

# 5

## Materials for Bearing Applications

### 5-1 Various grades and their characteristics

Table 17 Materials for machining (ram extrusion and compression molding)

Grade	Base Resin		Characteristics	Applications
BEAREE FL 3000	PTFE		*Less deformation under compression load *Superior wear, resists friction	*Sliding bearings *Valve seats *Piston rings
BEAREE FL 3020	PTFE		*Low friction under high pressure *Superior weather resistance	*Bearing pads
BEAREE FL 3030	PTFE		*Does not abrade soft mating material *Stable coefficient of friction	*Sliding bearings *Seal rings *Piston rings, friction plate
BEAREE FL 3040	PTFE		*Does not abrade soft mating material	*Sliding bearings *Piston cup seals
BEAREE FL 3050	PTFE		*Does not abrade soft mating material *Superior wear resistance under high temperature	*Sliding bearings
BEAREE FL 3060	PTFE		*Superior creep resistance	*Exclusively for ML bearings
BEAREE FL 3070	PTFE		*Superior sliding characteristics and creep resistance	*Compressor seals
BEAREE FL 3305	PTFE		*Low coefficient of friction under oil lubrication	*Sliding table for machine tools
BEAREE FL 3641	PTFE		*Passed regulations for food processing equipment *Superior wear resistance	*Sliding bearings *Seals
BEAREE FL 3700	PTFE		*Superior under water wear resistance *Superior chemical resistance	*Bearings for under water and /or chemical liquid
BEAREE FL 3900	PTFE		*Conductive (Volume resistive: $10 \Omega \cdot \text{cm}$ ) *Superior wear, resists friction	*Grounding buttons *Brushes
BEAREE UH 3000	PE		*Superior friction resistance and wear under low PV value *Superior shock resistance	*Sliding bearings *Washers
BEAREE UH 3954	PE		*Effective for anti-static *Less abrasion wear (Wear from paper or sand lapping)	*Sound damping washers *Cassette tape shims
BEAREE FL 9000 <sup>2)</sup>	PTFE		*Suitable under low speeds high pressures	*Sliding bearings *Rocking bearings
BEAREE ER 3000	E <sup>1)</sup>		*Has elasticity and low friction *Superior sealing anti-stick property and chemical, heat wear and creep resistance	*Food processing equipment seals
BEAREE ER 3600	E <sup>1)</sup>		*Meets regulations for rubber packaging and containers *Sliding bearings	

NOTE 1) E : Elastomer

2) BEAREE FL 9000 is the special material for tapes.










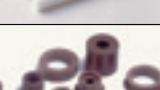




Specific gravity	Compressive creep %	Hardness <sup>1)</sup>	Tensile strength		Elongation %	Flexural strength		Flexural modulus		Water absorption %	Coef. of thermal expansion <sup>2)</sup> × 10 <sup>-5</sup> /°C	Max. service temp. °C
			MPa	kgf/cm <sup>2</sup>		MPa	kgf/cm <sup>2</sup>	MPa	kgf/cm <sup>2</sup>			
2.28	8.1	66	15	150	200	—	—	—	—	0.03	8.3	260
2.23	7.0	64	22	220	250	—	—	—	—	0.03	—	260
1.98	5.0	62	12	120	170	—	—	—	—	0.09	9.0	260
2.19	6.0	63	14	140	170	—	—	—	—	0.02	8.5	260
1.94	6.0	63	11	110	160	—	—	—	—	0.01	8.7	260
3.80	3.2	70	10	100	100	—	—	—	—	0.09	6.8	260
2.09	—	68	18	180	230	—	—	—	—	—	6.3	260
3.39	4.0	70	11	110	90	—	—	—	—	—	6.8	260
2.25	10.6	65	13	130	140	—	—	—	—	0.02	9.1	260
2.10	3.0	70	16	160	130	—	—	—	—	0.07	7.2	260
2.07	1.4	70	14	140	30	—	—	—	—	—	8.7	260
0.94	11.0	65	20	200	200	20	200	610	6 100	0.01	20.0	80
0.94	10.0	65	40	400	200	—	—	—	—	0.01	17.0	80
4.25	—	—	46	460	15	—	—	—	—	—	1.9	260
1.78	—	Hs70,80,90	10	100	290	—	—	—	—	0.05	10.0	230
2.10	—	Hs70,80,90	12	120	290	—	—	—	—	0.05	10.0	230

NOTE 1) Hardness: no code = durometer; Hs = rubber hardness; others = Rockwell hardness

2) Coefficient of linear expansion: the mean coefficient of linear expansion in the range from room temperature up to 150°C.

Values in the above table are representative test results.

