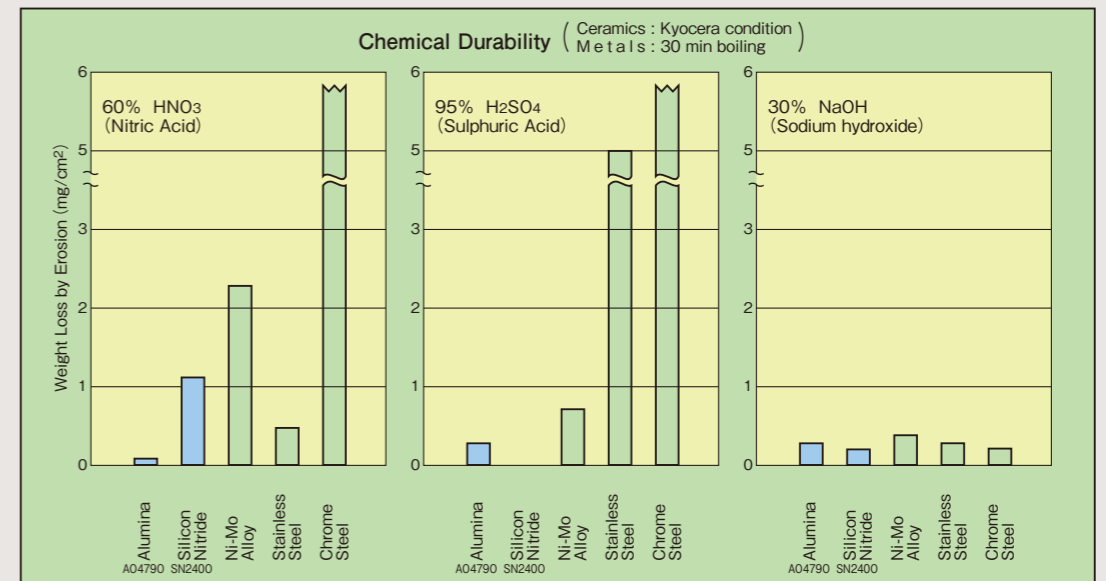
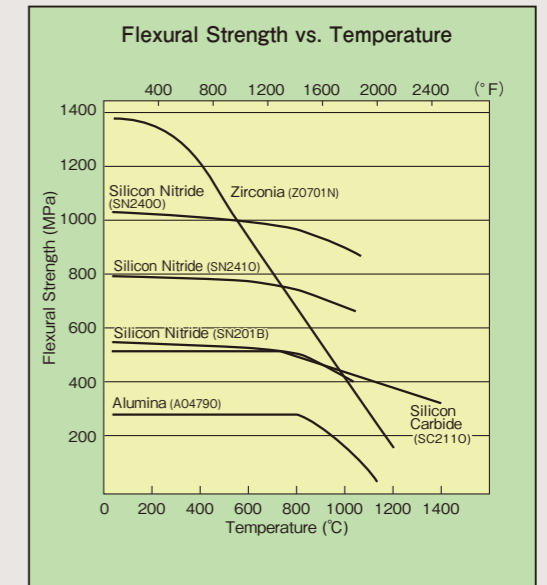
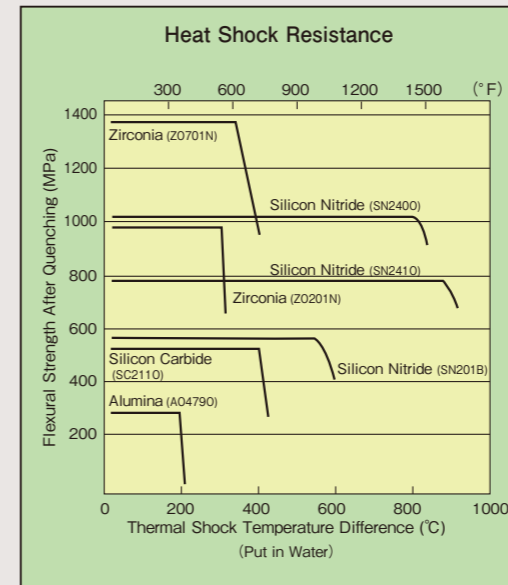
