MATERION

Tech Brief

SUPREMEX® COMPOSITES

Machining Recommendations for SupremEX Metal Matrix Composites

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SupremEX® metal matrix composites (MMCs) are a family of high-performance aluminum alloys reinforced with silicon carbide particulate. We offer several grades with different metal to reinforcement ratios with balanced physical and mechanical properties to meet specific application requirements.

Conventional milling, turning and grinding techniques are suitable for SupremEX composites. Faster aluminum cutting speeds and feed rates are preferred over slower machining rates like those used to machine titanium. Grades with lower SiC content and finer particles like 620XF machine easier than grades with higher SiC loading and larger particles such as 640XA. The SiC particles in SupremEX composites are much smaller than many AlSiC MMCs and allow precision machining operations with extended the tool life compared to other AlSiC MMCs.

Polycrystalline diamond (PCD) is recommended for production machining operations. High spindle speeds are preferred for PCD tooling, matching appropriate cutting speed for SupremEX MMC. PCD tools may require greater care on programming to avoid intermittent cutting operations.

Where PCD tooling is not available, DLC coated carbide or tool steel tips can be used, but tool life may be limited, depending on the grade of SupremEX composite.

Depth of cut should be consistent with surface quality requirements. A depth of cut to .020" (.5mm) can maximize the total material removed over the life of the cutter.

Mill into rather than away from edges to reduce the possibility of surface break up on un-constrained edges. Use conventional cutting fluids as appropriate.

Drilling is completed successfully in a wide range of geometries. Again, PCD tools are recommended, but high-quality diamond coated tools have also worked successfully. Sharp carbide tooling with TiN coating can work, understanding the tooling may not last as long.

Thread milling, tapping and forming conditions are dependent on the grade of SupremEX composite and the size of thread required.

For bandsaw cutting use bi-metal blades with tooth gap suited to width of cut and surface finish requirements. Lubrication use is dependent on the grade of SupremEX composite being machined. High speed dry cutting is used for most rough cutting operations, but lubrication can help with surface finish and cutting temperature.

Billets may be sliced using parting tools or cut off wheels. PCD inserts for parting operations are available and PCD tipped cutting wheels can be obtained; however bonded ceramic cut off wheels may be used for bar cutting operations.

Electrochemical techniques such as wire and sinker EDM and spark erosion are readily applied to SupremEX MMC. All SupremEX grades are electrically conductive. There is a preference to complete wire erosion in low residual stress heat treated condition to avoid pinching on the wire electrode. Materion is currently working to establish guidelines for EDM machining SupremEX composites.

Waterjet cutting can be used on SupremEX materials. The usual constraints on section thickness and accuracy apply as to other metallic materials.

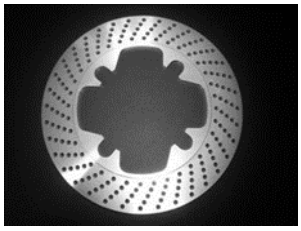
Laser cutting can be used with care on SupremEX composites. Care is required when laser cutting SupremEX materials due to the high reflectivity of the aluminum matrix materials and the potential for metal ceramic reactions in the cut zone.

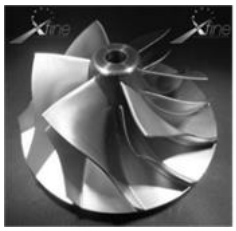
Heat treatment to peak strength condition is generally required prior to final machining. Heat treatment involves a solution heat treatment followed by a quench in water or polymer glycol solution. The heat treat and machining plan should consider and accommodate some distortion through the heat treatment and quench cycle.

Grinding has been successfully performed on SupremEX composites. Diamond-based wheels will provide the longest life, but in some cases SiC-based wheels are sufficient to surface SupremEX MMCs.

Please note: The values below are not specification limits. They are intended to be helpful starting points based on observation that may be further optimized through practice.

Tool Life Comparison*	SupremEX® 620XF 6061/SiC/20% (0.7µm)	SupremEX® 225XE 2124/SiC/25% (3µm)	SupremEX® 640XA 6061/SiC/40% (3µm)
HS Steel	✓	✘	✘✘
Carbide	✓✓	✓	✘
Poly Crystalline Diamond	✓✓✓	✓✓✓	✓✓



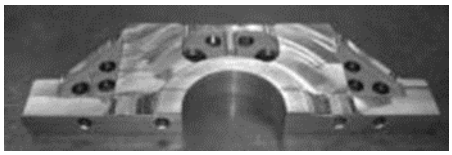


Milling	Tool Material	Surface Speed	Roughing Feed	Finishing Feed
SupremEX	PCD	500 - 800m/min	0.05 - 0.25mm/tooth	0.05 - 0.25mm/tooth
		1600 - 2600sfpm	.002" - .010"/tooth	.002" - .010"/tooth

Turning	Tool Material	Surface Speed†	Roughing Feed @ Depth	Finishing Feed
SupremEX	PCD	500 - 800m/min	0.05 - 0.50mm/rev	0.05 - 0.50mm/rev
		1600 - 2600sfpm	.002" - .020"/rev	.002" - .020"/rev

Drilling	Tool Material	Surface Speed	Feed
SupremEX	PCD	~113m/min	0.20 - 0.30mm/rev
		~371 sfpm	.008 - .012."/rev

This speed was tried in testing and worked successfully.



Sawing	Blade Type	Saw Blade Tooth Contact	Blade Speed
SupremEX	Variable Pitch Ground Tooth Bi-Metal Blade	10 - 12.5mm/tooth	40-50 m/min
		2 - 2.5 teeth per inch	131-164 sfpm

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