Horsepower Rating

The horsepower rating in Table IV on page A-24 is based on the following conditions:

1) The chains are operated under ordinary conditions. The ambient temperature range must be between 15°F and 140°F. They should not be used in an atmosphere in which abrasive dust or corrosive gas is present or where the humidity is high.
2) The two transmission shafts are in a horizontal position, and the chains are properly installed.
3) The suggested lubrication system and oil are used.
4) The load does not change significantly during transmission. The "Service Factor" given in Table I should be taken into account when the chains are used under various operating conditions. The load conditions will affect the life of the chain.
5) The increase in the horsepower rating of multiple strand roller chain cannot be calculated simply by multiplying the horsepower rating of one strand by the number of strands, since the load on each strand is not exactly the same. In order to estimate the service life of a multiple strand chain, the "Multiple Strand Factor" given in Table II must be used. When the chain length is 100 pitches and the above conditions are met, a service life of approximately 15,000 hours can be expected.

Procedures for Selecting Roller Chain

1) The following factors must be considered when selecting roller chain.
   a. Source of power
   b. Driven machine
   c. Horsepower to be transmitted
   d. RPM of driving and driven shafts
   e. Diameter of driving and driven shafts
   f. Center distance of the shafts
2) Use Table I to obtain the "Service Factor."
3) Multiply the horsepower value by the service factor to obtain the design horsepower value.
4) Use Table IV on page A-24 and the horsepower ratings tables on pages A-6 to A-19 to obtain the appropriate chain number and the number of teeth for small sprockets. Refer to the number of revolutions of the high speed shaft (the driving shaft when the speed is reduced; the driven shaft when the speed is increased) and the design horsepower value. For smoother chain drive, a smaller pitch chain is suggested. If a single strand chain does not satisfy the transmission requirements, use a multiple strand chain. If there are space limitations, a multiple strand roller chain with a smaller pitch may be used.
5) After determining the number of teeth necessary for the small sprocket, refer to the Sprocket Dimension Table (pages A-79 to A-82) to check if the sprocket diameter satisfies the space limitations.
6) The number of teeth for the large sprocket is determined by multiplying the number of teeth for the small sprocket by the speed ratio. More than 15 teeth on the small sprocket is suggested. The number of teeth for the large sprocket should be less than 120. By reducing the number of teeth for the small sprocket, the number of teeth for the large sprocket can be reduced.
7) For temperatures below 15°F, see the Environmental Temperatures and Points of Concern Table on page B-38.

Basic Formula for Chain Drive

1) Chain speed: S

$$S = \frac{P \cdot N \cdot n}{12} \text{ (ft./min.)}$$

P : Chain pitch (inch)
N : Number of teeth of sprocket
n : Revolution per minute (rpm)

2) Chain tension: T

$$T = \frac{33{,}000 \cdot HP}{S} \text{ (lbs.)}$$

S : Chain Speed (ft./min.)
HP : Horsepower to be transmitted (hp)

3) Number of pitches of chain: L

$$^{*}L = \frac{N_1+N_2}{2} + 2C + \frac{\left(\frac{N_2-N_1}{6.28}\right)^2}{C}$$

N_1 : Number of teeth (small sprocket)
N_2 : Number of teeth (large sprocket)
C : Center distance in pitches
* Any fraction of L is counted as one pitch.

4) Center distance in pitches: C

$$C = \frac{1}{8}\left\{2L - N_1 - N_2 + \sqrt{(2L-N_1-N_2)^2 - \frac{8}{9.86}(N_2-N_1)^2}\right\}$$

Table II: Multiple Strand Factor

Number of Roller Chain Strands	Multiple Strand Factor
2	1.7
3	2.5
4	3.3
5	3.9
6	4.6

Table I: Service Factor

Type of Impact	Machines	Source of Power		
		Electric Motor or Turbine	Internal Combustion Engine	
			With hydraulic drive	Without hydraulic drive
Smooth	Belt conveyors with small load fluctuation, chain conveyors, centrifugal blowers, general textile machines, machines with small load fluctuation	1.0	1.0	1.2
Some impact	Centrifugal compressors, marine engines, conveyors with some load fluctuation, automatic furnaces, dryers, pulverizers, general machine tools, compressors, general work machines, general paper mills	1.3	1.2	1.4
Large impact	Press, construction or mining machines, vibration machines, oil well rigs, rubber mixers, rolls, general machines with reverse or large impact loads	1.5	1.4	1.7

Example

Step 1 **Data Required**

1. Type of application:
   Centrifugal Blower
2. Shock Load:
   Small load fluctuation
3. Source of Power: Motor
4. HP to be transmitted: 40 hp
5. Drive shaft:
   Diameter 2 inches, 750 rpm
   Driven shaft:
   Diameter 3 inches, 250 rpm
6. Center distance:
   Less than 9 inches
7. Space limitation:
   Less than 20 inches

Step 2 **Use Table I to determine the service factor.**

Service Factor SF = 1.0

Step 3 **Obtain Design HP**

Design HP = (HP to be transmitted) • SF
= 40 hp • 1.0
= 40 hp

Step 4 **Obtain the chain number and the number of teeth on the small sprocket from the Roller Chain Selection Table (page A-24) referring to the above 40 hp and 750 rpm.**

Then check it by referring to the Horsepower Rating Tables (pages A-6 to A-19).