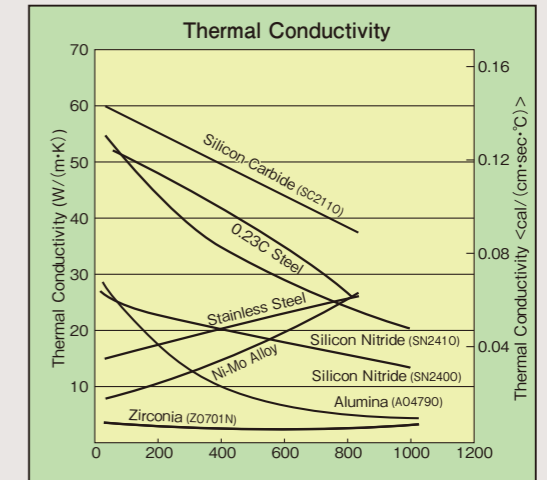
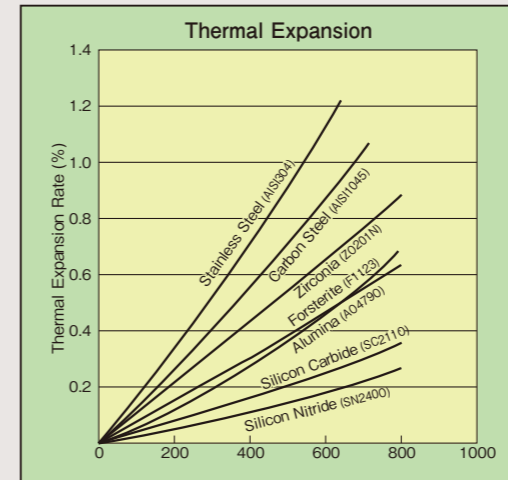
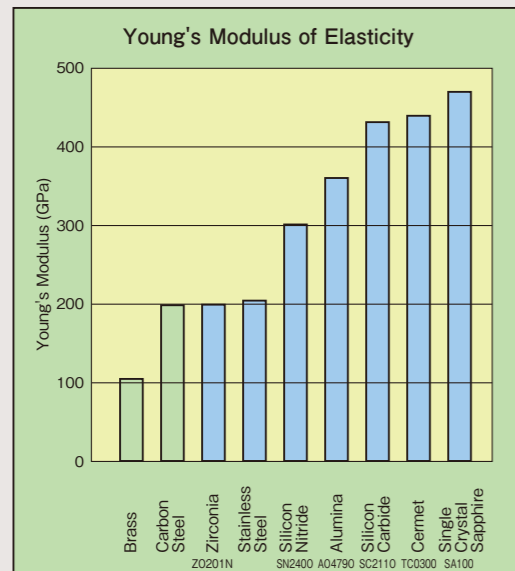
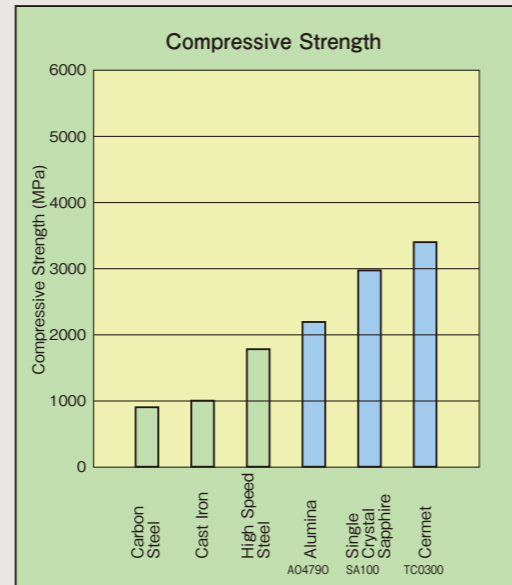
