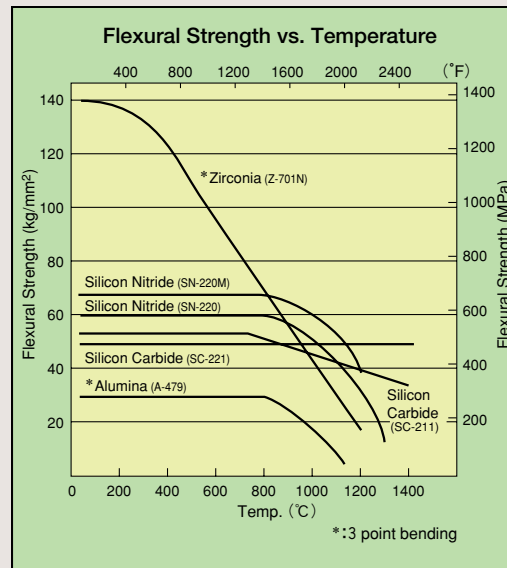
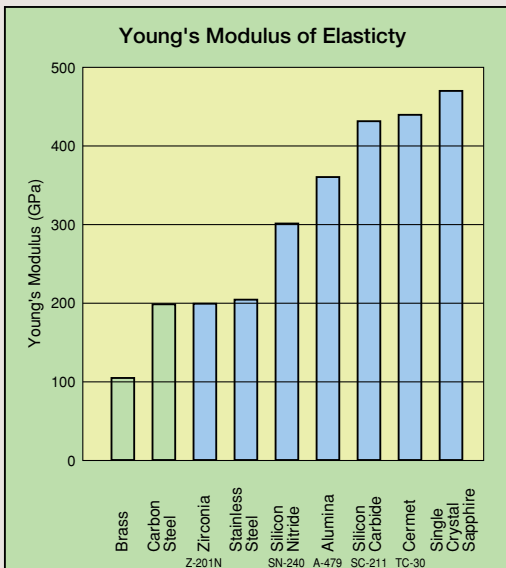
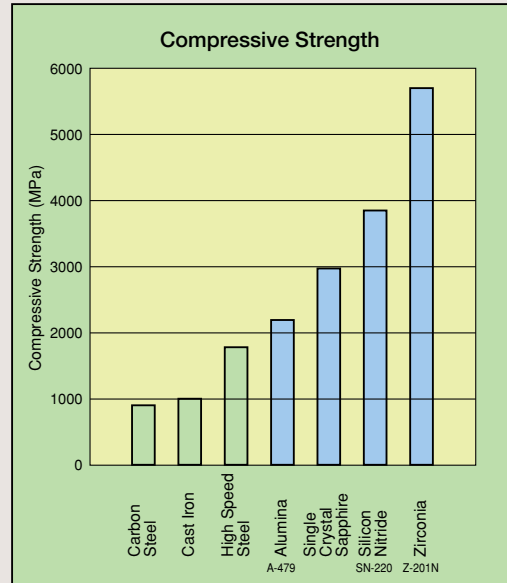
