Designing of Chain Drive Mechanism 1

Selection of Power Transmission Efficiency

The table of transmission performance in this catalog (P. 3506) is based on the following conditions.

1) The chain drive mechanism is run in an atmosphere with a temperature of -10°C~+60°C and with no abrasive particles.
2) There is no adverse impact on the mechanism, such as corrosive gas or high humidity.
3) The two shafts between which power is transmitted are parallel with each other and correctly installed.
4) The recommended lubrication method and oil are used.
5) The power transmission is subjected to minimum load variation.

Application Coefficient Table

The power transmission efficiency table (P.3506) is based on minimum load variation. The transmitted kW shown in the table should be corrected as follows depending on the actual magnitude of load variation.

Table 1. Application Coefficient Table

Impact Type	Prime Motor Type / Typical	Turbine Motor	Internal Combustion Engine: With Fluidic Mechanism	Internal Combustion Engine: Without Fluidic Mechanism
Smooth Transmission	Belt conveyor with small load variation, Chain conveyor, Centrifugal pump, Centrifugal blower, General textile machinery, General machinery with small load variation.	x1.0	x1.0	x1.2
Transmission with Moderate Impact	Centrifugal compressor, Marine propeller, Conveyor with moderate load variation, Automatic furnace, Drier, Pulverizer, General machine tools, Compressor, General earth-moving machinery, General paper manufacturing machinery	x1.3	x1.2	x1.4
Transmission with Large Impact	Press, Crusher, Construction and mining machinery, Vibrator, Oil well digger, Rubber mixer, Roll, Rollgang, General machinery with reverse or impact load	x1.5	x1.4	x1.7

Power Transmission Coefficient for Multiple Chains

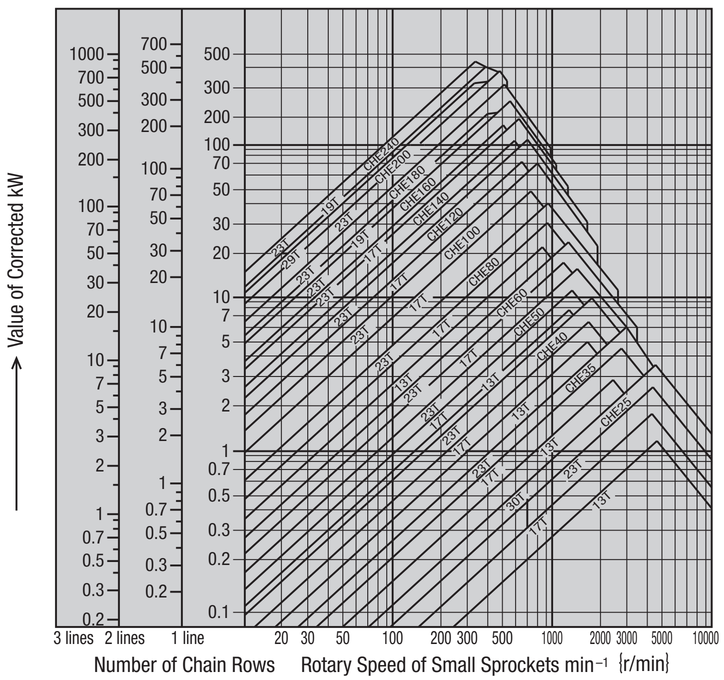
On multiple roller chains, the load is not shared evenly between each chain row. Therefore, the power transmission efficiency of multiple roller chains cannot be obtained by simply multiplying the power transmission efficiency of a single chain by the number of chain rows. The power transmission efficiency of multiple roller chains should be obtained by multiplying the power transmission efficiency of a single chain by the multiple chain power transmission coefficient.

Table 2. Power Transmission Coefficient for Multiple Chains

Number of Roller Chain Rows	Multiple Row Coefficient
2 lines	x1.7
3 lines	x2.5
4 lines	x3.3
5 lines	x3.9
6 lines	x4.6

Selection Guide Table

Table 3. Selection Guide Table



How to Read The Table

Ex. Corrected kW=5kW
Rotary Speed of Small Sprockets=300r/min
When single chain

The intersection point of the vertical axis (corrected kW) and the horizontal axis (rotary speed 300r/min) is below CHE 60 23T (23 toothed) and above 17T (17 toothed) A closer look at the location of the intersection point indicates that it most probably corresponds to 19T.

Specification Selection for Operation under Normal Conditions

1.Operating Conditions

When selecting roller chains, the following 7 parameters should be taken into account.

1. Machine to be used
2. Impact Type
3. Prime Motor Type
4. Power Transmission(kW)
5. Diameter and Rotary Speed of High-Speed Shaft
6. Diameter and Rotary Speed of Low-Speed Shaft
7. Inter-Shaft Distance

2. Application Coefficient

Select the application coefficient from the application table(Table 1) that is appropriate for the machine to be driven and the prime motor type.

