

Characteristic

Material			Alumina	Alumina	Alumina	Alumina	Alumina	
Nishimura No.			N-92	N-96	N-6H	N-9H	N-99	
Property			Al ₂ O ₃ 92%	Al ₂ O ₃ 96%	Al ₂ O ₃ 96%	Al ₂ O ₃ over 99.7%	Al ₂ O ₃ over 99.7%	
Color			White	White	White	Cream	Cream	
Bulk density	g/cm ³	JIS R1634	3.6	3.7	3.7	3.9	3.9	
Water absorption	%	JIS R1634	0	0	0	0	0	
Mechanical Properties	Vickers hardness	GPa	JIS R1610	15.7	15.7	15.7	16	16
	Flexural strength	MPa	JIS R1601	340	350	350	390	390
	Compressive strength	MPa	JIS R1608	2350	2450	2450	2940	2940
	Tensile strength	MPa	JIS R 1606	120	150	150	170	170
	Fracture toughness(SEPB)	MPa·m ^{1/2}	JIS R1607	—	—	—	—	—
Electrical Properties	Volume resistivity	Ω·cm	JIS C2141	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹⁶	>10 ¹⁴
	Dielectric constant(1MHz)		JIS C2141	8.5	9	9	9.3	9.3
	Dielectric loss tangent(1MHz)		JIS C2141	3.5 × 10 ⁻⁴	3.6 × 10 ⁻⁴	3.6 × 10 ⁻⁴	3.7 × 10 ⁻⁴	3.7 × 10 ⁻⁴
	Dielectric strength	kV/mm	JIS C2141	>10	>10	>10	>16	>16
	Te value	°C		1000	1100	1100	1100	1100
Thermal Properties	Thermal expansion coefficient	10 ⁻⁶ /°C	JIS R1608	7.5	7.7	7.7	8	8
	Thermal conductivity	W/m·K	JIS R1611	16.7	21.8	21.8	39	31.4
	Max. operation temperature	°C		1200	1200	1200	1200	1200
Strong Point			Heat resistant Abrasion/Wear resistant	Heat resistant Abrasion/Wear resistant	Excellent thermal radiation Wear resistant	Excellent thermal radiation Wear resistant	Heat resistant Wear resistant	
Usefulness			Insulator	Circuit board, Electronic parts Shaft	Heat sink material Electronic parts	Heat sink material Electronic parts	Electronic, Machine parts Semiconductor device	

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Characteristic

Material				Alumina	Alumina	Alumina	Alumina
Nishimura No.				N-999	N-999S	N-9000NS	N-9000T
Property				Al ₂ O ₃ over 99.9%	Al ₂ O ₃ over 99.9%	Al ₂ O ₃ over 99.95%	Al ₂ O ₃ over 99.9%
Color				White	Cream	Translucent	White
	Bulk density	g/cm ³	JIS R1634	3.93	3.97	3.99	3.99
	Water absorption	%	JIS R1634	0	0	0	0
Mechanical Properties	Vickers hardness	GPa	JIS R1610	17.6	21.37	21.4	18.8
	Flexural strength	MPa	JIS R1601	490	500	822	750
	Compressive strength	MPa	JIS R1608	3200	2500	5779	5500
	Tensile strength	MPa	JIS R 1606	175	—	213	213
	Fracture toughness (SEPB)	MPa·m ^{1/2}	JIS R1607	—	—	—	—
Electrical Properties	Volume resistivity	Ω·cm	JIS C2141	>10 ¹⁶	>10 ¹⁶	2.0×10 ¹⁶ (20~100°C)	2.0×10 ¹⁶ (20~100°C)
	Dielectric constant (1MHz)		JIS C2141	9.7	—	10	10
	Dielectric loss tangent (1MHz)		JIS C2141	4×10 ⁻⁴	1×10 ⁻³	1×10 ⁻³	1×10 ⁻³
	Dielectric strength	kV/mm	JIS C2141	>16	>16	>16	>16
	Te value	°C		1100	—	1000	1000
Thermal Properties	Thermal expansion coefficient	10 ⁻⁶ /°C	JIS R1608	8	7.84	8.2	8.2
	Thermal conductivity	W/m·K	JIS R1611	28.9	33.4	37	41
	Max. operation temperature	°C		1200	1200	1200	1200
Strong Point				Wear resistant Plasma resistant	Wear resistant Plasma resistant	Translucent Plasma resistant Wear resistant Very small crystal	High-reflectivity Ultraviolet resistant
Usefulness				Antifriction parts Plasma resistance parts	Antifriction parts Plasma resistance parts	LED circuit board Precision parts Substitution of Sapphire pipe, window application	Optical reflector

