Resin Plate Characteristics I

Epoxy Glass, Bakelite & Ceramics

For Heat Insulation Plates, see **P.3780–3791.**

Characteristics of Epoxy Glass, Bakelite and Ceramics

Characteristics of Epoxy Glass Plate

Compared with paper based bakelite plates and fabric based bakelite plates, MISUMI's epoxy glass plates have high strength (mechanical strength), excellent heat resistance and moisture resistance.

High Temperature Type has an excellent antistatic property.

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. Strong Fabric Type is also available.

Bakelite Color (Natural Color) may vary depending on production lot, but does not affect quality.

Characteristics of Ceramics

Alumina 96: Ceramics (Alumina 96/99) are excellent in abrasion resistance/insulation/heat resistance, and used for insulating/heat resisting parts in electronics, semiconductors and in other areas. In addition, it has equal or higher bending strength, compared with the common steel, and little elastic deformation.

Steatite: Ceramics Steatite are excellent in insulation as well as 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 Epoxy Glass and Bakelite

* For material colors or features, see **P.3069**

Item				Part Number			
				Epoxy Glass Plates		Bakelite	
				Standard	High Temperature	Paper Type	Fabric Type
			Plates	P.3096	P.3096	P.3098–3099	P.3887
			Circular Plates	P.3114	—	P.3114	P.3114
			Unit	EPXA	EPXAR	BLA BLBA	BLSA
Component	Main Base Material		—	Glass Fiber	Glass Fiber	Kraft Paper	Cotton
	Main Material		—	Epoxy Resin	Super-Insulated Epoxy	Phenol Resin	Phenol Resin
Mechanical Properties	Bending Strength		MPa {kgf/mm²}	310–450 {31–45}	499 (Vertical) / 553 (Horizontal) {51 (Horizontal) / 56 (Vertical)}	120–180 {12–18}	100–150 {10–15}
	Compression Strength	Vertical to Lamination	MPa {kgf/mm²}	470–539 {47–53.9}	—	250–320 {25–32}	200–250 {20–25}
		Horizontal to Lamination	MPa {kgf/mm²}	294–392 {29.4–39.2}	—	170–210 {17–21}	100–150 {10–15}
	Izot Impact Strength		J/cm	4.6 or More	—	0.2–0.5	0.5–0.7
	Cleavage Strength		kN	6.9–10.8	—	3.9–5.9	6.0–8.0
Thermal Characteristics	Recommended Operating Temperature (Note 1)		°C	Ambient Temperature: 155	Ambient Temperature: 260 (300°C Normal for 5 min.)	-50–100 (130°C 2 h Normal)	-50–100 (140°C 2 h Normal)
	Reference – Destructive Temp. (Note 2)		°C	—	—	120	140
	Expansion Coefficient		°C^{-1}	6.05 x 10^{-5}	6.0 x 10^{-5}	1.6x10^{-4}	0.6 x 10^{-4}
	Thermal Conductivity		W/m.k {cal/cm.sec.°C}	0.471 {1.125 x 10^{-3}}	0.38 {9.0 x 10^{-4}}	0.21 {0.5 x 10^{-3}}	0.38 {0.9 x 10^{-3}}
Electric Characteristics	Dielectric Breakdown (Cross Layer)		kV/mm	20–30	—	20–28	12–20
	Edgewise Withstand Voltage		kV	—	—	12–18	8–15
	Volume Resistivity	4 h / 150°C	Ω·cm	—	—	3.0 x 10^{9}	4.0 x 10^{8}
		100 h / 25°C / 90% RH	Ω·cm	—	—	9.0 x 10^{8}	5.0 x 10^{7}
	Surface Resistance			1013 - 10^{14}	1.0 x 10^{7}	5.0 x 10^{10}	9.0 x 10^{8}
	Insulation Resistance	Ordinary Condition		1012 - 10^{14}	—	1010 - 5 x 10^{11}	5 x 109 - 10^{10}
		After Boiling		5 x 1010 - 10^{13}	—	5 x 107 - 10^{8}	108 - 10^{9}
Others	Arc Resistance		sec	—	—	—	—
	Water Absorption Ratio		%	0.02–0.03	0.02	0.5–1.3	1.6–1.8
	Specific Gravity		—	1.75–1.9	1.95	1.4	1.4

Testing method conforms to JIS K6911. Listed values are not guaranteed values but representative values.

