

Boron Nitride Solids

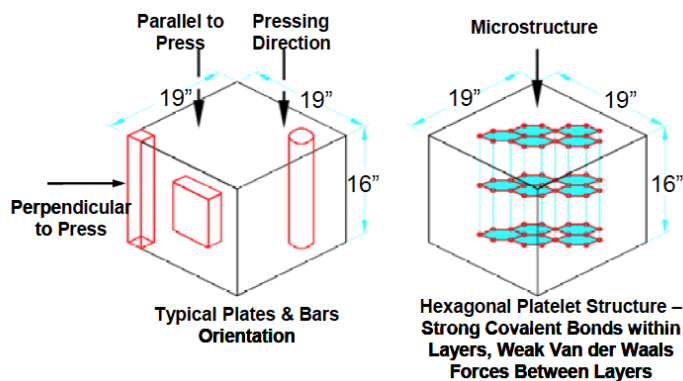


Machining Considerations

Combat® Solid Boron Nitride is a unique material from Saint-Gobain Advanced Ceramics that solves problems that could not possibly be tackled with ordinary ceramics. Depending on grade, Combat Solid Boron Nitride withstands temperatures of up to >2000°C, has a dielectric strength of >40,000 volts/mm, yet it can be machined to intricate shapes with narrow tolerances.

PROPERTIES BY ORIENTATION

Combat solids, made by unidirectional hot pressing of Boron Nitride, also referred to as “white graphite”, have a platy, hexagonal structure that orients during hot pressing.



Atoms in the basal or platelet plane are held by a strong covalent bond in a hexagonal array, thus yielding excellent physical, thermal and electrical performance under a wide range of applications. In contrast, the bonds between adjacent layers are weak Van der Waals bonds, providing excellent lubricity.

Consequently, many of the physical properties of Combat solid Boron Nitride are anisotropic, or, direction dependent.

When machining Combat solids, standard shapes are typically fabricated as shown in the illustration, unless specific orientation is needed.

A complete list of properties by Combat grade is available at www.bn.saint-gobain.com.

MACHINING

Combat Solid Boron Nitride Grades A, HP, AX05, M, M26 and ZSBN are truly machinable ceramics. Grades A, HP and AX20 can be machined using standard highspeed tool steel cutting tools. Carbide tipped tooling is recommended for machining Grades M and M26, and diamond tipped tooling is required for Grade ZSBN.

Grade	Spindle Speed RPM	Feed Rate IPR	Recommended Tooling
A	1000-2000	0.01-030	High Speed Steel or Carbide
HP	1000-2000	0.01-030	High Speed Steel or Carbide
AX05	1000-2000	0.01-030	High Speed Steel or Carbide
M	400-800	0.01-030	Carbide or Diamond
M26	400-800	0.01-030	Carbide or Diamond
ZSBN	1000-2000	0.01-030	Diamond

Machining by grinding may be done if preferred. Threads can be machined using standard taps and dies.

Cutting oils and coolants are not necessary and should not be used. In the case of organic solvents, cleaners or coolants, the formation of carbon may occur if the final product is subjected to elevated temperatures (>500°C). Therefore, the material **should always be machined dry.** This is easily done because Combat Solid Boron Nitride has self-lubricating properties due to its cleavage and crystal structure similar to that of graphite.

It is important that Combat solids be kept dry at all times, stored in airtight bags, containers or in dry ovens.

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EXPECTED TOLERANCES

Machined tolerances depend on the type of machining operation performed. In most cases ± 0.002 in. (0.05 mm) can be obtained when turning or finishing. For operations such as lengthy bore holes or drilling, ± 0.005 in. (0.125 mm) may be obtained.

OPERATIONAL MEASURES

Cutting tools should be sharp and clean. Rake angles can be slightly increased, if desired, but are not necessary. Cutting tools with negative rake angles should never be used.

All grinding should be dry using sharply dressed, soft graded grinding wheels. Conventional speeds and feed are necessary. All types of grinding wheels (vitrified, resinoid and metal bonded) and types of abrasives (aluminum oxide, silicon carbide, cubic boron nitride, diamond, etc.), can be used to grind Combat Solid Boron Nitride.

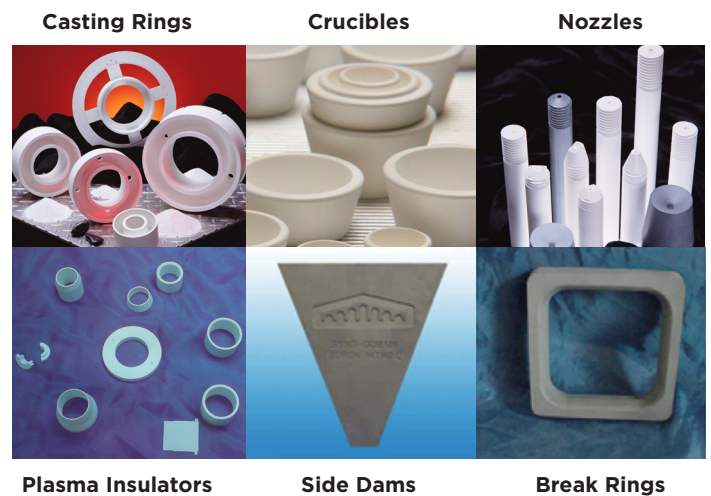
Care should be taken when chucking and clamping so that excessive pressure is not exerted. Climb milling techniques should be used to prevent corner and edge chipping. This material is non-toxic. Care should be used, however, to prevent inhalation of nuisance dusts.

Combat grade AX05, due to its high purity and very low Boric Oxide content, is extremely light sensitive and may turn pale yellowish brown to a gray hue when exposed to sunlight. Though the coloring has no impact on other unique properties of Combat grade AX05, it is recommended that AX05 is stored in light tight containers with a desiccant pack to avoid discoloration.

TYPICAL APPLICATIONS

The unusual properties of Combat solids make them ideal for fixture or jig materials for sealing or brazing operations in high temperature furnaces; for molten metal crucibles and nozzles; heat sinks and high temperature insulators.

Some of the typical machined shapes are illustrated below:



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