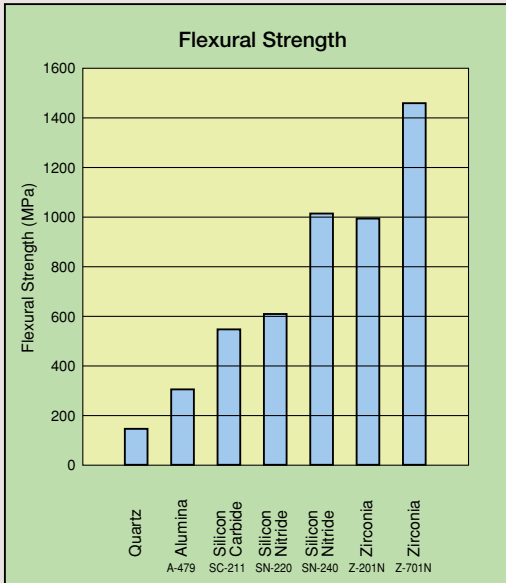
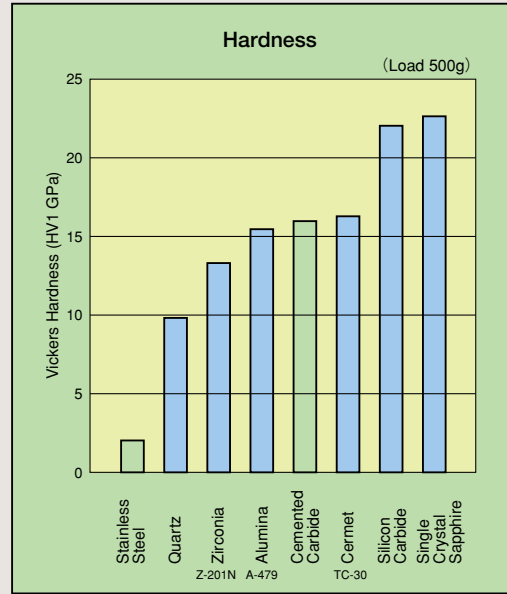
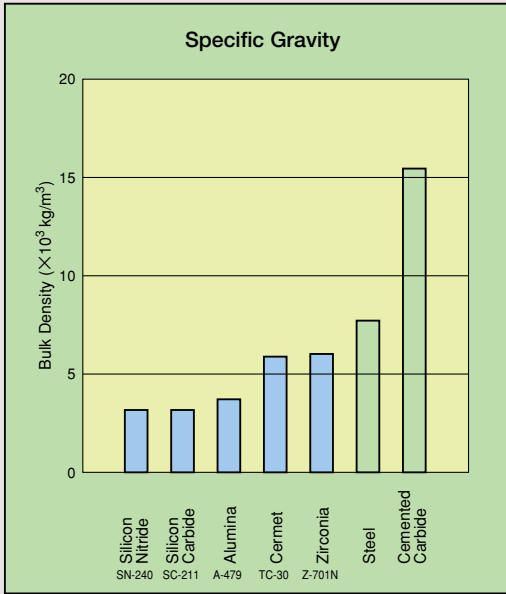