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Characteristic

Material			Alumina (Black)	Alumina (Black)	Porous Alumina	Porous Alumina	Zirconia
Nishimura No.			N-92D	N-9B	R-200	N-99EP	N-650
Property			Al ₂ O ₃	Al ₂ O ₃	Al ₂ O ₃	Al ₂ O ₃	(Tosoh) ZrO ₂
Color			Black	Black	White	White	Milky White
Bulk density	g/cm ³	JIS R1634	3.6	3.8	1.5	2.5	6
Water absorption	%	JIS R1634	0	0	35	14	0
Mechanical Properties	Vickers hardness	GPa	—	10.5			12.3
	Flexural strength	MPa	300	330		200	1200
	Compressive strength	MPa	1550	2600			—
	Tensile strength	MPa	JIS R 1606	120	160		—
	Fracture toughness (SEPB)	MPa·m ^{1/2}	JIS R1607	—	—		
Electrical Properties	Volume resistivity	Ω·cm	JIS C2141	>10 ¹⁴	>10 ¹⁴		>10 ¹²
	Dielectric constant (1MHz)		JIS C2141	8.5	8.5		33
	Dielectric loss tangent (1MHz)		JIS C2141	3.5 × 10 ⁻⁴	3.5 × 10 ⁻⁴		16 × 10 ⁻⁴
	Dielectric strength	kV/mm	JIS C2141	10	10		11
	Te value	°C		700	1000		—
Thermal Properties	Thermal expansion coefficient	10 ⁻⁶ /°C	JIS R1608	8.2	8.2		9.1
	Thermal conductivity	W/m·K	JIS R1611	16.7	22		3
	Max. operation temperature	°C		1000	1000	1100	1100
Strong Point					Pore size 1.4 μm Porosity 55.0%	Pore size 0.1 μm Porosity 35.0%	Wear resistant Fracture toughness
Usefulness			Electrical parts Optical parts	Electrical parts Optical parts	Vacuum Chuck Filter	Filter Bubble generator	Cutters Machine parts

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Characteristic

Material				Zirconia	Zirconia(Black)	Zirconia	Yttria	Aluminum nitride	
Nishimura No.				N-650H	N-650B	N-631	N-100Y	AlN-170	
Property				(Tosoh) ZrO ₂	(Tosoh) ZrO ₂	ZrO ₂ ·Al ₂ O ₃	Y ₂ O ₃	AlN	
Color				Gray	Black	Brown	White	Gray	
Bulk density		g/cm ³	JIS R1634	6	6	5.7	4.9	3.3	
Water absorption		%	JIS R1634	0	0	0	0	0	
Mechanical Properties	Vickers hardness		GPa	JIS R1610	12.7	12	12.5	6	10
	Flexural strength		MPa	JIS R1601	1700	1200	874	122	350
	Compressive strength		MPa	JIS R1608	—	—	—	—	—
	Tensile strength		MPa	JIS R 1606	—	—	—	—	—
	Fracture toughness(SEPB)		MPa·m ^{1/2}	JIS R1607	5~6	5~6	9.2	—	—
Electrical Properties	Volume resistivity		Ω·cm	JIS C2141	—	>10 ⁸	—	>10 ¹⁴	>10 ¹⁴
	Dielectric constant(1MHz)			JIS C2141	—	—	—	11.4	8.8
	Dielectric loss tangent(1MHz)			JIS C2141	—	—	—	—	5×10 ⁻⁴
	Dielectric strength		kV/mm	JIS C2141	—	—	—	—	—
	T _e value		°C		—	—	—	—	—
Thermal Properties	Thermal expansion coefficient		10 ⁻⁶ /°C	JIS R1608	—	9.1	9.26	—	4.5
	Thermal conductivity		W/m·K	JIS R1611	3	3	—	11.4	170
	Max. operation temperature		°C		1100	1100	—	—	—
Strong Point				Wear resistant Fracture toughness	Wear resistant Fracture toughness	Highest Fracture Toughness	Corrosion resistant	Excellent thermal conductivity	
Usefulness				Cutters Machine parts	Cutters Machine parts	Smart phone parts	Semiconductor, Plasma resistance parts	Semiconductor devices High heat conduction parts	

