

Thermally Conductive Filler Materials

APPLICATION

Thermal interface products (Sheets, Grease, Adhesive) | Integrated circuits, etc. |
Additive to various thermosetting resins, thermoplastic resins, rubber, etc.

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High Performance Material Business Headquarters
Ceramics Business Unit

Issue: 5, Nov., 2015
Revise: 15, Oct., 2024

✓ **RESONAC manufactures several kinds of Alumina and Hexagonal Boron Nitride. These have excellent characteristics for rubber and resin-based thermal conductive fillers.**

✦ Low-soda Alumina (AL Series)

The AL series is α -alumina which has reduced soda content, controlled by our proprietary technology. The AL series has several shapes and particle size distributions in production. Extra fine alumina particles are used as an ingredient in resins alongside coarse ingredients.

✦ Roundish Alumina (AS Series)

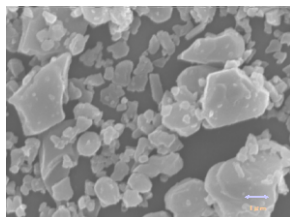
The AS series is a single-grained alumina with less crystal edges. Since the AS series has a large particle diameter and broad particle size distribution, it excels at filling resin and producing compounds with low viscosity and good fluidity.

✦ Spherical Alumina (Alunabeads CB Series)

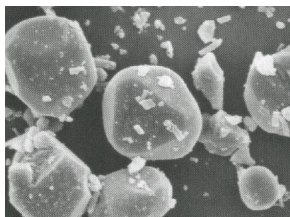
Alunabeads, also known as our CB series, is a spherical single-grained alumina. CB produces compounds with high filling rates and good viscosity. The CB series is featuring various particle sizes and particle distributions to meet your requirements.

✦ Hexagonal Boron Nitride (SHOBN UHP Series)

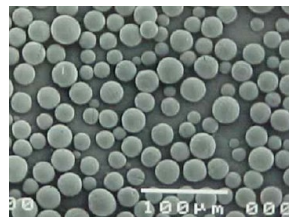
SHOBN, our UHP series is a high purity crystalized Hexagonal Boron Nitride. SHOBN has excellent thermal conductivity, high thermal stability, corrosion resistance, and good electrical characteristics (high electrical insulation, low dielectric constant). The UHP series is used for high heat radiation applications which require electrical insulation.



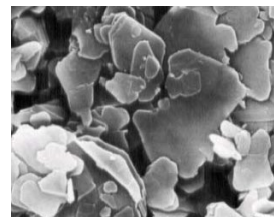
Low-soda (AL series)



Roundish (AS series)



Spherical (Alunabeads CB Series)



Hexagonal Boron Nitride (UHP series)

Comparison of thermal filler properties

Filler	Shape	Mean particle size	Features (filler or compound property)
Low soda Alumina (AL series)	Polygonal	1~2 μm	Low impurity (soda) property, Thixotropy
Roundish Alumina (AS series)	Roundish	9~36 μm	High filling, High purity, Low abrasion, High fluidity
Spherical Alumina (Alunabeads CB series)	Spherical	2~100 μm	High filling, high purity, Low abrasion, High fluidity
Hexagonal Boron Nitride (UHP series)	Platelets	0.7~11 μm	Low specific gravity, Low abrasion, Electrical insulation, Low dielectric constant, Thermal and Chemical stability

Application examples

❖ Thermal interface products (Sheets, Greases, Adhesives), IC circuits, etc., as an additive to various thermosetting, thermoplastic resins, rubbers, etc.

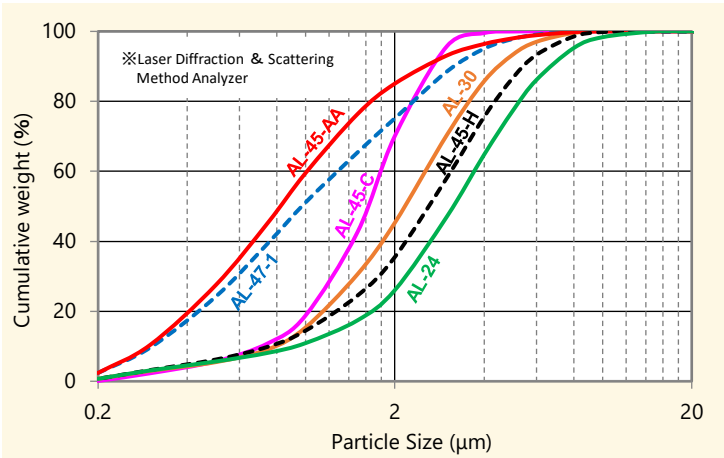
※The data shown above are representative figures. They are not guaranteed values.

