DWA ALUMINUM COMPOSITES USA

Data Sheet | 2017

6092/SiC/17.5p ALUMINUM MMC

6092/SiC/17.5p Aluminum Metal-Matrix-Composite (Al MMC) is ideal for aerostructures applications. Its combination of enhanced strength and stiffness make it ideal for precise-to-form extruded profiles and control surfaces.

TYPICAL AND MINIMUM MECHANICAL PROPERTIES FOR EXTRUSION AND SHEET

6092/SiC/17.5p-T6 Density= 2.80 g/cm^3 (0.1011 lb/in^3)		F, ty MPa	F, ty ksi	F, tu MPa	F, tu ksi	elong. %
Bar Extrusion, 31.7cm^2 (5in^2), Typical	(L)	393	57	462	67	7
Sheet, 3.2 mm (0.125in), Typical	(L)	393	57	462	67	6
	(LT)	379	55	455	66	7
Minimum Properties, Extrusion	(L)	352	51	434	63	3
Minimum Properties, Sheet	(L)	344	50	427	62	3
	(LT)	317	46	407	59	3

Notes:

1) Young's Modulus for extrusion is typically 107 GPa (15.5 msi) in the L orientation.
2) Young's Modulus for sheet is typically 100 GPA (14.5 msi) in both L and LT orientations.
3) Coefficient-of-Thermal-Expansion (CTE) is typically 16.6 ppm/°C (9.2 ppm/°F).
4) Typical Rockwell B hardness is 78-80.

Extrusion data is representative for 25mm (1 in) maximum section thickness during heat treatment. Mechanical properties will be dependent on the Al MMC material system, product form, geometry and heat treatment method.

6092/SiC/17.5p is a powder metallurgy Al MMC comprised of AA6092 aluminum and 17.5 Vol% Silicon Carbide particles. It is available in vacuum-hot-pressed billet, extruded, forged and sheet product forms.

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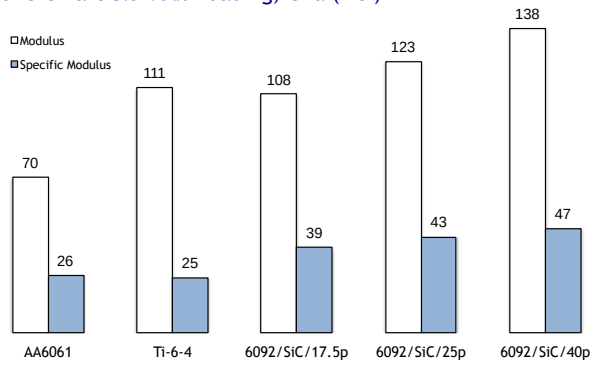
ALUMINUM METAL-MATRIX-COMPOSITES:

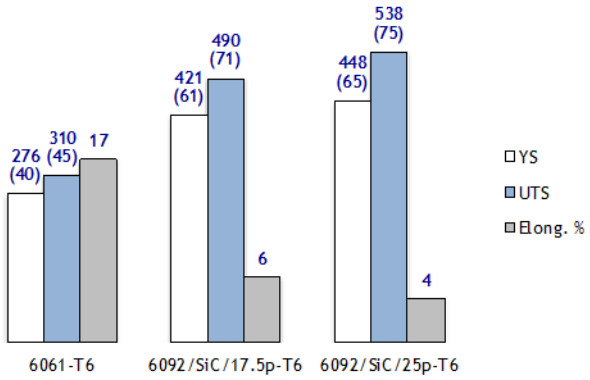
MORE THAN ALUMINUM

THE EXTREMELY LOW CTE OF THE SIC PARTICLES STRAINS THE ATOMIC LATTICE OF THE ALUMINUM MATRIX resulting in a dramatic increase in dislocation density. The combination of solid-state MMC processing and dislocation formation also results in a super-fine, coherent field of precipitates in the matrix. Ultimately, both the reinforcement and the precipitates limit the mobility of these dislocations leading to enhanced yield and ultimate tensile strength in the Al MMC. Further, it is important to note that there is a direct relationship between SiC content and Al MMC strength, as shown in the measured properties for extruded bar stock.

6092 Alloy Al MMC Modulus and Specific Modulus as a Function of SiC Particle Vol% Loading, GPa (msi)



6092 Alloy Al MMC Strength, MPa (ksi)



AL MMCS ARE CONVENTIONALLY HEAT-TREATED. THE PRESENCE OF SIC PARTICLES IN THE ALUMINUM MATRIX ACCELERATES precipitation aging kinetics. Peak strength (T6) through artificial aging is achieved in approximately 8 hours, while natural aging (T4) can achieve peak strength after 96 hours.

THE INCREASED MODULUS OF ELASTICITY (STIFFNESS) OF AL MMCS IS COMMONLY EXPLAINED USING THE RULE OF MIXTURES, i.e., $E_{MMC} = (E_{Al})(Vol\%_{Al}) + (E_{SiC})(Vol\%_{SiC})$, *and* the interaction of the aluminum matrix with the SiC particles. Enhanced modulus is also the result of load transfer between the ductile metallic phase and the non-deformable reinforcing ceramic phase, and the matrix constraint by the reinforcement. It also follows that an increasing SiC particle content results in higher stiffness Al MMCs. For Al MMCs with a balanced mix of properties, modulus enhancement is typically 40-50% higher than conventional aluminum.

SURFACE TREATMENTS

In general, DWA-USA Al MMCs can accept most surface treatments that are used for conventional aluminum. The fine aluminum grain size and fine to ultrafine SiC particle size distribution (PSD) translates to excellent surface treatment response compared to other Al MMCs that use far coarser reinforcement.

CHEMICAL SURFACE CONVERSIONS such as MIL-DTL-5541 Class 1A can easily be applied to Al MMCs without process modification.

ANODIZING of Al MMCs can be performed using chromic and sulfuric acid techniques.

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