Product Design Manual

Belts for Precision Conveyance

PS Belt

1. Product Introduction

The PS Belt is an abbreviation for Precision Seamless Belt and is a thin, seamless, woven flat belt. It is a new type of high-performance flat belt that was developed to meet requests for little non-uniformity of rotation, little vibration, and reliable feed for sheets, tickets, cards, or the like in OA equipment, financial equipment, computer peripheral devices, and automization equipment that are recently showing remarkable developments.

Features

■ Most suitable for miniaturization
The thin, seamless, and highly flexible belt can be designed with small pulleys.

■ Smooth rotation
As the tension member is seamless and at a fixed position at all times, the belt provides vibration-free, smooth rotation.

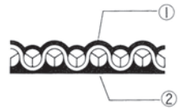
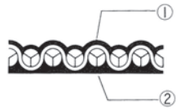
■ Re-tensioning is unnecessary
The specially processed tension member provides excellent dimensional stability and has little elongation during running.

■ Contributes to energy-saving
The thin, light, and highly flexible belt minimizes power transmission loss.

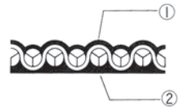
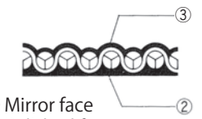
■ Rich selection
The wide selection of product types with various combinations of tension member, cover material, and surface profile allows optimum belt selection that matches the purpose of use and conditions.

Structure

(Unit: mm)

Product type	Structure	Thickness	Width
A-1C	 ① Rough face ② Smooth face	0.22	3～300
A-1N		0.22	
A-1U		0.22	
A-1H		0.22	
A-4C		0.6	5～300
A-4N		0.6	
A-4U		0.45	
A-4H		0.6	
A-10C		1.0	5～300
A-10N		1.0	
A-10U		0.9	
A-10H		1.0	
A-13C		1.1	5～300
A-13N		1.1	
A-13U		1.0	
A-13H		1.1	
B-2C	 ① Rough face ② Smooth face	0.8	5～300
B-2N		0.8	
B-2U		0.8	
B-2H		0.8	
B-3C		0.6	10～300
B-3N		0.6	
B-3U		0.6	
B-3H		0.6	
B-6C		1.0	10～300
B-6N		1.0	
B-6U		0.9	
B-6H		1.0	

(Unit: mm)

Product type	Structure	Thickness	Width
C-8C	 ① Rough face ② Smooth face	0.7	3～300
C-8N		0.7	
C-8U		0.6	
C-8H		0.7	
C-16C		0.7	3～300
C-16N		0.7	
C-16U		0.6	
C-16H		0.7	
Z-H250X	 ③ Mirror face	0.9	10～300
E-8U	 ④ Polished face	0.65 0.8 1.0	8～200
EXL-101	 ③ Mirror face ② Polished face	0.65 0.8 1.0	8～200

Indication Method

A-10N **20 × 500**

Product type — Width (20 mm) — Inside length (500 mm)

Table 1 Table for Characteristic and Functional Selections

Main use	Application	Belt specification (Note 1)	Structure: Face profile (Note 2) Designation	Face profile: Front face	Face profile: Back face	Tension member: Material	Tension member: No. of sheets	Cover material	Color tone	Manufacturable dimensions (mm) (Note 3): Thickness	Width	Inside length
Conveyance	For food stuffs (Note 5)	A-1UDW	P/S	Pressed face	Impregnated face	Polyester	1	Polyurethane	White	0.2	3～200	400～1500
		A-4UDG	F/R	Smooth face	Rough face	Polyester	1	Polyurethane	Green	0.45	5～200	180～2700
		A-4UDGr	F/S	Smooth face	Impregnated face	Polyester	1	Polyurethane	Gray	0.45	5～200	180～2700
		A-4UDW	P/S	Pressed face	Impregnated face	Polyester	1	Polyurethane	White	0.4	5～200	180～2700
		A-4UDBL	P/S	Pressed face	Impregnated face	Polyester	1	Polyurethane	Blue	0.4	5～200	400～2700
	Paper (sandwiched)	B-2CB	R/F	Rough face	Smooth face	Polyester	1	Chloroprene rubber	Black	0.80	5～200	250～2600
		C-16UB	R/F	Rough face	Smooth face	Polyester	1	Polyurethane	Black	0.60	3～200	160～2500
	Paper (vacuumed)	A-4UEB	F/R-A	Smooth face	Rough face	Polyester	1	Polyurethane	Black	0.45	～360	180～2700
		E-8UB	M/K-A	Mirror face	Polished face	Polyester	1	Millable urethane	Black	0.65/0.8/1.0	8～200	50～1457
	Bill (sandwiched)	E-8UB	K/K	Polished face	Polished face	Polyester	1	Millable urethane	Black	0.65/0.8/1.0	8～200	50～1457
		EXL101B	M/K	Mirror face	Polished face	Polyester	1	Millable urethane	Black	0.65/0.8/1.0	8～200	50～1457
Power transmission	Low torque	A-4CB	R/F	Rough face	Smooth face	Polyester	1	Chloroprene rubber	Black	0.60	5～200	180～2700
		A-4NB	R/F	Rough face	Smooth face	Polyester	1	Nitrile rubber	Black	0.60	5～200	180～2700
		B-6NB	R/F	Rough face	Smooth face	Polyester	1	Nitrile rubber	Black	1.00	10～200	250～2800
	Medium torque	A-10CB	R/F	Rough face	Smooth face	Polyester	1	Chloroprene rubber	Black	1.00	5～200	300～3000
		A-10NB	R/F	Rough face	Smooth face	Polyester	1	Nitrile rubber	Black	1.00	5～200	300～3000
		A-13CB	R/F	Rough face	Smooth face	Polyester	1	Chloroprene rubber	Black	1.10	5～200	300～3000
Special	Chipping	A-1UEW	F/F	Smooth face	Smooth face	Polyester	1	Polyurethane	White	0.22	3～50	100～1500
		A-1NB	P/M	Pressed face	Mirror face	Polyester	1	Nitrile rubber	Black	0.22	3～50	100～1500
		A-4UEW	M/P	Mirror face	Pressed face	Polyester	1	Polyurethane	White	0.4	5～200	180～2700
	Ultra-heat-resistant	ZH250X	M/M	Mirror face	Mirror face	Aramid	1	Silicone rubber	Dark brown	0.90	10～200	460～1500
	Bend-resistant	A-P	S/S	Woven material	Woven material	Nylon	2, 4, 8	Chloroprene impregnation	Black	—	10～100	200～2700
		A-PW	O/O	Woven material	Woven material	Nylon	2, 4, 8	Stiffening agent impregnation	White	—	10～100	200～2700
	Heat- and weather-resistant	B-2HW	R/F	Rough face	Smooth face	Polyester	1	CSM	White	0.80	5～200	250～2600
		B-2HG	R/F	Rough face	Smooth face	Polyester	1	CSM	Green	0.80	5～200	250～2600
	Support for reverse conveyance	A-ESS2W	M/O	Mirror face	Woven material	Polyester	2	Polyurethane	White	1.10	620	2482
	Ear fraying prevention	TA-4UEB	M/D	Mirror face	Texture-adjusted surface	Polyester	1	Polyurethane	Black	0.65	4.5～200	350～2700
		TA-4UW	D/D	Texture-adjusted surface	Texture-adjusted surface	Polyester	1	Polyurethane	White	0.45	5～200	350～2700
	Blade-resistant	G-15TSDK	M/O	Mirror face	Woven material	Polyester	1	Silicone rubber	Light yellow (Woven material base color)	0.55	200～500	1000～3000

Note 1) In addition to the above product types, various combinations of cover material, surface profile, and color are available; please contact us.

