Precautions for Designing and Using a Synchronous Belt

(1) How to appropriately tension a synchronous belt

An appropriate belt tension has no slack, and an excessive tension reduces the belt service life. If the tension is loose, a high shock load or a high starting torque may cause the belt to jump and be stranded on the pulley groove.

When numerically controlling the belt tension, follow the next procedure.

Step 1 Calculating the span

$$Ls = \sqrt{C^2 - \frac{(Dp - dp)^2}{4}}$$

Ls	: Span length	(mm)
C	: Center distance	(mm)
Dp	: Large pulley pitch diameter	(mm)
dp	: Pinion pitch diameter	(mm)

Step 2 calculating the slack and tension load

① Slack calculation

$$\delta = 0.016\ Ls$$

δ	: Deflection	(mm)
Ls	: Span length	(mm)

② Calculation of deflection load

$$F\delta = \frac{To + (Ls / Lp) \cdot Y}{16}$$

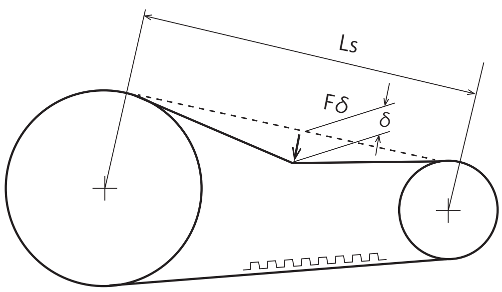
Fδ	: Deflection load	(N)
Ls	: Span length	(mm)
Lp	: Belt pitch length	(mm)
To•Y	: Constant **(Table 1/Table 2/Table 3)**	

* For the value of To, the deflection load is calculated by substituting the max and min in **Table 1** to **Table 3**. If there is a recommended value, perform the calculation with a recommended value.
Apply a tension so that the deflection load at this time falls within the range of Fδ that was calculated by substituting To max and To min. If you substituted a recommended value, apply a tension of calculated Fδ.

Step 3 Adjusting the tension

Apply a deflection of δ mm to the center of the span and apply a tension so that the deflection load at this time is Fδ.

[Note] If a shock load or the starting torque is high and the belt jumps and becomes stranded on the pulley groove, tension the belt to the maximum To.



(2) In the case of outside the range of tension meter measurement

When adjusting tension, the value may fall outside the range of measurement with a tension meter, such as when the belt is large (e.g., XH, XXH). In such a case, correct the equation for deflection load and change the value to the one that can be measured with a tension meter.

*Bando tension meter	
Applicable range of deflection	2 to 62 mm
Applicable range of deflection load	4.9 to 120 N (0.5 to 12 kgf)

Correction equation when the value is outside the range of measurement (Synchronous Belt / STS)

$$\Delta = 0.016 \cdot Ls \cdot A$$

$$F\delta = \frac{To + (Ls / Lp) \cdot Y \cdot A^2}{16/A}$$

A	: Correction rate (e.g. 1.5, 0.5, 0.3, 0.2)	
δ	: Deflection	(mm)
Ls	: Span length	(mm)
Fδ	: Deflection load	(N)
Y	: Constant	

[Calculation example]

With STS, if as a result of 1200 S14M3150, the deflection δ is 14.29 mm and the deflection load Fδ is 313.1 N, make the following correction.
In this case, the span Ls should be set as 893.3 mm.

[Correction value]

As the deflection load is 313.1N, in order to perform a measurement with a tension meter, it needs to be made 120 N or less.
Recommended To for an S14M belt with a belt width of 120 mm (1200): 4320 N
Span length Ls = 893.3 mm Effective length Lp = 3150 mm
Factor Y = 2430 N Correction rate A = 0.3

$$F\delta = \frac{4320 + 893.3/3150 \times 2430 \times (0.3)^2}{16/0.3} = 82.2$$

$$\delta = 0.016 \times 893.3 \times 0.3 = 4.29$$

Therefore, using 0.3 for the correction rate A, the result shown in the following table is obtained.

