

[Technical Calculations]
Selection of Timing Belts 1

Selection is easy with Timing Pulleys and Belts automatic calculation tool available at:
http://fawos.misumi.jp/FA\_WEB/pulley\_sea/

[Step 1]Setting the Necessary Design Conditions

- (1) Machine Type (2) Transmission Power (3) Load Fluctuation Level (4) Operation Hours Per Day (5) Rotary Speed of Small Pulley
- (6) Speed Ratio (Number of teeth of large pulley/Number of teeth of small pulley) (7) Temporary Inter-shaft Distance (8) Limit of Pulley Diameter (9) Other Conditions

[Step 2-a]Calculating the Design Power.....MXL/XL/L/H/S\_M/MTS\_M series

- Design Power (Pd) =Transmission Power (Pt) ×Overload Coefficient (Ks)
- Calculate the Transmission Power (Pt) in terms of the rated power of the prime motor. (Originally, it is ideal to calculate from the actual load applied to the belt)
- Overload Coefficient (Ks) =Ko+Kr+Ki Ko : Load Correction Coefficient (Table 1) Kr : Speed Ratio Correction Coefficient (Table 2) Ki : Idler Correction Coefficient (Table 3)

Table 1. Load Correction Coefficient (Ko)

| Typical Machines Using a Belt                                                                                                                                                                                                                                                                            | Motor                                             |                      |                      |                                                       |                      |                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|----------------------|----------------------|-------------------------------------------------------|----------------------|----------------------|
|                                                                                                                                                                                                                                                                                                          | Max. Output not Exceeding 300% of Rated Value     |                      |                      | Max. Output Exceeding 300% of Rated Value             |                      |                      |
|                                                                                                                                                                                                                                                                                                          | AC Motor (Standard Motor, Synchronous Motor)      |                      |                      | Special Motor ( High torque), Single-Cylinder Engine  |                      |                      |
|                                                                                                                                                                                                                                                                                                          | DC Motor (Shunt), Engine with 2 or More Cylinders |                      |                      | DC Motor (Series), Operation with Lye Shaft or Clutch |                      |                      |
|                                                                                                                                                                                                                                                                                                          | Operation Hours                                   |                      |                      | Operation Hours                                       |                      |                      |
|                                                                                                                                                                                                                                                                                                          | Intermittent use                                  | Regular Use          | Continuous Use       | Intermittent use                                      | Regular Use          | Continuous Use       |
|                                                                                                                                                                                                                                                                                                          | 1 Day<br>3 to 5 hrs                               | 1 Day<br>8 to 12 hrs | 1 Day<br>8 to 12 hrs | 1 Day<br>3 to 5 hrs                                   | 1 Day<br>8 to 12 hrs | 1 Day<br>8 to 12 hrs |
| Exhibit Instrument, Projector, Measuring Instrument, Medical Machine                                                                                                                                                                                                                                     | 1.0                                               | 1.2                  | 1.4                  | 1.2                                                   | 1.4                  | 1.6                  |
| Cleaner, Sewing Machine, Office Machine, Carpentry Lathe, Belt Sawing Machine                                                                                                                                                                                                                            | 1.2                                               | 1.4                  | 1.6                  | 1.4                                                   | 1.6                  | 1.8                  |
| Light Load Belt Conveyor, Packer, Sifter                                                                                                                                                                                                                                                                 | 1.3                                               | 1.5                  | 1.7                  | 1.5                                                   | 1.7                  | 1.9                  |
| Liquid Mixer, Drill Press, Lathe, Screw Machine, (Circular Sawing) Machine, Planer, Washing Machine, Paper Manufacturing Machine (Excluding Pulp Manufacturing Machine), Printing Machine                                                                                                                | 1.4                                               | 1.6                  | 1.8                  | 1.6                                                   | 1.8                  | 2.0                  |
| Mixer (Cement and Viscous Matter), Belt Conveyor (Ore, Coal and Sand), Grinder, Shaping Machine, Boring Machine, Milling Machine, Compressor (Centrifugal), Vibration Sifter, Textile Machine (Warper and Winder), Rotary Compressor, Compressor (Reciprocal)                                            | 1.5                                               | 1.7                  | 1.9                  | 1.7                                                   | 1.9                  | 2.1                  |
| Conveyor (Apron, Pan, Bucket and Elevator), Extraction, Fan, Blower (Centrifugal, Suction and Discharge), Power Generator, Exciter, Hoist, Elevator, Rubber Processor (Calender, Roll and Extruder), Textile Machine (Weaving Machine, Fine Spinning Machine, Twisting Machine and Weft Winding Machine) | 1.6                                               | 1.8                  | 2.0                  | 1.8                                                   | 2.0                  | 2.2                  |
| Centrifugal Separator, Conveyor (Flight and Screw), Hammer Mill, Paper Manufacturing Machine (Pulpapitor)                                                                                                                                                                                                | 1.7                                               | 1.9                  | 2.1                  | 1.9                                                   | 2.1                  | 2.3                  |

