Mechanical Properties

Bancord is widely used as a general industrial material, such as a power transmission belt, for its excellent mechanical properties. The main mechanical properties of Bancord are as follows.

Characteristics	#480	#485N	#485T	#485RB	#489	#490	#494C	#495 (V type)
Color tone	Orange, semi-transparent, black	Semi-transparent	Semi-transparent	Green	White	Semi-transparent, blue, red, green	Black	White
Hardness (JIS-Hs)	85°	86°	86°	86°	90°		94°	95°
Specific gravity	1.23	1.23	1.23	1.23	1.23		1.23	1.23
Tensile modulus 3% (GPa)	2.9×10^{-4}	2.9×10^{-4}	2.9×10^{-4}	3.3×10^{-4}	9.8×10^{-4}		5.6×10^{-4}	1.7×10^{-3}
Tensile modulus 4% (GPa)	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	4.4×10^{-4}	1.08×10^{-3}		8.3×10^{-4}	2.2×10^{-3}
Tensile modulus 5% (GPa)	4.9×10^{-4}	4.9×10^{-4}	4.9×10^{-4}	5.6×10^{-4}	1.47×10^{-3}		1.1×10^{-3}	2.6×10^{-3}
Tensile modulus 6% (GPa)	6.4×10^{-4}	6.4×10^{-4}	6.4×10^{-4}	7.3×10^{-4}	1.52×10^{-3}		1.4×10^{-3}	2.8×10^{-3}
Tensile modulus 7% (GPa)	6.9×10^{-4}	6.9×10^{-4}	6.9×10^{-4}	7.9×10^{-4}	1.72×10^{-3}		1.7×10^{-3}	3.1×10^{-3}
Tensile modulus 100% (GPa)	4.9×10^{-3}	5.4×10^{-3}	3.9×10^{-3}	5.4×10^{-3}	7.85×10^{-3}		8.8×10^{-3}	9.8×10^{-3}
Tensile break strength (GPa)	2.94×10^{-2} or more	2.94×10^{-2} or more	2.94×10^{-2} or more	2.94×10^{-2} or more	2.94×10^{-2} or more		1.96×10^{-2} or more	3.23×10^{-2} or more
Tensile break elongation rate (%)	450 or more	300 or more	400 or more	300 or more	350 or more		400 or more	350 or more
Linear expansion factor (1°C)	2.6×10^{-4}	2.6×10^{-4}	2.6×10^{-4}	2.6×10^{-4}	2.6×10^{-4}		2.6×10^{-4}	2.6×10^{-4}

Round belt

Cross-sectional diameter (mm)	1.5	2	2.5	3	3.5	4	5	6	7	8	9	10	11	12	15
Tensile strength (N/pc)	60	100	160	230	310	410	640	930	1150	1500	1900	2360	2850	3390	5300

V-belt

Type	M	A	B
Tensile strength (N/pc)	1450	2590	4400

Water Resistance

Bancord is especially studied and improved in water resistance; hence, it can be used for a very long period of time even under high humidity.

Variation per day in tensile strength under water (Material #489)				
Immersion period (day)	20	30	50	70
Remaining strength rate (%)	99	98	96	91

Note 1) The samples were immersed under water at a temperature of 40°C with 5% stretch.

Oil Resistance and Chemical Resistance

The following table shows a rough guide of applicability when oil or chemicals adhere to the belt at normal temperature.