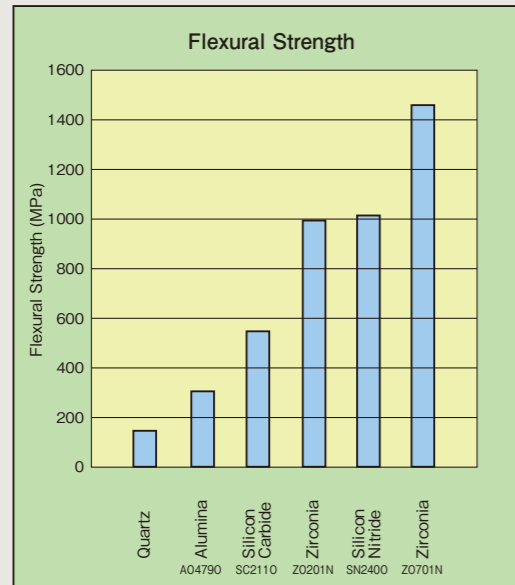
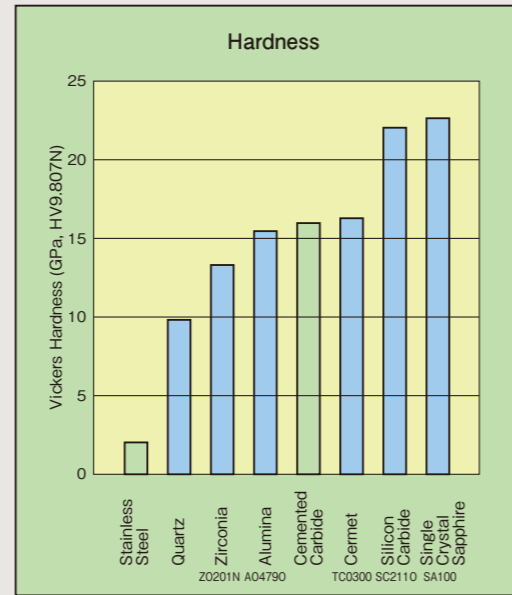
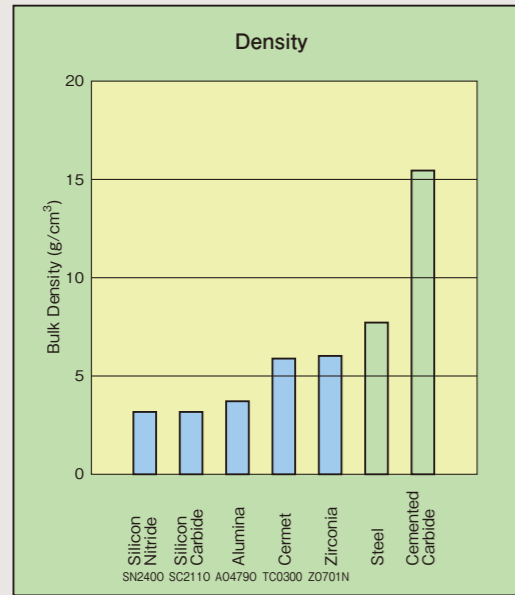


