SELECTION PROCEDURE

Attachment Chain Selection Guide

U.S. Tsubaki ASME/ANSI single and double pitch roller chain is widely used for conveyor service. The following procedure is useful for economical and quick chain selection.

Step 1 : Confirm the operating conditions of the conveyor
Step 2 : Tentatively select the chain size
Step 3 : Calculate the design chain tension (actual chain tension)
Step 4 : Verify the chain selection
Step 5 : Verify the allowable roller load

Step 1 Confirm the operating conditions of the conveyor

The following information is needed to design a chain conveyor.

① Type of conveyor (slat conveyor, bucket elevator, etc.)
② Method of chain travel (horizontal, inclined, or vertical conveyor)
③ Type, weight, and size of materials to be conveyed
④ Weight of materials to be transported per foot of conveyor length
⑤ Conveyor speed
⑥ Conveyor length
⑦ Lubrication
⑧ Considerations for special environments

Step 2 Tentatively select chain size

To tentatively select the chain size, estimate the chain tension (T) by the following formula. A chain with an allowable load equal to or over the above calculated chain tension may be tentatively selected.

$T\ (\text{lbs.}) = M_T \bullet f \bullet k_1$ ····· (1)

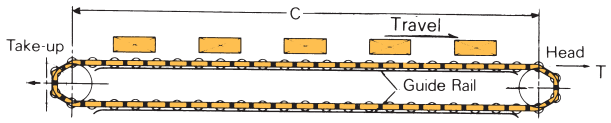
M_T : Total weight of material conveyed (lbs.)
f : Coefficient of friction, sliding and/or rolling (f_1 and/or f_2 of Table I and II)
k_1 : Chain speed coefficient (Table III)

Step 3 Calculate chain tension

Next, the chain tension should be calculated using the actual weight of the conveyor chain and material conveyed, as shown below.

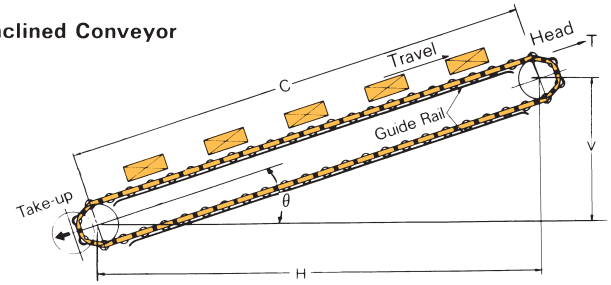
1. Chain rolling

■Horizontal Conveyor



$T = (M + 2.1w)f_1C$ ····· (2)

■Inclined Conveyor



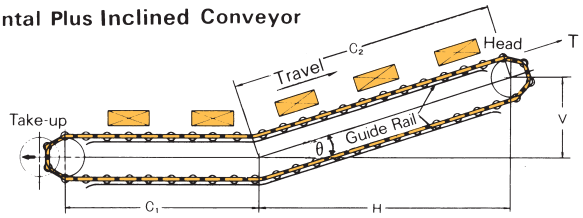
$T = (M + w)(f_1C\cos\theta + C\sin\theta) + 1.1w(f_1C\cos\theta - C\sin\theta)$ ····· (3)

When $(f_1C\cos\theta - C\sin\theta) < 0$, $1.1w(f_1C\cos\theta - C\sin\theta) = 0$

or $T = (M + w)(V + f_1H) + 1.1w(f_1H - V)$ ····· (4)

When $(f_1H - V) < 0$, $1.1w(f_1H - V) = 0$

■Horizontal Plus Inclined Conveyor



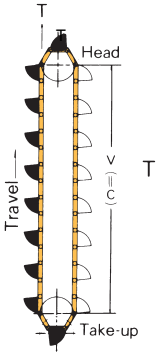
$T = (M + 2.1w)f_1C_1 + (M + w)(f_1C_2\cos\theta + C_2\sin\theta) + 1.1w(f_1C_2\cos\theta - C_2\sin\theta)$ ····· (5)

When $(f_1C_2\cos\theta - C_2\sin\theta) < 0$, $1.1w(f_1C_2\cos\theta - C_2\sin\theta) = 0$

or $T = (M + 2.1w)f_1C_1 + (M + w)(V + f_1H) + 1.1w(f_1H - V)$

When $(f_1H - V) < 0$, $1.1w(f_1H - V) = 0$ ····· (6)

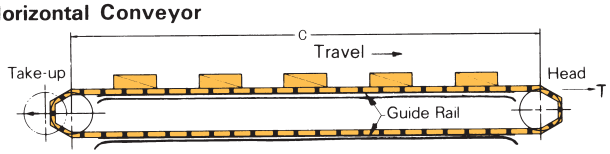
■Vertical Conveyor



$T = (M + w)V$ ····· (7)