<Typical properties of common grades>

			AL-45-AA	AL-47-1	AL-45-C	AL-30	AL-45-H	AL-24
Chemical Composition	L.O.I ※1	%	0.25	0.29	0.22	0.15	0.19	0.15
	Fe ₂ O ₃	%	0.02	0.01	0.02	0.02	0.02	0.01
	SiO ₂	%	0.02	0.03	0.08	0.06	0.03	0.03
	Na ₂ O	%	0.03	0.05	0.04	0.04	0.02	0.03
	Al ₂ O ₃	%	99.68	99.62	99.64	99.73	99.75	99.78
Mean Particle Size (d ₅₀)		μm	0.8	1.0	1.5	2.1	2.6	3.1
BET Specific Surface Area		m ² /g	3.6	3.2	1.9	1.4	1.5	1.3
Bulk Density	Loose	g/cm ³	0.7	0.7	0.8	0.7	0.9	0.9
	Tap	g/cm ³	1.2	1.1	1.1	1.1	1.4	1.4

※1 Loss on ignition

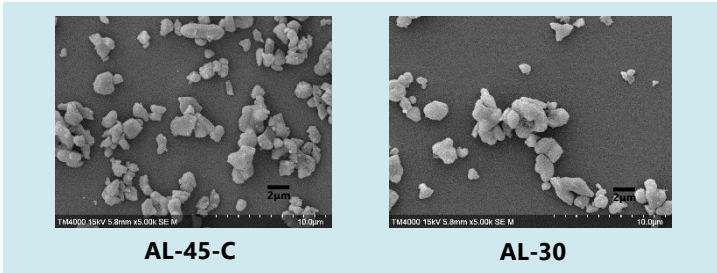
<Particle Size Distribution>



<Features and Advantages>

- 1. AL series is α-alumina which has reduced soda content. AL series has several crystal sizes, shapes, and distributions in production.
- 2. AL series has excellent dispersability, making it suitable for thermal filler.
- 3. Extra fine alumina particles are used as an ingredient in resins alongside coarse ingredients.

<SEM Images>



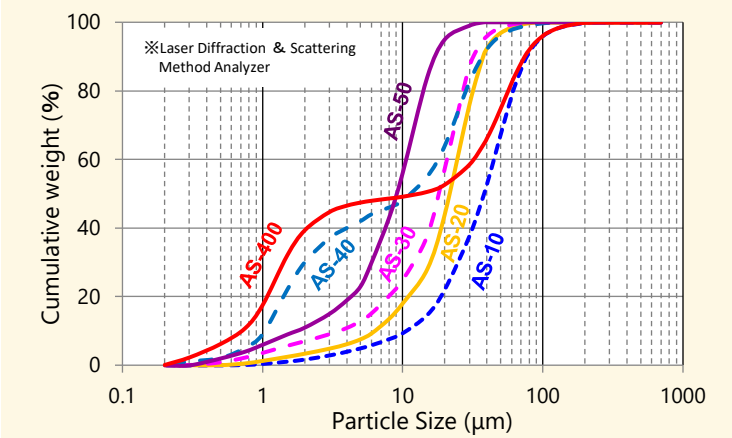
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<Typical properties of common grades>

			AS-10	AS-20	AS-30	AS-40	AS-50	AS-400
Chemical Composition	L.O.I ※1	%	0.06	0.08	0.11	0.11	0.19	0.12
	Fe ₂ O ₃	%	0.03	0.02	0.03	0.02	0.06	0.02
	SiO ₂	%	0.02	0.04	0.04	0.04	0.05	0.03
	Na ₂ O	%	0.02	0.02	0.02	0.02	0.02	0.02
	Na+ ※2	ppm	3	3	3	50	7	32
	Cl- ※2	ppm	1	1	1	2	1	1
	Al ₂ O ₃	%	99.87	99.84	99.80	99.81	99.68	99.81
Mean Particle Size (d ₅₀)		μm	36	22	19	14	9	19
Top cut Size		μm	105	75	75(or 45)	-	75(or 45)	-
BET Specific Surface Area		m ² /g	0.4	0.6	0.9	0.8	1.7	1.1
Bulk Density	Loose	g/cm ³	1.8	1.8	1.6	1.5	1.5	1.4
	Tap	g/cm ³	2.4	2.4	2.2	2.1	2.0	2.0
Electro Conductivity※3		μS/cm	3	3	4	26	10	33