Oil/chemical name	Applicability	Oil/chemical name	Applicability	Food name	Applicability
Oil-resistant ASTM #1	○	Strong acid	×	Water	○
Oil-resistant ASTM #3	○	Weak acid	○	Vinegar	○
Gasoline	○	Sodium hypochlorite	△	Soy sauce	○
Volatile oil	○	Sodium hypochlorite (600 ppm)	○	Sauce	○
Light oil	○	Ethanol	○	Syrup	○
Heavy oil	○	Acetone	×	Cream	○
Cutting oil	△	Benzine	×	Olive oil	○
Diesel oil	○	Methanol	△	Edible oil (salad oil)	○
Rust-inhibiting oil	△	Toluene (Toluol)	×	Butter	○
Machine oil	△			Sugar	○
Caustic soda (NaOH) solution (10%)	△			Flour	○
Strong alkali	×			Salt	○
Weak alkali	○			Bread	○
Soap	○			Vegetables	○
Hydrochloric acid (10%)	○			Meat	○
Acetic acid	×			Fish	○

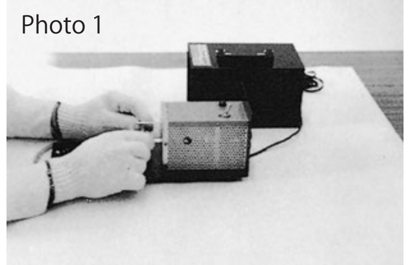
○: Not affected at all.
△: Affected to some extent.
(There is a possibility of embrittlement, discoloration, or swelling after use.)
×: Completely affected.

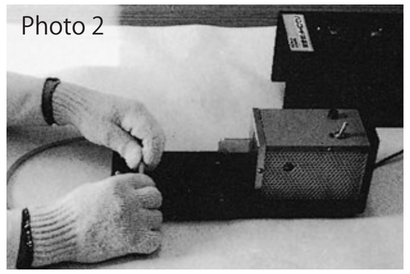
* If the belt is completely affected or you use the belt at a higher-temperature range than normal temperature, please consult our sales company or distributor.

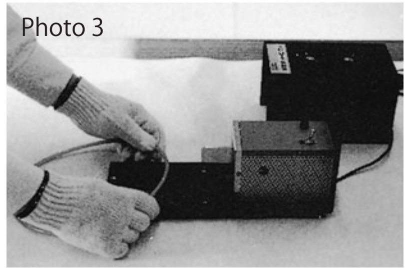
Bancord Round Belt/V-Belt

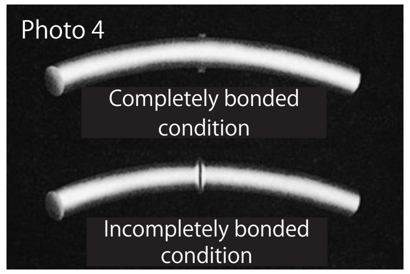
How to Join Bancord Belts

Join a Bancord with the following procedure.









■ Cutting a Bancord belt

① Calculate (or actually measure) the installation length of Bancord.
② Determine the joint length of the Bancord 3 to 7% (normally 5%) shorter than the installation length and cut the Bancord at right angles to the belt.
Example: When the installation length is 1 m, normally cut the belt to 950 mm.
Note: An excessively long Bancord causes slip, and an excessively short Bancord reduces the belt service life; be particularly careful.

■ Finishing the joint of the Bancord

① Put the Bancord lightly and uniformly in contact with both sides of the heating plate and melt the Bancord. (Photo 1)
The standard melting time is as follows. (Heating plate temperature: 240°C±10°C)

Compound	Diameter (mm)		
	1.5 to 5	6 to 10	11 to 15
#480	20 sec	50 sec	70 sec
#485N/485T	60 sec	80 sec	—
#485RB	60 sec	80 sec	—
#489/490	40 sec	60 sec	90 sec

* For a long V-belt, the time is 90 seconds for Types M, A, and B.

② If the Bancord melted, quickly press-fit the melted surfaces in alignment. (Photo 2)
③ While the Bancord is press-fit, hold it for one to two minutes and solidify the melted sections by cooling. (Photos 2 and 3)
④ Cut off protruding sections with scissors, a nail clipper, a grinder, etc. for finishing.
* If the joint is incomplete, a transparent layer as shown in (Photo 4) is created. (Especially with #489)

■ Bonding machine for Bancord

We also offer a bonding machine for Bancord (DX-81); please use it. (Standard setting temperature: 240°C±10°C)
* Bonding machine specifications: Width: 130 mm Depth: 210 mm Height: 130 mm Power supply: 100 VAC

■ For joining work, wear cotton work gloves or similar protective equipment to prevent a burn.