Note 2) Select an appropriate surface to be used in accordance with the operating conditions. (Normally, use the smooth face as the pulley surface.) In addition to the above surface profiles; impregnation / smooth face, smooth face / smooth face, and mirror face / mirror face are also available; please contact us.

Note 3) If you need belt dimensions outside the manufacturable range, please contact us.

Note 4) The above items describe general physical characteristics of cover rubber. These are not guaranteed values. Please contact us and perform sufficient evaluation before use.

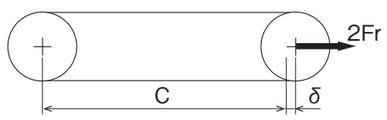
Note 5) For tones that conform to the Food Sanitation Law, select a tone from white, green, gray, and blue. Only the white tone conforms to AFD and PIM.

Note 6) These are a rough guide for belt selection and are not standard values.

Note 6) Tensile strength N/10 mm	Note 7) Stable shaft load with each stretch N/10mm	Minimum pulley diameter (mm)	Note 4) Abrasion resistance	Note 4) Oil resistance	Note 4) Conductivity	Note 4) Flame resistance	Note 4) Ozone resistance	Note 4) Heat and weather resistance	Note 4) Water proof/moisture resistance	Note 4) Food Sanitation	Operating limit temperature (°C) -40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260	Belt specification
150	0.5% 30	5	◎	◎	○	○	◎	○	×	◎		A-1UDW
400	0.5% 45	10	◎	◎	○	○	◎	○	×	◎		A-4UDG
400	0.5% 45	10	◎	◎	○	○	◎	○	×	◎		A-4UDGr
400	0.5% 45	10	◎	◎	○	○	◎	○	×	◎		A-4UDW
400	0.5% 45	10	◎	◎	○	○	◎	○	×	◎		A-4UDBL
250	1% 30 2% 50 3% 60	10	○	○	◎	◎	◎	○	◎	×		B-2CB
160	1% 20 2% 30 3% 40	7	◎	◎	×	○	◎	○	×	×		C-16UB
400	0.5% 45	10	◎	◎	◎	○	◎	○	×	×		A-4UEB
—	5% 10 6% 12 7% 14	8/12/14	◎	○	×	○	◎	○	×	×		E-8UB
—	5% 10 6% 12 7% 14	8/12/14	◎	○	×	○	◎	○	×	×		E-8UB
—	5% 10 6% 12 7% 14	8/12/14	◎	○	◎	○	◎	○	×	×		EXL101B
400	0.5% 45	10	○	○	◎	◎	◎	○	◎	×		A-4CB
400	0.5% 45	10	◎	◎	◎	○	×	○	◎	×		A-4NB
600	1% 180 2% 280 3% 360	25	◎	◎	◎	○	×	○	◎	×		B-6NB
1000	0.5% 110	15	○	○	◎	◎	◎	○	◎	×		A-10CB
1000	0.5% 110	15	◎	◎	◎	○	×	○	◎	×		A-10NB
1350	0.5% 170	20	○	○	◎	◎	◎	○	◎	×		A-13CB
150	0.5% 30	5	◎	◎	○	◎	◎	○	◎	×		A-1UEW
150	0.5% 30	5	◎	◎	◎	○	×	○	◎	×		A-1NB
400	0.5% 45	10	◎	◎	◎	○	◎	○	×	×		A-4UEW
400	1% 120	30	×	○	×	○	◎	◎	◎	×		ZH250X
	1% 130 2% 210	50	○	○	×	○	○	○	◎	×		A-P
			×	◎	×	×	◎	○	×	×		A-PW
250	1% 30 2% 50 3% 60	10	○	○	×	◎	◎	◎	◎	×		B-2HW
250	1% 30 2% 50 3% 60	10	○	○	×	◎	◎	◎	◎	×		B-2HG
780	0.5% 80	10	○	○	×	◎	◎	○	×	◎		A-ESS2W
400	0.5% 40	10	◎	◎	◎	○	◎	○	×	×		TA-4UEB
400	0.5% 45	20	◎	◎	×	○	◎	○	×	×		TA-4UW
800	0.5% 180	30	×	○	○	○	◎	◎	◎	◎		G-15TSDK

◎: Most suitable ○: Suitable △: Slightly problematic ×: Not usable

Note 7)



■ How to understand belt product names

B - 2 U F Gr R/F

Belt type	Tensile strength factor: N/10-mm width	Cover material: For A, B, and C series, four types of materials can be selected.	Additional function (Note 1): E Conductivity on a 100-Ω level	Additional function (Note 1): F Passed Article 20 of the Notice of the Ministry of Health, Labour and Welfare concerning food hygiene.	Color: B Black	Color: W White	Color: G Green	Color: Gr Gray	Face profile: R Rough face	Face profile: F Smooth face	Face profile: M Mirror face	Face profile: S Impregnation	Face profile: K Polished face	Face profile: P Pressed face	Face profile: O Woven material
A-1	The A series indicates 1/100 of the tensile strength.	C Chloroprene	○	×	○	—	—	—	○	○	We examine the manufacturability from the combination of the belt type and the cover material; please contact us.				
A-4															
A-10															
A-13															
B-2	The B series indicates 1/100 of the tensile strength.	N Nitrile rubber	×	×	○	—	—	—	○	○					
B-3															
B-6		U Polyurethane	×	×	○	—	—	—	—	—					
C-8	The C series indicates 1/10 of the tensile strength.			○	—	○	○	○	○	○					
C-16		H CSM	×	×	—	○	○	—	○	○					
E-8U	—	Urethane (Millable)	×	×	○	—	—	—	×	×	Note 2) ○	×	○	×	×
EXL-101	—		×	×	○	—	—	—	×	×	Note 2) ○	×	Note 2) ○	×	×

Note 1) Additional functions D: Charge prevention effect by conductive threads, E: 100-Ω-level conductivity by conductive rubber
F: Passed Notice No. 201 of the Ministry of Health, Labour and Welfare concerning food hygiene, AF: Passed the Food Sanitation Law and FDA, PF: Passed the Food Sanitation Law and PIM

Note 2) The mirror face profile of E-8U is only one side, and EXL-101 has a mirror face on one side and a polished face on the other side.

A, B, and C series: Dynamic friction factor (for PPC paper)

Face profile	Smooth face	Polished face	Mirror face	Rough face	Impregnation	Woven material
Friction factor	0.6～0.8	0.6～0.8	0.6～0.8	0.5	0.4	0.3

The above values differ slightly depending on the belt type (tension member and cover material); please contact us for details.