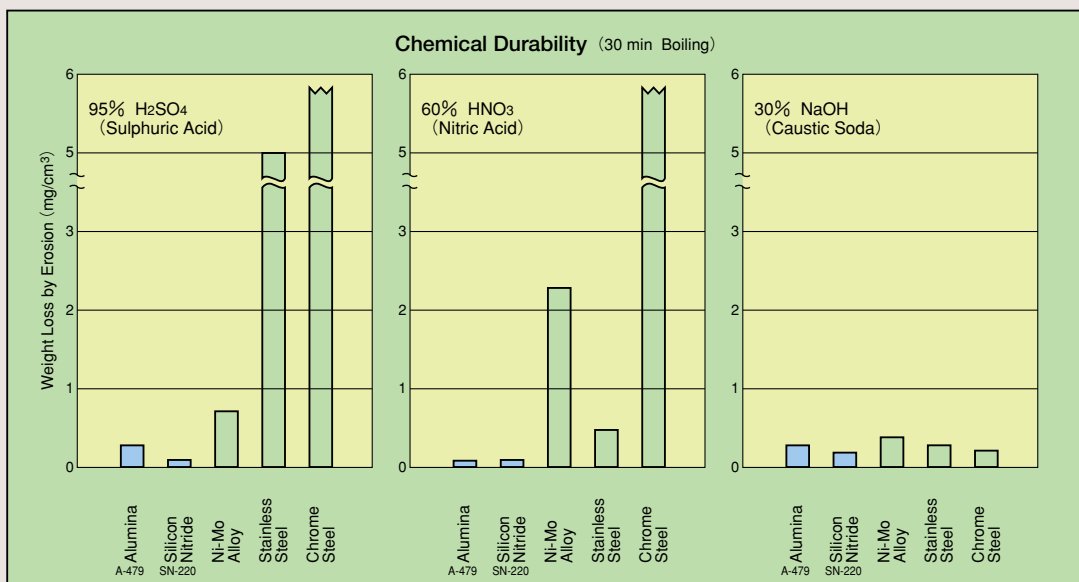
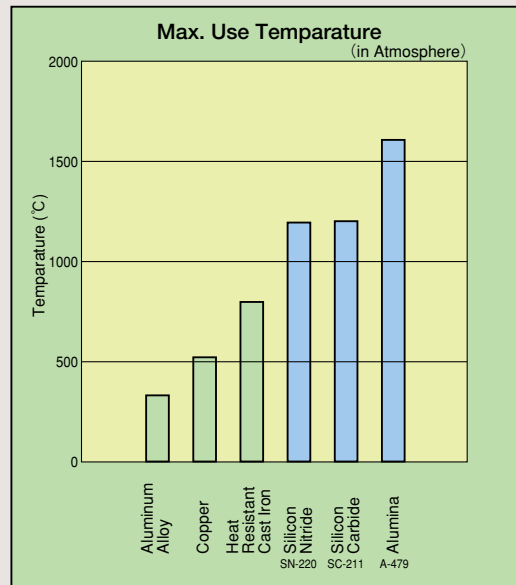
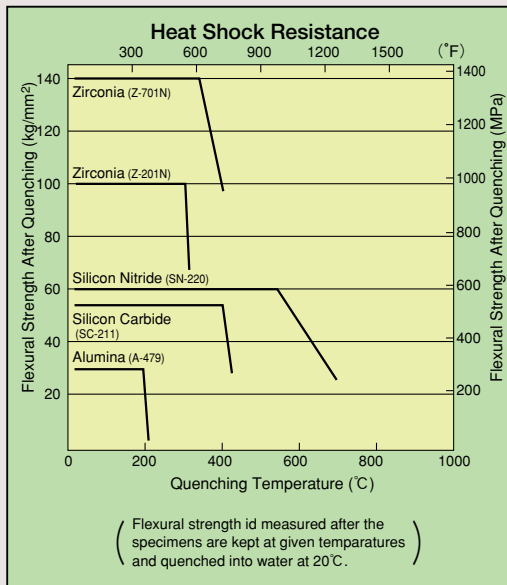
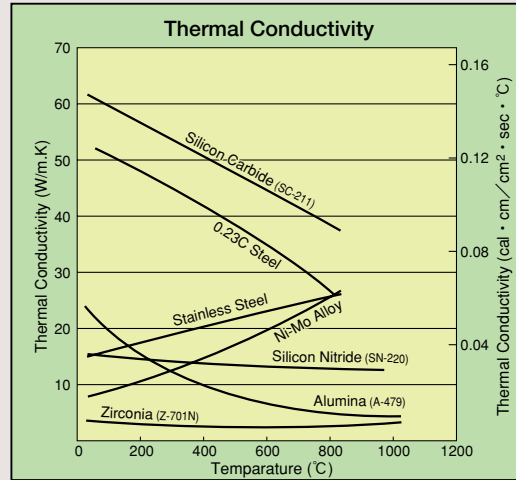
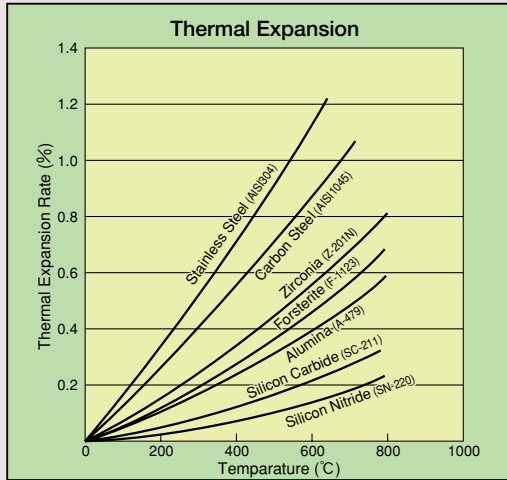
THE NEW VALUE FRONTIER



