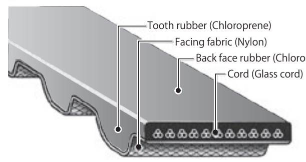
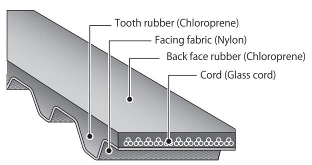
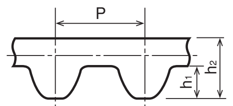
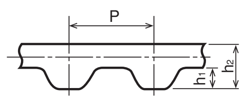
1. Long Synchronous Belt (Rubber) Product Introduction

This belt allows synchronous power transmission and synchronous conveyance over long spans. It is lighter and more quiet than chains and requires no lubrication.
Please utilize it in place of chains, flat belts, and conveyor belts for factory automation.

Structure and Tooth Profile Dimensions

Belt type	Long STS Belt	Long Synchronous Belt
Structure		
Tooth profile dimensions	 The dimensions in ( ) are of seamless type. (Unit: mm)	 The dimensions in ( ) are of seamless type. (Unit: mm)

Long STS Belt (Unit: mm)

Type \ Item	P	h_1	h_2
S2M	2.0	0.76	1.31
S3M	3.0	1.14	2.10
S4.5M	4.5	1.71	2.70
S5M	5.0	1.91	3.61
S8M	8.0	3.05	5.30(6.05)
S14M	14.0	5.30	(11.3)

Long Synchronous Belt (Unit: mm)

Type \ Item	P	h_1	h_2
MXL	2.032	0.51	1.10
XL	5.080	1.25	2.25
L	9.525	1.90	3.50
H	12.700	2.30	4.30(5.30)
XH	22.225	6.30	11.3(12.3)
XXH	31.75	9.60	15.8(16.1)

Type / Features / Standard Sizes / Indications

Type	Seamless (no joint)	Open-ended (band form)
Features	● The absence of a joint allows power transmission and conveyance with the same performance as that of standard synchronous belts. ● The effective length can be freely made in units of tooth. ● Special specifications (such as back face design and white color) can also be manufactured.	● Accurate reciprocal motions.

Standard size — Seamless (no joint)

Type	Standard nominal width	Manufacturable range
H	100, 200, 400 600, 800, 1000 (inches × 100)	4.7～30 (m)
XH		
XXH		
S8M	250, 500, 1000 1500, 2000, 2800 (mm×10) * For other widths than the above, please contact us.	4.7～30 (m)
S14M		

Standard size — Open-ended (band form) (Unit: m)

Nominal width	019	025	031	037	050	075	100	150	200	300
Width (mm)	4.8	6.4	7.9	9.5	12.7	19.1	25.4	38.1	50.8	76.2
MXL	41	30	24	41	30					
XL		54	43	36	26	34				
L					49	31	46			
H						41	30	38	27	16

Nominal width	50	60	70	80	100	140	150	200	250	300	400	500	600
Width (mm)	5	6	7	8	10	14	15	20	25	30	40	50	60
S2M	43	36	30	53									
S3M	50	42											
S4.5M		45			40	28							
S5M				53	42		42	30	24				
S8M					56		55	40	31	52	37	28	22

Indication

Seamless (no joint):

- Synchronous Belt

200 XH 10000
- Effective length (mm)
- Belt type (Type XH)
- Belt nominal width (2 inches: 50.8 mm)

- STS Belt

500 S14M 7770
- Effective length (mm)
- Belt type (Type S14M)
- Belt nominal width (50 mm)

Open-ended (band form):

- Synchronous Belt

XL 025 53m
- Effective length (m)
- Belt nominal width (0.25 inches: 6.4 mm)
- Belt type (Type XL)

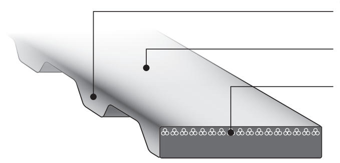
- STS Belt

250 S8M 30m
- Effective length (m)
- Belt type (Type S8M)
- Belt nominal width (25 mm)

2. Bancollan Long Synchronous Belt (Polyurethane)

This belt made of polyurethane allows synchronous power transmission and synchronous conveyance over long spans. It is suitable for food processing machines, clean power transmission, and conveyance. Various profiles can be fused on the back face of the belt to enhance the conveyance function.