■ Avoid joining using a candle, a cigarette lighter, or other inappropriate tools.

Operating Conditions

Classification	Item	
Round belt	Belt tension rate	3 to 7% (normally 5%)
	Pulley used	Pulley for Bancord round belt
	Angle of contact of pinion	180°
	Belt speed	#480・485N・485T・485RB：2〜12m/s #489/490: 2 to 20 m/s
	Operating temperature	0 to 50°C
V-belt	Belt tension rate	3 to 7% (normally 5%)
	Pulley used	Pulley for Bancord V-Belt
	Angle of contact of pinion	180°
	Belt speed	2 to 20 m/s
	Operating temperature	0 to 50°C

Precautions for Storage and Transportation

- When you transport or handle a heavy belt or pulley, use a transporting apparatus or device suitable for the weight. Lifting up with hands may hurt your lower back etc.
- Do not bend belts with unreasonable force or place a heavy object on belts when transporting or storing them. The belts may remain bent or become damaged, leading to early breakage.
- Store belts in a low-humidity location at temperatures of -10°C to 40°C. In addition, do not expose stored belts to direct sunlight.

2. How to Design

Step 1. Determining conditions required for the design

① Transmission power, or rated power of the driving machine
② Speed ratio
$\left(\frac{\text{Pinion revolution}}{\text{Revolution of large pulley}}\right)$
③ Center distance
④ Pulley diameter
⑤ Operating environment (high temperature, low temperature, oil, water, dirt, acid, alkali)

Step 2. Calculating the design power

Calculate the design power with Formula 1.

Formula 1

$$Pd = Pt \times Ko$$

Pd : Design power[Note 1] (W)
Ko : Load correction factor **(Table 1)**

Note 1) For transmission power, it is ideal to use the load of the driven machine; however, if it is unknown, use the rated power of the driving machine.
If torque or horsepower is used for indication, convert it into watt using Formula 2.

Formula 2

$$Pt = \frac{Tr \times n}{955}$$

Pt : Transmission power (W)
n : Revolution (rpm)
Tr : Load torque (N•cm)
1PS=735.5(W)

Table 1 Load correction factor (Ko)

Load characteristics	Factor Ko
When the maximum load is used	1.0
When a normal load is used	1.3
When the frequency of starting and stopping is high	1.5

Step 3. Calculating the belt speed

Determine the pulley diameter with Formula 3 and obtain the belt speed with Formula 4.

Formula 3

$$Dp = \frac{n_1}{n_2} \times dp$$

$$\text{Speed ratio} = \frac{n_1}{n_2}$$

dp : Pinion pitch diameter (mm)
Dp : Large pulley pitch diameter (mm)
n_1 : Pinion revolution (rpm)
n2 : Large pulley revolution (rpm)

Formula 4

$$v = \frac{dp \times n}{19100}$$

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

Step 4. Selecting a cross-sectional diameter

① Calculation of the pinion contact angle correction factor

From Formula 5, obtain the angle of contact of the pinion $\theta 1$ and from **Table 2**, obtain the correction factor $K\theta 1$.

