

Combat[®] Composite Boron Nitride Grade ZSBN

Product Datasheet

High wear resistance + high thermal conductivity = Combat Grade ZSBN.

Developed for demanding applications requiring the combination of thermal conductivity and wear resistance, Combat Grade ZSBN boron nitride is a composite material combining the best performance characteristics of hot-pressed boron nitride, silicon carbide and zirconia.

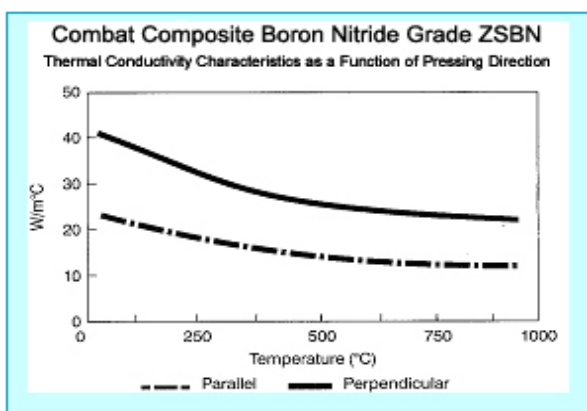
CHEMICALLY: Unparalleled resistance to molten metal wetting due to boron nitride content.

THERMALLY: Excellent high temperature operation and thermal shock resistance.

MECHANICALLY: Excellent wear resistance and increased strength from zirconia and a small amount of silicon carbide. This feature, unique to ZSBN, results in remarkable corrosion resistance over a wide range of temperatures.

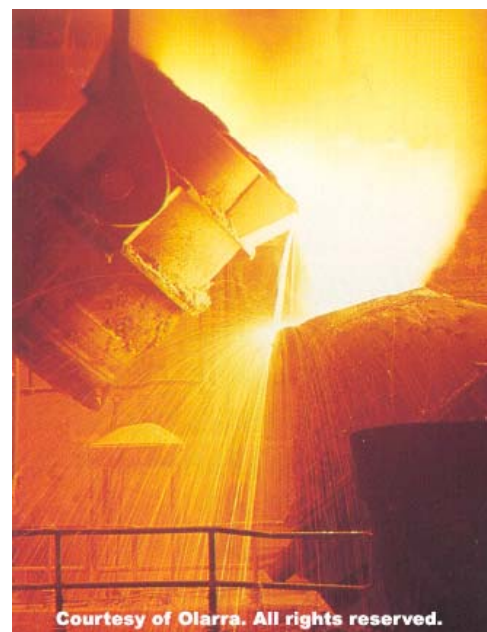
MACHINABILITY: Combat Grade ZSBN is easily machined, even to complex shapes and forms, quickly and inexpensively. Machining tolerances of 0.002" or better are achievable.

Hardness Properties	Grade ZSBN	Grade A	Grade HP	Grade AX05
Average Typical Hardness Knoop (kg/mm ²)	100	20	16	4
Bond	Reaction Bonded	B ₂ O ₃ Bonded	Calcium Borate Bonded	Self Bonded






Thermal Conductivity (W/m°C)	Perpendicular	Parallel
	25°C	40.21
316°C	29.39	15.46
437°C	27.16	13.98
557°C	24.96	13.32
711°C	23.11	12.78
918°C	21.88	11.65

Like pure boron nitride, the ZSBN crystal structure orients itself during hot pressing. Therefore, many physical properties of Combat ZSBN are anisotropic and are reported as a function of the orientation of the piece relative to hot pressing (perpendicular or parallel).