※1 Loss on ignition ※2 Warm water extraction (100°C, 2Hr) ※3 20g/100ml purified water

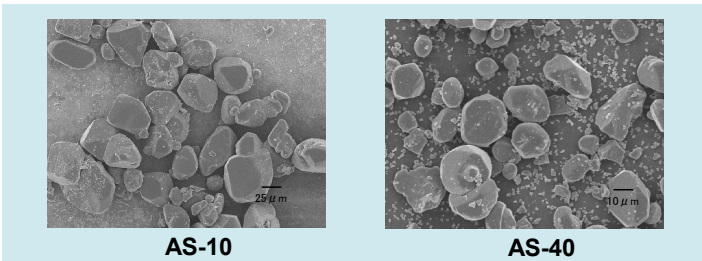
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<Features and Advantages>

- 1. Large particle sizes and broad particle size distributions allow for a high filling density in various resins.
- 2. Roundish shape makes AS Series suitable as a thermal filler with lower viscosity, and the shape also means large contact area between particles, increasing thermal conductivity of the compound.
- 3. Bimodal AS-400 is a grade specifically designed for achieving higher filling rates in resins.

<SEM Images>



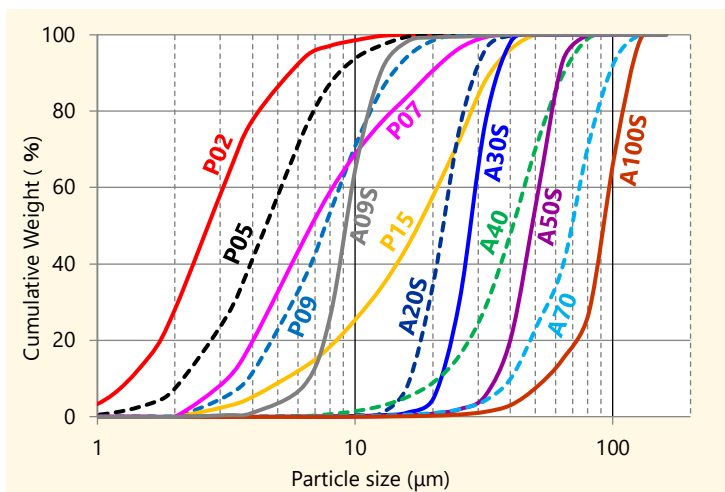
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<Typical properties of common grades>

			CB -P02	CB -P05	CB -P07	CB -P09 (Develop- ment)	CB -A09S	CB -P15	CB -A20S	CB -A30S	CB -A40	CB -A50S	CB -A70	CB -A100S
Chemical Composition	L.O.I ^{※1}	%	0.07	0.05	0.05	0.03	0.04	0.04	0.03	0.03	0.04	0.02	0.02	0.03
	Fe ₂ O ₃	%	0.01	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.01
	SiO ₂	%	0.04	0.02	0.02	0.01	0.04	0.06	0.02	0.01	0.01	0.04	0.01	0.04
	Na ₂ O	%	0.04	0.03	0.14	0.06	0.11	0.06	0.03	0.01	0.02	0.01	0.06	0.00
	Na+ ^{※2}	ppm	8	5	23	10	15	6	10	8	21	6	30	8
	Al ₂ O ₃	%	99.88	99.91	99.79	99.9	99.8	99.82	99.91	99.94	99.92	99.92	99.89	99.92
Mean Particle Size (d ₅₀)		μm	3	4	7	8	9	16	21	28	46	50	71	97
BET Specific Surface Area ^{※3}		m ² /g	1.1	0.6	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1
Bulk Density	Loose	g/cm ³	0.9	1.2	1.4	1.3	2.2	1.7	2.1	2.1	2.1	2.1	2.1	2.2
	Tap	g/cm ³	2.0	2.2	2.5	2.4	1.8	2.5	2.3	2.3	2.4	2.3	2.4	2.4
Electro Conductivity ^{※4}		μS/cm	12	17	20	8	8	8	7	6	17	4	24	48