E series

Face profile	Mirror face	Polished face
Friction factor	0.8～1.3	0.6～1.0

Belt Dimensions and Tolerance

Table 2 Standard effective lengths

(Unit: mm)

Belt type	Inside length																			
A-1	125	132	140	150	160	170	180	190	200	212	224	236	250	265	280	300	315	335	355	375
	400	425	450	475	500	530	560	600	630	670	710	750	800	850	900	950	1000	1060	1120	1180
	1250	1320	1400	1500																
A-4	180	190	200	212	224	236	250	265	280	300	315	335	355	375	400	425	450	475	500	530
	560	600	630	670	710	750	800	850	900	950	1000	1060	1120	1180	1250	1320	1440	1500	1600	1700
	1800	1900	2000	2120	2240	2710														
A-10	300	315	335	355	375	400	425	450	475	500	530	560	600	630	670	710	750	800	850	900
A-13	950	1000	1060	1120	1180	1250	1320	1440	1500	1600	1700	1800	1900	2000	2120	2200				
B-2	250	265	280	300	315	335	355	375	400	425	450	475	500	530	560	600	630	670	710	750
B-3	800	850	900	950	1000	1060	1120	1180	1250	1320	1440	1500	1600	1700	1800	1900	2000	2120	2240	2600
B-6																				
C-8	180	190	200	212	224	236	250	265	280	300	315	335	375	400	425	450	475	500	530	560
C-16	600	630	670	710	750	800	850	900	950	1000	1060	1120	1180	1250	1320	1400	1500	1600	1700	1800
	1900	2000	2120	2240	2600															
E-8U	41	66	72	76	82	90	95	103	104	106	110	114	116	118	120	121	125	128	131	134
	136	138	140	145	148	149	151	152	154	155	157	159	162	164	165	166	167	168	170	173
	176	178	180	182	185	187	189	191	192	194	197	200	204	205	207	210	211	212	214	216
	219	221	224	228	232	235	239	240	241	243	245	247	248	250	253	256	258	261	262	264
	267	269	272	276	280	282	284	286	288	293	295	296	300	302	303	305	309	312	314	318
	321	323	328	331	335	336	338	341	342	343	347	348	353	354	356	358	360	363	366	368
	371	376	381	382	383	388	393	394	399	404	405	410	417	421	423	426	431	435	438	442
	444	445	447	453	457	462	467	471	477	479	482	484	487	490	494	497	499	502	505	509
	514	518	520	525	534	540	547	552	555	559	564	569	573	577	580	586	591	593	597	603
	608	613	619	625	632	643	650	658	661	667	672	674	683	690	698	705	715	735	750	755
	764	773	777	787	803	811	815	820	828	833	843	847	857	865	867	881	899	909	914	925
	934	943	947	949	965	969	994	995	1000	1012	1020	1029	1039	1055	1061	1072	1100	1103	1164	1219
	1264	1335	1337	1398	1457	1579	1611													
EKL-101	111	113	115	122	125	128	131	133	135	137	140	142	145	146	148	149	151	152	154	156
	159	161	162	164	165	166	168	171	174	176	178	180	183	185	187	189	190	192	195	197
	201	202	204	207	208	209	211	213	216	218	221	225	229	232	236	237	238	240	242	244
	245	247	250	253	255	258	259	261	264	266	269	273	277	279	281	283	285	290	292	293
	297	299	300	302	306	309	311	315	318	320	325	328	332	333	335	338	339	340	344	345
	350	351	353	355	357	360	363	365	368	373	378	379	380	385	390	391	396	401	402	407
	414	418	420	423	428	432	435	439	441	442	444	450	454	459	464	468	474	476	479	481
	484	487	491	494	496	500	503	507	512	516	518	523	532	538	545	550	553	557	562	565
	569	573	578	584	589	591	594	600	605	610	616	622	629	640	647	655	658	664	669	671
	680	687	694	699	709	729	744	749	758	767	771	781	797	805	809	814	822	827	837	842
	852	860	862	876	893	903	908	919	928	937	941	943	959	963	988	989	994	1006	1014	1023
	1033	1049	1055	1066	1093	1106	1157													

Note 1) For the A, B, and C series, if you need other lengths than the above, please consult us.
Note 2) The E series is molded; if you need other lengths than the above, please consult us.

Z series	For the standard effective lengths, please contact us.

Table 3 Thickness

(Unit: mm)

A series		B series		C series		Z series		E series
A-1	±0.05	B-2 B-3 B-6	±0.1	C-8 C-16	±0.1	Z-H250X	±0.1	±0.05
A-4,A-10,A-13	±0.1							

Table 4 Widths

(Unit: mm)

Manufactured dimensions	Manufacturing tolerance					
	A series	B series	C series	Z series	Manufactured dimensions	E series
Less than 30	±0.5	±0.5	±0.5	±0.5	Less than 12	±0.3
30 to less than 100	±1.0	±1.0	±1.0	±1.0	12 to less than 20	±0.5
100 to less than 150	±1.5	±1.5	±1.5	±1.5	20 to less than 100	±1.0
150 to less than 200	±2.0	±2.0	±2.0	±2.0	100	±1.5
200～	±2.5	±2.5	±2.5	±2.5		

Table 5 Inside lengths

(Unit: mm)

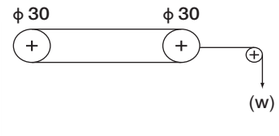
Manufactured dimensions	Manufacturing tolerance					
	A series	B series	C series	Z series	Manufactured dimensions	E series
Less than 300	±2	±2	±2	—	Less than 200	±2
300 to less than 600	±3	±3	±3	±5	200 to less than 400	±3
600 to less than 800	±4	±4	±4	±6	400 to less than 600	±5
800 to less than 1000	±5	±5	±5	±7	600 to less than 800	±6
1000	±0.5%	±0.5%	±0.5%	±0.5%	800 to less than 1000	±8
					1000	±0.8%

Note 1) If you need an accuracy higher than the above tolerance, please consult us.
Note 2) Matching tolerance: The tolerance between matches is as shown above. For tolerances within a match, 1 mm for a length of 1000 mm or less and 2 mm for longer lengths are available; please contact us.

Table 6 Table of measured loads (W) for inside length of belt

(Unit: N/mm width)

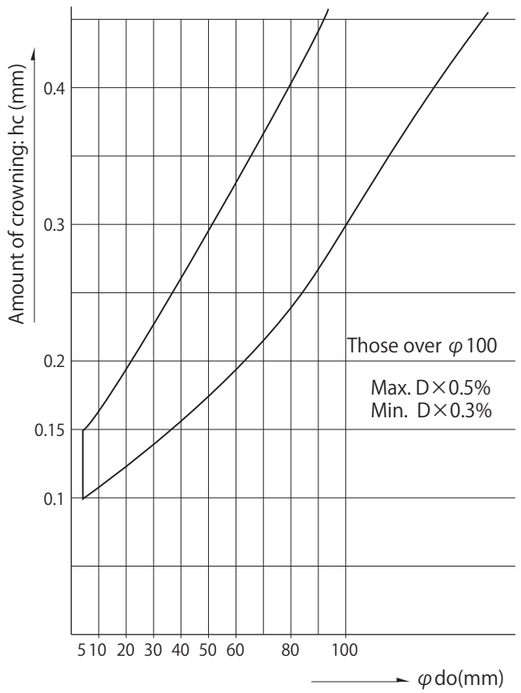
Belt type	Measured load	Belt type	Measured load	Belt type	Measured load	Belt type	Measured load
A-1	0.5	C-8,C-16	0.3	E-8U (1.0-mm thickness)	0.25	Z-H250X	0.98
A-10,A-13	2.0	E-8U (0.65-mm thickness)	0.15	EXL-101 (0.65-mm thickness)	0.15		
A-4,B-2,B-3,B-6	1.0	E-8U (0.8-mm thickness)	0.20				



About Pulleys

■ Pulley crown height

- Obtain a crown height from the graph on the right.



