

Product Data Sheet Metal Matrix Composites

MetcoXtreme™
MetcoXtreme™ ABR
MetcoXtreme™ Elite

1 Introduction

Component parts are supplied using novel manufacturing techniques and materials. Manufacturing breakthroughs enable the construction of complex designs including internal passages that would not be able to be made conventionally.

Utilizing different composites, a range of properties can be created that are application specific. Excellent erosion and abrasion resistance, together with a high resistance to thermal shock, is combined with toughness and strength comparable to metallic based materials.

Metal matrix composites contain hard and soft phases. The hard phase contains highly spherical tungsten carbide particles, providing both a high packing density (65 vol.%) and hardness (3,000 HV0.1). Soft phase maxtrix provides a high thermal conductivity and ductility, that promotes a high resistance to thermal shock and cracking. A textured surface on the spherical crystals, when reacted with the soft material produces a high interfacial strength between the two phases and improves the overall strength of the resulting composite.

Utilizing a proprietary patented **BZ treatment**, the tungsten carbides are enhanced to behave plastically when subject to localized stress. Improved thermal conductivity and toughness within a BZ treated crystal, enhances the fracture toughness and crack resistance of the composite.

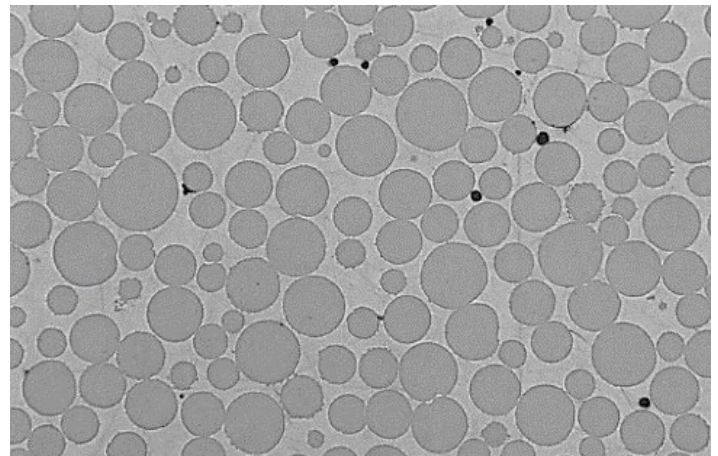
MetcoXtreme materials are engineered for extreme wear, high loading, and fluid erosion—making them ideal for the most demanding applications, including:

- Oil & gas downhole tools - Bottom Hole Assembly
- Sugar cane crushing
- Oil sand processing
- Bearings
- Nozzles
- Inserts
- Pump parts

The MetcoXtreme family combines high strength, ductility, and wear resistance—perfect for components exposed to heavy mechanical loads and erosive flows.



3D CAD Model Component Made from Metal Matrix Composites



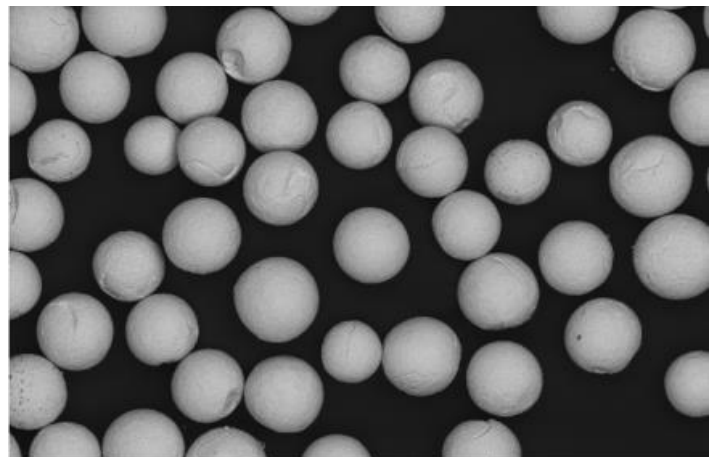
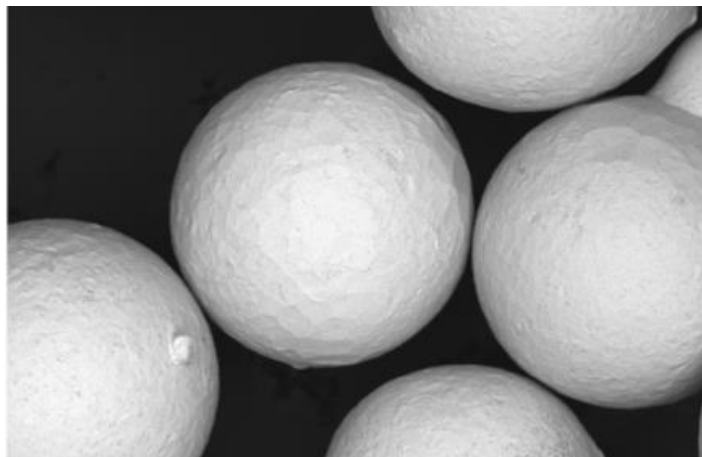
MetcoXtreme Spherical Hardphase (3000 HV) and Packing (20 microns)