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Superior properties for high temperature and wear resistant applications including:

-  Molten material casting—metal and glass processing
 - Crucibles
 - Molds
 - Nozzles for transfer or atomization—Al, Fe/Ni/Co, Fe, Au, Ag, Cu
-  Continuous casting
 - Break Rings
 - Side Dams
-  High Temperature Mechanical Components
 - Heat Treat Fixtures
 - Spacers
 - Jigs
 - Deck Plates
 - Molds
 - Muffles
 - High Temperature Valve Components
 - High Temperature Bearings



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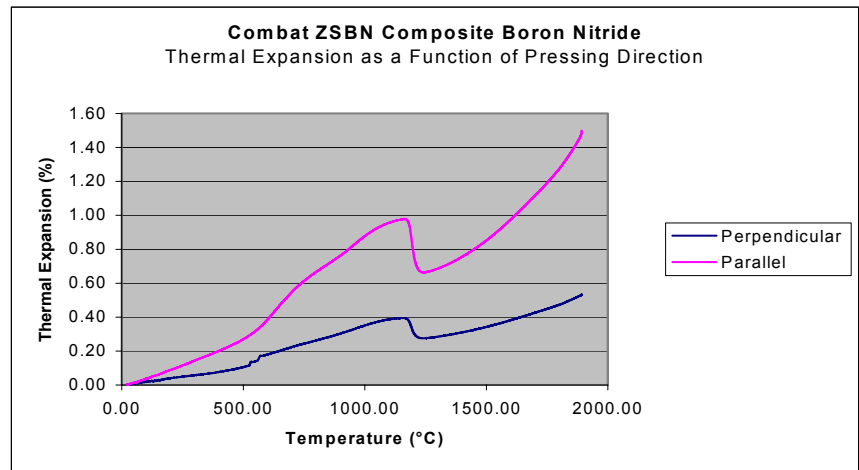
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Typical Physical Properties

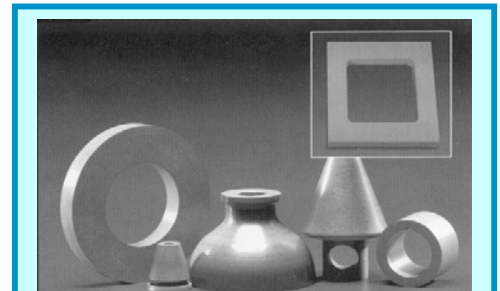
Maximum Use Temperature:
 Oxidizing Atmosphere: 850°C
 Inert Atmosphere: 1800°C
Density (g/cm³): 2.90
Porosity: 2.4- 3.4%

Crystalline Phases

Hexagonal BN Major
Mono ZrO₂ Major
Hexagonal ZrB₂ Minor
Alpha SiC Minor

Typical Chemical Analysis

	%
Zr	30.9
N ₂	26.0
B	21.7
O ₂	14.0
Si	4.3
C	2.2
B ₂ O ₃	1.0
Free Carbon	0.3



Combat Grade ZSBN boron nitride is available in rod, bar and shapes as well as custom-made to customer specifications. Diameters of up to 18" and lengths to 16" are possible, along with plates up to 16" x 20".

	Perpendicular	Parallel
Hardness		
Knoop (kg/mm ²)	105.0	95.0
Vicker's (GPa)	1.5	1.3
Shear Modulus (GPa)	32.2	27.7
Flexural Strength (psi)		
23°C	20900	15500
1000°C	8400	6360
1500°C	3700	2440
NOTE: The above tests were based on 4-pt bend test. Sample size: 51mm x 4mm x 3mm		
Weibull Modulus	14.63	27.72
Compressive Strength		
23°C	36.84	31.74
Coefficient of Thermal Expansion (x10⁻⁶ in/in/°C)		
40°C- 500°C	1.98	6.40
600°C- 1100°C	5.42	15.40
Specific Heat (J/g °C)		
100°C	0.705	0.722
200°C	0.835	0.850
300°C	0.910	0.938
400°C	0.965	0.979
500°C	1.029	1.055
Modulus of Elasticity (GPa)		
25°C	70.5	70.8
1000°C	59.5	63.8
1300°C	44.2	43.8
Thermal Diffusivity (cm²/s)		
19°C	0.12	0.22
204°C	0.08	0.13
504°C	0.05	0.08
1005°C	0.03	0.05
1507°C	0.02	0.04