Characteristic

Material				Alumina	Alumina	Alumina	Alumina	Alumina
Nishimura No.				N-92	N-96	N-6H	N-9H	N-99
Property				Al_2O_3 92%	Al_2O_3 96%	Al_2O_3 96%	Al_2O_3 over 99.7%	Al_2O_3 over 99.5%
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	16.0	16.0
	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)	$MPa \cdot m^{1/2}$	JIS R1607	–	–	–	–	–
	Young's Modulus	GPa	JIS R1 602	296	329	–	–	390
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	>20
	Te value	℃		1000	1100	1100	1100	1100
Thermal Properties	Thermal expansion coefficient	$10^{-6}/℃$	JIS R1608	7.5	7.7	7.7	8.0	8.0
	Thermal conductivity	W/m·K	JIS R1611	16.7	21.8	21.8	39	31.4
	Max. operation temperature	℃		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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NISHIMURA ADVANCED CERAMICS CO., LTD,
2026.4.15

Characteristic

Material				Alumina	Alumina	Alumina	Alumina
Nishimura No.				N-999	N-999S	N-9000NS	N-9000T
Property				Al_2O_3 over 99.9%	Al_2O_3 over 99.9%	Al_2O_3 over 99.9%	Al_2O_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	17.8	20.3	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)	$MPa \cdot m^{1/2}$	JIS R1607	–	–	–	–
	Young's Modulus	GPa	JIS R1 602	–	–	406	–
Electrical Properties	Volume resistivity	Ω·cm	JIS C2141	$>10^{16}$	$>10^{16}$	2.0×10^{16}(20～100℃)	2.0×10^{16}(20～100℃)
	Dielectric constant(1MHz)		JIS C2141	9.7	—	10	10
	Dielectric loss tangent(1MHz)		JIS C2141	4×10^{-4}	$1x10^{-3}$	1×10^{-3}	1×10^{-3}
	Dielectric strength	kV/mm	JIS C2141	>20	>20	>20	>20
	Te value	℃		1100	–	1000	1000
Thermal Properties	Thermal expansion coefficient	10^{-6}/℃	JIS R1608	8.0	7.8	8.2	8.2
	Thermal conductivity	W/m·K	JIS R1611	28.9	33.4	37	41
	Max. operation temperature	℃		1200	1200	1100	1100
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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2026.4.15

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_2O_3	Al_2O_3	Al_2O_3	Al_2O_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	6.0
Water absorption		%	JIS R1634	0	0	35	14	0
Mechanical Properties	Vickers hardness	GPa	JIS R1610	–	10.5			12.3
	Flexural strength	MPa	JIS R1601	300	330		200	1200
	Compressive strength	MPa	JIS R1608	1550	2600			–
	Tensile strength	MPa	JIS R 1606	120	160			–
	Fracture toughness (SEPB)	$MPa \cdot m^{1/2}$	JIS R1607	–	–			5～6
	Young's Modulus	GPa	JIS R1 602	–	–			–
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	℃		700	1000			–
Thermal Properties	Thermal expansion coefficient	10^{-6}/℃	JIS R1608	8.5	8.2			9.1
	Thermal conductivity	W/m·K	JIS R1611	16.7	22			3.0
	Max. operation temperature	℃		1000	1000	–		–
Strong Point						Pore size 1.4 μm	Pore size 0.1 μm	Wear resistant Fracture toughness
Usefulness				Electrical parts Optical parts	Electrical parts Optical parts			Cutters Machine parts

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2026.4.15

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	$ZrO2 \cdot Al_2O_3$	Y_2O_3	AlN
Color				Gray	Black	Brown	White	Amber
Bulk density		g/cm^3	JIS R1634	6.0	6.0	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	6.0	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)	$MPa \cdot m^{1/2}$	JIS R1607	5～6	5～6	9.2	–	–
	Young's Modulus	GPa	JIS R1 602	–	–	–	–	–
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	–	–	–	–	>20
	Te value	℃		–	–	–	–	–
Thermal Properties	Thermal expansion coefficient	10^{-6}/℃	JIS R1608	–	9.1	9.26	–	4.5
	Thermal conductivity	W/m・K	JIS R1611	3.0	3.0	–	11.4	170
	Max. operation temperature	℃		–	–	–	–	–
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		Semiconductor, Plasma resistance parts	Semiconductor devices High heat conduction parts