(Note 1) "Recommended Operating Temperature" is the temperature when 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	Unit	Part Number			
		CEA / PCEA	CEA	CCES / PCCES	CEM
Material Name	—	Alumina 96 Al_2O_3 96%	Alumina 99 Al_2O_3 99.5%	Steatite MgO / SiO_2	Machinable SiO_2 / MgO
Apparent Density	g/cm³	3.7	3.9	2.6	2.5
Water Absorption Ratio	%	0	0	0	0
Bending Strength	Mpa	350	450	160	94
Thermal Conductivity	W/m·k	24	24	3	1.46
Thermal Expansion Coefficient	(20–500°C) x 10^{-6}/°C	7.2	8	7.8	9.4
	(20–800°C) x 10^{-6}/°C	7.9	—	8.2	12.6
Melting Point	°C	2050	—	1557	1200
Safety Operating Temperature	°C	1300	1300	1000	1000
Insulation Resistance	kV/mm	>10	>10	>10	40
Specific Volume Resistivity	Ω·cm	>10^{14}	>10^{14}	>10^{14}	>10^{16}
Dielectric Constant	MHz	9	9	5.2	6.0
Loss Coefficient	—	10.0 x 10^{4}	—	7.0 x 10^{4}	—

Alumina 99 (Al_2O_3 99.5%) is for CEA with plate thickness 2/2.5 or for plate thickness 1 with hole machining.

Listed values are not guaranteed values but representative values.

Drilling Conditions of the Epoxy Glass

	Circular Cut	Milling	Drilling
Tools	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
Revolutions (r.p.m.)	Large – Small Blades 50–1000	Large – Small Blades 300–1000	Ø2 Drill 1000–1500 Ø5 Drill 500–1000
Cutting Depth (mm)	0.3–0.5	0.5–2.0	—
Feed (mm/Rotation)	0.1–0.2	0.1–0.2	0.1–0.5

The above values are references only.

Machinable Ceramics Drilling Conditions

	Tools	High-Speed Steel	Carbide
Circular Cut	Cutting Speed (m/min)	9–15	30–50
	Feed (mm/Rotation)	0.05–0.13	
	Cutting Depth (mm)	0.5–6	
Milling	Cutting Speed (m/min)	—	6–11
	Feed (mm/Rotation)	—	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 references only.

Resin Plates Characteristics II

General-Purpose Engineered Plastic Plates

Characteristics of MC Nylon, Polyacetal, Ultra High-molecular-weight Polyethylene (UHMW), Fluororesin, PEEK, PPS, ABS, PBT and Free-cutting Resin

MISUMI's general-purpose Engineered Plastic plates have superior properties of lightweight, noise reduction and corrosion resistance. They can be used as a replacement for metal plates.

Selectable from nine types of materials and several grades for various purposes.

MC Nylon: Having better abrasion resistance than that of polyacetal plates, MC nylon is generally used for slide guide plates. The product lineup is as follows: Sliding Grade with highly-improved sliding performance; High Strength Grade with excellent strength; three types of Conductive Grade effective for antistatic purposes; and Weather Resistance Grade superior in strength deterioration.

Polyacetal: Widely used in wheels, rollers and gears, because of its excellent mechanical strength. MISUMI's polyacetal plates are offered in two colors: white and black.
In addition, Sliding Grade with highly-improved sliding performance and Conductive Grade effective for antistatic purposes are also available.

Ultra High-Molecular-Weight Polyethylene (UHMW): It excels in abrasion resistance and sliding properties, and is used for carrier rollers and guide rails. In addition to Standard Grade, Conductive Grade effective for antistatic purposes is also available.

