

1. Precautions for Designing and Using a V-Belt

(1) How to appropriately tension a V-belt

An excessively low or high belt tension can cause a service life reduction; adjust the tension with the following procedure.

Step 1 Calculating the belt speed

$$V = \frac{dp \cdot n}{19100}$$

V : Belt speed (m/s)
 dp : Pinion pitch diameter (mm)
 n : Pulley revolution (rpm)

Step 2 Calculating the belt tension

$$T_t = 1.25 \times \frac{1000 \cdot Pd}{K\theta_1 \cdot V} + NmV^2$$

$$T_s = \frac{1.25 - K\theta_1}{K\theta_1} \times \frac{1000 \cdot Pd}{V} + NmV^2$$

T_t : Tight side tension (N)
 T_s : Slack side tension (N)
 Pd : Design power (W)
 N : Number of belts
 m : Belt unit mass (kg/m) (Table 1 → P. 309)
 V : Belt speed (m/s)
 Kθ¹ : Contact angle correction factor

Step 3 Calculating the initial tension

$$T_o = 0.9 \times \frac{T_t + T_s}{2}$$

T_o : Initial tension (N)
 T_t : Tight side tension (N)
 T_s : Slack side tension (N)

Step 4 Calculating the span length

$$L_s = \sqrt{C^2 - \frac{(D_p - d_p)^2}{4}}$$

L_s : Span length (mm)
 C : Center distance (mm)
 D_p : Large pulley pitch diameter (mm)
 d_p : Pinion pitch diameter (mm)

Step 5 Calculating the deflection and the deflection load

① Calculating the deflection

$$\delta = 0.016 L_s$$

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

② Calculating the deflection load

$$F_\delta = \frac{X(T_o / N) + Y}{16}$$

F_δ : Deflection load (N)
 T_o : Initial tension (N)
 N : Number of belts
 X : Constant (Table 2 → P. 309)
 Y : Constant (Table 3 → P. 309)

Table 1 Belt unit mass m

(Unit: kg/m)

Energy-Saving V-Belt Energy-Saving Power Ace		Power Ace Power Ace Cog		V-Belt Red Standard		Banflex Banflescrum		Rib-Ace 2	
A	0.11	3V	0.08	M	0.06	3M	0.005	PJ	0.009
B	0.18	5V	0.20	A	0.12	5M	0.01	PK	0.018
C	0.30	8V	0.50	B	0.20	7M	0.028	PL	0.032
D	0.57	3VX	0.08	C	0.36	11M	0.055		
3V	0.07	5VX	0.22	D	0.66	5MS	0.016		
5V	0.19			E	1.02	7MS	0.035		
8V	0.46					11MS	0.075		

Table 2 Constant X

	Deflection load of a new belt	Load when re-tensioned	
		First time	Second time and later
Power Ace / Power Ace Cog / Power Scrum	1.5	1.3	1.0
V-Belt Power Scrum	1.5	1.3	1.3
Banflex/Banflescrum	1.5	1.3	1.0
Rib-Ace	1.5	1.3	1.3

Table 3 Constant Y

(Unit: N)

Power Ace Power Ace Cog Power Ace Aramid Combo Energy-Saving Power Ace	Y	V-Belt Red Standard Energy-Saving V-Belt	Y	Banflex Banflescrum	Y	Rib-Ace 2	Y
3V/3VX	20	M	10	3M	4	PJ	0.8
5V/5VX	49	A	15	5M	8	PK	2.5
8V	98	B	20	7M	19	PL	4.2
5VK	170	C	29	11M	42		
8VK	400	D	59	5MS	8		
		E	108	7MS	19		
				11MS	42		

Step 6 Adjusting the tension

For tension adjustment, apply the deflection of δ mm on the center of the span length, read the deflection load $F\delta$ (N/pc) at this time, and adjust the belt tension so that this value becomes the value obtained in the calculation of the deflection load. However, the value $F\delta$ differs for a new belt and for re-adjustment.

In this case, it is convenient to use the tension meter. If the deflection or the deflection load is outside the range of application of the tension meter, calculate the correction with the following equation.

$$\delta = 0.016Ls \times A$$

$$F\delta = \frac{X \cdot (T_0/N) + Y \cdot A^2}{16/A}$$

- A : Correction rate (e.g. 1.5, 0.5, 0.3, 0.2)
- δ : Deflection (mm)
- Ls : Span length (mm)
- $F\delta$: Deflection load (N)
- N : Number of belts
- Y : Constant

Bando tension meter

(Applicable range of deflection: 2 to 62 mm)
(Applicable range of deflection load: 4.9 to 120 N (0.5~12kgf))

*Please note that the unit of deflection load is currently N (integer indication).