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2026.4.15

Characteristic

Material				Aluminum titanate	Forsterite	Forsterite(Black)	Steatite	Steatite(Black)
Nishimura No.				N-420	N-75	FB-10	N-68	N-6805B
Property				$Al_2O_3 \cdot TiO_2$	Mg_2SiO_4	Mg_2SiO_4	$MgO \cdot SiO_2$	$MgO \cdot SiO_2$
Color				Gray	Light yellow	Dark brown	White	Black
Bulk density		g/cm^3	JIS R1634	3.3	3.0	3.2	2.7	2.8
Water absorption		%	JIS R1634	＜2.0	0	0	0	0
Mechanical Properties	Vickers hardness	GPa	JIS R1610	–	–	8.19	7.5	–
	Flexural strength	MPa	JIS R1601	39	150	187	118	120
	Compressive strength	MPa	JIS R1608	176	–	–	550	560
	Tensile strength	MPa	JIS R 1606	–	–	–	59	60
	Fracture toughness(SEPB)	$MPa \cdot m^{1/2}$	JIS R1607	–	–	1.3	–	–
	Young's Modulus	GPa	JIS R1 602	–	–	–	–	–
Electrical Properties	Volume resistivity	Ω・cm	JIS C2141	3.8×10^{10}	–	＞10^{13}	＞10^{13}	＞10^{13}
	Dielectric constant(1MHz)		JIS C2141		6.5	–	6.0	6.0
	Dielectric loss tangent(1MHz)		JIS C2141	–	3×10^{-4}	–	5×10^{-4}	5×10^{-4}
	Dielectric strength	kV/mm	JIS C2141	＞10	–	＞10	10	10
	Te value	℃		–	–	–	640	630
Thermal Properties	Thermal expansion coefficient	10^{-6}/℃	JIS R1608	0.7	9.7	11.1	7.8	8.1
	Thermal conductivity	W/m・K	JIS R1611	1.5	3.4	5.9	2.5	–
	Max. operation temperature	℃		1500	1000	1000	1000	1000
Strong Point				Low-thermal expansion Thermal shock residence	High-thermal expansion Glass bond ability	High-thermal expansion Glass bond ability		
Usefulness				Thermal shock resistant parts Aluminum	High frequency insulation parts	Parts for optical instrument	Low frequency insulation parts	Low frequency insulation parts

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2026.4.15

Characteristic

Material				β-spodumene	Zircon	Zircon	Zircon	Zircon
Nishimura No.				N-10J	N-300	N-330	N-370	N-37C
Property				$LiO_2 \cdot Al_2O_3 \cdot SiO_2$	$ZrSiO_4$	$ZrSiO_4$	$ZrSiO_4$	$ZrSiO_4$
Color				White	White	White	Brown	White
Bulk density		g/cm^3	JIS R1634	2.2	3.2	2.8	2.8	3.6
Water absorption		%	JIS R1634	＜1.0	＜0.1	＜7	12～15	＜1
Mechanical Properties	Vickers hardness	GPa	JIS R1610	1.4	–	–	–	–
	Flexural strength	MPa	JIS R1601	80	100	25	25	120
	Compressive strength	MPa	JIS R1608	200	353	39.2	67.7	400
	Tensile strength	MPa	JIS R 1606	20	68.6	12.7	12.2	80
	Fracture toughness(SEPB)	$MPa \cdot m^{1/2}$	JIS R1607	–	–	–	–	–
	Young's Modulus	GPa	JIS R1 602	–	–	–	–	–
Electrical Properties	Volume resistivity	Ω·cm	JIS C2141	＞10^{13}	＞10^{13}	＞10^{14}	＞10^{13}	＞10^{13}
	Dielectric constant(1MHz)		JIS C2141	5.3	8.0	7.5	6.3	6.3
	Dielectric loss tangent(1MHz)		JIS C2141	4.8×10^{-4}	2.2×10^{-4}	3.8×10^{-4}	5.4×10^{-4}	5×10^{-4}
	Dielectric strength	kV/mm	JIS C2141	5～10	15	–	–	–
	Te value	℃		500	850	600	570	920
Thermal Properties	Thermal expansion coefficient	10^{-6}/℃	JIS R1608	0.4～0.5(20～25℃)	3.2	3.0	4.8	4.3
	Thermal conductivity	W/m·K	JIS R1611	2.0	7.0	5.5	5	6.7
	Max. operation temperature	℃		1000	1100	1100	1100	1200
Strong Point				Heat resistant Thermal shock resistant	Thermal shock resistance Great Arc-proof	Thermal shock resistance Great Arc-proof		Thermal shock resistant
Usefulness				Heat resistance parts Thermal shock resistance parts	Lateral plate Arc barrier	Lateral plate Arc barrier		Thermal shock resistant parts