Setting example with the correction equation

	Unit	Before correction	After correction
Deflection δ	mm	14.29	4.29
Deflection load Fδ	N	294.2	82.2

(2) Table of constants for synchronous belts

① Table of Constants for Synchronous Belts

Table 1-1 Table of To•Y constants for Synchronous Belts (Rubber) (Unit: N)

Belt type	Factor				025	031	037	050	075	100	150	200	300	400	500	600
Belt nominal width / Belt width (mm)			3.2	4.8	6.4	7.9	9.5	12.7	19.1	25.4	38.1	50.8	76.2	101.6	127.0	152.4
MXL	To	max	6.5	10.0	14.0		21.1	28.7								
		min	3.0	5.2	7.8		12.4	17.2								
	Y		5.5	9.1	12.7		19.7	27.0								
XL	To	max			30.0	38.0	45.0	76.0	129.0							
		min			14.0	20.0	25.0	39.0	66.0							
	Y				3.9	5.5	7.7	11.3	19.2							
L	To	max						78.0	127.0	178.0	287.0	394.0				
		min						53.0	89.0	125.0	195.0	268.0				
	Y							45.0	77.0	109.0	168.0	231.0				
H	To	max							299.0	429.0	659.0	907.0	1419.0			
		min							226.0	318.0	496.0	681.0	1068.0			
	Y								145.0	209.0	322.0	431.0	690.0			
XH	To	max										1029.0	1614.0	2286.0	2957.0	3606.0
		min										927.0	1455.0	2061.0	2664.0	3249.0
	Y											863.0	1385.0	1998.0	2480.0	3025.0
XXH	To	max										2520.0	3960.0	5615.0	7250.0	8834.0
		min										1136.0	1784.0	2528.0	3266.0	3981.0
	Y											1407.0	2270.0	3223.0	4177.0	4930.0

Table 1-2 Table of To•Y constants for polyurethane TN10/TN15 (Unit: N)

Belt type	Factor	Belt nominal width	1.0	2.0	3.0	4.0	5.0	6.0	7.0	10.0	13.0
		Belt width (mm)	1	2	3	4	5	6	7	10	13
TN10	To	max	0.62	2.03	3.3	3.92	5.18	7.06			
		Recommended	0.46	1.41	2.19	2.67	3.46	4.70			
		min	0.29	0.88	1.37	1.67	2.16	2.94			
	Y		0.05	0.16	0.32	0.46	0.62	0.78			
TN15	To	max			1.89		3.30		5.32	8.62	13.18
		Recommended			1.24		2.19		3.62	5.81	8.78
		min			0.78		1.37		2.26	3.63	5.49
	Y				0.32		0.62		0.90	1.60	2.35

Table 1-3 Table of To•Y constants for polyurethane MXL/XL/L (Unit: N)

Belt type	Factor	Belt nominal width			025	031	037	050	075	100	150	200
		Belt width (mm)	3.2	4.8	6.4	7.9	9.5	12.7	19.1	25.4	38.1	50.8
MXL	To	max	1.2	2.1	3.5		5.6	8.4				
		Recommended	0.8	1.4	2.3		3.7	5.6				
		min	—	—	—		—	—				
	Y		0.2	0.4	0.6		1.0	1.5				
XL	To	max			30.0	38.0	45.0	76.0	129.0			
		Recommended			14.0	20.0	25.0	39.0	66.0			
		min			—	—	—	—	—			
	Y				3.9	5.5	7.7	11.3	19.2			
L	To	max						78.0	127.0	178.0	287.0	394.0
		min						53.0	89.0	125.0	195.0	268.0
	Y							45.0	77.0	109.0	168.0	231.0

Table 1-4 Table of To•Y constants for polyurethane T5/T10 (Unit: N)

Belt type	Factor	Belt nominal width	5	10	15	20	25	30	50
		Belt width (mm)	5	10	15	20	25	30	50
T5	To	max	13.0	32.0	52.0	75.0			
		min	10.0	25.0	40.0	58.0			
	Y		7.0	17.0	27.0	39.0			
T10	To	max			125.0	182.0	228.0	285.0	490.0
		min			110.0	160.0	200.0	250.0	430.0
	Y				73.0	107.0	133.0	167.0	287.0

② Table of Constants for Ceptor-VI/Ceptor- X

Table 2-1 Table of To•Y constants for Ceptor-VI (Unit: N)

Belt type	Factor	Belt nominal width	60	100	150	200	250	400	600	800
		Belt width (mm)	6	10	15	20	25	40	60	80
S3M	To	max	43	78	122					
		min	26	47	74					
	Y		16	29	44					
S5M	To	max		177	285	396	507			
		min		89	143	198	254			
	Y			42	68	95	120			
S8M	To	max			390	530	680	1160	1830	2550
		min			350	470	600	1010	1610	2250
	Y				130	200	260	440	690	960