**CHARACTERISTICS
OF
KYOCERA
TECHNICAL
CERAMICS**

MATERIAL COMPARISON CHARTS





Unit Conversion Table

■ Stress			
MPa or N/mm ²	Kgf/mm ²	Kgf/cm ²	10 ³ lb/in ² (Kpsi)
1	1.0197 × 10 ⁻¹	1.0197 × 10	0.145
9.807	1	1 × 10 ²	1.422
9.807 × 10 ⁻²	1 × 10 ⁻²	1	1.422 × 10 ⁻²
6.895	0.703	70.3	1

■ Thermal Conductivity		
W/m · k	Kcal/m · h · °C	cal/cm · sec · °C
1	0.86	2.39 × 10 ⁻³
1.163	1	2.78 × 10 ⁻³
418.7	360	1

CHARACTERISTIC of Kyocera Fine Ceramics (1)

Item		Material		ALUMINA (Al ₂ O ₃)								
Kyocera No.				A-482R	A-459	A-445	A-471	A-473	A-484	A-476	A-479	
Appearance				Porous	Dense							
Color				Pink	Russet	Dark Brown	White	White	White	White	White	
Alumina Content (%)				Al ₂ O ₃ 76	89	90	92	92	92	96	99	
Main Characteristics		High Mechanical Strength, High Temperature Resistance, High Frequency Insulation, High										
		•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			
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			
Bulk Density		kg/m ³	JIS C2141	3.6×10 ³	3.6×10 ³	3.8×10 ³	3.6×10 ³	3.6×10 ³	3.6×10 ³	3.7×10 ³	3.8×10 ³	
Water Absorption		%	JIS C2141	0.6	0	0	0	0	0	0	0	
Mechanical Characteristics	Vickers Hardness Load 500g	(GPa)	JIS R1610	9.0	12.1	12.7	11.8	12.3	12.3	13.7	15.2	
	Flexural Strength	MPa	JIS R1601	120	310	320	390	340	370	350	310	
	Compressive Strength	MPa	—	—	—	—	—	2,300	—	—	2,160	
	Young's Modulus of Elasticity	GPa	JIS R1602	160	280	320	280	280	280	320	360	
	Poisson's Ratio	—		0.17	0.23	0.23	0.23	0.23	0.23	0.23	0.23	
	Fracture Toughness	MPa√m	JIS R1607	—	—	—	—	—	—	—	3~4	
Thermal Characteristics	Coefficient of Linear Thermal Expansion	40~400°C	×10 ⁻⁶ /°C	JIS R1618	7.1	7.0	7.3	7.1	6.9	6.8	7.2	7.2
		40~800°C			7.5	7.9	8.1	7.9	7.8	7.7	7.9	8.0
	Thermal Conductivity	20°C	W/(m·K)	JIS R1611	8	14	12	16	18	17	24	29
	Specific Heat	J/(kg·K)	JIS R1611	0.75×10 ³	0.75×10 ³	0.75×10 ³	0.79×10 ³	0.78×10 ³	0.78×10 ³	0.78×10 ³	0.78×10 ³	0.79×10 ³
	Heat Shock Resistance (Put in water)	°C	—	320	—	—	200	200	200	200	200	
Electrical Characteristics	Dielectric Strength		V/m	JIS C2141	12×10 ⁶	15×10 ⁶	12×10 ⁶	16×10 ⁶	16×10 ⁶	14×10 ⁶	15×10 ⁶	15×10 ⁶
	Volume Resistivity	20°C	Ω·cm		>10 ¹⁴	>10 ¹⁴	10 ¹¹	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴
		300°C			10 ¹⁰	10 ¹⁰	10 ⁷	10 ¹²	10 ¹²	10 ¹⁰	10 ¹⁰	10 ¹⁰
		500°C			10 ⁸	10 ⁸	10 ⁵	10 ⁹	10 ¹⁰	10 ⁸	10 ⁸	10 ⁸
	Dielectric Constant (1MHz)	—	8.4		8.8	9.8	8.9	9.0	8.9	9.4	9.9	
	Dielectric Loss Angle (1MHz)	(×10 ⁻⁴)	180		6	20	6	6	9	4	2	
	Loss Factor	(×10 ⁻⁴)	1,500		52	190	53	54	80	38	20	
Chemical Characteristics	Nitric Acid (60%) 90°C		WT Loss mg/cm ² /day	—	—	—	—	—	0.32	0.14	—	0.10
	Sulphuric Acid (95%) 95°C				—	—	—	—	0.65	0.34	—	0.33
	Caustic Soda(30%) 80°C				—	—	—	—	0.91	0.95	—	0.26