[Calculation example]

With Power Ace, if as a result of nine belts of 8V3150, the deflection δ is 36.40 mm and the deflection load $F\delta$ is 200.5 N, make the following correction. In this case, set the span Ls as 2353.2 mm.

[Correction value]

As the deflection load is 200.5N, in order to perform a measurement with a tension meter, it needs to be made 120 N or less.

Recommended belt T_0 for nine belts of Power Ace 8V3150: 18664.0 N

Span length Ls = 2353.2 mm No. of belts N = 9 belts
Factor Y = 98 Correction rate A = 0.3

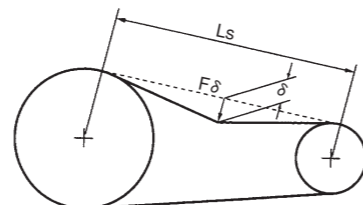
$$F\delta = \frac{1.5 \times (18664.0/9) + 98 \times (0.3)^2}{16/0.3} \approx 58.5N$$

$$\delta = 0.016 \times 2353.2 \times 0.3 = 10.9$$

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	36.4	10.9
Deflection load $F\delta$	N	200.5	58.5



Step 7 Minimum deflection load and shaft load

When the design power is very small, take into consideration that the deflection load needs to be corrected and that it must not be less than the value indicated in **Table 4 Minimum deflection loads** for Power Ace, Power Ace Cog, Power Scrum, V-Belt Power Scrum, and Rib-Ace.

○ Banflex/Banflescrum

For Banflex/Banflescrum, take into consideration that the value must not be less than **Table 5 Minimum initial tension**.

Table 4 Minimum deflection loads

○ Power Ace / Power Ace Cog / Power Scrum

Belt type	Range of pinion outside diameter (mm)	Minimum value of deflection load (N/ridge)	Shaft load (N/ridge)
3V 3VX	67~ 90	18	530
	91~115	20	590
	116~150	23	680
5V 5VX	151~	26	780
	150~230	58	1750
	231~310	70	2130
8V	311~	82	2540
	300~420	153	4700
	421~520	172	5300
	521~	184	5700

Table 5 Minimum initial tension

(Unit: N/ridge)

Belt type	Minimum initial tension
3M	23
5M	44
7M	89
11M	133
5MS	44
7MS	89
11MS	133

○ V-Belt Power Scrum

Belt type	Range of pinion pitch diameter (mm)	Minimum value of deflection load (N/ridge)		Shaft load (N/ridge)	
		Red Power Scrum	Standard	Red Power Scrum	Standard
M	40 to 50	7	5	200	140
A	67~ 80	11	8	310	230
	81~ 90	13	9	380	250
	91~105	16	11	460	300
	106~	19	12	550	340
B	118~135	22	14	670	440
	136~160	27	18	790	530
	161~	29	19	850	570
C	180~205	39	27	1210	820
	206~255	47	32	1460	1000
	256~	55	38	1690	1170
D	300~330	77	56	2340	1680
	331~390	88	67	2700	2040
	391~	96	73	2960	2210
E	450~550	132	102	4010	3100
	551~	152	122	4650	3710

○ Rib-Ace 2

(Unit: N/rib)

Belt type	Minimum value of deflection load	Shaft load
PJ	2	70
PK	6	200
PL	10	350

(2) How to use an idler for a V-belt

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

■ Example of use of an idler

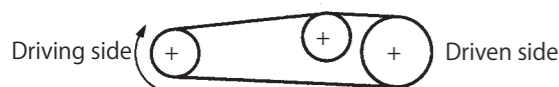
The use of an idler increases flex fatigue due to bending of the belt; hence, avoid using an idler except when it is absolutely necessary such as the following cases.

- Tension adjustment when the center distance cannot be adjusted
- Division of a long span to an extent that makes belt vibration a problem
- Automatic tension adjustment of spring type or weight type
- Guide for avoiding obstacles
- When increasing the angle of contact of the pinion
- Power Ace, Power Scrum, Power Ace Aramid Combo, and Power Ace Cog have a belt pitch line at a higher position than that of the standard V-belt. Hence, note that when the belt is reverse-bent from the outside of the belt using an idler pulley, the belt becomes more likely to crack.