- Typical machines using a belt are listed above. For other machines using a belt, a load correction coefficient should be fixed by reference to this table.
- In the case of starts and stops over 100 times per day or rapid acceleration and deceleration, check the above values multiplied by 1.3. (MTS\_M only)

Table 2. Speed Ratio Correction Coefficient (Kr)

| Speed Ratio  | Coefficient (Kr) |
|--------------|------------------|
| 1.00 to 1.25 | 0                |
| 1.25 to 1.75 | 0.1              |
| 1.75 to 2.50 | 0.2              |
| 2.50 to 3.50 | 0.3              |
| 3.50 or more | 0.4              |

Table 3. Idlers Correction Coefficient (Ki)

| Position of Idler                  | Coefficient(Ki) |
|------------------------------------|-----------------|
| Inside the loose side of the belt  | 0               |
| Outside the loose side of the belt | 0.1             |
| Inside the loose side of the belt  | 0.1             |
| Outside the loose side of the belt | 0.2             |

[Step 2-b]Calculating the Design Power .....When P\_M series

- Design Power (Pd) =Transmission Power(Pt)M Overload Coefficient (Ks)
- Calculate the Transmission Power (Pt) in terms of the rated power of the prime motor. (Originally, it is ideal to calculate from the actual load applied to the belt)
- Overload Coefficient (Ks) =Ko+Ki+Kr+Kh Ko : Application coefficient (Table 4) Ki : Correction coefficient when idler is used (Table 5) Kr : Speed increase correction coefficient (Table 6) Kh : Operating correction coefficient (Table 7)

Table 4. Application Coefficient (Ko)

| Type of Motor        |                                       | I                          | II         | III                 |                 |                 |
|----------------------|---------------------------------------|----------------------------|------------|---------------------|-----------------|-----------------|
| Type of Passive Unit | Peak Output/Basic Output              | 200% or Less               | 200 to 300 | 300% or More        |                 |                 |
| A                    | Extremely Smooth Transmission         | 1.0                        | 1.2        | 1.4                 |                 |                 |
| B                    | Fairly Smooth Transmission            | 1.3                        | 1.5        | 1.7                 |                 |                 |
| C                    | Transmission with Moderate Impact     | 1.6                        | 1.8        | 2.0                 |                 |                 |
| D                    | Transmission with Considerable Impact | 1.8                        | 2.0        | 2.2                 |                 |                 |
| E                    | Transmission with Large Impact        | 2.0                        | 2.2        | 2.5                 |                 |                 |
| Motor                | AC Motor                              | Single-Phase               |            | —                   | —               | All Types       |
|                      |                                       | Squirrel-Cage Induction    | 2 Poles    | 100kW or More       | 90~3.7kW        | 2.2kW or Less   |
|                      |                                       |                            | 4 Poles    | 55kW or More        | 45kW or Less    | —               |
|                      |                                       |                            | 6 Poles    | 37kW or More        | 30kW or Less    | —               |
|                      |                                       |                            | 8 Poles    | 15kW or More        | 11kW or Less    | —               |
|                      |                                       | Wire-Wound                 | 4 Poles    | —                   | 15kW or Less    | 11kW or Less    |
|                      |                                       |                            | 6 Poles    | —                   | 11kW or Less    | 7.5kW or Less   |
|                      |                                       |                            | 8 Poles    | —                   | 5.5kW or Less   | 3.7kW or Less   |
|                      |                                       |                            |            | Synchronous Motor   |                 | —               |
|                      |                                       | DC Motor                   |            | Shunt               | Compound        | Series          |
|                      |                                       | Internal Combustion Engine |            | 8 or More Cylinders | 7 ~ 5 Cylinders | 4 ~ 2 Cylinders |
|                      |                                       | Hydraulic Motor            |            | —                   | —               | All Types       |

