Selection of Power Transmission Efficiency

The table of transmission performance in this catalog (P. 2246) 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.

### Table 1. Power Transmission Efficiency Table

<table>
<thead>
<tr>
<th>Impact Type</th>
<th>Prime Motor Type</th>
<th>Turbine Motor</th>
<th>Internal Combustion Engine</th>
<th>Multi-Stage Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth Transmission</td>
<td>X1.0</td>
<td>X1.0</td>
<td>X1.2</td>
<td></td>
</tr>
<tr>
<td>Transmission with Motor Load Impact</td>
<td>X1.3</td>
<td>X1.2</td>
<td>X1.4</td>
<td></td>
</tr>
<tr>
<td>Transmission with Large Motor Load Impact</td>
<td>X1.5</td>
<td>X1.4</td>
<td>X1.7</td>
<td></td>
</tr>
</tbody>
</table>

### Service Coefficient Table

The power transmission efficiency (P.2246) 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.

#### Power Transmission Coefficient for Multiple Chains

On multiple-row roller chains, the load is not shared evenly between each chain row. Therefore, the power transmission efficiency of a single chain should be obtained by multiplying the power transmission efficiency of a single chain by the number of chain rows. The power transmission efficiency tables in this catalog (P. 2246) are for single-row roller chains. The power transmission efficiency of multiple-row roller chains should be obtained by multiplying the power transmission efficiency of a single row chain by the number of multiple row power transmission coefficient.

#### Table 2. Power Transmission Coefficient for Multiple Row Chains

<table>
<thead>
<tr>
<th>Number of Chain Rows</th>
<th>Multiple Row Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 lines</td>
<td>x1.7</td>
</tr>
<tr>
<td>3 lines</td>
<td>x1.5</td>
</tr>
<tr>
<td>4 lines</td>
<td>x1.3</td>
</tr>
<tr>
<td>5 lines</td>
<td>x1.9</td>
</tr>
<tr>
<td>6 lines</td>
<td>x1.6</td>
</tr>
</tbody>
</table>

### Selection Guide Table

#### Table 3. Selection Guide Table

<table>
<thead>
<tr>
<th>Number of Chain Rows</th>
<th>Rotary Speed of Small Sprocket (min⁻¹)</th>
<th>Value of Corrected kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>3.7 kW</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>1.9 kW</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>1.2 kW</td>
</tr>
</tbody>
</table>

#### How to Read The Table

Ex. Corrected kW = 6kW
Rotary Speed of Small Sprocket = 30 min⁻¹

The intersection point of the vertical axis (corrected kW) and the horizontal axis (rotary speed 300/min) is below CHE 92 23T (23 toothed) and above CHE 171 (17 toothed). Based on the above intersection point, it can be determined that 19T is applicable.

#### 4. Number and Length of Sprocket Teeth

Use the selection guide table to 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. 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

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

### 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) Diameter and Rotary Speed of High-Speed Shaft
3) Impact Type
4) Prime Motor Type
5) Diameter and Rotary Speed of Low-Speed Shaft
6) Power Transmission (kW)
7) Distance between Shaft Centers

#### 2. Service Coefficient

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

#### 3. Corrected Power Transmission (kW)

Correct the power transmission (kW) using the service coefficient.

- Single Row Chain: Corrected Power Transmission (kW) = Power Transmission (kW) × Service Coefficient
- Multiple Row Chains: Select the appropriate coefficient from the table for Power Transmission Coefficient for Multiple Row Chains (Table 2)

Corrected Power Transmission (kW) = Power Transmission (kW) × Multiple Row Coefficient

### 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: 3.7 kW
5) Rotary Speed: 1000/min

#### 2. Service Coefficient

From Table 1, an application coefficient of 1.2 is selected.

#### 3. Corrected Power Transmission (kW)

Corrected Power Transmission (kW) = Power Transmission (kW) × Service Coefficient

Corrected Power Transmission (kW) = 3.7 kW × 1.2 = 4.44 kW

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

#### 4. Chain and Number of Sprocket Teeth

When selecting roller chains, the load number of sprocket teeth (N) and the chain length (Lp) are identified.

\[
Lp = \frac{N}{2} \times \frac{1}{\cos \beta} = \frac{N}{2} \times \frac{1}{\cos 19°} = \frac{N}{2} \times \frac{1}{0.945} = \frac{N}{1.92} + \frac{N}{2} \times \frac{1}{0.945}
\]

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

#### 5. Chain and Length Distance between Shaft Centers

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

\[
Lp = \frac{N}{2} \times \frac{1}{\cos \beta} = \frac{N}{2} \times \frac{1}{\cos 19°} = \frac{N}{2} \times \frac{1}{0.945} = \frac{N}{1.92} + \frac{N}{2} \times \frac{1}{0.945}
\]