	52,5	64
47	83,9	65,8	51,4	63
46	83,5	64,8	50,3	62
45	83,0	64,0	49,0	60
44	82,5	63,1	47,8	58

Rockwell HRC	Rockwell SUPERFICIAL 15 N	30 N	45 N	SHORE
43	82,0	62,2	46,7	57
42	81,5	61,3	45,5	56
41	80,9	60,4	44,3	55
40	80,4	59,5	43,1	54
39	79,9	58,6	41,9	52
38	79,4	57,7	40,8	51
37	78,8	56,8	39,6	50
36	78,3	55,9	38,4	49
35	77,7	55,0	37,2	48
34	77,2	54,2	36,1	47
33	76,6	53,3	34,9	46
32	76,1	52,1	33,7	44
31	75,6	51,3	32,5	43
30	75,0	50,4	31,3	42
29	74,5	49,5	30,1	41
28	73,9	48,6	28,9	41
27	73,3	47,7	27,8	40
26	72,8	46,8	26,7	38
25	72,2	45,9	25,5	38
24	71,6	45,0	24,3	37
23	71,0	44,0	23,1	36
22	70,5	43,2	22,0	35
21	69,9	42,3	20,7	35
20	69,4	41,5	19,6	34

Hardness according AstM. Spec. E 48 - T 43

Table for extra tolerance before machining
(and before heat-treatment)

Round steel			Square steel			Flat steel & profiles			
	Ø			⌀					
From	Till	Extra/mm	From	Till	Extra/mm	Large		Extra/mm	
						From	Till	Large	Thickness
5	10	ca. 2	5	10	ca. 2	5	15	ca. 2	ca. 2
11	30	ca. 3	11	30	ca. 3	16	35	ca. 3	ca. 2-3
31	60	ca. 4	31	60	ca. 4	36	100	ca. 4	ca. 2-4
61	120	ca. 5	61	110	ca. 5	101	200	ca. 5	ca. 3-5
121	150	ca. 6	111	135	ca. 6	201	300	ca. 6 - 8	ca. 4-6
151	200	ca. 8	136	180	ca. 8	301	400	ca. 8 -10	ca. 5-8
201	300	ca. 10	181	250	ca. 10				
301	400	ca. 15	251	320	ca. 15				
401	550	ca. 20	321	490	ca. 20				