Table 2-2 Table of To•Y constants for Ceptor-X (Unit: N)

Belt type	Factor	Belt nominal width	150	250	400	600	800	1000	1200
		Belt width (mm)	15	25	40	60	80	100	120
S8M	To	max	700	1200	2020	3220	4500		
		min	350	600	1010	1610	2250		
	Y		180	360	620	970	1340		
S14M	To	max			3100	4820	6740	8660	10680
		min			1550	2410	3370	4330	5340
	Y				1360	2100	2980	3840	4740

③ Table of Constants for STS/HP-STS//HP-HTS

Table 3-1-1 Table 1 of To•Y constants for STS/HP-STS (Unit: N)

Belt type	Factor	Belt nominal width	40	50	60	70	80	90	100	120	150	200	250	300	350	400
		Belt width (mm)	4	5	6	7	8	9	10	12	15	20	25	30	35	40
S1.5M	To	max	11.0		16.0				30.0							
		min	5.8		9.0				17.0							
	Y		7.6		11.4				21.0							
S2M	To	max	12.0	14.9	18.0	21.4	25.0	28.9	33.0	42.0	57.4					
		min	6.4	8.3	10.0	12.5	15.0	16.7	19.0	23.1	29.5					
	Y		7.6	9.6	11.4	14.1	16.3	18.6	21.0	25.4	32.1					
S3M	To	max	20	26	33	40	46	53	60	74	94	128				
		min	12	16	20	24	28	32	36	45	57	79				
	Y		7	10	12	15	17	19	22	27	34	46				
S4.5M	To	max		23	27	32	36		45	57	68	102	136	170	202	235
		min		18	22	26	29		36	46	54	82	109	136	162	188
	Y			5	9	15	20		30	40	56	82	108	134	160	185
S5M HP-S5M	To	max		29	52	68	77	89	102	127	165	228	291	354	417	480
		min		23	30	39	45	52	59	73	95	132	169	207	245	284
	Y			11	14	19	21	24	28	35	45	63	80	98	115	132
S8M HP-S8M	To	max									300	410	520	640	760	890
		min									270	360	460	560	670	780
	Y										100	150	200	240	290	340
S14M HP-S14M	To	max												910	1060	1250
		min												860	1010	1190
	Y													500	600	700

Table 3-1-2 Table 2 of To•Y constants for STS/HP-STS (Unit: N)

Belt type	Factor	Belt nominal width	500	600	700	800	1000	1200	1250	1400	1500	1600	2000	2500	3000
		Belt width (mm)	50	60	70	80	100	120	125	140	150	160	200	250	300
S4.5M	To	max	302	381											
		min	242	305											
	Y		235	285											
S5M HP-S5M	To	max	606												
		min	363												
	Y		167												
S8M HP-S8M	To	max	1140	1410	1680	1960	2520		3250		3990		5550		8790
		min	1000	1240	1480	1730	2230		2880		3540		4230		6700
	Y		430	530	630	740	950		1230		1510		2100		3330
S14M HP-S14M	To	max	1600	1950		2730	3500	4320		5150		6020	7750	10000	12290
		min	1520	1850		2590	3330	4110		4890		5710	7350	9490	11670
	Y		850	1080		1530	1970	2430		2870		3380	4350	5610	6900

Table 3-2 Table of To•Y constants for polyurethane S2M/S3M

(Unit: N)

Belt type	Factor		40	60	100	150
	Belt width (mm)		4	6	10	15
S2M	To	max	19.0	32.5	56.0	
		min	14.0	24.5	43.0	
	Y		3.0	5.1	9.0	
S3M	To	max		45.0	80.5	128.0
		min		32.0	57.5	91.0
	Y			5.0	9.0	14.2

Table 3-3 Table of To•Y constants for HP-HTS

(Unit: N)

Belt type	Factor		20	25	30	40	50	55	60	70	85	100	115	120	130	150	170
	Belt width (mm)		20	25	30	40	50	55	60	70	85	100	115	120	130	150	170
8M	To	max	410	520	640	890	1140		1410		2100						
		min	360	460	560	780	1000		1240		1840						
	Y		150	200	240	340	430		530		790						
14M	To	max			910	1250		1780		2340	2920	3500	4120	4320	4730	5570	6430
		min			860	1190		1690		2220	2770	3330	3920	4110	4500	5300	6110
	Y				500	700		1000		1310	1640	1970	2320	2430	2660	3130	3610

