

Aluminum MMC Surface Resolution



As of 01/2017



As of 02/2018

► A2024-RAM10 (high-strength aluminum)

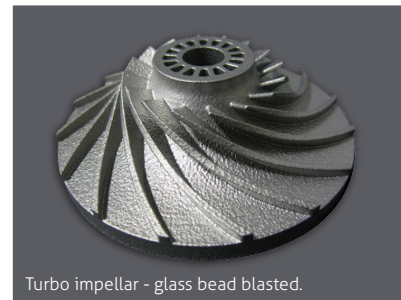
Product Information

Elementum 3D's AL2024-RAM10% Aluminum Metal-Matrix Composites (MMC) combine the ductility and toughness of metals with the strength, hardness, stiffness, and wear resistance of ceramic reinforcing phases. Aluminum MMCs are of particular interest to aerospace, automotive, and military applications that require high specific strength, extreme wear resistance, thermal conductivity and good retention of strength at temperature.

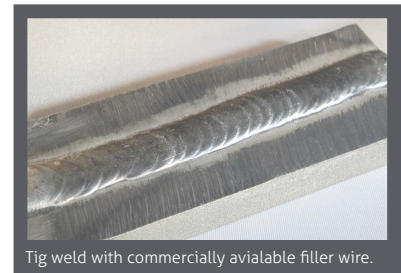
Physical and Chemical Properties

Material composition: A2024 w/10% ceramic

Ceramic Material (10 vol%)		Proprietary, ask for details.
Matrix Material (90 vol%)		wt%
Aluminum		Balance
Copper		4.2-4.8
Magnesium		1.0-1.7
Carbon		0.5-1.5
Manganese		0.4-1.0
Iron		≤ 0.40
Zinc		≤ 0.30
Silicon		≤ 0.25
Chromium		≤ 0.10



Turbo impellar - glass bead blasted.



Tig weld with commercially available filler wire.

Powder tap density: 1.68 g/cm³ (0.0601 lbs./in³)

Theoretical density: 2.97 g/cm³ (0.1073 lbs./in³)

Relative density: Approx. 99.8%

Thermal conductivity: 84 W/(m·K)

Deposition rate: 7.12 mm³/s

Surface roughness as built:

Upskin - Ra 5.1 µm, Ra 0.20 x 10⁻³ inch

Downskin - Ra 7.7 µm, Ra 0.30 x 10⁻³ inch



Room Temperature Testing	As Built	Heat Treated ^[1]
Ultimate tensile strength ^[2]	455 MPa (66 ksi)	555 MPa (81 ksi)
Yield strength ^[2]	379 MPa (55 ksi)	535 MPa (78 ksi)
Modulus of elasticity ^[3]	96 GPa (13.9 Msi)	98 GPa (14.2 Msi)
Elongation ^[2]	Approx. 2%	Approx. 2%
Hardness ^[4]	165±5 HBW (85±3 HRB)	195±5 HBW (92±3 HRB)
Wear ^[5] (Volume loss: lower is better)	Comparison: 17-4PH Stainless Steel: A380 Cast Aluminum:	71 mm ³ 300 mm ³ ^[6] 304 mm ³ ^[7]

Elevated Temperature Testing

Testing temperature		Ultimate tensile strength ^[2]		Yield strength ^[2]		Modulus of elasticity ^[3]		Elongation ^[2]
C	F	MPa	ksi	MPa	ksi	GPa	Msi	%
150°	302°	529	77	506	73	86	12.5	2.7
200°	392°	404	59	356	52	74	10.8	6.3
250°	482°	235	34	207	30	75	10.8	17.0
300°	572°	153	22	113	16	67	9.7	28.7

All samples above were heat treated ^[1]

All stated values are approximate values. All details given above are our current knowledge and experience, and are dependent on the equipment, parameters and operating conditions. The data provided in this document is subject to change and only intended as general information on a material set that is continually improving and developing. The data does not provide a sufficient basis for engineering parts. All samples were produced on an EOS M290. All tensile tests were performed at third party certified test labs such as Westmoreland Mechanical Testing & Research.

Please contact us at jacob@elementum3d.com for additional information.

[1] 500° C for 1.5 hrs. then water quenched

[2] ASTM E8

[3] ASTM E494-15

[4] Converted from HRB measured values

[5] ASTM G65 procedure E (1000 revolutions)

[6] Suthar et al. (2015). Comparative evaluation of abrasivewear resistance of various stainless steel grades. *GE- International Journal of Engineering Research*, 3(7)

[7] Lall and Williamson. Wear Resistance and Mechanical Properties of Selected PM Aluminum Alloys and Composites, Metal Powder Products Company