Formula 5

$$\theta_1 = 180 - \frac{57.3(Dp - dp)}{C}$$

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

Table 2 Pinion contact angle correction factors $K\theta_1$

$\frac{Dp-dp}{C}$	Angle of contact of pinion θ_1(°)	$K\theta_1$	$\frac{Dp-dp}{C}$	Angle of contact of pinion θ_1(°)	$K\theta_1$	$\frac{Dp-dp}{C}$	Angle of contact of pinion θ_1(°)	$K\theta_1$
0.00	180	1.00	**0.60**	145	0.91	**1.20**	106	0.77
0.10	174	0.99	**0.70**	139	0.89	**1.30**	99	0.73
0.20	169	0.97	**0.80**	133	0.87	**1.40**	91	0.70
0.30	163	0.96	**0.90**	127	0.85	**1.50**	83	0.65
0.40	157	0.94	**1.00**	120	0.82			
0.50	151	0.93	**1.10**	113	0.80			

② Selection of a cross-sectional diameter

Obtain the basic power rating with Formula 6 and obtain a cross-sectional diameter equivalent to a larger value than that value from **Table 4 "Table of basic power ratings" (→ P. 306)**.
When you select a cross-sectional diameter, check whether it satisfies **Table 3 "Minimum pulley pitch diameters."**

Formula 6

$$Pr \geq \frac{Pd}{K\theta_1}$$

Pr : Basic power rating (W)
Pd : Design power (W)
$K\theta_1$: Pinion contact angle correction factor

Table 3 Minimum pulley pitch diameter (Unit: mm)

Cross-sectional diameter	Minimum pulley pitch diameter	Cross-sectional diameter	Minimum pulley pitch diameter
1.5	12	11	91
2	17	12	107
2.5	20.5	15	143
3	23	Type M	50
4	29	Type A	75
5	40	Type B	125
6	46		
7	52		
8	63		
9	69		
10	80		

Note 1) When a pulley with a diameter equal to or smaller than the minimum pulley diameter is used, the flex fatigue of the belt increases, reducing the belt service life.

Table 4 Table of basic power ratings (Unit: W)

Belt speed (m/sec) \ Type / Cross-sectional diameter (mm)	Round belts #480/ # 485N/ # 485RB												Round belts #489/ # 490						V-belt		
	2	3	4	5	6	7	8	9	10	11	12	15	2	4	6	8	10	12	M	A	B
0.5			1	2	3	4	6	7	9	12	13	19	1	4	9	15	26	37	28	50	85
1		1	2	4	6	7	9	11	14	18	23	38	2	8	18	31	52	74	55	99	169
2	1	3	5	9	12	17	22	28	34	41	49	85	4	17	37	66	104	149	110	196	334
3	2	4	7	13	18	24	31	41	49	49	71	128	6	25	55	99	154	223	164	289	496
4	3	6	10	16	23	32	42	53	65	79	94	163	8	33	73	131	204	294	218	388	661
5	3	7	12	19	28	37	49	64	78	93	114	195	10	40	90	163	255	362	269	478	818
6	4	8	14	22	32	44	57	73	90	108	129	225	12	48	107	191	298	429	322	573	976
8	4	9	17	26	38	51	67	85	105	126	151	263	15	61	138	245	383	551	419	746	1271
10	4	10	17	26	39	53	68	87	107	129	154	271	18	72	164	291	454	654	508	905	1541
12	4	8	15	23	34	46	60	76	94	112	124	238	20	81	184	326	510	734	587	1044	1779
14													22	87	197	350	547	786	652	1161	1978
16													22	89	203	359	561	806	703	1252	2132
18													22	87	199	351	551	789	737	1312	2235
20													20	80	185	325	511	731	752	1339	2280

Step 5. Determining the effective length

Bancord is normally installed by applying a 3 to 7% initial stretch rate (standard: 5%); hence, make the effective length (joint length) 3 to 7% shorter than the post-installation length and determine it with Formula 7.

Formula 7

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

$$L' = L \times (0.93 \sim 0.97)$$

L : Post-installation effective length (mm)
L' : Joint effective length (mm)
Dp : Large pulley pitch diameter (mm)
dp : Pinion pitch diameter (mm)
C : Center distance (mm)

3. About Pulleys

- For pulleys for a round belt, the groove dimensions are as shown in **Fig. 1**; however, the pulley can also be used with the groove dimensions shown in **Fig. 2**.
- As a pulley for a V-belt, please use a pulley with the dimensions prescribed on **P. 235**.

