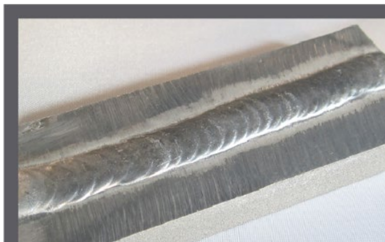
Surface resolution - 02/2018

A2024-RAM10 (High-Strength Aluminum)

Product Information

Elementum 3D's A2024-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.

Turbo impellar - glass bead blasted.



Tig weld with commercially avialable filler wire.

Physical and Chemical Properties

Material composition: A2024 w/10% ceramic

Maximum theoretical density: 2.97 g/cm^3

Printed relative density: > 99.7%

Ultimate tensile strength[1]: 80 ± 3 ksi (552 MPa)

Yield strength[1]: 77 ± 3 ksi (531 MPa)

Elongation[1]: 1.4 ± 1 %

Hardness[2]: 92 ± 3 HRB

Modulus of elasticity[3]: 14.2 ± 0.2 Msi (98 GPa)

Deposition rate[4]: 1.6 in^3/hr (7.13 mm^3/s)

Wear volume loss[5]: 4.3x10^{-3} in^3 (71 mm^3) (Note: Lower volume loss is better)

Comparison: [6]17-4 Stainless Steel 300mm^3, [7]A380 Cast Aluminum 304 mm^3

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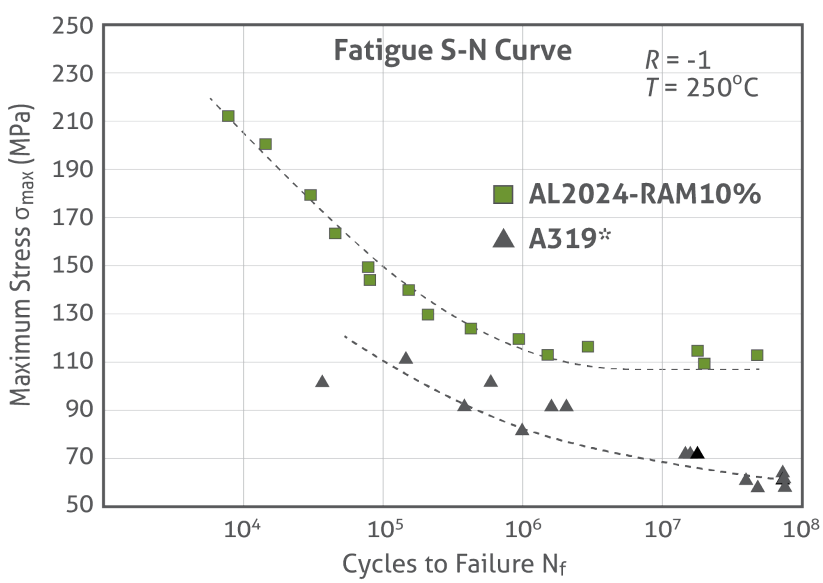
Surface roughness as built[8]:

Angle	Upskin		Downskin	
Deg. °	Ra µm	Ra µin	Ra µm	Ra µin
0 (top)	2.25±0.52	88.7±21		
40	5.01±0.74	197±29	13.67±4.89	538±193
45	4.29±0.63	169±25	10.11±6.20	398±244
50	4.59±0.44	181±17	5.47±1.10	215±43
90 (vertical)	3.97±0.22	156±9		

Elevated temperature testing[9]:

Testing temperature		Ultimate tensile strength[1]		Yield strength[1]		Elongation[1]
°C	°F	MPa	ksi	MPa	ksi	%
23	**73**	**552**	**80**	**531**	**77**	**1.4**
150	302	529	77	506	73	2.7
200	395	404	59	356	52	6.3
250	482	235	34	207	30	17.0
300	572	153	22	113	16	28.7

Fatigue:



Additive manufactured A2024-RAM10 exhibited greatly increase cycles to failure at given stress compared to A319 cast aluminum. *A319 is a designer alloy for high-temperature engine fatigue performance.

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[1]ASTM E8, [2]ASTM E18, [3]ASTM E494-15 (ultrasonic velocity), [4]Deposition rate calculation is for comparison purposes on an EOS M290 and does not include recoating time, laser migration time, contour exposures, etc., [5]ASTM G65 Procedure E, [7]Suthar et al. (2015). Comparative evaluation of abrasive wear resistance of various stainless steel grades. GE- International Journal of Engineering Research, 3(7), [8]Lall and Williamson. Wear Resistance and Mechanical Properties of Selected PM Aluminum Alloys and Composites, Metal Powder Products Company [8] Surface roughness determined by stylus profilometry [9]ASTM E21.

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 and Product Evaluations Systems.

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