

COMBAT® Boron Nitride Solids



COMBAT, a hot-pressed hexagonal Boron Nitride, exhibits a unique combination of chemical, electrical, mechanical and thermal properties, making it suitable for a wide range of high-performance industrial applications.

COMBAT's characteristics depend on the type and amount of binder, overall composition and the type of bond between layers. Backed with industry leading international technical support from Saint-Gobain, COMBAT provides a full spectrum of solutions in machinable blanks as well as custom finished shapes.

- **COMBAT AX05** does not use any binder and is self bonded, offering the highest purity for high temperature applications. Non-wet by almost all molten metals, AX05 is recommended for applications such as extreme high-temperature insulators and crucibles for high-purity processing.
- **COMBAT M and M26** combine the moisture resistance of silica with unique properties of boron nitride. Differentiated by the amount of SiO₂, COMBAT M offers unparalleled resistance to thermal shock while COMBAT M26 offers higher thermal conductivity. M and M26 are ideal for applications requiring extreme and exacting dielectric properties.
- **COMBAT ZSBN** combines the non-wetting properties of boron nitride with extreme refractory and wear resistance of zirconia. ZSBN is widely used in a variety of molten metal contact applications.
- **COMBAT A** uses boron oxide as a binder to create a hard, dense yet easily machinable product best used in inert and dry environments. It is ideal for general purpose high-performance applications.
- **COMBAT HP** leverages Boron Nitride's outstanding thermal shock resistance with Calcium Borate glass's moisture resistance. HP is ideal for light metal processing application such as aluminum, magnesium and zinc, particularly electrical insulation applications for up to 1000°C.

Features/Benefits

- Easily machinable to desired shapes and sizes
- Exceptional Heat Resistance
- High thermal conductivity
- Low thermal expansion, excellent thermal shock resistance
- Outstanding electrical insulation – even at high temperatures
- High wet resistance to molten metals, slags and glass
- Extreme corrosion and wear resistance

Key Applications

- MOCVD setters and components
- Insulators for high-temperature furnaces
- Muffles and crucibles for Nitride and SiAlon firing
- Nozzles for powder metal atomization
- Side dams for twin-roll casting
- Continuous casting break rings
- High temperature mechanical components such as bearings, valves, spacers
- Crucibles and molds for molten metal processing

Target Markets

- High Temperature Furnace construction
- Ceramic Manufacturing
- Semiconductor Industry
- PVD coating
- Microwave

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Typical Properties	Unit	A		HP		AXo5		M		M26		ZSBN	
Crystalline phase		Hexagonal BN		Hexagonal BN		Hexagonal BN >99%		BN-40%, SiO2 60%		BN-60%, SiO2 40%		BN-45%, ZrO2-45%, Borosilicate Glass <10%	
Binder Phase / Binder Type		Boric Oxide		Calcium Borate		Self Bonded		SiO2		SiO2		Borosilicate	
Color		White		White		White		White		White		Grey	
Typical Applications		General purpose		Outstanding Moisture Resistance, Refractory, Dielectric Strength		Extreme Corrosion Resistance, Thermal Conductivity, Purity		Extreme Thermal Shock, Moisture Resistance, Dielectric Strength		Extreme Thermal Conductivity, Moisture Resistance, Dielectric Strength		Extreme Wear Resistance & Corrosion Resistance in molten metals applications	
Directionality			⊥		⊥		⊥		⊥		⊥		⊥
Mechanical Properties													
Flexural Strength	MPa	94	65	59	45	22	21	103	76	62	34	144	107
Youngs Modulus	GPa	47	74	40	60	17	71	94	106			71	71
RT Compression	MPa	143	186	96		25		316.9	289.4			218.7	253.8
Open Porosity	%	2.84				19.3		6.880		6.724		1.066	
Density (g/cc min)		2		2		1.9		2.3		2.1		2.9	
Hardness – Knoop (Kg/mm2)		20		16		4						100	
Thermal Properties													
Thermal Conductivity at 25° C	W/mK	30	34	27	29	78	130	12	14	11	29	24	34
Coeff. of Thermal Expansion (10-6)	-												
25 - 400° C		3.0	3.0	0.6	0.4	-2.3	-0.7	1.5	0.2	3.0	0.4	4.1	3.4
400 - 800° C		2.0	1.4	1.1	0.8	-2.5	1.1	1.2	0.4	2.5	0.1	5.6	4.3
800 - 1200° C		1.9	1.8	1.5	0.9	1.6	0.4	1.2	0.8	3.0	0.1	7.2	5.2
1200 - 1600° C		5.0	4.8	2.8	2.7	0.9	0.3					4.6	3.4
1600 - 1900° C		7.2	6.1			0.5	0.9						
Specific Heat at 25° C	J/gK	0.86		0.81		0.81		0.76		0.77		0.64	
Max. Temp - Oxidizing / Inert		850°C / 1200°C		850°C / 1150°C		850°C / 2000°C		1000°C+		1000°C+		850°C / 1600°C	
Electrical Properties													
Dielectric Constant at 1MHz		4.6	4.2	4.3	4.0	4.0	4.0	3.4	3.7	4.5	3.8		
Dissipation factor at 1MHz		1.2E-03	3.4E-03	1.5E-03	2.1E-03	1.2E-03	3.0E-04	3.0E-03	3.1E-03	1.7E-03	6.7E-03		
Dielectric Strength	KV/mm	88		>10		79		>10		66			
RT Resistivity (ohm cm)	Ω cm	>10 ¹³	>10 ¹⁴	>10 ¹³	>10 ¹³	>10 ¹³	>10 ¹⁴	>10 ¹⁴	>10 ¹⁴	>10 ¹³	>10 ¹⁴	>10 ¹³	>10 ¹⁴

COMBAT® is a registered trademark of Saint Gobain Ceramic Materials.

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