1. According to the horsepower rating, the best choice would normally be a single strand of RS80-17 teeth. Since the speed ratio is 1/3 (250/750 rpm), the necessary number of sprocket teeth would be 17 for the small sprocket and 51 for the large sprocket. But, as the outside diameters are 5.94 inches for 17 teeth and 16.81 inches for 51 teeth (refer to sprocket dimensions on pages A-79 to A-82), it exceeds the space limitation of 20 inches (5.94 + 16.81 > 20 inches).

   Therefore, these sprockets are not suitable.
2. As a single strand chain is not suitable, a multiple-strand RS60-2, 22 and 66 teeth would be possible. But this combination is not suitable due to the space limitation again (5.67 + 16.18 > 20 inches).
3. For triple strand, RS60-3, 15 and 45 teeth would be possible.

   The sprockets' diameters are 3.90 inches and 11.18 inches respectively, the sum of which is less than 20 inches. The horsepower rating of a 15-tooth sprocket for the RS60-3 should be confirmed by the horsepower rating for the RS60 (see page A-11).

   The horsepower rating of a 15 tooth sprocket is 15.1 hp at 700 rpm and 17 hp at 800 rpm. So the horsepower rating at 750 rpm is about 16 hp. Since 16 hp is for a single strand chain, the horsepower rating must be multiplied by a multiple strand factor of 2.5 for a triple strand (see page A-22).

   Therefore, the horsepower rating of RS60-3, 15 teeth at 750 rpm is 40 hp (16 • 2.5 = 40).

Step 5 **Refer to Sprocket Section (C) in this catalog to check the diameter of the bore.**

A 45-tooth sprocket meets the necessary requirement, but since the maximum bore diameter (1.87 inches) of a 15-tooth sprocket is smaller than the drive shaft diameter of 2 inches, it can't be used.

A 16-tooth sprocket with a maximum bore diameter of 2 inches must be used. Check again that the outside diameter, 4.21 inches for 16 teeth and 11.89 inches for 48 teeth, is less than the space limitation (4.21 + 11.89 < 20).

A combination of RS60-3, 16 and 48 teeth must be used to fulfill all the necessary requirements.

Selection for Slow Speed

When the chain speed (S) is less than 160 ft./min., select the RS roller chain that is one size smaller than the chain chosen from the horsepower rating method mentioned above.

1. Tentatively select the chain and sprocket from Table IV (page A-24) and proceed by using a one-size-smaller chain and its sprocket with the number of teeth close to the sprocket selected above. Be sure to confirm that the sprocket meets the application requirements such as bore diameter and space limitation, etc.
2. Calculate the chain speed from the number of teeth on the driving sprocket using equation (A). Also check that the speed is less than 160 ft./min.
3. Calculate the chain tension for the above drive from equation (B).
4. Select the service factor and the chain speed coefficient from Table I (page A-22) and Table III.
5. Verify that the chain has maximum allowable load which satisfies equation (C).

$$S = \frac{P \bullet N \bullet n}{12} \text{ (ft./min.)} \quad \ldots\ldots\ldots\ldots (A)$$

$$T = \frac{33{,}000 \bullet HP}{S} \text{ (lbs.)} \quad \ldots\ldots\ldots\ldots (B)$$

T • Service Factor • Chain Speed Coefficient ≤ Maximum Allowable Load $\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$ (C)

S: chain speed (ft./min.)
P: chain pitch (inch)
N: number of sprocket teeth
n: revolutions per minute (rpm)
T: chain tension (lbs.)
HP: horsepower to be transmitted (hp)

There are two different ways to do the next step: to increase the number of teeth, or to use the same procedure for Super Chains of the same size (refer to Super Chains on pages A-35 to A-42).

Note: Please use press fit connecting links for slow speed chain selection.

Table III: Chain Speed Coefficient

Chain Speed	Speed Coefficient
Less than 50 ft./min.	1.0
50 to 100 ft./min.	1.2
100 to 160 ft./min.	1.4

Selection for High Temperatures

U.S. Tsubaki Improved Drive Chains are made of heat treated carbon steel. When exposed to high temperatures, the mechanical properties of the heat treated chain components are lost.