Note)When the transmission involves regular, reverse revolutions, large momentum or extreme impact, a basic-use coefficient of 2.5 or more can be used.

Table 5. Correction Coefficient when Idler is Used (Ki)

| Location of Idler in Use | Inside | Outside |
|--------------------------|--------|---------|
| Loose Side of the Belt   | 0      | +0.1    |
| Tense Side of the Belt   | +0.1   | +0.2    |

Should be added for each idler.

Table 6. Speed Increase Correction Coefficient (Kr)

| Speed Increase Ratio | Correction Coefficient |
|----------------------|------------------------|
| 1 to 1.25            | 0                      |
| 1.25 to 1.75         | +0.1                   |
| 1.75 to 2.5          | +0.2                   |
| 2.5 to 3.5           | +0.3                   |
| 3.5 or more          | +0.4                   |

Table 7. Operating Correction Coefficient (Kh)

| Operation Hours                                    | Correction Coefficient |
|----------------------------------------------------|------------------------|
| Operated 10 or More Hours a Day                    | +0.1                   |
| Operated 20 or More Hours a Day                    | +0.2                   |
| Operated 500 Hours or Less(For Seasonal Operation) | −0.2                   |

[Step 3]Temporarily Selecting the Type of Belt from Selection Guide Table

Table 8. Selection Guide Table 1 (MXL,XL,L,H,T5,T10)

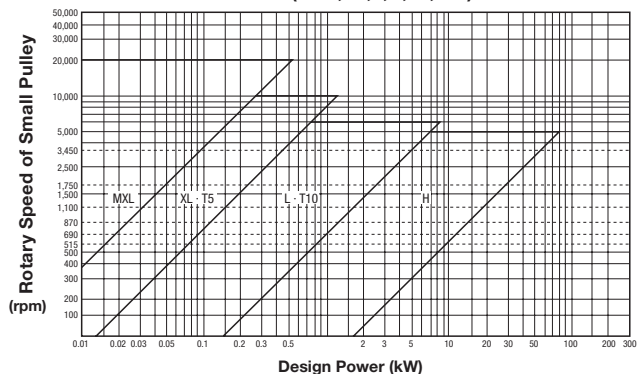


Table 9. Selection Guide Table 2 (S\_M series)

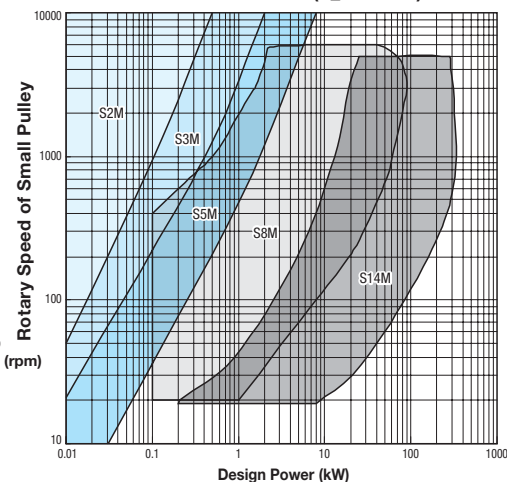


Table 10. Selection Guide Table 3 (P\_M series)