④ Table of Constants for King Power Synchronous Belt (KPS II)

Obtain the deflection load F δ of KPS using the following equation.

$$F\delta = \frac{To + W(Ls / Lp) \cdot Y}{16}$$

Table 4-1 Table of To •Y constants for KPS II

(Unit: N)

Belt type	To	Y
8M	Based on the following equation	18.96
14M		28.42

$$To\,(N) = (W / B_1) \times To'$$

W : Belt width (mm)
B_1 : 8M = 15 14M = 40
To′ : Based on **Table 4-2**

Table 4-2 List of To′

KPS II 8M (Unit: N)				
Revolution (rpm) \ Lp(mm)	800 or less	1200 or less	1600 or less	1960 or less
250 or less	382	461	510	539
500 or less	353	412	461	490
1000 or less	314	363	402	431
2000 or less	275	324	353	373
4000 or less	226	275	304	314
4001 or more	177	216	235	255

KPS II 14M (Unit: N)			
Revolution (rpm) \ Lp(mm)	1190 or less	1568 or less	1960 or less
150 or less	1706	1942	2138
300 or less	1569	1785	1981
600 or less	1432	1628	1804
1200 or less	1294	1471	1628
2400 or less	1157	1294	1432
2401 or more	961	1098	1196

⑤ Table of Constants for Long Synchronous Belts

Table 5-1 Table of To•Y constants for Long Synchronous Belts

(Unit: N)

Belt type	Factor		019	025	031	037	050	075	100	150	200	300	400	500	600
	Belt width (mm)		4.8	6.4	7.9	9.5	12.7	19.1	25.4	38.1	50.8	76.2	101.6	127.0	152.4
MXL	To	max	10.0	14.0		21.1	28.7								
		min	5.2	7.8		12.4	17.2								
	Y		9.1	12.7		19.7	27.0								
XL	To	max		30.0	38.0	45.0	76.0	129.0							
		min		14.0	20.0	25.0	39.0	66.0							
	Y			3.9	5.5	7.7	11.3	19.2							
L	To	max					78	127	178						
		min					53	89	125						
	Y						45	77	109						
H	To	max						299	429	659	907	1419			
		min						226	318	496	681	1068			
	Y							145	209	322	431	690			
XH	To	max									1029	1614	2286	2957	3606
		min									927	1455	2061	2664	3249
	Y										863	1385	1998	2480	3025
XXH	To	max									2520	3960	5615	7250	8834
		min									1136	1784	2528	3266	3981
	Y										1407	2270	3223	4177	4930

Table 5-2-1 Table 1 of To•Y constants for Long STS Belts

(Unit: N)

Belt type	Factor		50	60	80	100	150	200	250	300	400	500	600	700	800
	Belt width (mm)		5	6	8	10	15	20	25	30	40	50	60	70	80
S2M	To	max	15.0	18.0	25.0										
		min	8.0	10.0	15.0										
	Y		9.6	11.4	16.3										
S3M	To	max	26	33											
		min	16	20											
	Y		10	12											
S4.5M	To	max		27		45									
		min		22		36									
	Y			9		30									
S5M	To	max				102	165	228	291						
		min				59	95	132	169						
	Y					28	45	63	80						
S8M	To	max					300	410	520	640	890	1140	1410	1680	1960
		min					270	360	460	560	780	1000	1240	1480	1730
	Y						100	150	200	240	340	430	530	630	740
S14M	To	max								910	1250	1600	1950		2730
		min								860	1190	1520	1850		2590
	Y									500	700	850	1080		1530

Table 5-2-2 Table 2 of To•Y constants for Long STS Belts

(Unit: N)

Belt type	Factor		1000	1200	1250	1400	1500	1600	2000	2500	3000
	Belt width (mm)		100	120	125	140	150	160	200	250	300
S8M	To	max	2520		3250		3990		5550		8790
		min	2230		2880		3540		4230		6700
	Y		950		1230		1510		2100		3330
S14M	To	max	3500	4320		5150		6020	7750	10000	12290
		min	3330	4110		4890		5710	7350	9490	11670
	Y		1970	2430		2870		3380	4350	5610	6900