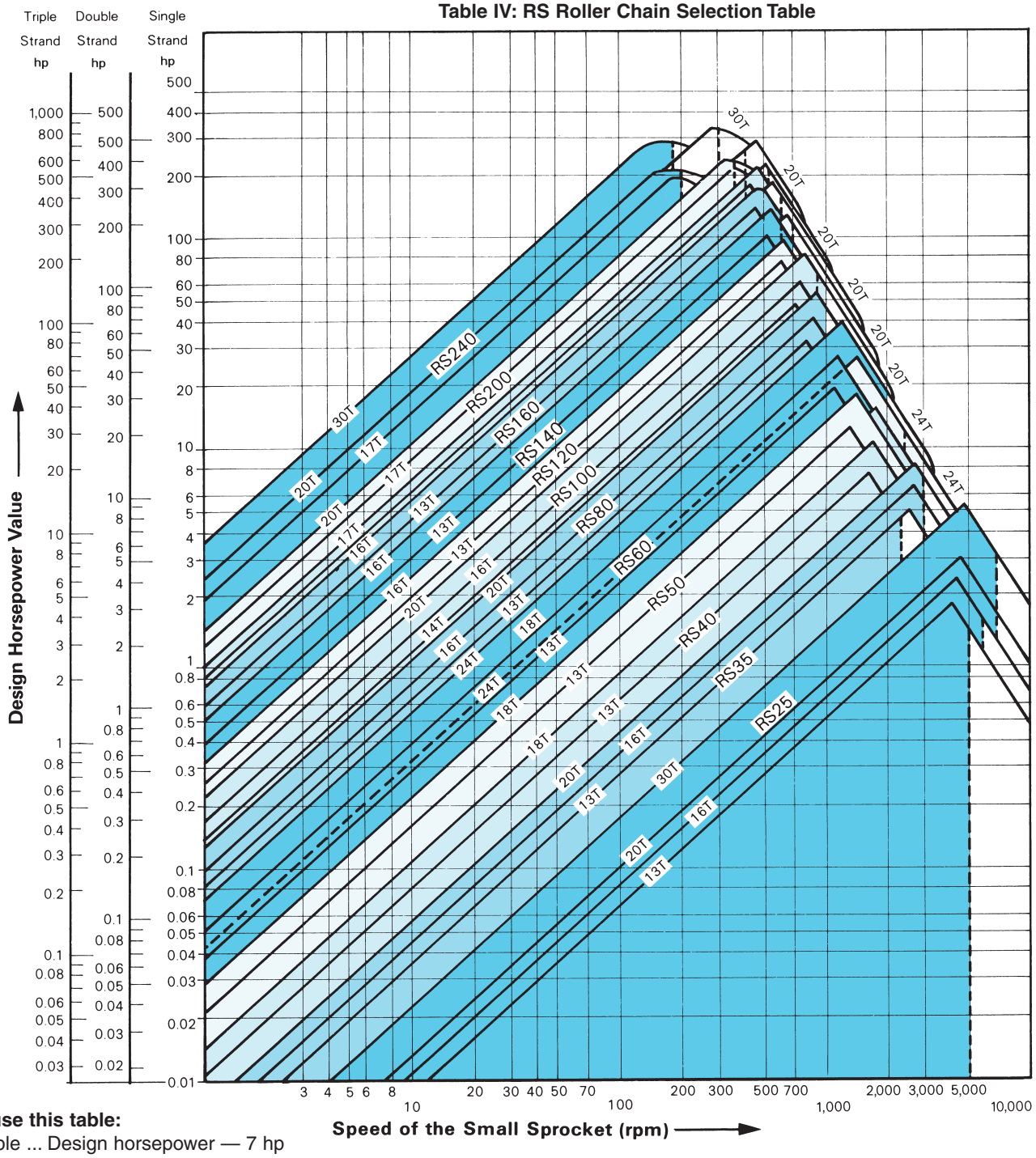
1. The hardness, and therefore the wear resistance of pins and bushings, is reduced.
2. At temperatures above 390°F, the rollers and plates lose their hardness and strength.

Standard roller chains can be used in temperatures up to 500°F with the following adjustments:

Temperature	Percentage of Catalog Capacity Rating
Up to 340°F	100%
390°F	75%
500°F	50%

For temperatures below 15°F, see the Environmental Temperatures and Points of Concern Table on page B-38.

Table IV: RS Roller Chain Selection Table



How to use this table:

1. Example ... Design horsepower — 7 hp
   a) Assume that the RPM of the small sprocket is 100.
   Judging from the intersection point of the design horsepower's value of 7 hp and the RPM value of 100, RS80 and a sprocket with either 17 teeth or 18 teeth can be selected. Sprockets with 17 teeth are more economical than those with 18 teeth.
   b) Assume that the RPM of the small sprocket is 300. An RS60, 15-tooth sprocket is appropriate from the intersection point in the same manner as above. The line for RS50-24 teeth can also be seen near the intersection of 7 hp and 300 rpm. Therefore, either RS60-15 teeth or RS50-24 teeth can be selected. This table is used to make a tentative selection. The Horsepower Rating Tables should be used to determine the most appropriate chain and sprocket.
2. Horsepower lines of 20, 24 and 30-tooth sprockets are shown only in the high speed range on the right hand side of the above chart. When checking the horsepower line of these sprockets, make a line parallel to the other lines on the left hand side of the dotted line for RS50-24 teeth.
3. When using a chain in the white part on the right side of the table, please consult with U.S. Tsubaki.
4. When the chain speed is less than 160 ft./min., it is more economical to select your RS roller chain by the selection method for slow speed drives (see page A-23).