■ Pulley surface finish

- We recommend approximately 3S to 6S as the surface finish roughness.

■ Pulley width

- We recommend a pulley width that is obtained with the following equation.

$$\text{Pulley width (bp)} = 1.1 \times b + 5 \text{ (mm)}$$

b : Belt width

■ Obtain the radius of curvature (R) of the pulley surface with the following equation. (This equation is applied to Types A to C.)

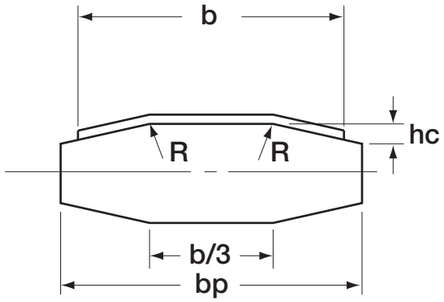
$$R \approx \frac{bp^2}{8hc} \text{(mm)}$$

(Note) For a wide belt (length / width < 12), measures may be required such as increasing the amount of crowning over the value shown in the graph on the right for belt side tracking prevention; however, there is a possibility of a reduction in transmission capacity and service life. Please be careful.

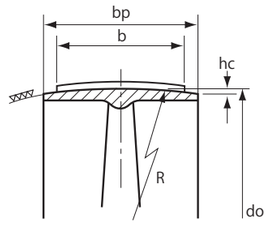
■ Pulley profile

- Use a symmetrical profile as shown in the right figure.
- Avoid a conical crown as it reduces the belt service life.

■ In the case of a wide conveyance belt



* Do not use a flange on the pulleys.



Defective profile

bp : Pulley width
b : Belt width
hc : Crown height
do : Pulley outside diameter
R : Radius of curvature

Precautions for Designing and Use

■ Environmental conditions

Use belts within the belt operating temperatures shown on **P. 320.**
At temperatures of the minimum operating temperature or less, belts may harden, and at temperatures of the maximum operating temperature or more, the service life may become shorter.

Avoid use in the presence of oil, chemicals, solvents, or the like.

Avoid use for applications in which the belt comes in direct contact with food stuffs.

However, B-2UF has passed Notice No. 20 of the Ministry of Health and Welfare and therefore is suitable for applications in which the belt comes in direct contact with food stuffs.

■ Pulley shaft misalignment

Pulley shaft misalignment (parallelism and eccentricity) can cause breakage due to belt meander or detachment from the pulleys; adjust the alignment within 20′ accurately.

■ Safety cover

Be sure to install a safety cover to prevent belt damage and accidents due to entrapment of foreign objects or other causes. However, complete sealing increases the temperature and affects the belt service life; provide sufficient ventilation.

■ Belt inspection

Be sure to turn off the power supply and wait until the rotation stops completely before maintaining and inspecting belts.

■ Belt storage

To prevent belts from setting and to avoid the effect of humidity and direct sunlight, it is ideal to store belts wrapped in the polyethylene bag that was used for delivery, in a well-ventilated, cool, and dark place.

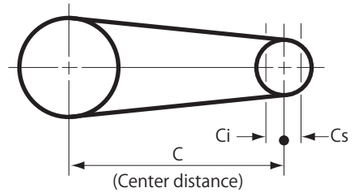
About Minimum Adjustment Range of Center Distance

For belt installation and tension adjustment, the drive device requires a device that adjusts the center distance. (A and B series) Depending on the effective length, a sliding space for belt installation (Ci) on the inner side than the appropriate position and a sliding space for tension adjustment (Cs) on the outer side than the appropriate position are required.

Table of minimum adjustment ranges of center distance

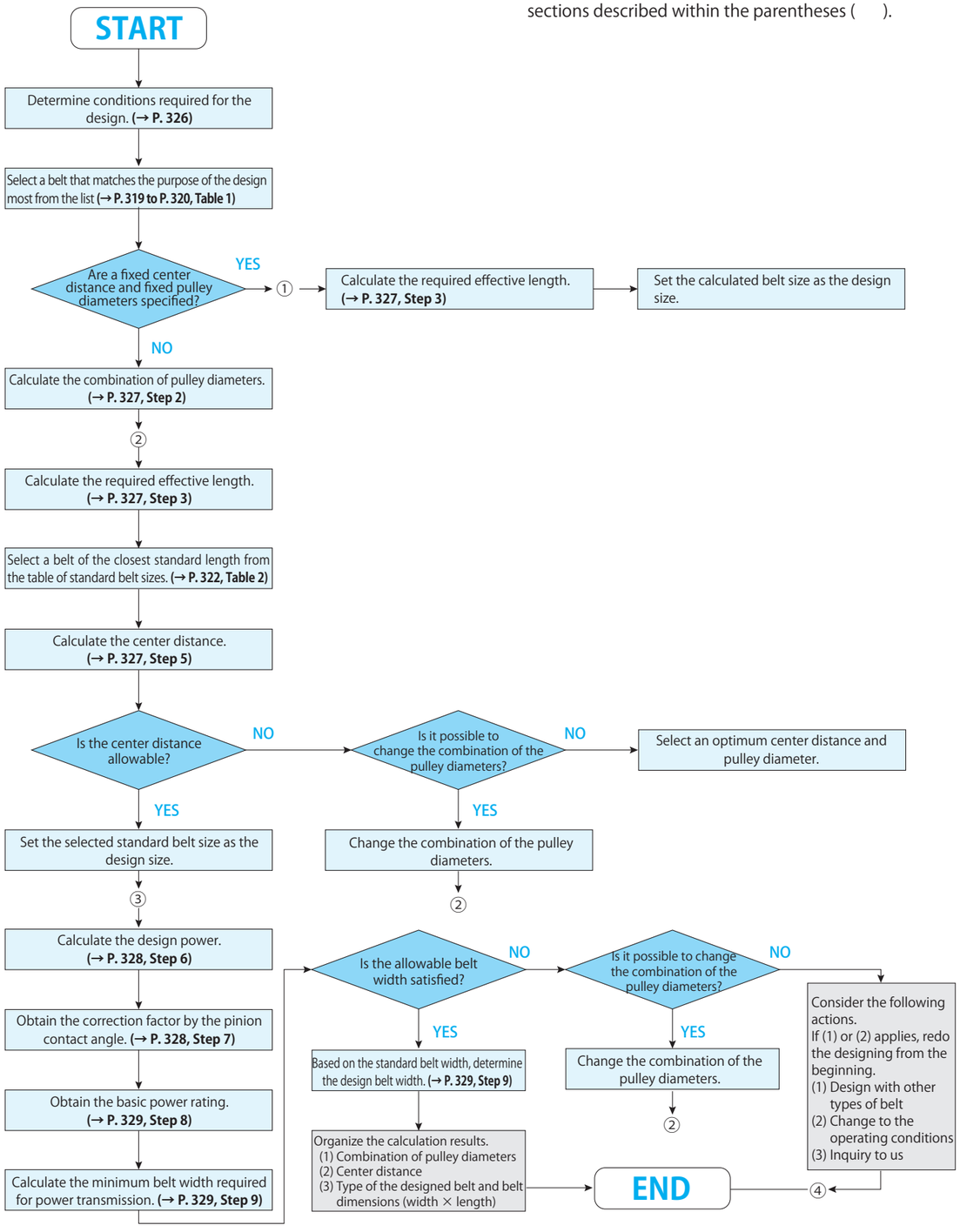
(Unit: mm)