Table 18 Injection molding materials

Grade	Base Resin	Characteristics		Applications
BEAREE PI 5001	PI		*Excellent wear resistance	*Sliding bearings *Washers *Piston rings
BEAREE PI 5010	PI		*Non-abrasive to soft mating materials	*Sliding bearings *Thrust bearings
BEAREE PI 5022	PI		*Precision moldable	*Picker fingers *Electrical and electronic parts
BEAREE PI 5030	PI		*High mechanical strength	*Gears *Retainers (bearing cages)
BEAREE PI 5040	PI		*High rigidity and electrical conductivity	*Gears *Heat insulating sleeves
BEAREE AI 5003	PAI		*Excellent impact resistance *High mechanical strength	*Heat insulation *Electrical and electronic parts
BEAREE AI 5017	PAI		*Excellent friction and wear properties *High mechanical strength *Small drop in heat resistance due to water absorption	*Picker fingers *Sliding bearings *Washers
BEAREE UH5000	PE		*Excellent impact resistance *Excellent resistance against abrasive wear	*Sliding bearings
BEAREE UH5041	PE		*Excellent sliding properties at low pressure	*Guide rollers
BEAREE AS5000	PPS		*Excellent sliding properties at high temperature *High max. allowable bearing pressure ( $P_{max} = 20$ MPa) *Non-abrading soft mating material	*Sliding bearings *Friction plates *Reciprocating bearings
BEAREE AS5005	PPS		*Excellent sliding properties at high temperature *High max. allowable bearing pressure ( $P_{max} = 20$ MPa) *Non-abrading soft mating material	*Sliding bearings
BEAREE AS5021	PPS		*Excellent strength for separating pins	*Picker fingers
BEAREE AS5053	PPS		*Excellent sliding properties at high temperature	*Fixing roller bearing
BEAREE AS5961	PPS		*Excellent sliding properties at high temperature	*Fixing roller bearing

Specific gravity	Compressive creep %	Hardness <sup>1)</sup>	Tensile strength		Elongation %	Flexural strength		Flexural modulus		Water absorption %	Coef. of thermal expansion $\times 10^{-5}/^{\circ}\text{C}$ <sup>2)</sup>	Max. service temp. $^{\circ}\text{C}$ <sup>3)</sup>
			MPa	kgf/cm <sup>2</sup>		MPa	kgf/cm <sup>2</sup>	MPa	kgf/cm <sup>2</sup>			
1.49	—	M94	67	670	1.3	108	1 080	8 500	85 000	0.10	2.2	240(300) <sup>3)</sup>
1.46	<0.2	M70	76	760	7	116	1 160	3 700	37 000	0.25	4.5	240(300) <sup>3)</sup>
1.80	—	M107	138	1 380	1	190	1 900	14 100	141 000	0.3	3.4	240(300) <sup>3)</sup>
1.58	<0.2	M99	160	1 600	3	250	2 500	11 000	110 000	0.22	1.5	240(300) <sup>3)</sup>
1.43	<0.2	M99	130	1 300	2	360	3 600	21 000	210 000	0.25	0.4	240(300) <sup>3)</sup>
1.40	<0.2	E91	190	1 900	12	220	2 200	4 700	47 000	0.28	4.0	250
1.51	<0.2	M105	82	820	—	170	1 700	8 800	88 000	0.18	4.1	250
0.94	11.0	R60	41	410	10	41	410	1 600	16 000	0.01	17.0	80
0.95	—	—	48	480	8.8	33	330	970	9 700	0.06	12.4	80
1.53	0.3	80	51	510	3	61	610	—	—	0.05	8.1	230
1.55	0.3	81	51	510	3	61	610	—	—	0.03	7.0	230
1.69	—	—	103	1 050	—	164	1 670	11 760	120 000	0.01	—	230
1.60	—	R95	67	670	4	86	860	3 700	37 000	—	10.8	230
1.56	—	R91	51	510	5	80	800	3 600	36 000	—	7.5	230

NOTE 1) Hardness: no code = durometer; others = Rockwell hardness

2) Coefficient of linear expansion: the mean coefficient of linear expansion in the range from room temperature up to 150°C.

3) Max. service temperature shown in brackets ( ): for the products after crystallizing treatment

Values in the above table are representative test results.