Structure and Features



Steel: Suitable for applications that require responsiveness, dimensions, positioning.
Aramid: Suitable for food stuff applications.

- **Little dust generation and excellent cleanliness**
- **Joint of any length possible**
- **Back face profile processing possible**
- **The steel cord specification has little belt elongation.**
- **Direct conveyance of food stuffs possible** (passed Notice No. 370 of the Ministry of Health and Welfare concerning food hygiene)
- **Synchronous power transmission over long spans possible**

How to Understand Product Name

[Inch-pitch trapezoidal teeth] (XL/L/H)

037 XL−1015 S W−C
- Cut (open-ended)
- Cord material (symbol)
- Rubber material (symbol)
- No. of teeth of belt
- Belt tooth profile (Type XL)
- Belt nominal width (0.37 inches: 9.5 mm)

[Round teeth] (S2M/S3M/S5M/S8M/S14M/S25M)

240 S3M−1000 L W-C
- Cut (open-ended)
- Cord material (symbol)
- Rubber material (symbol)
- No. of teeth of belt
- Belt tooth profile (Type S3M)
- Belt width (240: 24 mm)

[Millimeter-pitch trapezoidal teeth] (T5/T10/AT5/AT10/AT20)

25 T10−890 S W Z−J(P)
- Special processing
- Joint
- Special specifications
- Cord material (symbol)
- Rubber material (symbol)
- No. of teeth of belt
- Belt tooth profile (Type T10)
- Belt width (mm)

● **Rubber material symbols**
S: Standard, semi-transparent / **W**: Standard, white / **L**: Low friction, white / **B**: Low friction, blue / **M**: Moisture- and heat-resistant, white

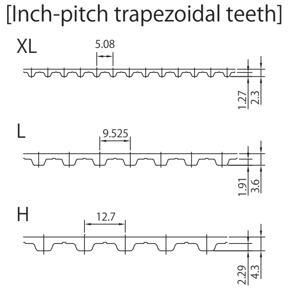
● **Cord material symbols**
W: Steel cord / **K** : Aramid cord

● **Special specifications**
Z: Canvas on mating flank / **G**: Back face polishing

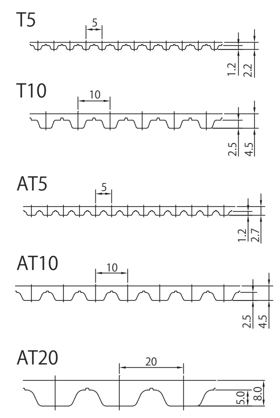
● **Joints and special processing**
C: Cut (open-ended) / **J**: Joint / **(P)**: Special processing (such as profile)

Tooth Profiles / Standard Sizes / Joints

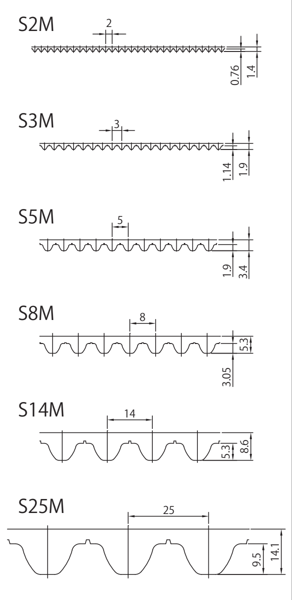
[Inch-pitch trapezoidal teeth]



[Millimeter-pitch trapezoidal teeth]



[Round teeth]



Tooth profile	Standard nominal width	Width (mm)	Maximum nominal width	Maximum length	Joint	Minimum joint length
XL	025	6.4	200	50m	○	0.5m
	031	7.9				
	037	9.5				
	050	12.7				
	075	19.1				
	100	25.4				
	150	38.1				
	200	50.8				
L	050	12.7	200	50m	○	0.5m
	075	19.1				
	100	25.4				
	150	38.1				
	200	50.8				
H	075	19.1	400	50m	○	0.5m
	100	25.4				
	150	38.1				
	200	50.8				
	300	76.2				2m
	400	101.6				
T5	7	7	50	50m	○	0.5m
	10	10				
	15	15				
	20	20				
	25	25				
	30	30				
	40	40				
	50	50				
T10	15	15	100	50m	○	0.5m
	20	20				
	25	25				
	30	30				
	40	40				
	50	50				
	60	60				2m
	75	75				
	100	100				
AT5	10	10	50	50m	○	0.5m
	15	15				
	20	20				
	25	25				
	30	30				
	40	40				
	50	50				