Belt Dimensions	Inner adjustment range Ci	Outer adjustment range Cs
Less than 500	2	4
500 to less than 1000	4	8
1000 to less than 1500	8	12
1500 to less than 2000	10	15
2000 to less than 2500	12	18
2500～	Belt inside length × 0.8%	Belt inside length × 1%



Flow Chart for Belt Design

1) This design flow chart is applied to a two-shaft transmission device for the PS belt.
2) For details on each design step, refer to the pages and sections described within the parentheses ( ).



Conditions Required for Belt Design

Designing of a PS belt requires the following conditions.
(sections are "must" conditions for design.)

Machinery name		Location of use of belt	
Driving machine	• Motor type • Others	Driven power	• Normal • Maximum PS / kW / W / N•m / N•mm
Driving pulley	• (Outside diameter / Pitch diameter) mm × rpm • Flange Use / Not use • Pulley/crown (hc)	Driven pulley	• (Outside diameter / Pitch diameter) mm × rpm • Flange Use / Not use • Pulley/crown (hc)
Power transmission characteristics	• Torque constant • Horsepower constant	When the revolution of driving shaft changes, please let us know.	
Tension pulley	• Use ϕ mm (Inside / Outside) (Slack side / Tight side) • Not use	Pulley space	Limitation • Maximum dia. mm ② • Maximum width mm
Center distance	± mm • [Enter ±0 mm when using the belt with a fixed center distance]	Operating time	• Ⅰ Intermittent use (3 to 5 hrs/day or seasonal) • Ⅱ Normal use (8 to 10 hrs/day) • Ⅲ Continuous use (16 to 24 hrs/day)
Allowable belt tension	N/pc (2Fr)		
Schematic drawing of use	Enter the type of the belt that drives the PS belt.		
Enter the power transmission type. ① Other than two shafts ② Special power transmission system - Parallel multiple belt use - Quarter turn ③ Application other than power transmission - What do you convey and how? - Others ④ Special profile ⑤ Sandwiched conveyance	①		
Sudden stop / sudden acceleration	• Yes • No • Is the brake on the driving side or the driven side?	Time until: • Sudden stop • Sudden acceleration) sec	• GD^2 = kg•m² (GD^2 means the flywheel effect.)
Especially required characteristics (Circle applicable items.)	1. Heat resistance 2. Cold resistance 3. Oil resistance 4. Water resistance 5. Chemical resistance 6. Abrasion resistance 7. Dist particle resistance 8. Ozone resistance 9. Pulsating load resistance	10. Shock absorption 11. Reverse rotation 12. Rotation (conveyance) accuracy 13. Dimensional accuracy 14. Electrical resistance 15. Flame resistance 16. Compactness 17. Low noise 18. Belt mark	19. Belt color 20. No rubber dropping 21. No meander 22. Alignment 23. Lighter weight 24. Maintenance-free 25. Standard of Notice No. 20 of the Ministry of Health, Labour and Welfare 26. Belt thickness 27. Friction factor
	Required service life (reliability)	(hours %)	

Enter specific details and standards of the requirements for circled items.

PS Belt Design Procedure

Step 1. Conditions required for PS belt design

When designing a PS belt, determine the **design conditions** on **P. 326**.

Step 2. Combination of pulley diameters

Obtain the optimum combination of pulley diameters with Formula 1.

Formula 1

$$i=\frac{do+2a}{Do+2a}$$

i : Speed ratio
do : Pinion outside diameter (mm)
Do : Large-pulley outside diameter (mm)
2a : Difference between pulley outside diameter and pitch diameter (mm) **(Table 7)**

From **Table 7**, obtain the difference between pulley outside diameter and pitch diameter (2a).

Step 3. Calculating the effective length

Obtain the required effective length with Formula 2.

Formula 2

$$Li=\frac{2C+1.57(Do+do)+\frac{(Do-do)^2}{4C}}{1+\varepsilon}$$

Li : Belt inside length (mm)
C : Center distance (mm)
do : Pinion outside diameter (mm)
Do : Large-pulley outside diameter (mm)
ε : Stretch rate **(Table 8)**

From **Table 8**, obtain the stretch rate (ε).
I) When you use other stretch rates than the standard stretch rate, the belt service life and transmission capability change; please contact us.

Step 4. Selecting the standard inside length

Select a belt with a standard inside length closest to the required belt inside length from **Table 2 (→ P. 322)**.

Step 5. Calculating the center distance

Obtain the center distance from the determined belt inside length with Formula 3.

Formula 3

$$C=\frac{B+\sqrt{B^2-2(Do-do)^2}}{4}$$

$$B=Li(1+\varepsilon)-1.57(Do+do)$$

C : Center distance (mm)
do : Pinion outside diameter (mm)
Do : Large-pulley outside diameter (mm)
Li : Belt inside length (mm)
ε : Stretch rate **(Table 8)**

Table 7 Table of a values (Unit: mm)

Belt type	a	Belt type	a
A-1	0.11	B-2	0.40
A-C, A-4N	0.30	B-3	0.30
A-4U	0.20	B-6	0.50
A-10	0.50	C-8C, C-8N	0.35
A-13	0.55	C-8U	0.30
		C-16C, C-16N	0.35
		C-16U	0.30
		E-8U, EXL-101	1/2 of the overall thickness

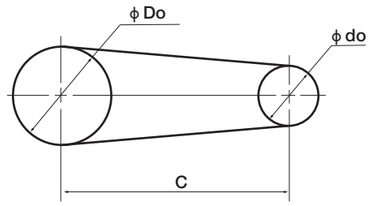


Table 8 Table of (ε) standard stretch rates

Belt series	A	B	C	E
Stretch rate	0.005	0.01	0.02	0.05

Step 6. Calculating the design power

Obtain the design power Pd with Formula 4.

Formula 4

$$Pd=Pt\times Ko$$

Pd : Design power (kW)
Pt : Transmission power (kW)
Ko : Load correction factor **(Table 9)**

1) From **Table 9**, select a load correction factor Ko that is suitable for the machine to be designed and its operating conditions.
2) When the machine name cannot be found in **Table 9**, use the load correction factor of a machine with a similar load fluctuation etc.