※1 Loss on ignition ※2 Warm water extraction (95°C, 5Hr) ※3 Coulter counter method ※4 20g/200ml purified water

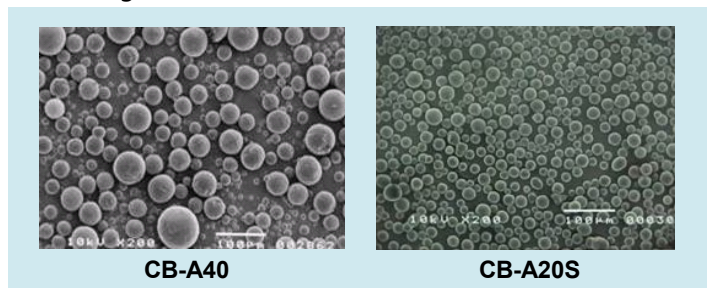
<Particle Size Distribution>



<Features and Advantages>

1. Spherical shape allows for especially high filling into resin. It is especially suitable for applications which require high fluidity.
2. CB-A20S, A30S, A50S, A100S grades have a sharp particle size distribution, while CB-P02, P05, P07, P10, P15, A40, A70 grades have a broad particle size distribution.
3. CB Series has good properties for special abrasives in addition to insulation and thermal filler applications.

<SEM Images>



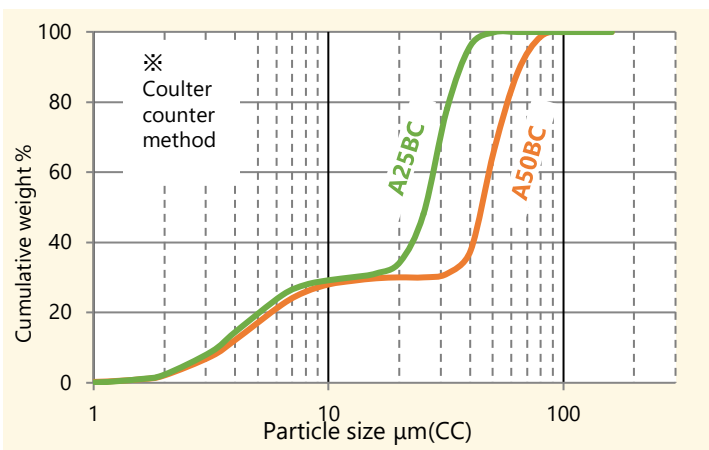
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<Typical properties of common grades>

			CB-A25BC	CB-A50BC
Chemical Composition	L.O.I.※ ¹	%	0.04	0.02
	Fe ₂ O ₃	%	0.01	0.01
	SiO ₂	%	0.02	0.02
	Na ₂ O	%	0.03	0.02
	Na ⁺ ※ ²	ppm	15	8
	Al ₂ O ₃	%	99.90	99.93
Mean Particle Size (d ₅₀) ※ ³		μm	26	45
BET Specific Surface Area		m ² /g	0.3	0.2
Bulk Density	Loose	g/cm ³	1.6	1.5
	Tap	g/cm ³	2.3	2.4
Electro Conductivity※ ⁴		μS/cm	17	12
Viscosity	Epoxy resin (250PHR)	Poise	630	590
	Silicone resin (600PHR)	Poise	550	420

※¹ Loss on ignition ※² Warm water extraction (95°C, 5Hr) ※³ Coulter counter method ※⁴ 20g/200ml purified water

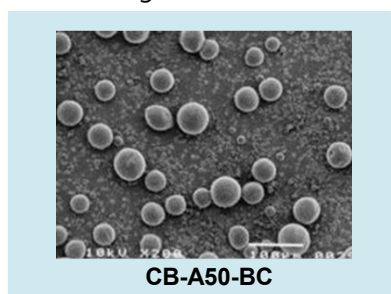
<Particle Size Distribution>



<Features and Advantages>

1. Alunabeads CB Blend Series ("BC") is a series of bimodal grades for achieving even higher filler rates in various resins.
2. In addition, we can offer several blends of different alumina types. We are open to work on customized blends, as well.