Tooth profile	Standard nominal width	Width (mm)	Maximum nominal width	Maximum length	Joint	Minimum joint length
AT10	15	15	100	50m	○	0.5m
	20	20				
	25	25				
	30	30				
	40	40				
	50	50				
	60	60				2m
	75	75				
	100	100				
AT20	25	25	100	50m	×	—
	50	50				
	75	75				
	100	100				
S2M	50	5	400	60m	×	—
	100	10				
	150	15				
	200	20				
	250	25				
	300	30				
	350	35				
	400	40				
S3M	60	6	480	60m	×	—
	120	12				
	180	18				
	240	24				
	300	30				
	360	36				
	420	42				
	480	48				
S5M	100	10	500	50m	○	0.5m
	150	15				
	200	20				
	250	25				
	300	30				
	400	40				
	500	50				
S8M	150	15	1000	50m	○*1	0.5m
	200	20				
	250	25				
	300	30				
	400	40				
	500	50				
	750	75				2m
	1000	100				
S14M	1000	100	1000	30m	×	—
S25M	250	25	1000	20m	×	—
	330	33				
	1000	100				

* The maximum joint length for connectable product types is 50 m.
If this is exceeded, please consult our sales company or distributor.
* If you need other widths than the standard widths, please consult our sales company or distributor.
*1 There is a limitation on use; please make an inquiry.

Bancollan Long Synchronous Belt System Table

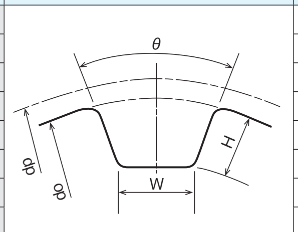
Tooth profile	Cord type	Rubber type					Canvas affixation
		S: Standard	W: Standard	L: Low friction	B: Low friction	M: Moisture- and heat-resistant	Mating flank
		Semi-transparent	White	White	Blue	White	
XL	Steel cord	○	○			○	
	Aramid cord	○					
L	Steel cord	○	○			○	
	Aramid cord	○					
H	Steel cord	○	○			○	
	Aramid cord	○	○			○	
T5	Steel cord	○	○			○	○
	Aramid cord	○	○				
T10	Steel cord	○	○			○	○
	Aramid cord	○	○			○	
AT5	Steel cord	○	○				
AT10	Steel cord	○	○				
AT20	Steel cord	○	○				
S2M	Steel cord			○			
S3M	Steel cord			○			
S5M	Steel cord		○				
	Aramid cord		○				
S8M	Steel cord		○				
	Aramid cord		○*				
S14M	Steel cord			○			
S25M	Steel cord			○			
	Aramid cord				○*		

* The ○ mark indicates that it is manufacturable.
* Cord symbol Steel: W
  Aramid: K
* S14M and S25M are used for conveyance; please contact us for details.

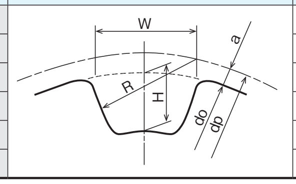
* For the aramid specifications of S8M and S25M, please contact us.

About Pulleys

- Synchronous belt pulley

Type	Tooth profile	Dimensions (mm) W	H	Θ (degree)
XL		1.27	1.40	50
L		3.10	2.13	40
H		4.24	2.59	40
T5		1.50	1.70	50
T10		3.40	3.00	50
AT5		2.70	1.10	50
AT10		5.40	2.35	50
AT20		10.80	4.65	50

- STS pulley

Type	Tooth profile	Dimensions (mm) W	R	H	a
S2M		1.30	1.325	0.76	0.254
S3M		1.95	1.975	1.14	0.381
S5M		3.25	3.275	1.77	0.480
S8M		5.20	5.30	2.83	0.686
S14M		9.10	9.28	4.95	1.397
S25M		16.25	16.56	8.65	2.055

- No. of teeth of pulley applied to each belt type (minimum, maximum)

Synchronous belt pulley			XL	L	H	T5	T10	AT5	AT10	AT20
Pitch (mm)			5.08	9.525	12.7	5	10	5	10	20
Minimum No. of teeth of pulley	Revolution rpm	900	10	12	14	12	14	15	15	18
		1200			16		16			
		1800	12	14	18	14	18			
		2360		16	20	16	20			
		3000								
		3600								
		4800	14	18		20				
Maximum No. of teeth of pulley			30	40	40	69	69	80	80	50