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Characteristic

Material			Silicon Carbide	Silicon Nitride	Dense cordierite	Aluminum titanate	Forsterite	
Nishimura No.			-	-	N-600	N-420	N-75	
Property			SiC	Si3N4	2MgO·2Al2O3·5SiO2	Al2O3·TiO2	Mg2SiO4	
Color			Black	Gray	White	Gray	Light yellow	
Bulk density	g/cm ³	JIS R1634	3.1	3.2	2.5	3.3	3	
Water absorption	%	JIS R1634	0	0	0	<2.0	0	
Mechanical Properties	Vickers hardness	GPa	25	15	9	—	—	
	Flexural strength	MPa	490	800	150	39	150	
	Compressive strength	MPa	—	—	—	176	—	
	Tensile strength	MPa	—	—	—	—	—	
	Fracture toughness(SEPB)	MPa·m ^{1/2}	JIS R1607	—	—	—	—	—
Electrical Properties	Volume resistivity	Ω·cm	JIS C2141	>10 ⁶	>10 ¹⁴	>10 ¹⁴	3.8x10 ¹⁰ (oxidation firing)	—
	Dielectric constant(1MHz)		JIS C2141	—	—	4.9	—	6.5
	Dielectric loss tangent(1MHz)		JIS C2141	—	—	9×10 ⁻⁴	—	3×10 ⁻⁴
	Dielectric strength	kV/mm	JIS C2141	—	—	19	>10	—
	Te value	°C		—	—	—	—	—
Thermal Properties	Thermal expansion coefficient	10 ⁻⁶ /°C	JIS R1608	4.2	3.1	1.7(30~700°C)	0.7	9.7
	Thermal conductivity	W/m·K	JIS R1611	170	24	4.8	1.5	3.4
	Max. operation temperature	°C		—	—	—	1500	1000
Strong Point					Dense and low thermal expansion (Almost zero TEC in room temperature)	Low-thermal expansion Thermal shock residence	High-thermal expansion Glass bond ability	
Usefulness					Low dielectric constant high heat	Thermal shock resistant parts Aluminum	High frequency insulation parts	

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Characteristic

Material			Forsterite (Black)	Steatite	Steatite (Black)	β -spodumene	Zircon	
Nishimura No.			FB-10	N-68	N-6805B	N-10J	N-300	
Property			Mg_2SiO_4	$MgO \cdot SiO_2$	$MgO \cdot SiO_2$	$LiO_2 \cdot Al_2O_3 \cdot SiO_2$	$ZrSiO_4$	
Color			Dark brown	White	Black	White	White	
Bulk density	g/cm ³	JIS R1634	3.2	2.7	2.8	2.2	3.2	
Water absorption	%	JIS R1634	0	0	0	<1.0	<0.1	
Mechanical Properties	Vickers hardness	GPa	8.19	7.5	—	1.4	—	
	Flexural strength	MPa	187	118	120	80	100	
	Compressive strength	MPa	—	550	560	200	353	
	Tensile strength	MPa	—	59	60	20	68.6	
	Fracture toughness (SEPB)	MPa·m ^{1/2}	JIS R1607	1.3	—	—	—	—
Electrical Properties	Volume resistivity	$\Omega \cdot cm$	$>10^{13}$	$>10^{13}$	$>10^{13}$	$>10^{13}$	$>10^{13}$	
	Dielectric constant (1MHz)		—	6	6	5.3	8	
	Dielectric loss tangent (1MHz)		—	5×10^{-4}	5×10^{-4}	4.8×10^{-4}	2.2×10^{-4}	
	Dielectric strength	kV/mm	JIS C2141	>10	10	10	5~10	15
	Te value	°C		—	640	630	500	850
Thermal Properties	Thermal expansion coefficient	$10^{-6}/^{\circ}C$	JIS R1608	11.1	7.8	8.1	0.4~0.5 (20~25°C)	3.2
	Thermal conductivity	W/m·K	JIS R1611	5.9	2.5	—	2	7
	Max. operation temperature	°C		1000	1000	1000	1100	1100
Strong Point			High-thermal expansion Glass bond ability			Heat resistant Thermal shock resistant	Thermal shock resistance Great Arc-proof	
Usefulness			Parts for optical instrument	Low frequency insulation parts	Low frequency insulation parts	Heat resistance parts Thermal shock resistance parts	Lateral plate Arc barrier	