<SEM images>

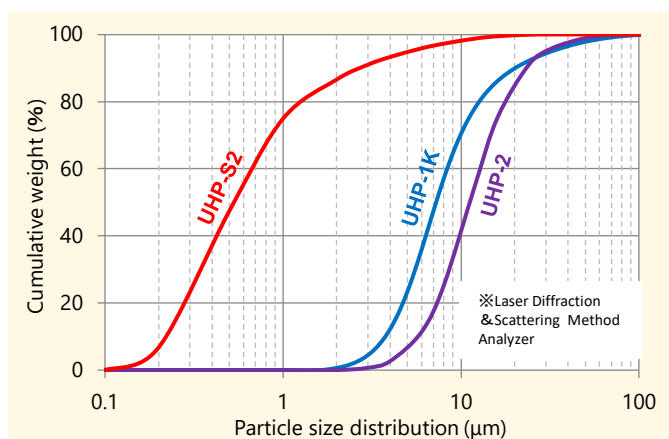


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<Typical properties of common grades>

Shape			Platelet		
			UHP-S2	UHP-1K	UHP-2
Chemical Composition	B ₂ O ₃	%	0.04	0.03	0.04
	CaO	%	0.01	0.01	0.02
	C	%	0.02	0.02	0.02
	BN	%	99.9	99.9	99.9
Mean Particle Size (d ₅₀)		μm	0.7	8	11
BET Specific Surface Area		m ² /g	8-12	3-5	3-5
Bulk Density (Tap)		g/cm ³	0.25	0.22	0.30

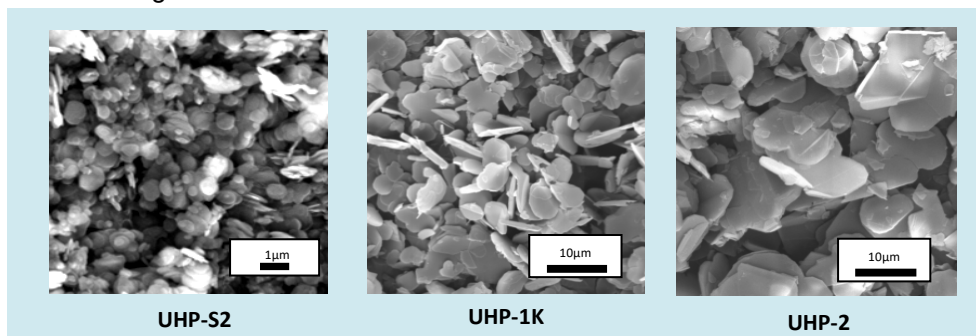
<Particle Size Distribution>



<Features and Advantages>

1. SHOBN, our UHP Series, offers superior thermal conductivity, high thermal stability, corrosion resistance, and strong electrical characteristics (i. e. high electrical insulation, low dielectric constant).
2. SHOBN, UHP contains few impurities and has low dielectric constant, making it possible to produce durable materials without impairing the properties of mixed resins.
3. SHOBN, UHP is suitable for applications which require lubricity and mold-release efficiency.

<SEM images>



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Basic properties

Fillers		Al ₂ O ₃	h-BN	AlN	BeO	MgO	SiO ₂	
							Crystalline	Fused
Crystal		Hexagonal	Hexagonal	Hexagonal	Hexagonal	Cubic	Trigonal	Amorphous
Density	g/cm ³	3.98	2.27	3.27	3.02	3.58	2.65	2.21
Specific heat (Room temperature)	J/kg · °C	750	810	700	1090	960	740	770
CTE	×10 ⁻⁶ / °C	6	1	4.5	6.4	13	15	0.5
Volume Resistivity	Ω/cm	10 ¹⁵	10 ¹⁴	>10 ¹⁴	>10 ¹⁴	10 ¹⁷	10 ¹⁵	>10 ¹⁷
Dielectric constant	-	8.5	3.6~4.2	8.5	-	-	-	-
Hardness	Mohs	9	2	8	9	5.5	7	7
Notes				hydrophilic	toxicity			

Thermal conductivity

Material	Diamond (C)	Silicon Carbide (SiC)	Beryllia (BeO)	Aluminum Nitride (AlN)	Hexagonal Boron Nitride (h-BN)	Silicon Nitride (Si ₃ N ₄)	Magnesium Oxide (MgO)	Aluminum Oxide (Al ₂ O ₃)	Silica (SiO ₂)	
									Crystalline	Fused
Thermal conductivity (W/m · k)	2000	270	250	70~270	① >200 ② several ③ 60	30~80	40	20~36	10	1.3
Notes		Semiconduction	Toxicity		① X direction ② Z direction ③ Compact					

Source: TECHNICAL INFORMATION INSTITUTE.CO.LTD

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