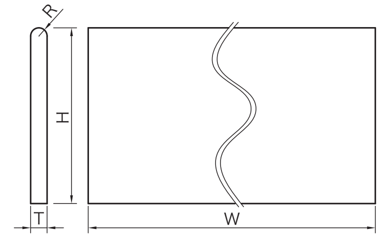
STS pulley			S2M	S3M	S5M	S8M	S14M	S25M
Pitch (mm)			2	3	5	8	14	25
Minimum No. of teeth of pulley	Revolution rpm	870	27	27	16	22	26	28
		1160				24		
		1750			20	26		
		2670				28		
		5000			24			
Maximum No. of teeth of pulley			60	60	60	84	48	38

(Grey) indicates "not applicable."
Please use pulleys with the number of teeth equal to or larger than the minimum number of teeth of a pulley and equal to or smaller than the maximum number of teeth of a pulley.
An applicable minimum number of teeth of a pulley varies depending on the revolution.
For synchronous belt pulleys and STS pulleys, the classification of revolution differs due to the difference in pitch between inch and millimeter.
Please use Types S2M and S3M at a belt speed of 10 m/s or less.

Look-up Table of Profiles for Bancollan Long Synchronous Belts

For Bancollan Long Synchronous Belts, functions can be added by welding various profiles on belts.
If you need other profiles than the standard profiles, please consult our sales company or distributor.

■P-0102～P-0108

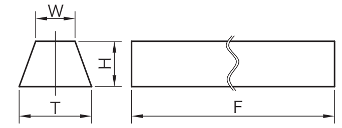


H and W can be cut according to your request.

(Unit: mm)

Profile No.	T	Tolerance	H	W	R
P-0102	2.0	±0.2	50.0	101.6	1.0
P-0103	5.0	±0.25	50.0	101.6	2.5
P-0104	6.0	±0.25	50.0	101.6	3.0
P-0105	8.0	±0.3	50.0	101.6	4.0
P-0106	10.0	±0.4	50.0	101.6	5.0
P-0107	3.0	±0.2	50.0	101.6	1.5
P-0108	4.0	±0.25	50.0	101.6	2.0

■P-0201～P-0203

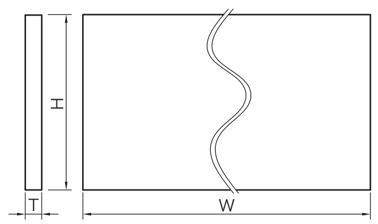


F can be cut to a length of your request.

(Unit: mm)

Profile No.	T	H	W
P-0201	8.0	5.0	4.4
P-0202	10.0	5.0	6.0
P-0203	12.7	8.0	6.9

■P-0302～P-0308

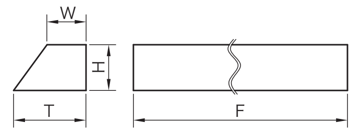


H and W can be cut according to your request.

(Unit: mm)

Profile No.	T	Tolerance	H	W
P-0302	2.0	±0.2	45.0	101.6
P-0303	5.0	±0.25	45.0	101.6
P-0304	6.0	±0.25	45.0	101.6
P-0305	8.0	±0.3	45.0	101.6
P-0306	10.0	±0.4	45.0	101.6
P-0307	3.0	±0.2	45.0	101.6
P-0308	4.0	±0.25	45.0	101.6

■P-0401～P-0403

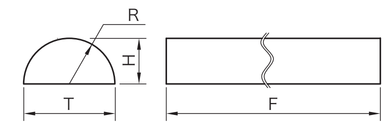


F can be cut to a length of your request.

(Unit: mm)

Profile No.	T	H	W
P-0401	4.0	5.0	2.2
P-0402	5.0	5.0	3.0
P-0403	6.4	8.0	3.5

■P-0501～P-0504

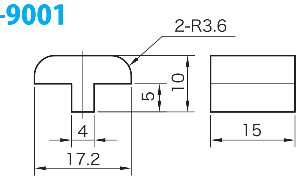


F can be cut to a length of your request.