Table 5-3-1 Table 1 of To•Y constants for Bancollan Long Synchronous Belts (open-ended)

(Unit: N)

Belt type	Factor		025	031	037	050	075	100	150	200	300	400
	Belt width (mm)		6.4	7.9	9.5	12.7	19.1	25.4	38.1	50.8	76.2	101.6
XL	To	max	30.0	38.0	45.0	76.0	129.0	182.0	284.0	389.0		
		min	14.0	20.0	25.0	39.0	66.0	93.0	145.0	199.0		
	Y		3.9	5.5	7.7	11.3	19.2	27.0	42.1	57.8		
L	To	max				78	127	178	284	394		
		min				53	89	125	195	268		
	Y					45	77	109	168	231		
H	To	max					299	429	659	907	1419	2003
		min					226	318	496	681	1065	1484
	Y						145	209	322	431	690	948

Table 5-3-2 Table 2 of To•Y constants for Bancollan Long Synchronous Belts (open-ended) (Unit: N)

Belt type	Factor		Belt nominal width	10	15	20	25	30	40	50	75	100
			Belt width (mm)	10	15	20	25	30	40	50	75	100
T5	To	max		32	52	75	108	132	178	224		
		min		25	40	58	72	88	118	149		
	Y			17	27	39	48	59	79	100		
T10	To	max			169	235	294	368	471	633	833	1192
		min			108	157	196	245	314	422	588	794
	Y				72	105	130	164	208	282	388	519

Table 5-4-1 Table 1 of To•Y constants for Bancollan Long STS Belts (open-ended) (Unit: N)

Belt type	Factor		Belt nominal width	50	100	150	200	250	300	350	400	500	750	1000
			Belt width (mm)	5	10	15	20	25	30	35	40	50	75	100
S2M	To	max		15	32	50	69	86	104	122	139			
		min		8	19	29	40	50	61	72	81			
	Y			22	47	73	99	126	152	178	204			
S5M	To	max			102	165	228	291	354		480	606		
		min			59	95	132	169	207		280	354		
	Y				28	45	63	80	98		133	168		
S8M	To	max			183	276	367	458	550		734	917	1375	1834
		min			131	197	263	329	394		526	657	986	1314
	Y				92	138	185	231	278		370	461	691	922

Table 5-4-2 Table 2 of To•Y constants for Bancollan Long STS Belts (open-ended) (Unit: N)

Belt type	Factor		Belt nominal width	60	120	180	240	300	360	420	480
			Belt width (mm)	6	12	18	24	30	36	42	48
S3M	To	max		32	72	112	152	192	231	272	312
		min		19	44	68	92	117	140	165	189
	Y			23	52	81	110	138	163	196	225

Table 5-5 Value T conversion table (Unit: N)

Width (mm)	AT5			AT10			AT20		
	TO		Y	TO		Y	TO		Y
	MIN	MAX		MIN	MAX		MIN	MAX	
10	54	81	36						
15	81	121	54	171	256	114			
20	108	162	72	227	340	151			
25	136	204	91	302	453	201	453	680	302
30	166	250	111	358	537	239			
40	220	331	147	492	738	328			
50	286	429	191	607	910	405	911	1366	607
75				929	1393	619	1394	2090	929
100				1270	1905	846	1906	2858	1270

Table 6-1 Table 1 of To•Y constants for Bancollan Long Synchronous Belts (endless) (Unit: N)

Belt type	Factor		Belt nominal width	025	031	037	050	075	100	150	200	300	400
			Belt width (mm)	6.4	7.9	9.5	12.7	19.1	25.4	38.1	50.8	76.2	101.6
XL	To	max		15.0	19.0	22.5	38.0	64.5	91.0	142.0	194.5		
		min		7.0	10.0	12.5	19.5	33.0	46.5	72.5	99.5		
	Y			2.0	2.8	3.9	5.7	9.6	13.5	21.1	28.9		
L	To	max					39.0	63.5	89.0	143.5	197.0		
		min					26.5	44.5	62.5	97.5	134.0		
	Y						22.5	38.5	54.5	84.0	115.5		
H	To	max						150	215	330	454	710	1001
		min						113	159	248	341	534	742
	Y							73	105	161	216	345	487

Table 6-2 Table 2 of To•Y constants for Bancollan Long Synchronous Belts (endless) (Unit: N)