Table 9 Table of load correction factors (Ko)

Duty cycle / Machinery name	Intermittent use 3 to 5 hrs/day or seasonal use	Normal use 8～10Hrs/day	Continuous use 16～24Hrs/day
- Audio equipment - Communication equipment - Cassette tape winding machines - Balancing machines - Line printers - Copiers	1.0	1.1	1.2
- Vending machines - Automatic ticket gates - Card readers - Magnetic discs - Printers - Yarn-twisting machines - Automatic packaging machines	1.1	1.2	1.3
- Fiber machines - Grinders - Machining centers - Router machines - Deposit automatic reception/payment machines	1.3	1.4	1.5

Step 7. Correction factor by the pinion contact angle.

From Formula 5, obtain the angle of contact of the pinion $\theta 1$.
Then, from **Fig. 1**, obtain the correction factor K θ .

Formula 5

$$\theta_1=180-\frac{57(Do-do)}{C}$$

θ_1 : Angle of contact of pinion (°)
Do : Large-pulley outside diameter (mm)
do : Pinion outside diameter (mm)
C : Center distance (mm)

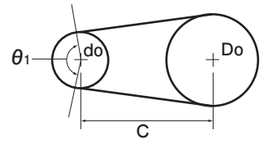
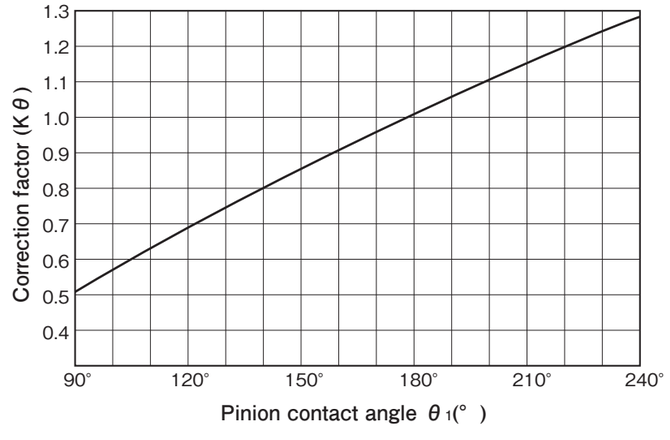


Fig. 1 Correction factor by the pinion contact angle (K θ)



PS Belt Design Procedure

Step 8. Calculating the basic power rating

From Formula 6 or **Tables 12 to 15 (→ P. 330)**, obtain the basic power rating.

Formula 6

$$Pr = dp \times n \left[C_1 - C_2 (dp_1 \times n)^2 \right]$$

Pr : Basic power rating (kW)
dp1 : Pinion pitch diameter (mm)
n : Pinion revolution (rpm) $\times \frac{1}{1000}$
C_1 and C_2: (Table 10)

1) When you use the A series with the standard stretch rate, obtain the basic power rating from **Table 12 to Table 15** and for the basic power rating for other cases, obtain it with Formula 6.
2) When the power of the transmission device is indicated in torque (moment of rotation), convert it into power with Formula 7.
3) As the E series is for conveyance, Formula 6 is not used.

Formula 7

$$Pt = \frac{n \times Tr}{9550}$$

Pt : Driven power (kW)
n : Pinion revolution (rpm) $\times \frac{1}{1000}$
Tr : Load torque (N•m)

Step 9. Calculating the belt width

Calculate the minimum belt width required for power transmission with Formula 8 and roundup the obtained width to the standard width indicated in **Table 11**.

Formula 8

$$b = \frac{10 \times Pd}{Pr \times K\theta_1}$$

b : Minimum belt width (mm)
Pd : Design power (kW)
Pr : Basic power rating (kW/cm width)
$K\theta_1$: Pinion contact angle correction factor

Table 10 Table of C_1 and C_2 values

Belt type		Stretch rate used (%) 0.5	1.0	2.0	3.0
A-1	C_1	Table 12	13.54×10^{-4}	—	—
	C_2		3.16×10^{-12}	—	—
A-4	C_1	Table 13	20.31×10^{-4}	—	—
	C_2		8.84×10^{-12}	—	—
A-10	C_1	Table 14	19.65×10^{-4}	—	—
	C_2		13.9×10^{-12}	—	—
A-13	C_1	Table 15	76.73×10^{-4}	—	—
	C_2		15.2×10^{-12}	—	—
B-2	C_1	—	6.77×10^{-4}	11.28×10^{-4}	13.54×10^{-4}
	C_2	—	11.4×10^{-12}	11.4×10^{-12}	11.4×10^{-12}
B-3	C_1	—	15.80×10^{-4}	27.08×10^{-4}	31.60×10^{-4}
	C_2	—	8.84×10^{-12}	8.84×10^{-12}	8.84×10^{-12}
B-6	C_1	—	40.62×10^{-4}	63.19×10^{-4}	81.25×10^{-4}
	C_2	—	13.9×10^{-12}	13.9×10^{-12}	13.9×10^{-12}
C-8	C_1	—	—	3.39×10^{-4}	4.51×10^{-4}
	C_2	—	—	10.1×10^{-12}	10.1×10^{-12}
C-16	C_1	—	—	6.77×10^{-4}	9.03×10^{-4}
	C_2	—	—	10.1×10^{-12}	10.1×10^{-12}

Table 11 Table of standard widths

(Unit: mm)

Belt type \ Standard width	3	5	7	10	15	20	25	30	40	50	75	100	150	200
A-1	○	○	○	○	○	○								
A-4		○	○	○	○	○	○	○						
A-10				○	○	○	○	○	○	○				
A-13				○	○	○	○	○	○	○	○			
B-2			○	○	○	○	○	○	○	○	○	○		
B-3			○	○	○	○	○	○	○	○	○	○		
B-6				○	○	○	○	○	○	○	○	○		
C-8	○	○	○	○	○	○	○	○						
C-16	○	○	○	○	○	○	○	○						
E-8U/EXL-101	E series standard width: 8, 10, 12, 14, 16													

Note When the standard widths cannot be applied due to the machinery design, we will cut the belt to a desired width; please consult us.