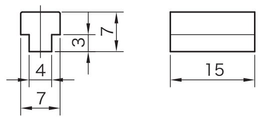
(Unit: mm)

Profile No.	T	H	R
P-0501	5.0	10.0	5.0
P-0502	3.0	6.0	3.0
P-0503	4.0	8.0	4.0
P-0504	6.0	12.0	6.0

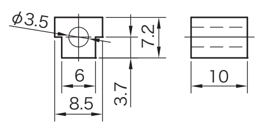
■ P-9001



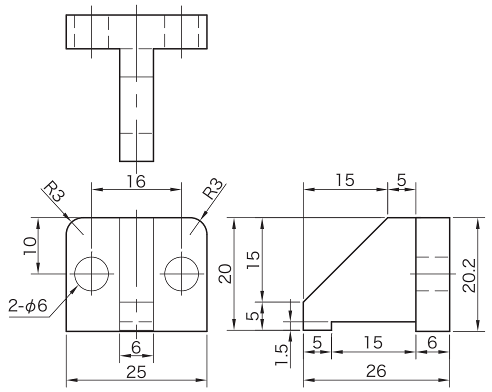
■ P-9002



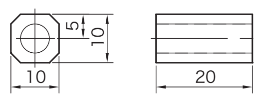
■ P-9004



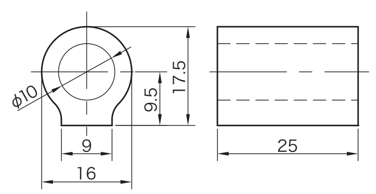
■ P-9005



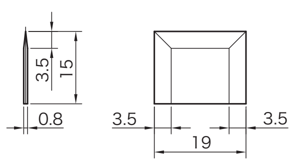
■ P-9008



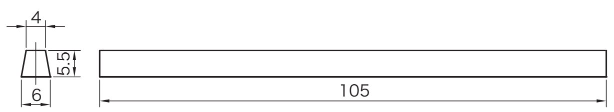
■ P-9006



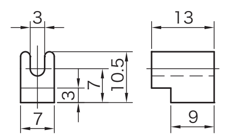
■ P-9012



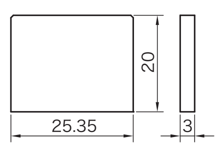
■ P-9007



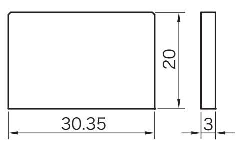
■ FUZE-2



■ P-9022



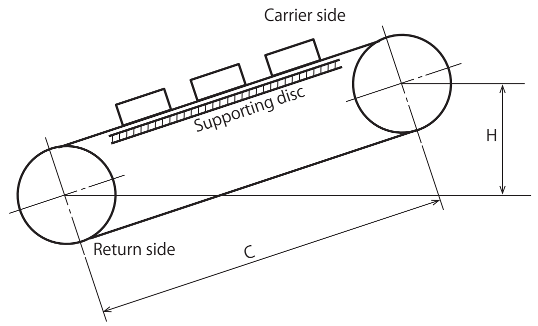
■ P-9023



Long Synchronous Belt

3. How to Design a Long Synchronous Belt (Rubber)

(1) How to design a belt when using it for conveyance



Step 1 Calculating the effective length

(when the rotation ratio is 1:1)

Formula 1

$$L = 2C + Z \cdot Pt$$
$$= 2C + \pi \cdot Dp$$

- L : Effective length (mm)
- C : Center distance (mm)
- Z : No. of teeth of pulley
- Pt : Pulley tooth pitch (mm)
- Dp : Pulley pitch diameter (mm)

For information on how to design a Bancollan Long Synchronous Belt, refer to the separate "Bancollan Long Synchronous Belt Design Manual."

Step 2 Calculating the drive power (effective tension)

Formula 2

$$Te' = 9.8f\,(W_G + m)\,C \pm 9.8W_G H$$

+: Ascending incline
-: Descending incline

- Te' : Drive power (effective tension) (N)
- f : Frictional factor of belt and support plate **(Table 1)**
- W_G : Amount of material conveyed per meter of the effective length (kg/m)
- m : Belt unit mass **(Table 2)**
- C : Center distance (m)
- H : Difference of elevation (m)

Table 1 Frictional factors (f)

Support plate material	Rubber belt	Bancollan (polyurethane) belt	
		Standard specification	Low-friction specification
Iron (e.g. S45C)	0.3	0.5	0.3
Aluminum	0.3	0.4	0.3
High-molecular polyethylene	0.2	0.3	0.2

Table 2 Belt unit mass (m)

Rubber (seamless) / Type	H	XH	XXH	S8M	S14M
Belt unit width (mm)	25.4	25.4	25.4	50	100
Unit mass (kg/m)	0.167	0.346	0.413	0.326	1.053

Rubber (open-ended) / Type	MXL	XL	L	H	S2M	S3M	S4.5M	S5M	S8M
Belt unit width (mm)	6.4	25.4	25.4	25.4	4.0	6.0	25.0	25.0	25.0
Unit mass (kg/m)	0.0073	0.068	0.096	0.133	0.0064	0.0138	0.031	0.097	0.138

Step 3 Correcting the effective tension (Te)

When using an idler pulley, correct the effective tension (Te').