Fig. 1

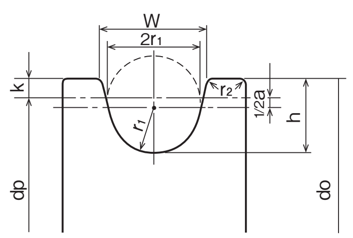
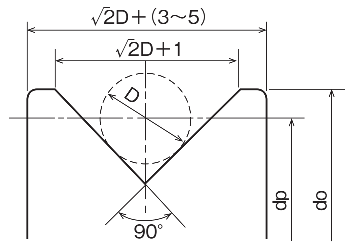


Fig. 2



- Determine the dimension of each section with the following equation.

$$W = D + 0.2$$

$$h = \frac{2}{3} \times D$$

$$2K = 2\left(h - \frac{D}{2}\right)$$

$$r_1 = \frac{1}{2} \times (D - a)$$

r_2 = R0.3

a = Constant

Belt cross-sectional diameter (D) mm	a
1.5~ 3	0.20
4 ~ 5	0.25
6 ~ 8	0.35
9 ~12	0.40
15	0.50

D = Belt cross-sectional diameter (mm)

Step 1. Determining conditions required for the design

- Driven machine: Fiber machine
- Motor power: Maximum load 40 W / 1750 rpm
- Driving pulley pitch diameter: 66 mm
- Revolution of driven shaft: 1150 mm
- Minimum maintenance and inspection

Step 2. Calculating the design power

① From Formula 1(→ **P. 305)**, calculate the design power.

$Pd=40\times1.0=40W$

Step 3. Calculating the belt speed

① From Formula 3 **(→ P. 305)**, calculate the large pulley pitch diameter.

$$Dp=\frac{1750}{875}\times66$$
$$=132mm$$

② Calculate the belt speed with Formula 4 **(→ P. 305)**.

$$V=\frac{66\times1750}{19100}$$
$$\fallingdotseq 6.0\ m/s$$

Step 4. Selecting a cross-sectional diameter

① From Formula 5 **(→ P. 305)**, obtain the angle of contact of the pinion $\theta 1$ and from **Table 2 (→ P. 305)**, obtain the correction factor $K\theta 1$.

$$\Theta_1 = 180 - \frac{57(132 - 66)}{300}$$
$$=167.5^\circ \quad \rightarrow K\theta_1=0.96$$

② From Formula 6 **(→ P. 305)**, obtain the basic power rating.

$$Pr \geqq \frac{40}{0.96} \fallingdotseq 41.7\ W$$

Obtain the cross-sectional diameter of #480 that is equivalent to a value larger than 41.7 W when the belt speed is 6.0 m/sec indicated in **Table 4 Table of basic power ratings (→ P. 306)**.

41.7 W < 44 W → Cross-sectional diameter 7 mm

③ From **Table 3 (→ P. 305)**, satisfy the recommended minimum pulley pitch diameter of 52 mm for a cross-sectional diameter of 7 mm.

Step 5. Determining the effective length

Post-installation effective length

$$L=2\times300+1.57(132+66)+\frac{(132-66)^2}{4\times300}$$
$$=910.9m$$

The belt joint length is

$$L'=910.9\times0.95$$
$$\fallingdotseq 865\ mm$$

Examination result

- Belt: Bancord round belt #480
- Cross-sectional diameter : 7 mm
- Post-installation effective length : 910.9 mm
- Belt joint length : 865 mm
- Pinion pitch diameter : 66 mm
- Large pulley pitch diameter : 132 mm

Design power: 40 W

Large pulley pitch diameter: 132 mm

Belt speed: 6.0 m/s

Pinion contact angle correction factor: 0.96

Cross-sectional diameter: 7 mm

Post-installation effective length: 910.9 mm

Belt joint length: 865 mm