Table 12 Table of basic power ratings for PS belt Type A-1 (kW/cm width)

Pulley revolution (rpm) \ Pulley outside diameter (mm)	5	10	15	20	25	30	35	40	45	50
950	0.002	0.005	0.009	0.013	0.018	0.023	0.029	0.035	0.042	0.048
1160	0.003	0.006	0.011	0.016	0.022	0.028	0.035	0.043	0.051	0.059
1425	0.003	0.008	0.013	0.019	0.026	0.034	0.043	0.052	0.062	0.072
1750	0.004	0.009	0.016	0.023	0.032	0.042	0.052	0.064	0.075	0.088
2850	0.006	0.015	0.026	0.038	0.052	0.067	0.084	0.101	0.120	0.139
3450	0.008	0.018	0.031	0.045	0.062	0.080	0.100	0.121	0.143	0.165
500	0.001	0.003	0.005	0.007	0.009	0.012	0.015	0.019	0.022	0.026
600	0.001	0.003	0.005	0.008	0.011	0.015	0.018	0.022	0.026	0.031
700	0.002	0.004	0.006	0.009	0.013	0.017	0.021	0.026	0.031	0.036
800	0.002	0.004	0.007	0.011	0.015	0.019	0.024	0.030	0.035	0.041
900	0.002	0.005	0.008	0.012	0.017	0.022	0.027	0.033	0.039	0.046
1000	0.002	0.005	0.009	0.014	0.019	0.024	0.030	0.037	0.044	0.051
1200	0.003	0.006	0.011	0.016	0.022	0.029	0.036	0.044	0.052	0.061
1400	0.003	0.007	0.013	0.019	0.026	0.034	0.042	0.051	0.061	0.071
1600	0.004	0.009	0.014	0.022	0.030	0.038	0.048	0.058	0.069	0.080
1800	0.004	0.010	0.016	0.024	0.033	0.043	0.054	0.065	0.077	0.090
2000	0.005	0.011	0.018	0.027	0.037	0.048	0.060	0.072	0.086	0.100
2500	0.006	0.013	0.022	0.033	0.046	0.059	0.074	0.089	0.106	0.123
3000	0.007	0.016	0.027	0.040	0.054	0.070	0.088	0.106	0.125	0.146
3500	0.008	0.018	0.031	0.046	0.063	0.081	0.101	0.122	0.144	0.167
4000	0.009	0.021	0.035	0.052	0.071	0.092	0.115	0.138	0.163	0.188
4500	0.010	0.023	0.040	0.059	0.080	0.103	0.127	0.153	0.181	0.208
5000	0.011	0.026	0.044	0.065	0.088	0.113	0.140	0.168	0.198	0.228
7500	0.017	0.038	0.064	0.094	0.126	0.161	0.197	0.234	0.272	0.309
10000	0.022	0.050	0.084	0.121	0.161	0.202	0.244	0.285	0.325	0.362
20000	0.043	0.094	0.149	0.202	0.250	0.289	0.314	0.324	0.315	0.289
30000	0.062	0.130	0.191	0.237	0.258	0.249	0.209	0.142		
40000	0.080	0.156	0.210	0.244	0.192					
50000	0.096	0.174	0.205							

Table 13 Table of basic power ratings for PS belt Type A-4 (kW/cm width)

Pulley revolution (rpm) \ Pulley outside diameter (mm)	10	20	30	40	50	60	70	80	90	100
950	0.006	0.016	0.026	0.038	0.052	0.068	0.089	0.103	0.122	0.142
1160	0.008	0.018	0.031	0.046	0.063	0.082	0.103	0.124	0.147	0.171
1425	0.010	0.022	0.038	0.057	0.077	0.100	0.125	0.151	0.178	0.207
1750	0.012	0.027	0.047	0.069	0.094	0.122	0.151	0.182	0.214	0.248
2850	0.019	0.044	0.074	0.109	0.147	0.188	0.232	0.276	0.321	0.337
3450	0.023	0.053	0.089	0.130	0.174	0.221	0.270	0.319	0.368	0.415
500	0.003	0.008	0.014	0.020	0.028	0.036	0.045	0.055	0.066	0.076
600	0.004	0.010	0.016	0.024	0.033	0.043	0.054	0.066	0.078	0.091
700	0.005	0.011	0.019	0.028	0.039	0.050	0.063	0.077	0.091	0.106
800	0.005	0.013	0.022	0.032	0.044	0.057	0.072	0.087	0.103	0.120
900	0.006	0.014	0.024	0.036	0.050	0.064	0.081	0.098	0.116	0.135
1000	0.007	0.016	0.027	0.040	0.055	0.071	0.089	0.108	0.128	0.149
1200	0.008	0.019	0.032	0.048	0.066	0.085	0.106	0.129	0.152	0.177
1400	0.009	0.022	0.038	0.056	0.076	0.099	0.123	0.148	0.175	0.203
1600	0.011	0.025	0.043	0.063	0.086	0.112	0.139	0.168	0.198	0.229
1800	0.012	0.028	0.048	0.071	0.097	0.125	0.155	0.187	0.220	0.254
2000	0.013	0.031	0.053	0.078	0.107	0.137	0.170	0.205	0.241	0.278
2500	0.017	0.039	0.066	0.097	0.131	0.168	0.207	0.248	0.290	0.333
3000	0.020	0.046	0.078	0.114	0.154	0.197	0.242	0.287	0.334	0.380
3500	0.023	0.054	0.090	0.131	0.176	0.224	0.273	0.322	0.371	0.419
4000	0.027	0.061	0.102	0.148	0.197	0.249	0.301	0.353	0.402	0.449
4500	0.030	0.068	0.113	0.163	0.217	0.271	0.326	0.378	0.427	0.470
5000	0.033	0.075	0.124	0.178	0.235	0.292	0.347	0.398	0.444	0.482
7500	0.049	0.109	0.175	0.241	0.304	0.357	0.397	0.419	0.419	0.395
10000	0.064	0.139	0.215	0.282	0.333	0.358	0.351	0.307		
20000	0.118	0.218	0.260	0.213						
30000	0.159	0.226	0.127							
40000	0.185	0.163								
50000	0.196									

Table 14 Table of basic power ratings for PS belt Type A-10 (kW/cm width)

Pulley revolution (rpm) \ Pulley outside diameter (mm)	15	30	45	60	75	90	105	120	135	150
950	0.02	0.05	0.09	0.14	0.19	0.25	0.31	0.37	0.44	0.51
1160	0.03	0.07	0.11	0.17	0.23	0.30	0.37	0.45	0.53	0.61
1425	0.04	0.08	0.14	0.20	0.26	0.36	0.45	0.54	0.63	0.73
1750	0.04	0.10	0.17	0.25	0.34	0.43	0.53	0.64	0.75	0.86
2850	0.07	0.16	0.27	0.39	0.52	0.65	0.79	0.93	1.07	1.20
3450	0.08	0.19	0.32	0.45	0.60	0.75	0.90	1.05	1.19	1.31
500	0.01	0.03	0.05	0.07	0.10	0.13	0.17	0.20	0.24	0.28
600	0.01	0.03	0.06	0.09	0.12	0.16	0.20	0.24	0.28	0.33
700	0.02	0.04	0.07	0.10	0.14	0.18	0.23	0.28	0.33	0.38
800	0.02	0.05	0.08	0.12	0.16	0.21	0.26	0.32	0.37	0.43
900	0.02	0.05	0.09	0.13	0.18	0.23	0.29	0.35	0.42	0.48
1000	0.02	0.06	0.10	0.15	0.20	0.26	0.32	0.39	0.46	0.53
1200	0.03	0.07	0.12	0.17	0.24	0.31	0.38	0.46	0.54	0.63
1400	0.03	0.08	0.14	0.20	0.27	0.35	0.44	0.53	0.62	0.72
1600	0.04	0.09	0.15	0.23	0.31	0.40	0.49	0.59	0.70	0.80
1800	0.04	0.10	0.17	0.25	0.35	0.43	0.55	0.66	0.77	0.88
2000	0.05	0.11	0.19	0.28	0.38	0.49	0.60	0.72	0.84	0.96
2500	0.06	0.14	0.24	0.34	0.46	0.59	0.72	0.85	0.98	1.12
3000	0.07	0.17	0.28	0.40	0.54	0.68	0.82	0.97	1.40	1.24
3500	0.08	0.19	0.32	0.46	0.61	0.76	0.91	1.06	1.19	1.32
4000	0.10	0.22	0.36	0.51	0.67	0.83	0.98	1.13	1.25	1.35
4500	0.11	0.24	0.40	0.56	0.73	0.89	1.04	1.17	1.27	1.34
5000	0.12	0.27	0.43	0.61	0.78	0.94	1.08	1.19	1.26	1.30
7500	0.18	0.38	0.59	0.77	0.92	1.04	1.02	0.95		
10000	0.23	0.47	0.69	0.83	0.88	0.80				
20000	0.40	0.64	0.58	0.21						
30000	0.51	0.50								
40000	0.54									
50000	0.51									

