Engineered Plastic Characteristics II

Bakelite, Epoxy Glass and Ceramics

For Heat Insulation Plates, see **P.1675~1686**.

■Characteristics of Bakelite, Epoxy Glass and Ceramics

· Characteristics of Bakelite Plate

MISUMI's Bakelite Plates are products which can be used as insulating plates for switch board, controller and breaker.
Paper Type is available in natural color and black, and strong Cloth Type is also available.
Bakelite Color (Natural Color) may vary depending on production lot, but does not affect quality.

· Characteristics of Epoxy Glass Plate

Compared with paper based bakelite plates and cloth based bakelite plates, MISUMI's epoxy glass plates have higher strength (mechanical strength), and superior heat/moisture resistance.
High Temperature Type has an excellent antistatic property.

· Characteristics of Ceramics

Alumina 96 : Excellent in abrasion/insulation/heat resistance, and used for insulating/heat resisting parts in electricity, semiconductors and the other areas. In addition, it has equal or higher bending strength, compared with the common steel, and little elastic deformation.
Steatite : Steatite Ceramics are excellent in insulation and high frequency characteristic and are used as general insulation parts. It is a relatively low-cost material.
Machinable : Excellent machinability. Can be machined into complex forms. Precision finishing. Provides an excellent electric and thermal insulation.

■Physical Property Values of Bakelite and Epoxy Glass

* For material colors or features, see **P.951**.

Item			Representative Products			
			Bakelite		Epoxy Glass	
			Paper Type	Cloth Type	Standard	High Temperature
		Plate	P.1001	P.1001	P.1007	P.1007
		Circular Plate	P.1023	P.1023	P.1023	-
		Unit	BLA BLBA	BLSA	EPXA	EPXAR
Component	Main Base Material	-	Kraft Paper	Cotton	Glass Fiber	Glass Fiber
	Main Material	-	Phenol Resin	Phenol Resin	Epoxy Resin	Super-insulated Epoxy
Mechanical Properties	Bending Strength	MPa {kgf/mm²}	120~180 {12~18}	100~150 {10~15}	310~450 {31~45}	499 (Horizontal) / 553 (Vertical) {51 (Horizontal) / 56 (Vertical)}
	Compression Strength Vertical to Lamination	MPa {kgf/mm²}	250~320 {25~32}	200~250 {20~25}	470~539 {47~53.9}	-
	Compression Strength Horizontal to Lamination	MPa {kgf/mm²}	170~210 {17~21}	100~150 {10~15}	294~392 {29.4~39.2}	-
	Izod Impact Strength	J/cm	0.2~0.5	0.5~0.7	4.6 or More	-
	Cleavage Strength	kN	3.9~5.9	6.0~8.0	6.9~10.8	-
Thermal Characteristics	Recommended Operating Temperature (Note 1)	°C	-50 ~ 100 (130°C 2h Normal)	-50 ~ 100 (140°C 2h Normal)	Ambient Temp. ~ 155	Ambient Temp. ~260 (300°C Normal for 5 min.)
	Reference - Destructive Temp. (Note 2)	°C	120	140	-	-
	Expansion Coefficient	$°C^{-1}$	$1.6x10^{-4}$	$0.6x10^{-4}$	$6.05x10^{-5}$	$6.0x10^{-5}$
	Thermal Conductivity	W/m・K {cal/cm, sec, °C}	0.21 {$0.5x10^{-3}$}	0.38 {$0.9x10^{-3}$}	0.471 {$1.125x10^{-3}$}	0.38 {$9.0x10^{-4}$}
Electric Characteristics	Through Layer Dielectric Breakdown	kV/mm	20~28	12~20	20~30	-
	Edgewise Withstand Voltage	kV	12~18	8~15	-	-
	Volume Resistivity 4h/150°C	Ω・cm	$3.0×10^{9}$	$4.0×10^{8}$	-	-
	Volume Resistivity 100h/25°C/90%RH	Ω・cm	$9.0×10^{8}$	$5.0×10^{7}$	-	-
	Surface Resistance	Ω	$5.0×10^{10}$	$9.0×10^{8}$	10^{13}~10^{14}	$1.0×10^{7}$
	Insulation Resistance Ordinary Condition	Ω	10^{10}~$5x10^{11}$	$5x10^{9}$~10^{10}	10^{12}~10^{14}	-
	Insulation Resistance After Boiling	Ω	$5x10^{7}$~10^{8}	10^{8}~10^{9}	$5x10^{10}$~10^{13}	-
Others	Arc Resistance	sec	-	-	-	-
	Water Absorption Ratio	%	0.5~1.3	1.6~1.8	0.02~0.03	0.02
	Specific Gravity	-	1.4	1.4	1.75~1.9	1.95