Table 18














Grade	Base Resin	Characteristics		Applications
BEAREE AS5700	PPS		*Superior wear resistance in water *Superior chemical resistance	*Bearings in water *Bearings in chemicals
BEAREE AS5910	PPS		*High modulus	*Lens holders
BEAREE LC5020	ARPES		*High mechanical strength high heat resistance *Picker fingers mold well because of material's fluidity	*Picker fingers
BEAREE PK5030 <sup>4)</sup>	PEEK		*Excellent wear resistance	*Washers
BEAREE PK5900	PEEK		*Excellent wear resistance *Superior shock resistance	*Sliding bearings *Bearings in oil
BEAREE PK5300	PEEK		*Excellent wear, friction, chemical and heat resistance *Superior sealing	*Seal rings
BEAREE NY5000	PA		*Excellent friction and wear characteristic at low PV value	*Sliding bearings *Door wheels
BEAREE DM5030	POM		*Excellent wear resistance ensuring stable low friction coefficient for a long period of time *Suitable for aluminum or copper mating material	*Sliding bearings *Gears *Rollers

Table 19 Coating materials

Grade	Characteristics		Applications
BEAREE FL7075		*Excellent friction and wear characteristics *Strong coat layer	*Washers *Valve plates *Rollers
BEAREE FE7010		*Thick, strong layer is achievable	*Roots pump rotors
BEAREE FE7031		*Excellent anti-stick properties *Strong coat layer	*Picker fingers *Slide guides
BEAREE FE7080		*Accuracy of coated parts can be maintained due to extremely thin layer of coating *Excellent anti-stick properties	*Picker fingers *Sliding bearings
BEAREE FE7092		*Excellent anti-stick properties	*Picker fingers

Specific gravity	Compressive creep %	Hardness <sup>1)</sup>	Tensile strength		Elongation %	Flexural strength		Flexural modulus		Water absorption %	Coef. of thermal expansion $\times 10^{-5}/^{\circ}\text{C}$	Max. service temp. $^{\circ}\text{C}$
			MPa	kgf/cm <sup>2</sup>		MPa	kgf/cm <sup>2</sup>	MPa	kgf/cm <sup>2</sup>			
1.70	—	R120	60	600	2	110	1 100	10 000	100 000	0.03	2.3	230
1.93	—	R121	41	410	1	110	1 100	35 000	350 000	0.03	1.4	230
1.82	—	—	173	1 730	3	198	1 980	23 700	237 000	—	—	300
1.30	—	—	130	1 300	100	—	—	—	—	0.13	5.0	250
1.39	—	R118	126	1 260	2	207	2 070	7 400	74 000	—	4.4	250
1.63	—	M79	82	820	1	130	1 300	9 900	99 000	—	3.0	250
1.40	0.6	68	20	200	20	—	—	—	—	—	—	100
1.42	—	—	50	500	35	80	800	2 650	26 500	—	—	100

NOTE 1) Hardness: no code = durometer; others = Rockwell hardness

2) Coefficient of linear expansion: the mean coefficient of linear expansion in the range from room temperature up to 150°C.

Values in the above table are representative test results.

Layer thickness $\mu\text{m}$	Bond strength					Max. continuous service temperature	Baking temperature	Coating method		
	Cross-cut test	Pencil hardness test		Pin scratching test	Spray coating			Dip coating	Powder coating	
		Causing scratches	Causing tear							
10~30	100/100	H	3H	5	180	230	○			
500~1 000	100/100	6H	—	5	180	315			○	
10~20	100/100	3H	5H	5	180	230	○			
<1	100/100	—	—	—	180	—	○	○		
10~20	100/100	B	H	4	330	370	○			

Values in the above table are representative test results.

Surface treatment temperature of BEAREE FE7080 performs in the range from room temperature up to 250°C.

Table 20 Testing methods for each property

	Unit	Testing methods				
		Fluoroplastic based material	General plastics	Rubber	Coating	FL3020
Specific gravity	—	ASTM D792	ASTM D792	JIS K6350	—	JIS K6888
Compressive creep	%	ASTM D621	ASTM D621	JIS K6301	—	—
Hardness		ASTM D2240	ASTM D785	JIS K6301	—	JIS K7215
Tensile strength	MPa  kgf/cm <sup>2</sup>	ASTM D638	ASTM D638	JIS K6301	—	JIS K6888
Elongation	%	ASTM D638	ASTM D638	JIS K6301	—	JIS K6888
Flexural strength	MPa  kgf/cm <sup>2</sup>	—	ASTM D790	—	—	—
Flexural modulus	MPa  kgf/cm <sup>2</sup>	—	ASTM D790	—	—	—
Compressive strength	MPa  kgf/cm <sup>2</sup>	ASTM D695	ASTM D695	JIS K6301	—	JIS K7208
Water absorption	%	ASTM D570	ASTM D570	JIS K6301	—	JIS K7209
Coef. of thermal expansion	× 10 <sup>-5</sup> /°C	TMA method	TMA method	TMA method	—	—
Cross-cut	Score (0~10)	—	—	—	JIS K5400	—
Pencil hardness	Pencil hardness	—	—	—	JIS K6894	—
Pin scratching	Score (0~5)	—	—	—	JIS K6894	—

The material property values shown in the catalog are only representative test results obtained from the tests under specific test conditions. This data may not be directly applicable to applications under different service conditions. Those characteristic values are merely representative test results which are not to be used as specifications.