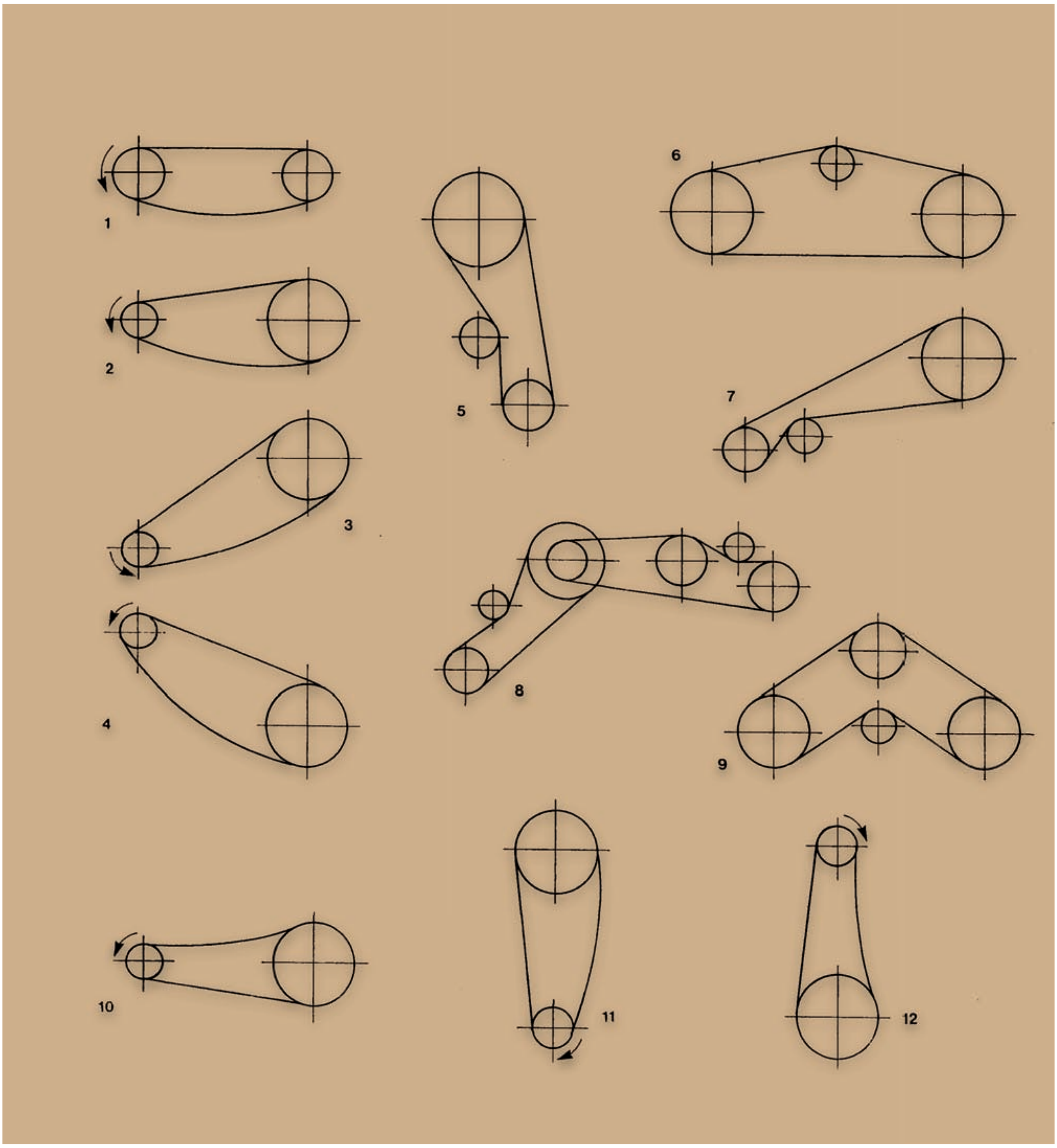
GENERAL INFO

Installation tips concerning chain transmissions
(some examples)

Recommended
Recommended with small sag. Nr. 2, 3, 4
Vertical drives only with shoe chain tensioner. Nr.5

Guide roller necessary for extended centerlines. Nr. 6, 7
Two sprockets drive with guide sprockets. Nr. 8, 9

Not recommended. Nr. 10, 11, 12



GENERAL INFO

Comparison table BS / Metric
(for length, surface, volume, weight, capacity)

Length dimensions :						
mm	x	0,03937	= inches	x	25,4	= mm
cm	x	0,3937	= inches	x	2,54	= cm
m	x	39,37	= inches	x	0,0254	= m
m	x	3,281	= feet	x	0,3048	= m
m	x	1,0936	= yards	x	0,9144	= m
Km	x	3280,8	= feet	x	0,0003048	= Km
Km	x	1093,6	= yards	x	0,0009144	= Km
Km	x	0,6214	= miles	x	1,609	= Km
Surface dimensions :						
mm²	x	0,00155	= 1 sq. inches	x	645,2	= mm²
cm²	x	0,155	= sq. inches	x	6,452	= cm²
m²	x	10,764	= sq. feet	x	0,0929	= m²
m²	x	1,196	= sq. yards	x	0,8361	= m²
Km²	x	0,3861	= sq. miles	x	2,59	= Km²
ha	x	2,471	= acres	x	0,4047	= ha
Volume :						
cm³	x	0,061023	= cu. inches	x	16,387	= cm³
cm³	x	0,3381	= fl. ounces	x	29,57	= cm³
l	x	61,023	= cu. inches	x	0,016387	= l
l	x	0,03531	= cu. Feet	x	28,317	= l
l	x	0,2642	= U.S. gallon	x	3,785	= l
l	x	0,22	= Imperial gallon	x	4,544	= l
m³	x	35,314	= cu. Feet	x	0,02832	= m³
Weight :						
g	x	15,432	= grains	x	0,0648	= g
g	x	0,0353	= oz. avoir-dupois	x	28,35	= g
Kg	x	35,27	= oz. avoir-dupois	x	0,02835	= Kg
Kg	x	2,2046	= lbs	x	0,4536	= Kg
Kg	x	0,001102	= U.S. tons	x	907,2	= Kg
Kg	x	0,000984	= long tons	x	1016,048	= Kg
Capacity :						
l/min	x	0,2642	= U.S.gpm	x	3,785	= l/min
l/min	x	0,03531	= cfm	x	28,317	= l/min
l/hr	x	0,0044	= U.S.gpm	x	227,1	= l/hr
m³/min	x	35,314	= cfm	x	0,02832	= m³/min
m³/hr	x	0,5886	= cfm	x	1,6992	= m³/hr
m³/hr	x	4,4028	= U.S.gpm	x	0,2271	= m³/hr

(*) British standard and American standard…

GENERAL INFO