Belt type	Factor		Belt nominal width	10	15	20	25	30	40	50	75	100
			Belt width (mm)	10	15	20	25	30	40	50	75	100
T5	To	max		16.0	26.0	37.5	54.0	66.0	89.0	112.0		
		min		12.5	20.0	29.0	36.0	44.0	59.0	74.5		
	Y			8.5	13.5	19.5	24.0	29.5	39.5	50.0		
T10	To	max			81.0	117.5	147.0	184.0	235.5	316.5	441.5	596.0
		min			54.0	78.5	98.0	122.5	157.0	211.0	294.0	397.0
	Y				36.0	52.5	65.0	82.0	104.0	141.0	194.0	259.5

Table 7 Table of To•Y constants for Bancollan Long STS Belts (endless) (Unit: N)

Belt type	Factor		Belt nominal width	10	15	20	25	30	40	50
			Belt width (mm)	10	15	20	25	30	40	50
S5M	To	max		51.0	82.5	114.0	145.5	177.0	240.0	303.0
		min		24.5	47.5	66.0	84.5	103.5	142.0	181.5
	Y			14.0	22.5	31.5	40.0	49.0	66.5	84.0

Synchronous Belt Unit Mass [g/mm/m]

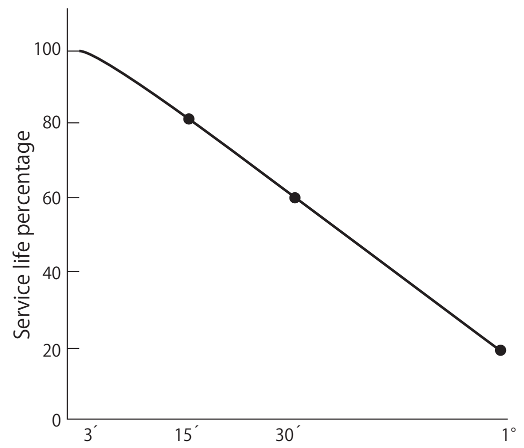
* Weight per width of a millimeter and length of one meter

Belt classification	Belt classification	Unit mass (g/mm/m)
KPS II	S8M	3.8
	S14M	6.6
Ceptor-X	S8M	4.5
	S14M	7.6
Ceptor-VI	S3M	2.3
	S5M	3.3
	S8M	4.6
HP-STS	S5M	3.5
	S8M	5.6
	S14M	8.9
HP-HTS	8M	5.6
	14M	10.3
STS	S1.5M	1.1
	S2M	1.3
	S3M	2.3
	S4.5M	2.8
	S5M	3.8
	S8M	5.4
	S14M	9.0
Bancollan STS	S2M-UG	1.2
	S3M-UG	1.7
Double-Sided STS	DS2M	1.6
	DS3M	2.3
	DS4.5M	2.9
	DS5M	3.9
	DS8M	5.8
	DS14M	10.2

Belt classification	Belt classification	Unit mass (g/mm/m)
Synchronous Belt	MXL	1.1
	XXL	1.5
	XL	2.2
	L	3.3
	H	4.3
	XH	12.3
	XXH	15.8
Bancollan Synchronous Belt	MXL-UK	0.8
	XL-UK	1.6
	L-UK	2.6
	T2.5	1.1
	T5	2.0
	T10	4.3
Double-Sided Synchronous Belt	DXL	2.3
	DL	3.5
	DH	4.5

(3) Pulley alignment (parallelism of shafts)

A synchronous belt tracks to one side of the ends of the pulleys even when the pulley alignment is correctly adjusted. Although that strength is very small, if pulley alignment is not correctly adjusted, the strength of side tracking becomes extremely large and causes the belt to be strongly pushed onto the pulley flange, causing abrasion damage on the side of the belt.
In addition to abrasion, the non-uniform tension applied on the belt tension member causes abnormal strength fatigue, significantly reducing the service life.

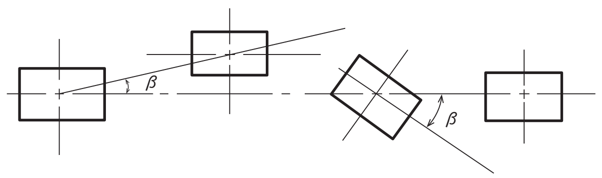


Relationship between pulley alignment and belt service life

Hence, adjust the pulley alignment correctly based on **Table 8** before using a belt.