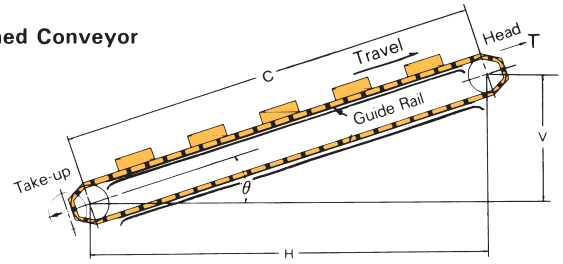
2. Chain sliding

■Horizontal Conveyor



$$T = (M + 2.1w)f_2C \quad \cdots\cdots\cdots\cdots\cdots (8)$$

■Inclined Conveyor



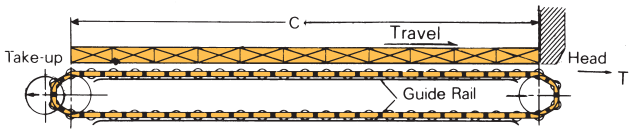
$$T = (M + w)(f_2C\cos\theta + C\sin\theta) + 1.1w(f_2C\cos\theta - C\sin\theta) \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (9)$$

When $(f_2C\cos\theta - C\sin\theta) < 0$, $1.1w(f_2C\cos\theta - C\sin\theta) = 0$

$$\text{or } T = (M + w)(V + f_2H) + 1.1w(f_2H - V) \quad \cdots\cdots\cdots\cdots\cdots (10)$$

When $(f_2H - V) < 0$, $1.1w(f_2H - V) = 0$

■Horizontal Conveyor for Top Roller Chain and Plastic Outboard Roller Chain



$$T = \left\{ M(f_1 + f_2) + 2.1w\frac{f_1 + f_2}{2} \right\} C \quad \cdots\cdots (11)$$

3. Calculate the required power

Calculate the required power to drive the conveyor from the following formula.

■Horizontal and/or Inclined Conveyor

$$HP = \frac{T \cdot S}{33{,}000 \times \eta} \quad \cdots\cdots\cdots\cdots\cdots\cdots (12)$$

■Vertical Conveyor

$$HP = \frac{M \cdot V \cdot S}{33{,}000 \times \eta} \quad \cdots\cdots\cdots\cdots\cdots\cdots (13)$$

Where,

- T = Chain tension (lbs.)
- w = Weight of chain and attachments per ft.(lbs./ft.)
- M = Weight of material conveyed per ft.(lbs./ft.)
- V = Vertical center distance of conveyor (ft.)
- H = Horizontal center distance of conveyor (ft.)
- C = Center distance between sprocket (ft.)
- f_1 = Coefficient of rolling friction between chain and guide rail (Table I)
- f_2 = Coefficient of sliding friction between chain and guide rail (Table II)
- η = Transmission efficiency
- $S = \text{Speed} = \frac{P \cdot N \cdot n}{12}$ (ft./min.)
- P = Chain pitch (inch)
- N = Number of teeth
- n = Sprocket speed (rpm)

Table I : Coefficient of Rolling Friction (f_1)

Type of Roller	Dry	Lubricated
Oversize "R" roller type	0.12	0.08
Standard "S" roller type	0.21	0.14
Top roller type	0.09	0.06

Table II : Coefficient of Sliding Friction (f_2)

Dry	Lubricated
0.3	0.2

Step 4 **Verify chain selection**

Multiply the chain tension (T) by the chain speed coefficient (K_1) listed in Table III and verify the following formula.

$$T \bullet K_1 \leq \text{Max. allowable load of the chain} \quad \cdots\cdots\cdots\cdots\cdots (14)$$

Table III : Chain Speed Coefficient (K_1)

Chain Speed (ft./min)	Speed Factor (K_1)
0 ~ 50	1.0
50 ~ 100	1.2
100 ~ 160	1.4
160 ~ 230	1.6
230 ~ 300	2.2
300 ~ 360	2.8
360 ~ 400	3.2

When the design chain tension ($T \bullet K_1$) is over the allowable load or much less than it, try the same steps again for the next bigger or smaller chain size to select a more suitable chain.

Step 5 **Verify the allowable roller load**

When the load is carried on the rollers, the total weight of the chain and load per roller should not exceed the allowable roller load shown in Table IV.

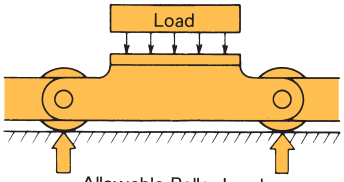


Table IV : Allowable Roller Load

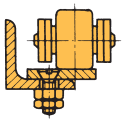
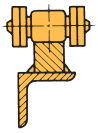
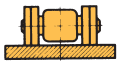
Chain No.		Allowable Roller Load lbs./roller		
		Oversize Roller	Plastic Oversize Roller	Standard Roller
C2040	RS40	143	44	33
C2050	RS50	220	66	44
C2060H	RS60	350	110	66
C2080H	RS80	590	198	120
C2100H	RS100	880	286	180
C2120H	RS120	1,320	—	260
—	RS140	—	—	300
C2160H	RS160	2,160	—	430

Note: Oversize "R" rollers are available only for double pitch roller chains.