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Characteristic

Material				Zircon	Zircon	Zircon	Zircon Cordierite
Nishimura No.				N-330	N-370	N-37C	N-32
Property				ZrSiO ₄	ZrSiO ₄	ZrSiO ₄	ZrO ₂ ·SiO ₂ - 2MgO·2Al ₂ O ₃ ·5SiO ₂
Color				White	Brown	White	White
Bulk density		g/cm ³	JIS R1634	2.8	2.8	3.6	2.8
Water absorption		%	JIS R1634	<7	12~15	<1	0
Mechanical Properties	Vickers hardness		GPa	JIS R1610	—	—	7
	Flexural strength		MPa	JIS R1601	25	25	120
	Compressive strength		MPa	JIS R1608	39.2	67.7	400
	Tensile strength		MPa	JIS R 1606	12.7	12.2	80
	Fracture toughness(SEPB)		MPa·m ^{1/2}	JIS R1607	—	—	—
Electrical Properties	Volume resistivity		Ω·cm	JIS C2141	>10 ¹⁴	>10 ¹³	>10 ¹³
	Dielectric constant(1MHz)			JIS C2141	7.5	6.3	6.3
	Dielectric loss tangent(1MHz)			JIS C2141	3.8×10 ⁻⁴	5.4×10 ⁻⁴	5×10 ⁻⁴
	Dielectric strength		kV/mm	JIS C2141	—	—	—
	Te value		°C		600	570	920
Thermal Properties	Thermal expansion coefficient		10 ⁻⁶ /°C	JIS R1608	3.0	4.8	4.3
	Thermal conductivity		W/m·K	JIS R1611	5.5	5	6.7
	Max. operation temperature		°C		1100	1100	1200
Strong Point				Thermal shock resistance Great Arc-proof	Far infrared heater	Thermal shock resistant	Thermal shock resistant
Usefulness				Lateral plate Arc barrier	Far infrared heater	Thermal shock resistant parts	Thermal shock resistant parts Circuit breaker

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Characteristic

Material			Cordierite	Cordierite	Mullite	Ordinary porcelain	
Nishimura No.			N-23S	N-53	N-800	N-04	
Property			$2\text{MgO} \cdot 2\text{Al}_2\text{O}_3 \cdot 5\text{SiO}_2$	$2\text{MgO} \cdot 2\text{Al}_2\text{O}_3 \cdot 5\text{SiO}_2$	$3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	$\text{SiO}_2 \cdot \text{Al}_2\text{O}_3$	
Color			White	Dark Brown	White	White	
Bulk density	g/cm ³	JIS R1634	2.2	2.2	2.7	2.3	
Water absorption	%	JIS R1634	<0.5	0	<0.01	<0.01	
Mechanical Properties	Vickers hardness	GPa	JIS R1610	1.4	7.5	9.8	—
	Flexural strength	MPa	JIS R1601	120	98	180	80
	Compressive strength	MPa	JIS R1608	566	392	1200	300
	Tensile strength	MPa	JIS R 1606	35	29	130	20
	Fracture toughness (SEPB)	MPa·m ^{1/2}	JIS R1607	—	—	—	—
Electrical Properties	Volume resistivity	Ω·cm	JIS C2141	>10 ¹³	>10 ¹³	>10 ¹³	>10 ¹³
	Dielectric constant (1MHz)		JIS C2141	4	5.9	6.5	5.9
	Dielectric loss tangent (1MHz)		JIS C2141	4 × 10 ⁻⁴	4 × 10 ⁻⁴	3.7 × 10 ⁻⁴	5.3 × 10 ⁻⁴
	Dielectric strength	kV/mm	JIS C2141	—	10~20	10~20	10
	Te value	°C		500	750	650	300
Thermal Properties	Thermal expansion coefficient	10 ⁻⁶ /°C	JIS R1608	2.8	2.6	5.3	6.7
	Thermal conductivity	W/m·K	JIS R1611	1.25	1.8	4.2	1.7
	Max. operation temperature	°C		1100	1100	1100	800
Strong Point			Low-thermal expansion Thermal shock resistant	Thermal shock resistance Low-thermal expansion	Thermal shock resistance Electric insulation		
Usefulness			Parts for semiconductor devices Low-thermal expansion parts	Thermal shock resistant parts Low-thermal expansion parts	Thermal shock resistant parts	Electric insulation parts Insulator	

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