Formula 3-1

$$Te = Te'\,(Kq + Ki \times N)$$

- Te : Effective tension after correction
- Kq : Factor by frequency of use **(Table 3)**
- Ki : Idler correction factor **(Table 4)**
- N : No. of idlers

If the conveyance conditions are unknown, use the following equation.

Formula 3-2

$$Te' = \frac{1000Pt}{v}$$

- Te : Drive power (effective tension) (N)
- v : Belt speed (m/s)
- Pt : Transmission power (kW)

Table 3 Factor by frequency of use (Kq)

3~5 hr/day	8~10 hr/day	16~24 hr/day
1.0	1.2	1.3

Table 4 Idler correction factor (Ki)

Idler installation location	Ki
No idlers	0.0
Installed from the inside on the slack side	0.0
Installed from the outside on the slack side	0.1
Installed from the inside on the tight side	0.1
Installed from the outside on the tight side	0.2

Step 4 Selecting a belt type and width

4-1) Selecting the number of teeth of a pulley

For relations among the number of teeth of pulleys, pulley diameter, and pitch diameter, refer to the pulley section for Synchronous Belts and Super-Torque Synchronous Belts. (→**P.83~99**)

● **Check of the minimum number of teeth of a pulley**

Generally, when a pulley with a small diameter is used, the flex fatigue of the belt increases, reducing the belt service life. Hence, please use a pulley with a larger number of teeth than the ones shown in **(Table 5)** at least.

4-2) Selecting the number of teeth (length) of a belt (Bz)

Formula 4

$$L' = 2C + 1.57(Dp + dp) + \frac{(Dp - dp)^2}{4C}$$

$$Bz = \frac{L'}{P}$$

- L' : Rough effective length (mm)
- C : Center distance (mm)
- Dp : Large pulley pitch diameter (mm)
- dp : Pinion pitch diameter (mm)
- Bz : No. of teeth of belt
- P : Belt tooth pitch (mm)

Table 5 Minimum number of teeth of pulleys

Rubber

Long Super-Torque Synchronous Belt

Pinion revolution (rpm)	S2M	S3M	S4.5M	S5M	S8M	S14M
870 or less	14	14	12	14	22	34
Over 870 to 1160 or less	14	14	14	16	24	38 (1120 rpm or less)
Over 1160 to 1750 or less	16	16	16	20	26	
Over 1750 to 3500 or less	18	18	18	24	28 (2670 rpm or less)	
Over 3500 to 4500 or less	20	20	18	24		
Over 4500 to 5500 or less	20	20	18	24 (5000 rpm or less)		
Over 5500	20	20	18			

Long Synchronous Belt

Pinion revolution (rpm)	MXL	XL	L	H	XH	XXH
900 or less	12	10	12	14	22	22 (850 rpm or less)
Over 900 to 1200 or less	12	10	12	16	24 (1120 rpm or less)	
Over 1200 to 1800 or less	14	12	14	18		
Over 1800 to 3600 or less	16	12	16	20 (2360 rpm or less)		
Over 3600 to 4800 or less	18	15	18 (3490 rpm or less)			

* Please use Types S2M and S3M with a minimum number of teeth of a pulley of 27 or more and at a belt speed of 10 m/s or less as they have higher responsiveness than that of previous belts.

4-3) Correction by the number of meshed teeth (Zm)

From Formula 5, calculate the number of meshed teeth of the pinion, and from **(Table 6)**, obtain the correction factor by the number of meshed teeth Km.