THE NEW VALUE FRONTIER



**CHARACTERISTICS
OF
KYOCERA
FINE
CERAMICS**

MATERIAL COMPARISON CHARTS



Unit Conversion Table

■ Stress		
MPa or N/mm ²	kgf/mm ²	psi (=lbf/in ²)
1	1.020 × 10 ⁻¹	1.450 × 10 ²
9.807	1	1.422 × 10 ³
6.895 × 10 ⁻³	7.031 × 10 ⁻⁴	1

■ Thermal Conductivity

W/(m·K)	kcal/(m·h·°C)	cal/(cm·sec·°C)
1	8.600 × 10 ⁻¹	2.389 × 10 ⁻³
1.163	1	2.778 × 10 ⁻³
4.186 × 10 ²	3.600 × 10 ²	1

CHARACTERISTICS of Kyocera Fine Ceramics (1)

Item		Material	ALUMINA (Al ₂ O ₃)											SAPPHIRE	CORDIERITE (2MgO · 2Al ₂ O ₃ · 5SiO ₂)		STEATITE (MgO · SiO ₂)		FORSTERITE (2MgO · SiO ₂)					
Material Code (Old)		A482R	A459	A445	A471	A473	A484	A476	A479	A479S	A479M A479G	A480S	A601D A601L	SA100	CO220	CO720	S210	S211	F1120	F1023				
Material Code (New)		AO482R	AO459K	AO445O	AO471O	AO473O	AO484O	AO476O	AO479O	AO479S	AO479M AO479G	AO480S	AO601D AO601L	SA100	CO220O	CO720O	SO210O	SO211O	F1120O	F1023O				
Appearance		Porous	Dense											Dense	Dense	Dense	Dense		Dense					
Color		Pink	Russet	Dark Brown	White	White	White	White	White	Ivory	Ivory	Ivory	Ivory	Transparent	Gray	Gray	White	Dark Brown	Light Yellow					
Content (%)		Al ₂ O ₃ 76	89	90	92	92	92	96	99	99.5	99.5	99.7	99.9	99.99	—	—	—	—	—	—				
Main Characteristics		High Mechanical Strength, High Temperature Resistance, High Frequency Insulation, High Chemical Resistance											Single Crystal	•Very Low Thermal Expansion •Light Weight		•Thermal Insulator	•Good Light Shield	•Good Surface Finish	•High Thermal Expansion					
		•High Heat Resistance	•Good for Metallizing	•Light Intercepting, •High Heat Dissipation	•Wear Resistant	•Good for Metallizing, •Mechanically Strong	•Wear Resistant	•Good Surface Smoothness	•Hard and Chemically Stable	•Hard and Chemically Stable, •Fine Grain Strong and Smooth	•High Chemical Resistance,	•Good Anti-Plasma, •Wear Resistance •High Purity		•High Heat Resistance, •High Chemical Resistance	•Void Less									
Main Applications		•Welding Nozzle, •Nozzle for Glass Fiber Manufacturing	•Magnetron	•IC Packages	•Liner •Pulverizer	•IC Multi-Layer Packages, •Electron-tube Housing	•Wire-Drawing Parts, •Capstans, •Mechanical Seal Rings	•Hybrid IC Substrates	•Heat, Corrosion and Wear Resistant Parts	•Pump •Shafts	•Wear Resistant Parts •Chemically Resistant Parts •Semiconductor Processing Equipment Parts		•Thin Film Substrates, •Windows, •Chemically Resistant Parts	•Lithography Stage Component •Wafer Inspection Stage Component •SEM/TEM	•Various Circuit Parts		•Substrate For Resistor •Core For Resistor							
		Density (*1)	g/cm ³	JIS R 1634	3.6	3.6	3.8	3.6	3.6	3.6	3.7	3.8	3.9	3.9	3.9	3.9	3.97	2.5	2.5	2.8	3.1	3.0	3.0	