Table 15 Table of basic power ratings for PS belt Type A-13 (kW/cm width)

Pulley revolution (rpm) \ Pulley outside diameter (mm)	20	40	60	80	100	120	140	160	180	200
950	0.05	0.11	0.19	0.28	0.39	0.50	0.62	0.75	0.88	1.02
1160	0.06	0.14	0.23	0.34	0.47	0.60	0.74	0.90	1.05	1.22
1425	0.07	0.17	0.28	0.41	0.56	0.72	0.89	1.07	1.25	1.44
1750	0.09	0.20	0.34	0.50	0.68	0.86	1.06	1.27	1.48	1.69
2850	0.14	0.32	0.53	0.77	1.02	1.27	1.52	1.77	2.00	2.21
3450	0.17	0.38	0.63	0.90	1.17	1.44	1.69	1.93	2.13	2.29
500	0.03	0.06	0.10	0.15	0.21	0.27	0.34	0.41	0.49	0.57
600	0.03	0.07	0.12	0.18	0.25	0.32	0.40	0.49	0.58	0.67
700	0.04	0.08	0.14	0.21	0.29	0.37	0.47	0.56	0.67	0.78
800	0.04	0.10	0.16	0.24	0.33	0.42	0.53	0.64	0.76	0.88
900	0.05	0.10	0.18	0.27	0.37	0.47	0.59	0.71	0.84	0.97
1000	0.05	0.12	0.20	0.30	0.40	0.52	0.65	0.78	0.92	1.07
1200	0.06	0.14	0.24	0.35	0.48	0.62	0.77	0.92	1.09	1.25
1400	0.07	0.16	0.28	0.41	0.55	0.71	0.88	1.05	1.24	1.42
1600	0.08	0.19	0.31	0.46	0.62	0.80	0.99	1.18	1.38	1.58
1800	0.09	0.21	0.35	0.51	0.69	0.89	1.09	1.29	1.51	1.72
2000	0.10	0.23	0.39	0.57	0.76	0.97	1.18	1.40	1.63	1.85
2500	0.13	0.29	0.48	0.69	0.92	1.16	1.40	1.64	1.87	2.10
3000	0.15	0.34	0.56	0.80	1.06	1.32	1.57	1.82	2.04	2.24
3500	0.17	0.39	0.64	0.91	1.18	1.45	1.71	1.94	2.13	2.29
4000	0.20	0.44	0.71	1.00	1.29	1.56	1.80	2.00	2.15	2.23
4500	0.22	0.49	0.78	1.09	1.38	1.64	1.85	2.00	2.09	2.03
5000	0.24	0.53	0.85	1.16	1.45	1.69	1.86	1.95	1.95	1.86
7500	0.35	0.74	1.10	1.38	1.54	1.54	1.37			
10000	0.45	0.90	1.23	1.35	1.24					
20000	0.76	1.04								
30000	0.90									
40000	0.88									
50000										

Note) When your operating conditions do not apply to the pulley diameters and revolutions shown in the above tables, perform linear correction from the closest value, respectively. (Proportional distribution)

Condition		Examination result
1. Consideration for ozone resistance is required. 2. Machine name: Micro-printer roller drive 3. Load: 320 N•mm max 4. Duty cycle: Normal use (8 to 10 hrs/day) 5. Revolution: 500 rpm at ϕ60 on the driving side	6. Revolution ratio 1:1.5 deceleration 7. Center distance: 90 mm 8. Pulley outside diameter: Specified Driving side ϕ60, Driven side ϕ90 9. Allowable belt width: 9 mm max	- Belt specification: A-4CB - Belt size: $0.6^{t} \times 7_{W} \times 416_{L}$ (mm) - Stretch rate used: 0.5%

Step 1. Selecting from the List of Types

As this is for driving, select the **A series (→P. 319 to P. 320)** and select A-4CB from the necessity for ozone resistance.

Here, start with **A-4C**.

Step 2. Calculating the Required Effective Length

(As pulleys have been selected, proceed to ① of the flow chart.)

From Formula 2 **(→ P. 321)**, $L_1 = \dfrac{2\times90+1.57\,(60+90)+\dfrac{(90-60)^2}{4\times90}}{1+0.005}$

[For the stretch rate used, use 0.5% of the standard.]

$= 415.9$ mm - 416 mm

As there is no standard size, use **416 mm**.

Effective length = **416 mm**

Step 3. Calculating the Design Power

(Since the effective length was determined, proceed to ③ of the flow chart.)
Because the load is given in torque, convert it into power.

From Formula 7 **(→ P. 329)**, $Pt = \dfrac{\dfrac{500}{1000}\times320}{9550} = 167.54\times10^{-4}$ kW

From **Table 9 (→ P. 328)**, obtain the load correction factor Ko. → **1.1**

From Formula 4 **(→ P. 328)**, **Pd** = $167.54\times10^{-4}\times1.1 = \mathbf{184.29\times10^{-4}}$ **kW**

Pd=**184.29×10^{-4} kW**

Step 4. Obtaining the Correction Factor by the Pinion Contact Angle

From Formula 5 **(→ P. 328)**, $\theta_1 = 180\,\dfrac{57(90-60)}{90} = 161°$

From **Fig. 1 (→ P. 328)**, Kθ = **0.91**

Kθ = **0.91**

Step 5. Obtaining the Basic Power Rating

Assuming the belt is A-4CB and the stretch rate used is 0.5%
From the table of basic power ratings in **Table 13 (→ P. 330)**, obtain the basic power rating when the pinion revolution is 500 rpm and the pinion outside diameter is 60 mm.

Pr=**360×10^{-4} kW**

Step 6. Obtaining the Belt Width

From Formula 8 **(→ P. 329)**, $b = \dfrac{10\times167.54\times10^{-4}}{360\times10^{-4}\times0.91} = 5.6$ mm

When the standard width is obtained from **Table 11 (→ P. 329)**, the width is **7 mm**.

b = **7 mm**

Check of the Pulley Width and Belt Width

From the **pulley width calculation equation (→ P. 323)**, obtain the optimum pulley width for the belt with a width of 7 mm.

$7 \times 1.1 + 5 = 12.7$ mm → **13 mm**

br = **13 mm**

Belt specification **A-4CB $0.6^{t}\times7^{W}\times416^{L}$**

The stretch rate used is 0.5%.