U.S. Tsubaki Hi-Tech and Specialty Attachment chains.
In addition to the attachment chains shown in this general catalog, we offer a large variety of Specialty Attachment chains. Refer to our U.S. Tsubaki Attachment Chain Catalog No. LI0666 for additional selections.

General Engineering Information

Method of chain travel and type of rollers

Method of Chain Travel	Type of Roller	Features
Chain Rolling (Horizontal or Vertical) 	**Oversize "R" roller type** • Heavy in chain weight • Greater allowable roller load • Less roller wear	• Smooth operation • Less vibration • Lower friction and less power required • Generally used for: conveyor lengths over 35 ft. conveyor speeds over 70 ft./min.
Chain Rolling 	**Standard "S" roller type** • Light weight • Lower allowable roller load	• Generally used for: conveyor lengths less than 35 ft. conveyor speeds less than 70 ft./min.
Chain Sliding (Double Pitch chain) 		• Suitable for impact and dirty conditions • Economical • Impact resistant • Greater power required

Points to consider:

1) For long conveyors, use take-up devices to eliminate chain slack. Take-up stroke = (center distance between sprockets • 0.02) + catenary sag allowance.
2) Chain must always be engaged with at least 3 sprocket teeth.
3) When two or more strands of conveyor chain operate, all sprocket teeth on the head shaft should be aligned. The chain may be matched at the factory for uniform length and attachment alignment for accurate multiple strand operation.

Considerations for Use in Special Environments

ANSI standard and double pitch conveyor chain can be operated normally in ambient temperatures between 15°F and 140°F without trouble.

When the chain is operated in very low or high temperatures, or in an abrasive or corrosive atmosphere, the following should be taken into account.

1. Under very low or high temperatures:
   Chain must be selected in a different manner when it is operated in freezing chambers, cold areas, when it passes through a heat-treatment furnace, or is affected by heat from the material conveyed.

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Environmental Temperatures and Points of Concern

Temperatures	Chain Selection	Caution
-60° F ～-20° F	• Under -20°F or lower conditions, ASME/ANSI 304 stainless steel chains and 600 series stainless steel chains are suggested. • Carbon chains are not suggested.	(1) Low temperature embrittlement may occur on link plates of carbon steel chain. (2) Freezing of lubricant. (3) Rust due to condensation. (4) Seizure due to freezing.
-20° F ～15° F	The chain should be selected on the basis of the corrected working load, below.	
140° F ～300° F	Special lubrication is required.	
300° F ～480° F	The chain should be selected on the basis of the corrected working load, below. Selection of the next larger pitch chain over the originally selected one is suggested.	(1) Excessive wear due to decrease of hardness of pin and bushing. (2) Poor lubrication due to deterioration of lube.
480°F～	ASME/ANSI 304 stainless steel chain and ASME/ANSI 600 series stainless steel chain are suggested.	

Table V: Corrected Working Load

Temperature	Corrected Working Load	
-20° F ~ -4° F	(Max. allowable load in catalog)	x 0.25
-4° F ~ 15° F	(Max. allowable load in catalog)	x 0.3
15° F ~ 300° F	(Max. allowable load in catalog)	x 1.0
300° F ~ 390° F	(Max. allowable load in catalog)	x 0.75
390° F ~ 480° F	(Max. allowable load in catalog)	x 0.5

2. In wet conditions:
   When chain is exposed to water, e.g., in a sterilizer or water screen, excessive wear due to insufficient lubrication and rust may shorten chain life. In these cases, a larger chain size provides less bearing pressure and stainless steel or plated chain will provide rust prevention.

3. In corrosive conditions:
   When chain is exposed to an acidic or alkaline solution or operated in a corrosive atmosphere, excessive wear may occur due to chemical corrosion on the chain parts in addition to mechanical wear.

   Hydrogen embrittlement may also occur in an acidic atmosphere. Roller chain is more easily affected by acid than alkali. In special cases, electro-chemical corrosion may occur on the chain due to sea or mine water. Refer to the table on page A-60 “Corrosion Resistance Guide”, for the corrosion resistance of stainless steel.

4. In dusty conditions:
   When conveyor chain is operated in dusty conditions, i.e., in the presence of coke, metal powder, and sand, the chain wears very quickly because foreign material gets between the parts of the chain and also the engaging surfaces of the sprocket teeth and chain.

   In such cases, select a larger chain size to reduce the bearing pressure or choose a chain especially designed for high wear resistance.

The foregoing information is intended to provide general guidelines for conveyor chain selection. Please consult with U.S. Tsubaki for specific application problems.