DWA
ALUMINUM COMPOSITES USA

Data Sheet | 2017

HIGHLY LOADED ALUMINUM MMCs

Highly Loaded Al MMCs contain SiC particle contents of 40 Vol% and greater. Matrix alloy selection is based on specific manufacturing and application requirements. AA6091 is selected to maximize forgeability; AA6092 for maximized strength in the billet form. Minimum Coefficient-of-Thermal-Expansion (CTE) and maximum elastic modulus are the material property objectives of these material systems.

TYPICAL AND MINIMUM MECHANICAL PROPERTIES FOR EXTRUSIONS AND FORGINGS

6091 & 6092/SiC/40p-T6 Density= 2.92 g/cm^3 (0.1054 lb/in^3)		F, ty MPa	F, ty ksi	F, tu MPa	F, tu ksi	elong. %
6091/SiC/40p-T6 Extrusion, 19.4cm^2 (3in^2) & Closed Die Forgings, 152mm (6in)	(L, LT)	427	62	538	78	1.9
6092/SiC/40p-T6 Extrusion, 19.4cm^2 (3in^2)	(L, LT)	517	75	565	82	1.5
Minimum Properties	(L, LT)	379	55	448	65	1

Notes:

1) Young's Modulus is typically 138 GPa (20 msi) in both the L and LT orientations.
2) Coefficient-of-Thermal-Expansion (CTE) is typically 12.1 ppm/°C (6.7 ppm/°F).
3) Typical Rockwell B hardness is 86-88.

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

Highly Loaded Al MMCs are available in vacuum-hot-pressed billet, extruded and forged product forms.

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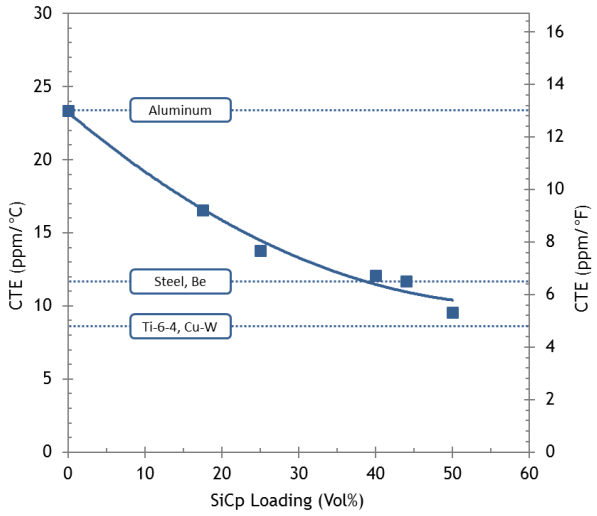
ALUMINUM METAL-MATRIX-COMPOSITES:

MORE THAN ALUMINUM

THE COEFFICIENT-OF-THERMAL-EXPANSION (CTE) OF AL MMCS DECREASES WITH INCREASING SIC PARTICLE REINFORCEMENT volume loading. At a 40% SiC content, Al MMC CTE is equivalent to Beryllium. At a 50% SiC content, Al MMC CTE begins to approach that of far heavier electronic packaging materials such as Copper-Tungsten (Cu-W).

6092 Alloy Al MMC Coefficient-of-Thermal-Expansion



SiC Vol%	CTE ppm°C	CTE ppm°F
0p	23.4	13.0
17.5p	16.6	9.2
25p	13.8	7.7
40p	12.1	6.7
44p	11.7	6.5
50p	9.6	5.3

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.

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.

PLATING of Al MMCs has been routinely demonstrated for SiC particle loadings up to 50 Vol%.

PRIMER AND PAINT on Al MMCs will exhibit adhesion superior to that for conventional aluminum due to their fine grain size and the exposure of fine to ultrafine SiC particles after conventional aluminum surface preparation.

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