*For material colors or features, see **P.3069**

Item			Testing Method ASTM		Part Number										
					MC Nylon							Polyacetal		Ultra High-molecular-weight Polyethylene	
					Standard	Sliding	High Strength	Weather Resistance	Conductivity CDR2	Conductivity CDR6	Conductivity CDR9	Standard	Electric Conductivity	Standard	Electric Conductivity
				Plates	P.3100, 3118	P.3100	P.3100	P.3100	P.3100	P.3100, 3118	P.3100	P.3102	P.3102	P.3104	P.3114
				Circular Plates	P.3114	P.3114	—	P.3114	P.3114	P.3114	P.3114	P.3114	P.3114	P.3114	P.3114
				Unit	MCA MCAW MCAB	MCAS	MCAY	MCAPS	MCCA	MCDA MCDB	MCEA	PAA PABA PAAB	PACA	UPA	UPACA
Mechanical Properties	Tensile Strength	Normal Temperature	D-638	MPa {kgf/cm²}	96 {980}	66 {670}	98 {1000}	83 {850}	68 {700}	74 {760}	88 {900}	61 {620}	42 {430}	45 {460}	35 {360}
		Continuous Use at High Temperature		MPa {kgf/cm²}	39 (120°C) {400 (120°C)}	—	—	—	—	—	—	29 (95°C) {300 (95°C)}	—	—	—
	Elongation		D-638	%	30	19	20	40	10	7	7	40	30	400	300
	Bending Strength		D-790	MPa {kgf/cm²}	110 {1120}	92 {940}	152 {1550}	110 {1120}	117 {1200}	117 {1200}	132 {1350}	89 {910}	49 {500}	25 {250}	25 {250}
	Flexural Modulus		D-790	MPa	3530	2599	4609	—	4110	4020	4160	2589	1370	900	1103
	Compression Strength	Yield Point	D-695	MPa {kgf/cm²}	103 {1050}	—	—	101 {1030}	—	—	—	—	—	20 {200}	—
		5% Deformation		MPa {kgf/cm²}	95 {970}	75 {760}	118 {1200}	93 {948}	98 {1000}	93 {950}	—	103 {1050}	44 {450}	—	25 {250}
	Izot Impact Strength		D-256	J/m	50	39	50	50	35	35	35	74	77	Does Not Break	Does Not Break
	Rockwell Hardness	R Scale	D-785	—	120	110	120	120	119	117	119	119	111	56	52
		M Scale		—	—	—	—	—	—	—	—	78	—	—	—
Thermal Characteristics	Temperature of Continuous Use		—	°C	-40–120	-40–120	Ambient Temp.: 150	Ambient Temp.: 120	Ambient Temp.: 120	Ambient Temp.: 120	Ambient Temp.: 150	-45–95	Ambient Temp.: 80	-100–80	-100–80
	Melting Point		—	°C	222	221	222	222	215	215	218	165	—	136	—
	Deflection Temp. Under Load	0.45 Mpa	D-648	°C	215	215	215	215	215	215	—	158	—	80	108
		1.82Mpa		°C	200	115	200	200	200	200	200	110	106	—	55
	Linear Expansion Coefficient		D-696	°C^{-1}	9.0 x 10^{-5}	9.0 x 10^{-5}	6.5 x 10^{-5}	9.0 x 10^{-5}	8.0 x 10^{-5}	7.5 x 10^{-5}	8.6 x 10^{-5}	9.0 x 10^{-5}	16.7 x 10^{-5}	1.7 x 10^{-4}	19 x 10^{-5}
	Thermal Conductivity		D-177	W/m·k	0.233	0.233	—	0.23	0.512	0.709	—	0.233	—	0.42	—
Electric Characteristics	Surface Resistivity		D-257	—	—	—	—	—	—	—	—	—	—	10^{13}	—
	Specific Volume Resistivity		D-257	Ω·cm	4.2 x 10^{15}	—	—	—	10^{2}–10^{4}	10^{4}–10^{6}	10^{6}–10^{8}	>10^{14}	10^{10}–10^{12}	10^{17}	10^{4}
	Insulation Breakdown Voltage		D-149	kV/mm	20	—	—	18	—	—	—	20	—	68	—
	Dielectric Constant	10^{6}Hz	D-150	—	3.7	—	—	3.7	—	—	—	3.7	—	2.3	—
	Dissipation Factor	10^{6}Hz	D-150	—	0.02	—	—	0.02	—	—	—	0.007	—	—	—
Others	Specific Gravity		D-792	—	1.16	1.11	1.27	1.16	1.2	1.23	1.19	1.41	1.33	0.94	0.95
	Water Absorption Ratio	In Water, Level	D-570	%	6	—	—	6.0	—	—	—	0.7	—	<0.01	—
		In Water, 24hs	D-570	%	0.8	0.5	—	0.8	—	—	—	0.22	2	0.8	—
	Abrasion Resistance		—	—	Good	Excellent	Good	Excellent	Acceptable	Acceptable	Good	Acceptable	Good	Excellent	Good
	Sliding Properties		—	—	Good	Excellent	Good	Good	Good	Good	Good	Good	Good	Excellent	Good
	Dynamic Friction Coefficient		—	—	—	0.05–0.1	—	—	—	—	—	—	0.18	0.07–0.22	0.17–0.19
	Dimension Stability		—	—	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Good	Acceptable	Acceptable	Acceptable
	Impact Resistance		—	—	Good	Good	Good	—	Good	Good	Good	Good	Good	Excellent	Excellent
	Flame Resistance		[UL94]	—	(HB or Equivalent)	(HB or Equivalent)	(HB or Equivalent)	(HB or Equivalent)	(HB or Equivalent)	(HB or Equivalent)	(HB or Equivalent)	(HB or Equivalent)	(HB or Equivalent)	(HB or Equivalent)	(HB or Equivalent)
	Food Sanitation Laws		—	—	Suitable*	Suitable*	Suitable*	Suitable (After Boiling)	Suitable*	Suitable*	Suitable*	Suitable	Suitable	Suitable	Suitable
	FDA Registration		—	—	—	—	—	—	—	—	—	—	—	Finished	—
	Chemical Resistance	Oil	—	—	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
		Acid	—	—	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Acceptable / Poor	Acceptable / Poor	Excellent	Good
		Alkali	—	—	Good / Acceptable	Good / Acceptable	Good / Acceptable	Good / Acceptable	Good / Acceptable	Good / Acceptable	Good / Acceptable	Good	Good	Excellent	Good
		Organic Solvent	—	—	Good	Good	Good	Good	Good	Good	Good	Good	Good	Excellent	Good

*Comply with Food Sanitation Laws in Japan (MC Nylon, Standard, Sliding Grade and High Strength Grade: After boiling for 1.5 hours; Conductive CDR2, CDR6 and CDR9: After boiling for 2 hours)

Listed values are not guaranteed values but representative values.

Transparent Resin / Glass / Mirror / Engineered Plastic Plates