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

				SAPPHIRE	MULLITE (3Al ₂ O ₃ ·2SiO ₂)	CORDIERITE (2MgO·2Al ₂ O ₃ ·5SiO ₂)		STEATITE (MgO·SiO ₂)		FORSTERITE (2MgO·SiO ₂)		
A-479SS	A-479M A-479G	A-480S	A-601D A-601L	SA-100	ML-652	CO210	CO710	S-210	S-211	F-1120	F-1023	FC112M
				Dense	Dense	Dense	Dense	Dense		Dense		
Ivory	Ivory	Ivory	Ivory	Transparent	Dark Brown	White	White	White	Dark Brown	Light Yellow		Black
99.5	99.5	99.7	99.9	99.99		—	—	—	—	—	—	—
Chemical Resistance				Single Crystal	•Low Thermal Expansion	•Very Low Thermal Expansion		•Thermal Insulator	•Good Light Shield	•Good Surface Finish	•High Thermal Expansion	•Electro Static Ossipation •Less Voids
•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								
•Pump •Shafts	•Wear Resistant Parts •Chemically Resistant Parts •Semiconductor Processing Equipment Parts			•Thin Film Substrates, •Windows, •Chemically Resistant Parts	•IC Packages	•Semiconductor Processing Equipment Parts		•Various Circuit Parts		•Substrate For Resistor •Core For Resistor		•HDD Parts
3.9×10 ³	3.9×10 ³	3.9×10 ³	3.9×10 ³	3.97×10 ³	3.2×10 ³	2.6×10 ³	2.7×10 ³	2.8×10 ³	3.1×10 ³	3.0×10 ³	3.0×10 ³	3.6×10 ³
0	0	0	0	0	0	0	0	0	0	0	0	0
16.0	15.7	17.2	17.5	22.5	10.8	7.2	7.7	5.8	6.7	7.3	5.9	8.7
360	370	380	400	690	280	150	170	190	220	180	160	210
2,350	—	—	—	2,940	—	—	—	—	—	—	—	—
370	370	380	380	470	210	140	140	120	130	150	150	190
0.23	0.23	0.23	0.23	—	0.27	0.31	0.31	0.22	0.22	0.24	0.24	0.27
4	—	—	5~6	—	—	—	—	—	—	—	—	1~2
7.2	7.2	7.2	7.2	Parallel to Axis C 5.3	5.0	< 0.1 (22~23°C)	< 0.1 (22~23°C)	7.7	9.2	9.7	10.1	10.5
8.0	8.0	8.0	8.0	Vertical to Axis C 4.5	5.8			8.0	10.4	—	—	12.0
32	32	32	34	41	5	4	4	2	3	5	5	4
0.78×10 ³	0.78×10 ³	0.79×10 ³	0.78×10 ³	0.75×10 ³	0.75×10 ³	0.73×10 ³	0.73×10 ³	0.75×10 ³	0.72×10 ³	0.78×10 ³	0.75×10 ³	0.77×10 ³
250	—	—	—	—	—	—	—	—	—	—	—	—
15×10 ⁶	15×10 ⁶	15×10 ⁶	15×10 ⁶	48×10 ⁶	15×10 ⁶	19×10 ⁶	19×10 ⁶	18×10 ⁶	14×10 ⁶	17×10 ⁶	13×10 ⁶	—
>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹³	>10 ¹⁴	>10 ¹⁴	10 ⁴
10 ¹³	10 ¹³	10 ¹³	10 ¹³	—	10 ¹²	10 ¹⁴	10 ¹⁴	10 ¹⁰	10 ⁹	10 ¹³	10 ⁹	—
10 ¹⁰	10 ¹⁰	10 ¹⁰	10 ¹⁰	10 ¹¹	10 ⁹	10 ¹¹	10 ¹¹	10 ⁷	10 ⁷	10 ¹⁰	10 ⁹	—
9.9	9.9	9.9	9.9	Parallel to Axis C 11.5 Vertical to Axis C 9.3	7.4	4.8	4.8	6	8	6.5	6.5	—
1	1	1	1	<1	18	10	10	18	750	3	5	—
10	10	10	10	—	148	48	48	108	6,000	20	30	—
0.07	—	0.05	0.03	≒0.00	—	—	—	—	—	—	—	—
0.25	—	0.22	0.19	≒0.00	—	—	—	—	—	—	—	—
0.05	—	0.04	0.03	≒0.00	—	—	—	—	—	—	—	—