Water Absorption		%	JIS C 2141	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Mechanical Characteristics	Vickers Hardness HV9.807N	GPa	JIS R 1610	9.0	12.1	12.7	11.8	12.3	12.3	13.7	15.2	16.0	15.7	17.2	17.5	Surface a	22.5	8	8.5	5.8	6.7	7.3	5.9	
	Flexural Strength 3 P.B.	MPa	JIS R 1601	120	310	320	390	340	370	350	310	360	370	380	400	Surface a Axis c	690	190	200	190	220	180	160	
	Compressive Strength	MPa	JIS R 1608	—	—	—	—	2,300	—	—	2,160	2,350	—	—	—	2,940		—	—	—	—	—	—	
	Young's Modulus of Elasticity	GPa	JIS R 1602	160	280	320	280	280	280	320	360	370	370	380	380	470		140	145	120	130	150	150	
	Poisson's Ratio	—		0.17	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	—		0.31	0.31	0.22	0.22	0.24	0.24	
	Fracture Toughness (SEPB)	MPa · m ^{1/2}	JIS R 1607	—	—	—	—	—	—	—	3 ~ 4	4	—	—	5 ~ 6	—		1 ~ 1.5	1 ~ 1.5	—	—	—	—	
Thermal Characteristics	Coefficient of Linear Thermal Expansion	40 — 400°C	× 10 ⁻⁶ /K	JIS R 1618	7.1	7.0	7.3	7.1	6.9	6.8	7.2	7.2	7.2	7.2	7.2	Parallel to Axis c	7.7	1.5 (40°C~400°C)	1.5 (40°C~400°C)	7.7	9.2	9.7	10.1	
		40 — 800°C			7.5	7.9	8.1	7.9	7.8	7.7	7.9	8.0	8.0	8.0	8.0	8.0	Vertical to Axis c	7.0	2.1 (40°C~800°C)					2.1 (40°C~800°C)
	Thermal Conductivity	20°C	W/(m · K)	JIS R 1611	8	14	12	16	18	17	24	29	32	32	32	34	41		4	4	2	3	5	5
	Specific Heat Capacity	J/(g · K)	JIS R 1611	0.75	0.75	0.75	0.79	0.78	0.78	0.78	0.79	0.78	0.78	0.78	0.79	0.78	0.75		0.71	—	0.75	0.72	0.78	0.75
Thermal Shock Temperature Difference (Put in Water, Relative Method)	°C	JIS R 1648	320	—	—	200	200	200	200	200	250	—	—	—	—		—	400	—	—	—	—	—	
Electrical Characteristics	Dielectric Strength		kV/mm	JIS C 2141	12	15	12	16	16	14	15	15	15	15	15	48		19.1	19.3	18	14	17	13	
	Volume Resistivity	20°C	Ω · cm		> 10 ¹⁴	> 10 ¹⁴	10 ¹¹	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	> 10 ¹³	> 10 ¹⁴	> 10 ¹⁴
		300°C			10 ¹⁰	10 ¹⁰	10 ⁷	10 ¹²	10 ¹²	10 ¹⁰	10 ¹⁰	10 ¹⁰	10 ¹⁰	10 ¹³	10 ¹³	10 ¹³	10 ¹³	—	10 ¹²	10 ¹²	10 ¹⁰	10 ⁹	10 ¹³	10 ⁹
		500°C			10 ⁹	10 ⁸	10 ⁵	10 ⁹	10 ¹⁰	10 ⁸	10 ⁸	10 ⁸	10 ¹⁰	10 ¹⁰	10 ¹⁰	10 ¹⁰	10 ¹⁰	10 ¹¹	10 ¹⁰	10 ¹⁰	10 ⁷	10 ⁷	10 ¹⁰	10 ⁹
	Dielectric Constant (1MHz)	—	8.4		8.8	9.8	8.9	9.0	8.9	9.4	9.9	9.9	9.9	9.9	9.9	Parallel to Axis c	11.5	4.9	4.9	6	8	6.5	6.5	
	Dielectric Loss Angle (1MHz)	(× 10 ⁻⁴)	180		6	20	6	6	9	4	2	1	1	1	1	Vertical to Axis c	9.3							
Loss Factor	(× 10 ⁻⁴)	1,500	52	190	53	54	80	38	20	10	10	10	10	—		—	—	108	6,000	20	30			
Chemical Characteristics	Nitric Acid (60%) 90°C, 24H		(Weight Loss) mg/cm ²	—	—	—	—	0.32	0.14	—	0.10	0.07	—	0.05	0.03	≒ 0.00		—	—	—	—	—	—	
	Sulphuric Acid (95%) 95°C, 24H			—	—	—	—	0.65	0.34	—	0.33	0.25	—	0.22	0.19	≒ 0.00		—	—	—	—	—	—	
	Sodium Hydroxide (30%) 80°C, 24H			—	—	—	—	0.91	0.95	—	0.26	0.05	—	0.04	0.03	≒ 0.00		—	—	—	—	—	—	

The values are typical material properties and may vary according to products configuration and manufacturing process. For more details, Please feel free to contact us.

