[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) DC Motor (Shunt), Engine with 2 or More Cylinders			Special Motor (High torque), Single-Cylinder Engine DC Motor (Series), Operation with Lye Shaft or Clutch		
	Operation Hours			Operation Hours		
	Intermittent use 1 Day 3 to 5 hrs	Regular Use 1 Day 8 to 12 hrs	Continuous Use 1 Day 8 to 12 hrs	Intermittent use 1 Day 3 to 5 hrs	Regular Use 1 Day 8 to 12 hrs	Continuous Use 1 Day 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 Ration 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 Passive Unit / Peak Output/Basic Output				Type of Motor Ⅰ 200% or Less	Ⅱ 200 to 300	Ⅲ 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		–	Average Torque	High Torque
	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.

Type	Typical Passive Machines
A	Measuring Instrument, Camera Device, Radar, Medical Machine, Projector
B	Belt Conveyor (For Light Load) Chain Conveyor (For Light Load) Driller Press, Lathe, Screw Machine Electric Typewriter, Calculator, Duplicator, Printing Press, Cutter, Paper Folder, Printer, Mixer, Calender-Dryer, Lathe, Belt Sawing Machine, Plane, Circular Sawing Machine, Planer, Mixer (Liquid), Bread Baking Machine, Flour Kneading Machine, Sifter (Drum and Cone), Sawing Machine
C	Belt Conveyor (Ore, Coal, Sand), Elevator, Boring Mill, Grinder, Milling Machine, Shaper, Metal Sawing Machine, Wind Hoist, Dryer, Washing Machine (Including a Wringer), Excavator, Mixer, Granulating Machine, Pump (Centrifugal, Gear and Rotary), Compressor (High-Speed Center), Stirrer, Mixer (Viscous Matter), Centrifugal Forced Blower, General Rubber Handling Machine, Power Generator, Sifter (Electric)
D	Conveyor (Apron, Bucket, Flight, Screw), Hoist, Cutting Press, Shattering Machine, Pulp Manufacturing Machine, Weaving Machine, Spinning Machine, Twisting Machine, Blender, Centrifugal Separator, Blower (Axial Flow, for Mining and Roots), General Construction Equipment, Hammer Mill, Rollgang
E	Crank Press, Pump (Reciprocal), Compressor (Reciprocating), Civil Engineering, Mining Equipment Including Crushing Machine (Ball, Rod, Gravel), Rubber Mixer

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)

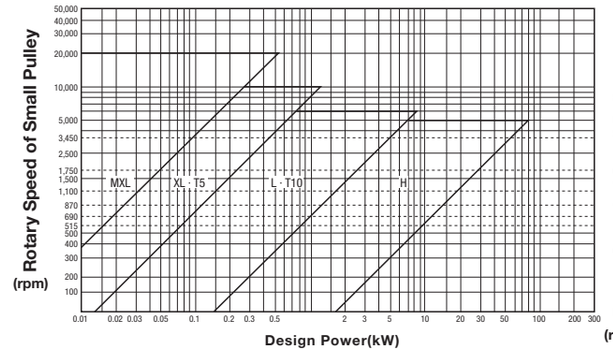


Table 9. Selection Guide Table 2 (S_M series)

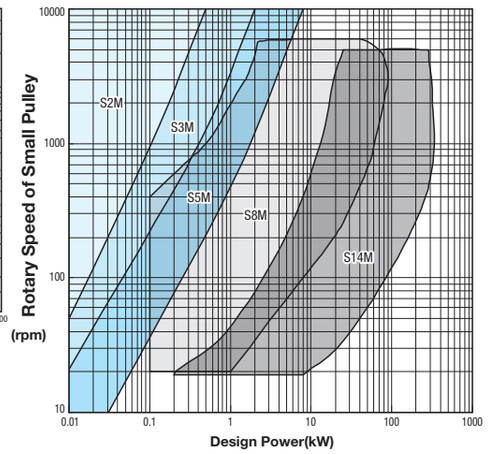


Table 10. Selection Guide Table 3 (P_M series)

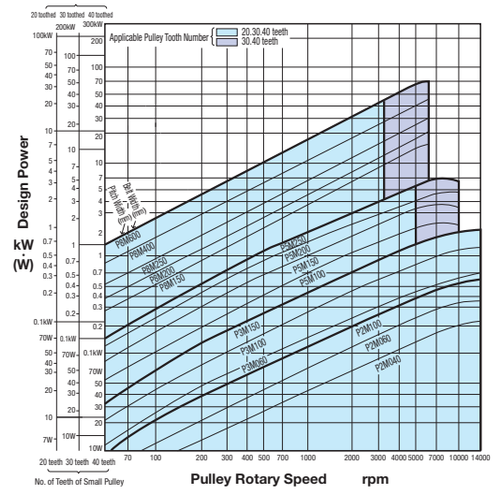
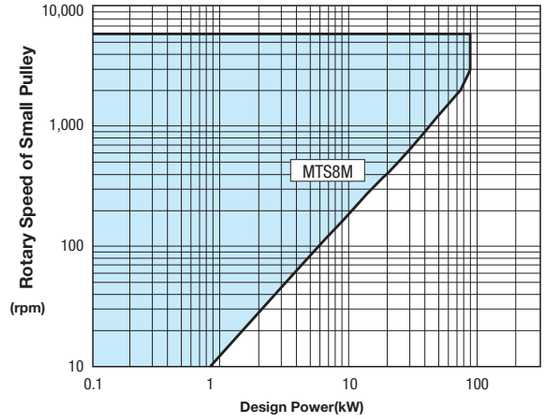


Table 11. Selection Guide Table 4 (MTS8M)



[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 predeterminated 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.)

$$\text{Speed Ratio}=\frac{\text{Number of Teeth of Large Pulley}}{\text{Number of Teeth of Small Pulley}}$$

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	T10
900 or Less	12	10	12	14	14	14	14	22	–	24	12	14
Over 900 1200 or Less	12	10	12	16	14	14	16	24	34	24	12	16
Over 1200 1800 or Less	14	11	14	18	16	16	20	26	38	24	14	18
Over 1800 3600 or Less	16	12	16	20	18	18	24	28	40	24	16	20
Over 3600 4800 or Less	–	16	20	24	20	20	26	30	48	24	20	22
Over 4800 10000 or Less	–	–	–	–	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).

$$Lp'=2C'+\frac{\pi(Dp+dp)}{2}+\frac{(Dp-dp)^2}{4C'}$$

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

$$C=\frac{b+\sqrt{b^2-8(Dp-dp)^2}}{8}$$

$$b=2Lp-\pi(Dp+dp)$$

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