The **MetcoXtreme ABR** series offers moderate strength and is specially formulated for surface regions subject to high-stress abrasion. ABR materials are often used in combination with MetcoXtreme and MetcoXtreme Elite, strategically placed where extreme surface wear occurs. With BZ treatment, surface carbides undergo plastic deformation, delivering wear resistance comparable to Cemented Tungsten Carbide—without the risk of heat-checking or cracking.

For the next level of performance, **MetcoXtreme Elite** offers enhanced ductility and thermal conductivity, while maintaining exceptional strength and wear resistance. It's the material of choice for load-bearing parts exposed to impact and vibration, where both toughness and performance longevity are essential.

2 Material Property Information

	MetcoXtreme	MetcoXtreme	MetcoXtreme ABR	MetcoXtreme ABR	MetcoXtreme Elite
Classification	065-85A	065-53A	300-85B	530-85B	065-85B
	Spherical Tungsten Carbide particles / Copper-based binder		Tungsten Carbide-based		Spherical Tungsten Carbide particles
Carbide	Blended	Blended	Proprietary BZ Treatment	Proprietary BZ Treatment	Proprietary BZ Treatment
Carbide Content	65 %	65 %	65 %	65 %	65 %
Component Density (g/cc)	13.7	13.6	13.5	13.4	13.5
Vickers Hardness (HV0.1)	2800	2800	2200	2170	2800
Rockwell (HRC)	40				
Transverse Rupture Strength (ksi)	230	200	130	105	215
High Stress Abrasion - B611 (cc)	0.70	0.59	0.10	0.07	0.07
Un-notched Charpy impact test (ft-lbs)	6.7	5.2	4.0		9.0
Cavitation erosion (µm)	157	86			
Young's Modulus (GPa)	340				
Poisson's Ratio	0.29				
Thermal Conductivity (W/m·K)	34				56
Thermal Expansion	11.3				
Purpose	Strength, toughness, wear resistance		Increased abrasion resistance		Higher toughness and impact resistance



SEM and stereo photomicrographs showing typical morphology/shape of these materials. A: MetcoXtreme, B: MetcoXtreme ABR

2 Material Property Information

2.1 Mechanical Properties of Metal Matrix Composite Material

Metal matrix composite material exhibits exceptional mechanical performance, combining high strength and durability with excellent wear resistance. The material achieves a flexural strength of up to 1,700 MPa (250 ksi), ensuring robust performance under demanding conditions. With a hardness rating of over 50 HRC and a wear resistance of 1.7 krev/cc (per ASTM B611 test), it offers outstanding resistance to cracking and deformation. With Oerlikon Metco's proprietary BZ treatment, the wear resistance number can be as high as 9.2 krev/cc. These characteristics make it ideal for applications requiring a balance of strength, toughness, and wear resistance.

2.2 Thermal Properties of Metal Matrix Composite Material

The new metal matrix composite material exhibits outstanding thermal performance, making it ideal for high-temperature applications. With a thermal conductivity of 34 W/m·K (60 W/m·K with BZ treatment), it ensures efficient heat dissipation even under demanding conditions. Its low thermal expansion coefficient of $11.3 \times 10^{-6}/K$ minimizes dimensional changes over a wide temperature range, enhancing stability and durability. The material's specific heat capacity of 0.33 J/g·K at room temperature (RT) enables effective energy absorption, while its thermal diffusivity of 7.6 mm²/s promotes rapid temperature equilibration. These properties make this composite ideal for thermal management systems and effective in preventing thermal shock and cracking.

2.3 Key Selection Criteria

- Composites containing MetcoXtreme are selected for high strength and erosion resistance.
- Regions containing MetcoXtreme ABR combat high stress abrasion, including direct rubbing against itself where it acts as a bearing surface.
- MetcoXtreme Elite offers enhanced ductility and thermal conductivity, while maintaining exceptional strength and wear resistance.