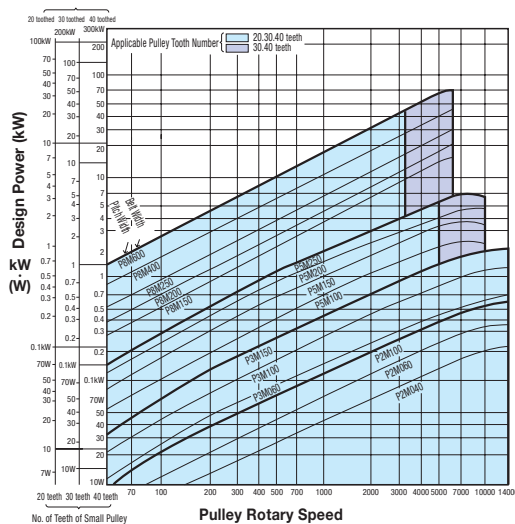
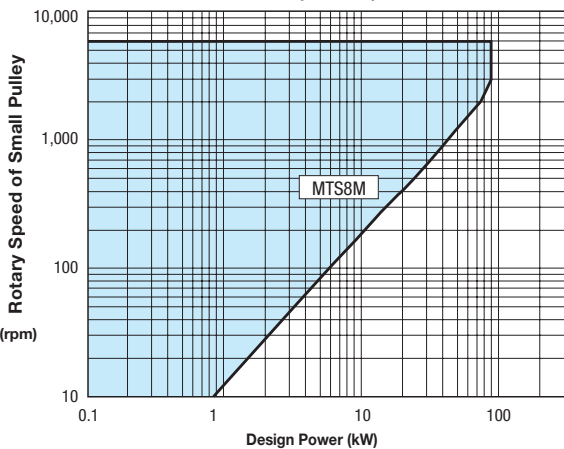


Table 11. Selection Guide Table 4 (MTS8M)



[Step 4]Determining Number of Teeth of Large and Small Pulley, Belt Length, Inter-Shaft Distance

- (1) Select the number of teeth of large and small pulley from P.2827~2835, which can satisfy the predetermined speed ratio. (However, note that the number of teeth for small pulley should be larger than the min. number of teeth shown in Table 12.)

Speed Ratio= Number of Teeth of Large Pulley / Number of Teeth of Small Pulley

Table 12. Min. Number of Teeth of Pulley

| Rotary Speed of Small Pulley(rpm) | Type of Belt, Minimum Number of Teeth |    |    |    |     |     |     |     |      |       |    |
|-----------------------------------|---------------------------------------|----|----|----|-----|-----|-----|-----|------|-------|----|
|                                   | MXL                                   | XL | L  | H  | S2M | S3M | S5M | S8M | S14M | MTS8M | T5 |
| 900 or Less                       | 12                                    | 10 | 12 | 14 | 14  | 14  | 14  | 22  | —    | 24    | 12 |
| Over 900                          | 12                                    | 10 | 12 | 16 | 14  | 14  | 16  | 24  | 34   | 24    | 12 |
| Over 1200                         | 14                                    | 11 | 14 | 18 | 16  | 16  | 20  | 26  | 38   | 24    | 14 |
| Over 1800                         | 16                                    | 12 | 16 | 20 | 18  | 18  | 24  | 28  | 40   | 24    | 16 |
| Over 3600                         | —                                     | 16 | 20 | 24 | 20  | 20  | 26  | 30  | 48   | 24    | 20 |
| Over 4800                         | —                                     | —  | —  | —  | 20  | 20  | 26  | —   | —    | —     | —  |

- (2) Determine approx. belt circum. length (Lp') in terms of temporary inter-shaft distance (C'), diameter of large pulley(Dp)and diameter of small pulley (dp).

Lp' = 2C' + (pi(Dp+dp))/2 + ((Dp-dp)^2)/4C'

C' : Temporary Inter-shaft Distance Dp : Pitch Diameter of Large Pulley (mm) dp : Pitch Diameter of Small Pulley (mm) Lp' : Approx. Belt Circum. Length (mm)

- (3) Determine a belt circum. length (Lp') that is the nearest value to approx. belt circum. length referring to P.2013~2020, and then calculate the correct inter-shaft distance using the following formula.

C = (b + sqrt(b^2 - 8(Dp-dp)^2))/8

b = 2Lp - pi(Dp+dp)

Dp : Pitch Diameter of Large Pulley (mm) dp : Pitch Diameter of Small Pulley (mm) Lp : Belt Circum. Length (mm) C : Inter-shaft Distance