Table 8 Alignment tolerance

Belt width (mm)	~25	26~60	61~
tan β (or less)	$\frac{6}{1000}$	$\frac{4.5}{1000}$	$\frac{3}{1000}$



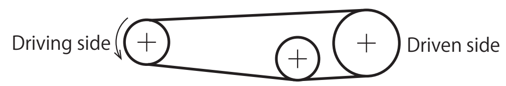
(4) About the use of idlers

When using an idler for a synchronous belt power transmission device, take the following into consideration in order to obtain the best power transmission device.

■ Example of use of an idler
The use of an idler increases fatigue due to bending of the belt; hence, avoid using an idler if possible except when it is absolutely necessary such as the following cases.
- Tension adjustment when the center distance cannot be adjusted
- Division of a long span to an extent that makes belt vibration a problem
- Guide for avoiding obstacles
- When increasing the number of meshed teeth (angle of contact) on the pinion side

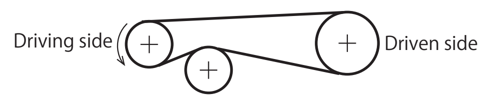
■ How to use an idler
Fasten an idler and always use it on the slack side. When using an idler on the tight side, tooth skipping is likely to occur; hence, it needs to be used with a stronger belt tension than the standard, which affects the belt's service life as well.
In addition, use an idler at an angle as low as possible.

When using an idler on the inside



- Use a synchronous pulley.
- Move the idler installation position close to the large pulley.
This decreases the reduction in the angle of contact of the pinion.

When using an idler on the outside



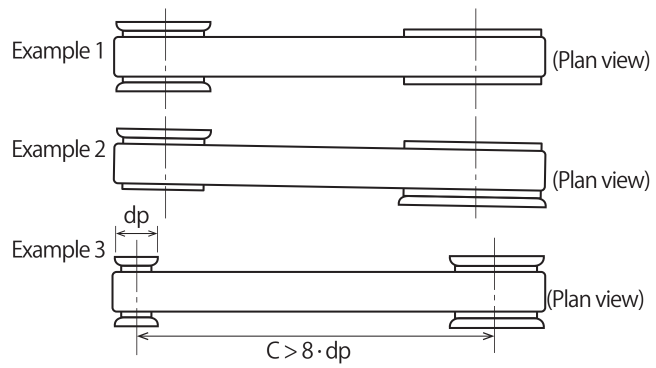
- Use a flat pulley without a crown.
- Move the idler installation position close to the pinion.

■ Idler diameter
Use a diameter of an inner idler that is equal to or larger than the minimum pulley diameter for the revolution to be used, and for a flat pulley that is used on the outer side, use an idler diameter that is 1.2 to 1.4 times as large as the minimum pulley diameter.
(The limitation differs depending on the belt; for individual designs, please contact us.)

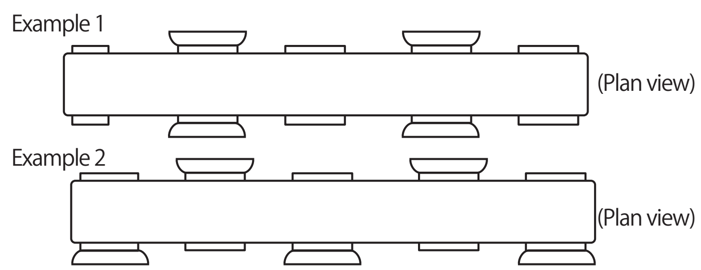
(5) Pulley flanges

A synchronous pulley is not fitted with a crown unlike a flat pulley; hence, the belt tracks to one side during operation due to the parallelism of the shafts and the belt revolution. At the time of designing, attach flanges with the following procedure.

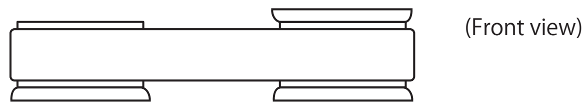
■ In the case of two-shaft power transmission
Attach a flange to both sides of one of the two pulleys **(Example 1)** or attach one flange to each of opposite sides of the two pulleys. **(Example 2)**
When the center distance is eight times or more of the pinion diameter, attach a flange to both sides of both pulleys. **(Example 3)**
* When attaching a flange to both sides, it is economical to attach flanges to the pinion side.