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2026.4.15

Characteristic

Material				Zircon Cordierite	Cordierite	Cordierite	Cordierite
Nishimura No.				N-32	N-23S	N-53	N-600
Property				$ZrO_2 \cdot SiO_2$– $2MgO \cdot 2Al_2O_3 \cdot 5SiO_2$	$2MgO \cdot 2Al_2O_3 \cdot 5SiO_2$	$2MgO \cdot 2Al_2O_3 \cdot 5SiO_2$	2MgO·2Al2O3·5SiO2
Color				White	White	Dark Brown	White
Bulk density		g/cm^3	JIS R1634	2.8	2.2	2.2	2.5
Water absorption		%	JIS R1634	0	＜0.5	0	0
Mechanical Properties	Vickers hardness	GPa	JIS R1610	7	1.4	7.5	9.0
	Flexural strength	MPa	JIS R1601	120	120	98	150
	Compressive strength	MPa	JIS R1608	400	566	392	–
	Tensile strength	MPa	JIS R 1606	80	35	29	–
	Fracture toughness(SEPB)	$MPa \cdot m^{1/2}$	JIS R1607	–	–	–	–
	Young's Modulus	GPa	JIS R1 602	–	–	–	–
Electrical Properties	Volume resistivity	Ω·cm	JIS C2141	＞10^{13}	＞10^{13}	＞10^{13}	＞10^{14}
	Dielectric constant(1MHz)		JIS C2141	6.2	4.0	5.9	4.9
	Dielectric loss tangent(1MHz)		JIS C2141	$3.1x10^{-4}$	4×10^{-4}	4×10^{-4}	9×10^{-4}
	Dielectric strength	kV/mm	JIS C2141	10～20	–	10～20	＞20
	Te value	℃		800	500	750	–
Thermal Properties	Thermal expansion coefficient	10^{-6}/℃	JIS R1608	3.2	2.8	2.6	1.28(RT～600℃) ≦0.02(22～23℃)
	Thermal conductivity	W/m·K	JIS R1611	1.7	1.25	1.8	4.75
	Max. operation temperature	℃		1100	1100	1100	1100
Strong Point				Thermal shock resistant	Low-thermal expansion Thermal shock resistant	Thermal shock resistant	Zero thermal expansion at room temperature, low expansion, and lightweight
Usefulness					Parts for semiconductor devices Low-thermal expansion parts	Thermal shock resistant parts	Material for measuring instruments Calibration reference material

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2026.4.15

Characteristic

Material				Cordierite	Mullite	Ordinary porcelain
Nishimura No.				N-600SP	N-800	N-04
Property				2MgO·2Al2O3·5SiO2	$3Al_2O_3 \cdot 2SiO_2$	$SiO_2 \cdot Al_2O_3$
Color				Gray	Light Gray	White
Bulk density		g/cm^3	JIS R1634	2.5	2.7	2.3
Water absorption		%	JIS R1634	0	＜0.01	＜0.01
Mechanical Properties	Vickers hardness	GPa	JIS R1610	8.6	9.8	–
	Flexural strength	MPa	JIS R1601	263	180	80
	Compressive strength	MPa	JIS R1608	–	1200	300
	Tensile strength	MPa	JIS R 1606	–	130	20
	Fracture toughness(SEPB)	$MPa \cdot m^{1/2}$	JIS R1607	–	–	–
	Young's Modulus	GPa	JIS R1 602	143	–	–
Electrical Properties	Volume resistivity	Ω·cm	JIS C2141	–	＞10^{13}	＞10^{13}
	Dielectric constant(1MHz)		JIS C2141	4.9	6.5	5.9
	Dielectric loss tangent(1MHz)		JIS C2141	6.9×10^{-3}	3.7×10^{-4}	5.3×10^{-4}
	Dielectric strength	kV/mm	JIS C2141	–	10～20	10
	Te value	℃		–	650	300
Thermal Properties	Thermal expansion coefficient	10^{-6}/℃	JIS R1608	1.28(RT～600℃) ≦0.02(22～23℃)	5.3	6.7
	Thermal conductivity	W/m·K	JIS R1611	4.79	4.2	1.7
	Max. operation temperature	℃		1100	1100	800
Strong Point				Zero thermal expansion at room temperature, low expansion, and lightweight	Thermal shock resistance Electric insulation	
Usefulness				Material for measuring instruments Calibration reference material	Thermal shock resistant parts	Electric insulation parts Insulator

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2026.4.15