■ How to use an idler

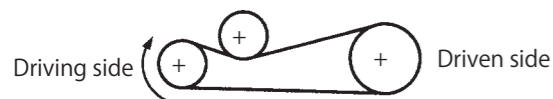
The best way of using an idler is to attach it on the slack side on the inside to reduce the flex fatigue of the belt. Please note that the use on the outside significantly affects the belt service life.

When using an idler on the inside



- Use a grooved pulley. In this case, the groove profile can be the one with which the bottom of the belt comes in contact with the bottom of the pulley groove.
- 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.
- Never use Banflex or Banflescrum.

■ Idler diameter

● Power Ace / Power Scrum / Power Ace Aramid Combo

When you use an inner idler, use the one with a diameter that is equal to or larger than the pinion diameter of the two power transmission pulleys.

When you use an outer idler, use the one with a diameter that is equal to or larger than 1.3 times the pinion diameter of the two power transmission pulleys.

● V-Belt Power Scrum

The diameter of an idler is 1.3 times the pinion diameter; however, even when this cannot be satisfied due to a limited space etc., use a pulley diameter larger than the idler diameter indicated in the table.

Table 6 Minimum idler pulley diameters (Unit: mm)

Type	A	B	C	D	E
Inner idler diameter	75	125	230	330	530
Outer idler diameter	100	165	300	430	700

● Rib-Ace 2

Use an idler with a diameter larger than the idler diameters indicated in the table of minimum idler diameters.

Table 7 Minimum idler pulley diameters (Unit: mm)

Type	PJ	PK	PL
Inner idler diameter	20	50	70
Outer idler diameter	50	80	150

● Banflex/Banflescrum

Use a diameter equal to or larger than the small pulley of the power transmission system.

■ Others

For Rib-Ace, do not use an idler for tension clutching.

2. Precautions for Using a V-Belt

Be sure to maintain and inspect belts with the machine completely stopped (powered off).

① 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 or floor 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.

② At the time of belt installation

■ When using multiple belts, please use a matched set.

When you place an order, please specify a matched set.

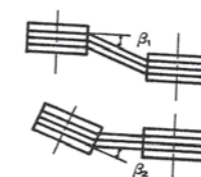
- When the effective length varies, tension is not applied uniformly, which causes belt fatigue and pulsation, which reduce the belt service life.

■ When you attach a belt on a pulley, use a motor slide etc. and avoid plying it in using a lever.

- If you plied a belt in, the belt may flip over during operation and break early.

■ Accurately adjust the parallelism and alignment of the power transmission shafts.

- Poor parallelism or alignment of the power transmission shafts causes partial abrasion or flipping over of the belt.
- We recommend using pulley alignment with the following standard.



	Pulley alignment ($\beta_1 + \beta_2$)
V-belt	20' or less
Flat belt	

■ Appropriately tension the belt.

- For belt tension adjustment, calculate the deflection and load and apply an accurate tension.
- Exercise due caution as an excessive tension causes bearing breakage and an insufficient tension causes belt slip, heat generation of the belt, and reduced durability.
- For tension adjustment, please use Bando tension meter, which can simultaneously measure the deflection and the load.

■ Finish the surface roughness of pulleys to approximately 3S to 12S.

- Rust or other abnormalities also promote abrasion; remove them before using the pulley.
- Avoid painting the pulley groove section or the belt or applying wax on them. It promotes belt abrasion and reduces the service life.

Never convey or hoist a heavy object with a belt as it has a risk of causing an accident.

③ At the time of belt operation

- 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 inhibits heat dissipation and reduces the belt service life; therefore, perform sufficient ventilation.
- Avoid dirt or oil splashing over the belts. In particular, adhesion of oil not only causes larger slip and prevents the power transmission capability from being obtained sufficiently but also causes the resulting generated heat to reduce the belt service life.

④ At the time of belt replacement

- When you are using multiple belts, if even some of the belts break, replace all belts with new ones and keep the old belts as spares. If you use new belts and old belts together, their lengths and elongations during operation are different, which can cause misaligned belts.
- Check that the pulleys are not abraded. If a pulley is abraded, it can cause early break of the belt; replace it with a new pulley.

⑤ Application to food machines

- Do not use belts for applications in which the belts come in direct contact with food stuffs (conveyance of unpackaged food stuffs). When abraded powder of the belts are dispersed and may adhere to food stuffs, separate the belts with covers or the like.

⑥ About seasonal use

- Loosen the belts during the off-season, and when you resume using the belts, check the pulleys for rust, adjust the belt tension, and perform running in.