■ In the case of multi-shaft power transmission
Use a double-flanged pulley for every other pulley **(Example 1)** or use single-flanged pulleys with different installation directions. **(Example 2)**



■ In the case of a vertical shaft drive
When using a vertical shaft drive, the belt may protrude from the pulleys under its own weight; be sure to attach a flange on both sides of one of the pulleys and attach a flange on one side (the following example) of the other pulley (in particular Types S14M, XH, and XXH).



Flanges for a cast pulley should be installed with screws. **(→ P. 190)**

(6) Handling of synchronous belts

■ Belt storage
If belts are poorly stored, their performance deteriorates; store belts in the following conditions.
- Store belts at normal temperature avoiding exposure to direct sunlight.
- Do not place belts directly on the ground while hanging on a shelf or a wall.
- Avoid piling up a large amount of belts or storing belts in a sharply folded condition.
- Take care to avoid adhesion of oil or chemicals on belts.

■ Belt installation
- When attaching a belt on a pulley, forcing the belt to climb over a flange may cause an early break; attach a belt by sliding the motor or loosening the idler device.
- Adhesion of a large amount of oil on a rubber synchronous belt causes the belt to swell and reduction of the belt's service life; take care to avoid adhesion of oil.
- Adjust the belt tension within an appropriate range. (**→P.208~214**)
- Use pulley alignment (parallelism of shafts) within the standard (**→ P. 215**).
- When a pulley has rust or other abnormalities, abrasion occurs early; remove them before using the pulley.

■ Belt operation
- A foreign substance trapped during operation may lead to a belt break. When there is such a possibility, install a belt cover.

(7) Causes of and countermeasures against early damage on belts and pulleys

Phenomenon	Cause	Countermeasure
1. Break (The belt has no fatigue condition and is broken at one point.)	The belt's power transmission capacity is insufficient.	Reconsider the design. (Increase the belt width, increase the pulley diameter, or redo the belt selection.)
	Bending of the belt with unreasonable force.	Take care in storage or handling of the belt.
	The belt was forcibly plied in when it was installed.	Attach the belt by sliding the pulley or loosening the tension pulley.
	Trapping of foreign objects.	Install a belt cover.
	Misalignment is significant, causing the belt to be stranded on the flange of a pulley.	Adjust the pulley alignment.
2. The belt became hard and the surface cracked.	The ambient temperature is high. (90° C or more)	Improve the environment or use a heat-resistant belt.
3. The belt teeth are damaged.	An insufficient belt tension is causing skipping.	Appropriately control the belt tension.
	Poor machining of the pulley tooth dimensions, or the dimensions have changed due to abrasion.	Replace the pulley with the one with appropriate tooth dimensions. If dust particles have scattered over, install a belt cover.
	Sudden stops are not taken into consideration.	Extend the period of a sudden stop or redo the selection of the belt.
	An insufficient number of meshed teeth due to a mistake in the design.	Install a back face idler pulley with an appropriate diameter on the slack side. Or change the design.
4. The canvas on the mating flank of the belt becomes abraded early.	Excessive belt tension.	Appropriately control the belt tension.
	Dust particles have scattered over.	Install a belt cover.
5. The belt side face is abraded or damaged.	The pulley's misalignment is large.	Adjust the alignment.
	The outside diameters of the pulley on the left side and the right side are different.	Replace the pulley with the one with appropriate outside diameters.
6. The belt meanders.	The pulley's misalignment is large.	Adjust the alignment.

(7) Causes of and countermeasures against early damage on belts and pulleys

Phenomenon	Cause	Countermeasure
7. Vertically torn	When the belt ran protruding from the end of a pulley.	Correct the pulley position and pulley alignment.
	When the belt became stranded over a flange of a pulley.	Correct the pulley position and pulley alignment.
8. Rubber swelling	A large amount of oil is splashed over.	Install a belt cover or use an oil-resistant belt.
9. Occurrence of metallic noise	Excessive belt tension.	Appropriately control the belt tension.
	A load exceeding the design value is applied.	Reconsider the design.
	The belt speed is too high.	Reduce the pulley diameter, including a change of the belt profile.
10. Abrasion of pulley teeth	Excessive belt tension.	Appropriately control the belt tension.
	Inappropriate pulley material.	Use a harder one or apply a surface treatment.