Formula 5

$$Zm = Z \times \frac{\theta_1}{360}$$

$$\Theta_{11} = 180 - \frac{57.3(Dp-dp)}{C}$$

Zm : Number of meshed teeth of pinion
Z : Number of teeth of pinion
θ_1 : Angle of contact of pinion (°)
Dp : Large pulley pitch diameter (mm)
dp : Pinion pitch diameter (mm)
C : Center distance (mm)

Table 6 Correction factor by the number of meshed teeth Km

Number of meshed teeth Zm	Km
6 or more	1.00
5	0.80
4	0.60
3	0.40
2	0.20

4-4) Calculation of belt width

Select a belt width that satisfies Formula 6 from the allowable tension **(Tables 7-1 to 2)**.

Formula 6

$$Ta \geqq \frac{Te}{Km}$$

Ta : Allowable tension **(Table 7)**
Te : Effective tension (N)
Km : Correction factor by the number of meshed teeth

Table 7-1 Allowable belt tension (Ta)

Rubber Long Synchronous (Seamless) (N)

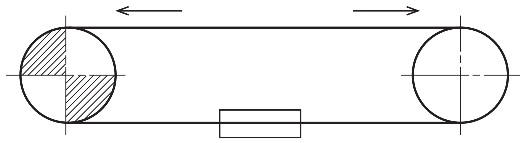
Belt width \ Type	H	XH	XXH	Belt width \ Type	S8M	S14M
100(25.4mm)	460	590	620	250(25.0mm)	810	1040
200(50.8mm)	1020	1300	1370	500(50.0mm)	1800	2300
400(101.6mm)	2070	2640	2780	1000(100.0mm)	3650	4670
600(152.4mm)	3180	4060	4270	1500(150.0mm)	5540	7080
800(203.2mm)	4250	5420	5710	2000(200.0mm)	7420	9480
1000(254.0mm)	5360	6830	7190	3000(300.0mm)	11030	14100

Table 7-2 Allowable belt tension (Ta)

Rubber Long Synchronous (Open-Ended) (N)

Belt width \ Type	MXL	XL	L	H	Belt width \ Type	S4.5M	S5M	S8M
019 (4.8mm)	16	—	—	—	60 (6.0mm)	50	—	—
025 (6.4mm)	22	25	—	—	80 (8.0mm)	—	240	—
031 (7.9mm)	28	35	—	—	100(10.0mm)	90	310	340
037 (9.5mm)	35	45	—	—	140(14.0mm)	130	—	—
050(12.7mm)	48	70	95	—	150(15.0mm)	—	490	560
075(19.1mm)	—	120	165	425	200(20.0mm)	—	680	750
100(25.4mm)	—	—	235	600	250(25.0mm)	—	850	950
150(38.1mm)	—	—	—	900	300(30.0mm)	—	—	1150
200(50.8mm)	—	—	—	1250	400(40.0mm)	—	—	1550
300(76.2mm)	—	—	—	2000	500(50.0mm)	—	—	1960
					600(60.0mm)	—	—	2360

(2) How to design a belt when using it for reciprocal motions



Step 1 Calculating the maximum drive tension

Formula 7

$$Tmax = \frac{1000 \cdot Pt}{v} + mv^2$$

$$v = \frac{Dp \times \pi \times n}{60000}$$

Tmax	: Maximum drive tension	(N)
Pt	: Transmission power	(kW)
v	: Belt speed	(m/sec)
m	: Belt unit mass	(kg/m)
Dp	: Pulley pitch diameter	(mm)
n	: Pulley revolution	(rpm)

Step 2 Correcting the maximum drive tension

When using an idler pulley, correct the maximum drive tension (Tmax) with Formula 8.

Formula 8

$$T'max = Tmax \times (Kq + Ki \times N)$$

T'max : Maximum drive tension correction
Kq : Correction factor by frequency of use (→ **Table 3 on P. 204**)
Ki : Idler correction factor (→ **Table 4 on P. 204**)
N : No. of idlers

Step 3 Selecting a belt type and width

3-1) Selecting the number of teeth of a pulley
For relations among the number of teeth of pulleys, pulley diameter, and pitch diameter, refer to the pulley section for Synchronous Belts and Super-Torque Synchronous Belts. **(→P.88～99)**

3-2) Selecting a belt width
When selecting a belt width, select one so that the T'•max obtained with Formula 8 forms T'•max < Ta from **(Tables 7-1 to 2)**.

(3) How to design a belt when there are sudden stops and sudden accelerations

Under conditions of sudden stop and sudden acceleration, an abnormal torque may be applied to the belt due to the inertial force of the machine; check with Formula 9 in advance, and if the width falls short, it needs to be corrected.
Calculate Te by substituting the Pdq obtained with Formula 9 as Pt of Formula 3-2 **(→ P. 204)** in **Step 3** and select a belt width by following **Step 4 (→ P. 204)**.
Also, compare belt widths in the same way without considering sudden stops and sudden accelerations and use the wider belt.