1kgf/mm²=9.807MPa

1cal/cm·sec·°C=418.7W/(m·K)

1cal/g·°C=4.18J/g·K=4.187×10³J/(kg·K)

CHARACTERISTIC of Kyocera Fine Ceramics (2)

Item		Material	YTTRIA (Y ₂ O ₃)	TITANIA			SILICON CARBIDE (SiC)				
Kyocera No.			Y0100A	T-716	T-716H	T-792H	SC-211	SC1000			
Appearance			Dense	Dense			Dence				
Color			White	Light Brown	Light Brown	Grayish Yellow	Black	Black			
Alumina Content (%)			—	—	—	—	—	—			
Main Characteristics			•Good Plasma Resistance	Good Surface Finish			<ul style="list-style-type: none"> •High Temperature Strength •High Chemical Resistance, •Excellent Thermal Conductivity 				
				•CaTiO ₃	•BaTiO ₃				•Fracture Toughness	•Chemical Resistance	
Main Applications			•SPE Parts	•Slider Pads for Disk Drive Heads			<ul style="list-style-type: none"> •Mechanical Seal, •High Temperature Resistance Parts 				
Bulk Density		kg/m ³	JIS C2141	4.9×10 ³	3.9×10 ³	4.0×10 ³	4.5×10 ³	3.2×10 ³	3.16×10 ³		
Water Absorption		%	JIS C2141	0	0	0	0	0	0		
Mechanical Characteristics	Vickers Hardness Load 500g		(GPa)	JIS R1610	6.0	8.5	8.8	8.1	22.0	23.0	
	Flexural Strength		MPa	JIS R1601	130	320	320	230	540	450	
	Compressive Strength		MPa	—	—	—	—	—	—	—	
	Young's Modulus of Elasticity		GPa	JIS R1602	160	260	270	180	430	440	
	Poisson's Ratio		—		—	—	—	—	0.16	0.17	
	Fracture Toughness		MPa √m	JIS R1607	1.1	—	—	—	4~5	2~3	
Thermal Characteristics	Coefficient of Linear Thermal Expansion		40~400°C	×10 ⁻⁶ /°C	JIS R1618	7.2	11.5	11.5	9.6	3.7	3.7
			40~800°C			7.6	12.1	12.1	—	4.4	4.4
	Thermal Conductivity		W/(m · K)	JIS R1611	14	4	4	2	60	200	
	Specific Heat		J/(kg · K)	JIS R1611	0.45×10 ³	0.71×10 ³	0.71×10 ³	0.59×10 ³	0.67×10 ³	0.67×10 ³	
	Heat Shock Resistance (Put in water)		°C	—	—	—	—	—	400	—	
Electrical Characteristics	Dielectric Strength		V/m	JIS C2141	11×10 ⁶	—	—	—	—	—	
	Volume Resistivity	20°C	Ω · cm		>10 ¹³	10 ¹²	10 ¹²	10 ¹²	10 ⁵	10 ⁸	
		300°C			10 ¹⁰	—	—	—	10 ⁴	10 ⁴	
		500°C			10 ⁷	—	—	—	10 ³	10 ³	
	Dielectric Constant (1MHz)		—		11	—	—	—	—	—	
	Dielectric Loss Angle (1MHz)		(×10 ⁻⁴)		5	—	—	—	—	—	
	Loss Factor		(×10 ⁻⁴)		55	—	—	—	—	—	
Chemical Characteristics	Nitric Acid (60%) 90°C		WT Loss mg/cm ² /day	—	—	—	—	—	0.04	≒0.00	
	Sulphuric Acid (95%) 95°C				—	—	—	—	0.01	≒0.00	
	Caustic Soda (30%) 80°C				—	—	—	—	≒0.00	≒0.00	