3. Precautions for Designing and Using a Bancollan Belt

(Applied to Bancollan V-Belt and Bancollan Polybanrope)

1. How to Store Belts

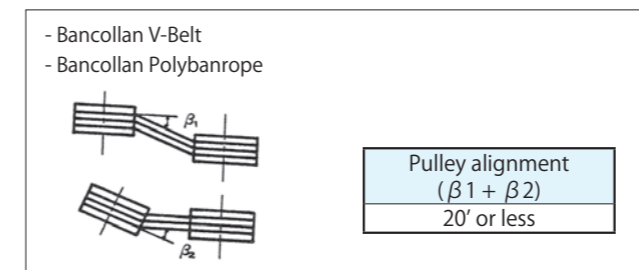
- If belts are poorly stored, their performance deteriorates; store belts by hanging them in a ring form or placing them on a flat board in a natural form in a well-ventilated, cool, and dark place. The Bancollan products become discolored slightly, but it does not affect the performance.

2. Environmental Conditions

- Use belts at ambient temperatures from -30°C to 70°C.
- At temperatures of -30°C or less, belts harden, and at temperatures of 70°C or more, the service life may become shorter.
- Avoid using belts in locations at high temperature and high humidity and locations that are exposed to strong acid or strong alkaline products or organic solvents.
- Do not use belts for applications in which the belts come in direct contact with food stuffs.

3. Parallelism and Alignment of Power Transmission Shafts

Poor parallelism or alignment of power transmission shafts causes partial belt abrasion or noise; adjust them to the following standard.



4. Idler Pulley

- **Bancollan V-Belt**
Avoid using an idler pulley if possible. (Especially the use for the DC type is not allowed.) If you use an idler pulley, use a V-grooved pulley with a diameter of 1.3 times the pinion diameter from the slack side of belt.
- **Bancollan Polybanrope**
Avoid using an idler pulley if possible. (Especially the use of a back face idler is not allowed.) If you use a back face idler, use a pulley with a diameter equal to or larger than the pinion diameter of the power transmission system on the inside on the slack side of belt.

5. Precautions for Belt Installation

- Bancollan V-Belt

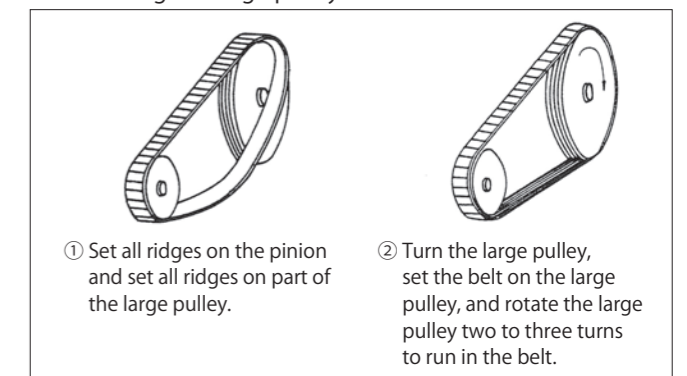
When you attach a belt on a pulley, use a motor slide etc. and avoid plying it in using a lever.

- Bancollan Polybanrope

(How to attach a belt with a fixed center distance)
When attaching a belt with a fixed center distance, follow the procedure below.

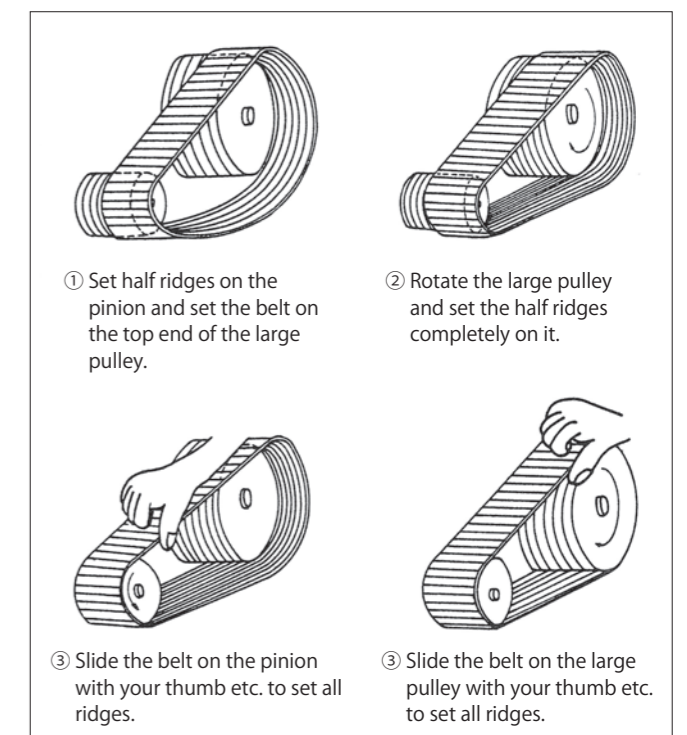
A. Number of belt ridges: 5 or less

First, set all ridges of the belt on the pinion, then set all ridges on part of the large pulley, and set the belt by rotating the large pulley one turn.