Formula 9

$$Trq = \frac{\Sigma GD^2 \times (n_1 - n_2)}{38.2 \times t} \quad (N{\cdot}m)$$

$$Ptq = \frac{n \times Trq}{9550} \quad (kW)$$

$$Pdq = Ptq \times Kq \quad (kW)$$

Trq	: Rotational torque at the time of a sudden stop or sudden acceleration	(N•m)
ΣGD^2	: Flywheel effect (Sum total of GD2 on the opposite side to the brake)	(kgf•m²)
$n_1 - n_2$	: Difference in revolution (opposite side to the brake)	
t	: Time to change from n_1 to n_2	(S)
Pdq	: Design power	
Kq	: Correction factor (table below)	

Correction factor Kq by rotation at the time of a sudden stop or sudden acceleration

revolutions/day	1	2	3～4	5～10	11～15
Kq	1.0	1.2	1.3	1.5	1.6
revolutions/day	16～25	26～40	41～60	61～100	101～
Kq	1.7	1.8	1.9	2.0	2.1

Data Edition

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

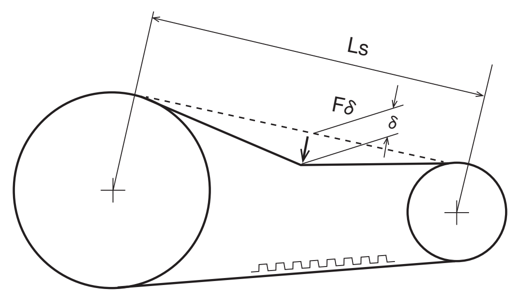
$$F\delta = \frac{To + (Ls / Lp) \cdot Y}{16}$$

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

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

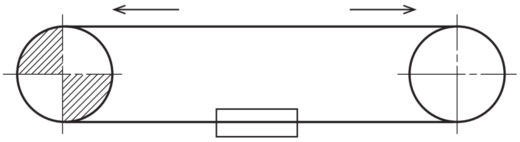
$$\delta = 0.016 \times 893.3 \times 0.3 = 4.29$$

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) How to design a belt when using it for reciprocal motions



Step 1 Calculating the maximum drive tension

Formula 7

$$Tmax = \frac{1000 \cdot Pt}{v} + mv^2$$

$$v = \frac{Dp \times \pi \times n}{60000}$$

Tmax : Maximum drive tension (N)
Pt : Transmission power (kW)
v : Belt speed (m/sec)
m : Belt unit mass (kg/m)
Dp : Pulley pitch diameter (mm)
n : Pulley revolution (rpm)

Step 2 Correcting the maximum drive tension

When using an idler pulley, correct the maximum drive tension (Tmax) with Formula 8.

Formula 8

$$T'max = Tmax \times (Kq + Ki \times N)$$

T'max : Maximum drive tension correction
Kq : Correction factor by frequency of use (→ **Table 3 on P. 204**)
Ki : Idler correction factor (→ **Table 4 on P. 204**)
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When selecting a belt width, select one so that the T'•max obtained with Formula 8 forms T'•max < Ta from **(Tables 7-1 to 2)**.

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Under conditions of sudden stop and sudden acceleration, an abnormal torque may be applied to the belt due to the inertial force of the machine; check with Formula 9 in advance, and if the width falls short, it needs to be corrected.
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$$Ptq = \frac{n \times Trq}{9550} \quad (kW)$$

$$Pdq = Ptq \times Kq \quad (kW)$$

Trq : Rotational torque at the time of a sudden stop or sudden acceleration (N•m)
ΣGD^2 : Flywheel effect (Sum total of GD2 on the opposite side to the brake) (kgf•m^2)
n_1 - n_2 : Difference in revolution (opposite side to the brake)
t : Time to change from n_1 to n_2 (S)
Pdq : Design power
Kq : Correction factor (table below)

Correction factor Kq by rotation at the time of a sudden stop or sudden acceleration

revolutions/day	1	2	3～4	5～10	11～15
Kq	1.0	1.2	1.3	1.5	1.6
revolutions/day	16～25	26～40	41～60	61～100	101～
Kq	1.7	1.8	1.9	2.0	2.1