1kgf/mm² = 9.807MPa

1cal/(cm · sec · °C) = 418.6W/(m · K)

* 1: All values for apparent density and bulk density are the same, except for A482R which lists apparent density only.

CHARACTERISTICS of Kyocera Fine Ceramics (2)

Item	Material	YTTRIA (Y ₂ O ₃)			TITANIA			SILICON CARBIDE (SiC)		SILICON NITRIDE (Si ₃ N ₄)			ALUMINIUM NITRIDE (AlN)		ZIRCONIA (ZrO ₂)				CERMET	
		YO100A	T716	T716H	T792H	SC211	SC1000	SN201B	SN240	SN241	AN216A	AN2000	Z220	Z201N	Z701N	Z21H04	TC30			
Material Code (New)	YO100A	TO716O	TO716H	TO792H	SC211O	SC1000	SN201B	SN240O	SN241O	AN216A	AN2000	ZO220O	ZO201N	ZO701N	Z21H04	TC0300				
Appearance	Dense	Dense			Dense		Dense			Dense		Dense				Dense				
Color	White	Light Brown	Light Brown	Grayish Yellow	Black	Black	Black	Black	Black	Gray	Ivory	Yellow	Ivory	Ash Black	Black	Silver				
Content (%)	—	—	—	—	—	—	—	—	—	—	A ₂ N _{99.9}	—	—	—	—	—				
Main Characteristics	<ul style="list-style-type: none"> • Good Plasma Resistance 	Good Surface Finish <ul style="list-style-type: none"> • CaTiO₃ • BaTiO₃ 			<ul style="list-style-type: none"> • High Temperature Strength • High Chemical Resistance, Excellent Thermal • Conductivity 	<ul style="list-style-type: none"> • High Temperature Strength • Wear Resistant • Excellent Thermal Shock Resistance • Light Weight 	<ul style="list-style-type: none"> • High Electrical Insulation, • High Thermal Conductivity 	<ul style="list-style-type: none"> • High Mechanical Strength, • Excellent Wear Resistance, • Good Surface Finish, • High Fracture Toughness 	<ul style="list-style-type: none"> • High Mechanical Strength, • Excellent Wear Resistance, • High Heat Shock Resistance, • Electrical Conductivity 											
Main Applications	<ul style="list-style-type: none"> • SPE Parts 	<ul style="list-style-type: none"> • Slider Pads for Disk Drive Heads 			<ul style="list-style-type: none"> • Mechanical Seal, • High Temperature Resistance Parts 	<ul style="list-style-type: none"> • Anti Wear Liner • Powder Equipment • Molten Metal Parts • Metal Forming Tool 	<ul style="list-style-type: none"> • Heat Uniformity Parts, • High Temperature Treatment Fixtures, • Semiconductor Processing Equipment Parts 	<ul style="list-style-type: none"> • Pump Parts, Dies, Knives, • Cutting Blades, Spikes, • Club Faces, Scissors 	<ul style="list-style-type: none"> • Cutting Tool Tips, • Wear Resistant Parts, • Metal Forming Tools 											
Density (*1)	g/cm ³	JIS R 1634	4.9	3.9	4.0	4.5	3.2	3.16	3.2	3.3	3.2	3.4	3.2	5.6	6.0	6.0	5.6	6.0		