3. Corrected Power Transmission(kW)

Correct the power transmission(kW)using the application coefficient.
•Single Chain…Corrected Power Transmission(kW)=Power Transmission(kW)×Application Coefficient
•Multiple Chains…Select the appropriate coefficient from the table multiple-chain power transmission coefficients(Table 2).

$$\text{Corrected Power Transmission(kW)} = \frac{\text{Power Transmission(kW)} \times \text{Application Coefficient}}{\text{Multiple Row Coefficient}}$$

4. Chain and Number of Sprocket Teeth

Using the selection guide table(Table 3)or the power transmission efficiency tables, select the chain and the number of small sprocket teeth that satisfy the rotary speed of the high-speed shaft and the corrected power transmission(kW). The chain pitch should be as small as possible, as long as the required power transmission efficiency is achieved. This should minimize noise and ensure smooth transmission of power. (If a single chain does not provide the required power transmission efficiency, use multiple chains instead. If the installation space requires that the inter-shaft distance as well as the outer diameter of sprocket be minimized, use small-pitch multiple chains.)There should be a minimum wrap angle of 120° between the small sprocket and the chain.

5. Number of Large Sprocket Teeth

Number of Large Sprocket Teeth = Number of Small Sprocket Teeth × Speed Ratio Once the number of small sprocket teeth is determined, multiplying this by the speed ratio provides the number of large sprocket teeth. Generally, the appropriate number of small sprocket teeth is 17 or greater, or 21 or greater for high-speed operation, or 12 or greater for low speed operation. The number of large sprocket teeth should be 120 or less.Select the sprocket with as great a number of teeth as possible for a speed ratio of 1:1 or 2:1. The speed ratio should normally be 1:7 or less, and ideally 1:5.

6. Shaft Diameter

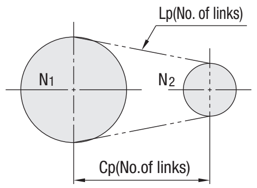
Ensure that the small sprocket selected as above is compatible with the diameter of the existing shaft on which it is to be installed. Refer to the specification table on this page. When the shaft diameter is too large for the bore in the sprocket, select another sprocket with a greater number of teeth or a larger chain.

7. Inter-shaft Distance between Sprockets

The distance between the shafts can be reduced as long as the sprockets do not interfere with each other and the wrap angle between the small sprocket and the chain is 120° or more. Generally, the inter-shaft distance should preferably be 30~50 times the pitch of the chain used. Under pulsating load conditions, decrease the distance to 20 times the chain pitch or less.

8. Chain Length and Distance between Shaft Centers

Once the chain, the number of teeth on both sprockets, and the inter-shaft distance are available, determine the number of chain links as follows.



Lp:Chain Length Expressed in Number of Links
N_1 : Number of Large Sprocket Teeth
N_2 : Number of Small Sprocket Teeth
Cp: Distance between Shaft Centers Expressed in Number of Links
π : ≈3.14

(1) Calculating the chain length (when the number of sprocket teeth N_1 and N_2 and the distance between shaft centers Cp are available)

$$Lp = \frac{N_1+N_2}{2} + 2Cp + \frac{\left(\frac{N_1-N_2}{2\pi}\right)^2}{Cp}$$

*Round up decimals of Lp to the next whole number.

Generally, when the chain length number of chain links obtained is an odd number, this should be raised to the next even number. When the inter-shaft distance demands the chain length to be an odd number, an offset link needs to be used. However, it should be avoided and an even number should be used as much as possible by adjusting the number of sprocket teeth or the inter-shaft distance.

(2) Calculating the distance between shaft centers (when the number of sprocket teeth N_1,and N_2 as the chain length Lp are available)

$$Cp = \frac{1}{8}\left\{2Lp - N_1 - N_2 + \sqrt{(2Lp-N_1-N_2)^2 - \frac{8}{\pi^2}(N_1-N_2)^2}\right\}$$

The pitch number obtained by the chain length formula is, in most cases, only approximate and not in exact agreement with a given inter-shaft distance. Therefore, it will be necessary to calculate the exact distance between the shaft centers based on the required overall length.

Example of Selection for Operation under Normal Conditions

The following is an example of selection when a 3.7 kW 1,000r/min electric (motor) is used to drive a compressor.

[1] Operating Conditions
1) Machine to be used············ Compressor,10 hours operation
2) Impact Type ························ Smooth Transmission
3) Prime Motor Type ··············· Electric Motor
4) Power Transmission ··········· 3.7kW
5) Rotary Speed ······················ 1000r/min

[2] Application Coefficient
From Table 1, an application coefficient of 1.2 is selected.

[3] Corrected Power Transmission(kW)
Corrected Power Transmission(kW)=Power Transmission(kW)×Application Coefficien
=3.7kW×1.2=4.44kW

[4] Chain and Number of Sprocket Teeth
Searching the selection guide table(Table 3)for a combination of 1,000 r/min and 4.44 kW provides a CHE40 chain and 17T sprocket.
On the power transmission efficiency table for the CHE40 chain, a combination of 13T and 1,000r/min provides a power transmission efficiency of 4.09 kW, which does not meet the required 4.44 kW. Therefore, 19T, which achieves 4.6 kW, should be selected to meet the requirement.
Results The CHE40 chain should be selected.
Number of Small Sprocket Teeth=19T