5-2 Chemical compatibility of each grade

NTN engineering plastics materials are inert against almost all chemicals. Chemical resistance of the base resins of BEAREE materials are shown in table 21.

The following table shows the characteristics of base resin on each grade, therefore they may differ according to the contained filler. Contact us for selection.

Table 21 Chemical properties of NTN Engineering Plastics materials.

Chemicals	BEAREE FL	BEAREE FE	BEAREE PI	BEAREE AI	BEAREE UH	BEAREE AS	BEAREE LC	BEAREE PK	BEAREE NY	BEAREE DM	BEAREE ER <3000type>	
Acids	Concentrated sulfuric acid	⊙	⊙	×		○	○	⊙	×	×	×	○
	15% Acetic acid	⊙	⊙	△	⊙	○	⊙	⊙	×	×	×	×
	75% Acetic acid	⊙	⊙	△	⊙	×	⊙	⊙	×	×	×	×
	Hydrochloric acid	⊙	⊙	⊙	○	⊙	⊙	⊙	×	×	×	⊙
	15% Nitric acid	⊙	⊙	○		○	○	⊙	⊙	×	×	○
	70% Nitric acid	⊙	⊙	△	×	×	×	⊙	△	×	×	○
	Formic acid	⊙	⊙	△	×	⊙	⊙	⊙	×	×	×	×
	85% Phosphoric acid	⊙	⊙	△	⊙	×	⊙	⊙	⊙	×	×	○
	40% Chromic acid	⊙	⊙			×	○	⊙	○	×	×	○
	100% Lactic acid	⊙	⊙	△	⊙	⊙	⊙	⊙	⊙	×		⊙
	Hydrogen peroxide	⊙	⊙			○	○	○	⊙	×	○	⊙
Alkali	30% Ammonia aqueous solution	⊙	⊙	△	○	⊙	○	×	○	×	○	⊙
	Iron chloride	⊙	⊙	△	⊙	⊙	⊙		⊙	○	○	⊙
	Calcium chloride	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	○	⊙
	Sulfate	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	△	○	△
	Calcium hydroxide	⊙	⊙	⊙	⊙	⊙	⊙	×	⊙	○	○	○
	Mineral water	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	○	⊙
Solvents	Methyl alcohol	⊙	⊙	⊙	⊙	○	⊙	○	×	○	○	○
	Acetone	⊙	⊙	○	⊙	×	⊙	⊙	⊙	○	○	×
	Benzene	⊙	⊙	○	⊙	×	⊙	⊙	⊙	○	○	○
	Carbon tetrachloride	⊙	⊙	×	⊙	×	⊙	⊙	⊙	○	○	○
	Ethyl-ether	⊙	⊙	⊙	⊙	×	⊙	⊙	⊙	○	○	×
	Ethylene glycol	⊙	⊙	△	⊙	⊙	⊙	⊙	○	⊙	○	⊙
Oils Kerosene	Diesel engine oil	⊙	⊙	⊙	⊙		⊙	⊙	⊙	○	○	○
	Lubricating oil	⊙	⊙	⊙	⊙	×	⊙	⊙	⊙	○	○	⊙
	Animal oil, Vegetable oil	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	○	⊙
	Kerosene	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	○	⊙
	Naphtha	⊙	⊙	○	⊙	×	⊙	⊙	○	⊙	△	⊙
Others	Nitrate	⊙	⊙	△	⊙		○	○	⊙	⊙	○	×
	Hydro-carbon fuel	⊙	⊙	⊙	⊙	○	⊙	⊙	⊙	○	○	⊙
	Fluorine gas	⊙	⊙	△	⊙		×	△	×	×		△
	Molten metallic sodium	×	×	×			×		×			
	CFC (Freon) 134a	⊙	⊙	⊙	⊙		⊙	⊙	⊙	○	○	×
	Liquid oxygen	⊙	⊙	○	⊙	⊙	⊙	⊙	○	⊙		○
	Carbon dioxide	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	○	○
Nitrogen dioxide	⊙	⊙	△	⊙	⊙	⊙	⊙				⊙	

Description of symbols: ⊙ : Excellent, ○ : Normal × : Incompatible \* Under high temperature and pressure

The above shown chemical resistance is the resistance of the base resin only, and characteristics of each grade may differ depending on its filler.