B. Number of belt ridges: 6 to 10 ridges

Although the method is basically the same as A, since the number of ridges is large, set half ridges first, move them from the pinion to the large pulley, and set the belt completely.



Troubleshooting

Troubles that occur during the use of a belt always have a cause. In order to determine the cause and take appropriate countermeasures, causes and countermeasures are listed by phenomenon of troubles. Please use the table as a troubleshooting guide.

① V-belts

Phenomenon	Cause	Countermeasure
The bottom of the belt cracks.	Dust particles or chemicals are adhering to the belt.	Install a belt cover.
	The pulley diameter is too small.	Change the pulley diameter to an appropriate one, or make a design change to use a belt with which a small pulley diameter can be used.
	Excessive heat is applied.	Consider a cooling method or use a heat-resistant belt.
	The belt tension is loose, and the belt slips.	Control the tension for an appropriate tension.
	The back face idler pulley diameter is small.	Change the pulley diameter to an appropriate one, change the back face idler to an inner face idler, or stop using the idler.
The belt flips over.	The pulley's misalignment is large.	Adjust the alignment.
	Poor machining of the pulley groove angle or partial abrasion during use.	Replace the pulley with the one with an appropriate groove angle.
	Trapping of foreign objects.	Install a belt cover.
	Although multiple belts are used, they are not a matched set.	Replace the belts with belts of a matched set.
	The belt tension is inappropriate.	Control the tension for an appropriate tension.
	The pulsating load is significantly large.	Use a Scrum belt, a Poly V-belt, or a flat belt.
The belt breaks early.	The number of belts is small. (The evaluation of the load is inappropriate.)	Increase the number of belts, or change the design to use a belt with a higher transmission capability.
	Trapping of foreign objects.	Install a belt cover.
	The pulley diameter is too small.	Change the pulley diameter to an appropriate one, or make a design change to use a belt with which a small pulley diameter can be used.
The belt side face became abraded early or is partially abraded.	Dust particles have scattered over.	Install a belt cover.
	The belt tension is insufficient.	Control the tension for an appropriate tension.
	The number of belts is small.	Increase the number of belts.
	The pulley groove rusted.	Remove the rust or replace the pulley with a new one.
	Poor machining of the pulley groove angle.	Replace the pulley with the one with an appropriate groove angle.
Abnormal noise occurs.	The belt tension is insufficient.	Control the tension for an appropriate tension.
	There are sudden starts or stops.	Extend the time of start or stop to make the operation gentle.
	The number of belts is small.	Increase the number of belts.
	Inappropriate selection of the belt type.	Re-select a belt that matches the operating conditions.

① V-belts

Phenomenon	Cause	Countermeasure
The belt slips significantly.	The belt tension is insufficient.	Control the tension for an appropriate tension.
	The number of belts is small.	Increase the number of belts.
	The angle of contact is small.	Install a back face idler pulley with an appropriate diameter on the slack side or change the design to use a synchronous belt.
	Oil or water is splashed over.	Install a belt cover. Completely wipe off the oil or water.
The belt is partially burned or melted.	The pulley diameter is too small.	Change the pulley diameter to an appropriate one, or make a design change to use a belt with which a small pulley diameter can be used.
	The belt tension is insufficient.	Control the tension for an appropriate tension.
	There are sudden starts or stops.	Extend the time of start or stop to make the operation gentle.
	The evaluation of the load is inappropriate.	Increase the number of belts, or change the design to use a belt with a higher transmission capability.
The belt vibrates.	Oil or water is splashed over.	Install a belt cover. Completely wipe off the oil or water.
	The center distance is long.	Install an idler pulley between the shafts.
	The belt tension is insufficient.	Control the tension for an appropriate tension.
The belt remains bent.	Although multiple belts are used, they are not a matched set.	Replace the belts with belts of a matched set.
	The belt is bent with unreasonable force or piled up in storage.	Unpack belts immediately and store them by suspending them from a cross arm.