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

SILICON NITRIDE (Si ₃ N ₄)		ALUMINIUM NITRIDE (AlN)		ZIRCONIA (ZrO ₂)				CERMET	
SN-220	SN-240	AN216A	AN2000	Z-220	Z-201N	Z-701N	Z21H04	TC-30	TC-50
Dence		Dence		Dence				Dence	
Black	Black	Gray	Ivory	Yellow	Ivory	Ash Black	Black	Silver	Silver
—	—	—	AlN 99.9	—	—	—	—	—	—
<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 	
<ul style="list-style-type: none"> ●Internal Combustion Engine Parts, ●Molten Metal Parts, ●Gas Turbine 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 	
3.2×10 ³	3.3×10 ³	3.4×10 ³	3.2×10 ³	5.6×10 ³	6.0×10 ³	6.0×10 ³	5.6×10 ³	6.0×10 ³	7.7×10 ³
0	0	0	0	0	0	0	0	0	0
13.9	14.0	10.4	11.2	10.7	13.2	12.7	10.8	16.2	14.2
610	1,020	310	220	750	1,000	1,470	710	1,470	1,860
3,820	—	—	—	—	5,690	—	—	3,430	3,430
290	300	320	310	200	200	220	210	440	410
0.28	0.28	0.24	0.24	0.31	0.31	0.31	—	0.21	0.23
5	7	—	—	7~8	4~5	4~5	3~4	—	—
2.6	2.8	4.6	4.6	10	10.5	10.8	10.3	7.4	7.8
3.2	3.3	5.3	5.2	10.5	11.0	11.3	11.4	8.3	—
20	27	150	67	3	3	3	3	17	13
0.66×10 ³	0.65×10 ³	0.71×10 ³	0.72×10 ³	0.46×10 ³	0.46×10 ³	0.46×10 ³	0.48×10 ³	—	—
550	>800	—	—	450	300	350	—	310	360
10×10 ⁶	13×10 ⁶	14×10 ⁶	16×10 ⁶	13×10 ⁶	11×10 ⁶	—	—	—	—
>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	10 ¹³	—	10 ⁸	10 ⁻⁴	10 ⁻⁴
10 ¹²	10 ¹²	10 ¹⁰	10 ¹¹	10 ⁶	10 ⁶	—	—	—	—
10 ¹⁰	10 ¹⁰	10 ⁸	10 ⁹	10 ⁴	10 ³	—	—	—	—
—	9.6	8.6	8.5	28	33	—	—	—	—
—	19	3	2	17	16	—	—	—	—
—	—	26	17	476	520	—	—	—	—
1.00	1.11	—	—	—	≒0.00	≒0.00	—	6.0	2.6
0.40	0.00	—	—	—	0.04	0.04	—	0.26	0.73
0.36	0.20	—	—	—	0.08	0.08	—	0.02	0.03

1kgf/mm²=9.807MPa

1cal/cm · sec · °C=418.7W/(m · K)

1cal/g · °C=4.18J/g · K=4.187×10³J/(kg · K)



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Application and the using conditions are required to be consulted on when to consider purchase.