Testing method conforms to JIS K6911. Listed values are for reference, not guaranteed.
(Note 1) "Recommended Operating Temperature" is the temperature under which even a long-term use does not reduce the quality rapidly.
(Note 2) "Destructive Temperature" is the temperature to start carbonization, collapse and melt.

■Physical Property Values of Ceramics

Item		Representative Products			
	Plate	P.989	P.989	P.989	P.990
	Circular Plate	P.991	P.991	-	-
	Unit	CEA, PCEA	CCES, PCCES	CEM	CEMN
Material Name	-	Alumina 96 $Al_2O_3$96%	Steatite MgO, SiO_2	Machinable SiO_2, MgO	Al2O3/Alumina 99 $Al_2O_3$99.7%
Apparent Density	g/cm^3	3.7	2.5	2.5	3.9
Water Absorption Ratio	%	0	0	0	0
Bending Strength	MPa	300	120	94	340
Thermal Conductivity	W/m・k {cal/cm, sec, °C}	18 {$4.0x10^{-2}$}	2 {$5.0x10^{-3}$}	1.46	30
Thermal Expansion Coefficient	(20~500°C) $x10^{-6}$/°C	7.3	7.4	9.4	7.5 (For RT ~ 600°C)
	(20~800°C) $x10^{-6}$/°C	8	8.1	12.6	9.9
Melting Point	°C	2050	1557	1200	2000
Safety Operating Temperature	°C	1300	1000	1000	1500
Insulation Resistance	kV/mm	>10	>10	40	>10
Specific Volume Resistivity	Ω・cm	$>10^{14}$	$>10^{14}$	$>10^{16}$	$>10^{15}$
Dielectric Constant	MHz	9	5.2	6	10
Loss Coefficient	-	$10.0×10^{4}$	$7.0×10^{4}$	-	30

Listed values are for reference, not guaranteed.

• Drilling Conditions of the Epoxy Glass

	Circular Cut	Milling	Drilling
Tool	Carbide (K-10)	Carbide (K-10)	Carbide (K-10)
Cutting Speed V (m/min)	Large ~ Small Blades 45~200	Large ~ Small Blades 100~300	Large ~ Small Blades 120~350
Speed (r.p.m.)	Large ~ Small Blades 50~1000	Large ~ Small Blades 300~1000	Ø2 Through 1000 ~ 1500 Ø5 Through 500 ~ 1000
Cutting Depth (mm)	0.3~0.5	0.5~2.0	-
Feed (mm/rev)	0.1~0.2	0.1~0.2	0.1~0.5

The above values are for references only.

• Machinable Ceramics Drilling Conditions

	Tool	High-Speed Steel	Carbide
Circular Cut	Cutting Speed (m/min)	9~15	30~50
	Feed (mm/rev)	0.05~0.13	
	Cutting Depth (mm)	0.5~6	
Milling	Cutting Speed (m/min)	-	6~11
	Feed (mm/rev)	-	0.05
	Cutting Depth (mm)	-	0.5~5
Note	Revolution Frequency	Revolutions per Minute = Cutting Speed (m/min) / Diameter (mm) x 0.00314	

The above values are for references only.