Water Absorption	%	JIS C 2141	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Mechanical Characteristics	Vickers Hardness HV9.807N	GPa	JIS R 1610	6.0	8.5	8.8	8.1	22.0	23.0	13.9	14.0	13.8	10.4	11.2	10.7	12.3	12.7	10.8	16.2	
	Flexural Strength 3 P.B.	MPa	JIS R 1601	130	320	320	230	540	450	580	1,020	790	310	220	750	1,000	1,470	710	1,470	
	Compressive Strength	MPa	JIS R 1608	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3,430	
	Young's Modulus of Elasticity	GPa	JIS R 1602	160	260	270	180	430	440	290	300	290	320	310	200	200	220	210	440	
	Poisson's Ratio	—		—	—	—	—	0.16	0.17	0.28	0.28	0.28	0.24	0.24	0.31	0.31	0.31	—	0.21	
Fracture Toughness (SEPB)	MPa · m ^{1/2}	JIS R 1607	1.1	—	—	—	4 ~ 5	2 ~ 3	4 ~ 5	7	6 ~ 7	—	—	7 ~ 8	4 ~ 5	4 ~ 5	3 ~ 4	—		
Thermal Characteristics	Coefficient of Linear Thermal Expansion	40 – 400°C	× 10 ⁻⁶ /K	JIS R 1618	7.2	11.5	11.5	9.6	3.7	3.7	2.4	2.8	2.9	4.6	4.6	10	10.5	10.8	10.3	7.4
		40 – 800°C			7.6	12.1	12.1	—	4.4	4.4	3.2	3.3	3.5	5.3	5.2	10.5	11.0	11.3	11.4	8.3
	Thermal Conductivity	20°C	W/(m · K)	JIS R 1611	14	4	4	2	60	200	25	27	54	150	67	3	3	3	3	17
	Specific Heat Capacity	J/(g · K)	JIS R 1611	0.45	0.71	0.71	0.59	0.67	0.67	0.64	0.65	0.66	0.71	0.72	0.46	0.46	0.46	0.48	—	
Thermal Shock Temperature Difference	(Put in Water, Relative Method)	°C	JIS R 1648	—	—	—	—	400	—	550	800	900	—	—	450	300	350	—	310	
Electrical Characteristics	Dielectric Strength	kV/mm	JIS C 2141	11	—	—	—	—	—	—	13	12	14	16	13	11	—	—	—	
	Volume Resistivity	20°C		>10 ¹³	10 ¹²	10 ¹²	10 ¹²	10 ⁵	10 ⁸	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	10 ¹³	—	10 ⁸	10 ⁻⁴
		300°C		10 ¹⁰	—	—	—	10 ⁴	10 ⁴	10 ¹²	10 ¹²	10 ¹²	10 ¹⁰	10 ¹¹	10 ⁶	10 ⁶	—	—	—	
		500°C		10 ⁷	—	—	—	10 ³	10 ³	10 ¹⁰	10 ¹⁰	10 ¹⁰	10 ⁹	10 ⁹	10 ⁴	10 ³	—	—	—	
	Dielectric Constant	(1MHz)		—	11	—	—	—	—	—	—	9.6	9.6	8.6	8.5	28	33	—	—	—
	Dielectric Loss Angle	(1MHz)		(× 10 ⁻⁴)	5	—	—	—	—	—	—	19	18	3	2	17	16	—	—	—
Loss Factor	(× 10 ⁻⁴)	55	—	—	—	—	—	—	—	—	—	26	17	476	520	—	—	—		
Chemical Characteristics	Nitric Acid (60%) 90°C, 24H	(Weight Loss) mg/cm ²	—	—	—	—	0.04	≒ 0.00	—	1.11	0.18	—	—	—	≒ 0.00	≒ 0.00	—	6.0		
	Sulphuric Acid (95%) 95°C, 24H		—	—	—	—	0.01	≒ 0.00	—	0	0	—	—	—	0.04	0.04	—	0.26		
	Caustic Soda (30%) 80°C, 24H		—	—	—	—	≒ 0.00	≒ 0.00	—	0.22	0.07	—	—	—	0.08	0.08	—	0.02		

The values are typical material properties and may vary according to products configuration and manufacturing process. For more details, Please feel free to contact us.

1kgf/mm² = 9.807MPa

1cal/(cm · sec · °C) = 418.6W/(m · K)

* 1: All values for apparent density and bulk density are the same, except for A482R which lists apparent density only.

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