A1000-RAM10 (High Temperature Performance)

Product Information

A1000-RAM10 is one of the most versatile aluminum alloy products offered by Elementum 3D. Key advantages include high strength at elevated temperatures, thermal stability, no post process heat treatment required and is economically priced for small and large production runs. A1000-RAM10 is also one of Elementum 3D's metal-matrix composite (MMC) products, which provides the added benefit of combining the ductility, conductivity, and toughness of metals with the strength, hardness, stiffness, and wear resistance of ceramic reinforcing phases. A1000-RAM10 is an all-purpose material and is well suited for aerospace, automotive, and military applications.

Physical and Chemical Properties

Material composition: Proprietary A1000 w/10% ceramic (no heat treatment is required)

Theoretical maximum density: 2.89 g/cm³

Printed relative density: > 99.8%

Ultimate tensile strength[1]: 46 ± 2 ksi (320 MPa)

Yield strength[1]: 37 ± 0.5 ksi (260 MPa)

Elongation[1]: 12 ± 1%

Hardness[2]: 45 ± 2 HRB

Modulus of elasticity[3]: 13.7 ± 0.2 Msi (95 GPa)

Deposition rate[4]: 1.51 in^3/hr (6.8 mm^3/s)

Wear volume loss[5]: 5.1x10^{-3} in^3 (84 mm^3) (Note: Lower volume loss is better)

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

Coefficient of Thermal Expansion (CTE) [8]: approximately 19 ppm/°C

Thermal conductivity [9]: 112 W/m·K (5.42 BTU/hr·in·°F)

(NOTE: Laser Flash is not the ideal method for measuring thermal conductivity in composite materials. Measurement result is lower than reality.

Surface roughness as-built[10]:

Angle	Upskin		Downskin	
Deg. °	Ra µm	Ra µin	Ra µm	Ra µin
0 (top)	4.74±0.40	187±15		
40	5.46±1.14	215±46	15.86±3.13	624±123
45	4.12±0.33	162±13	8.46±2.28	333±90
50	3.83±0.89	151±35	7.86±1.83	309±72
90 (vertical)	3.04±0.84	120±33		

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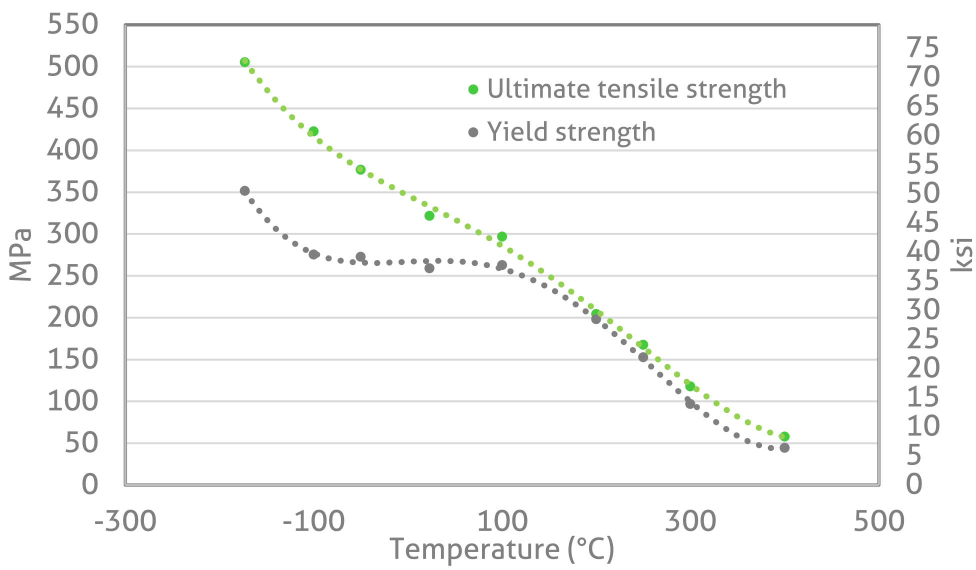
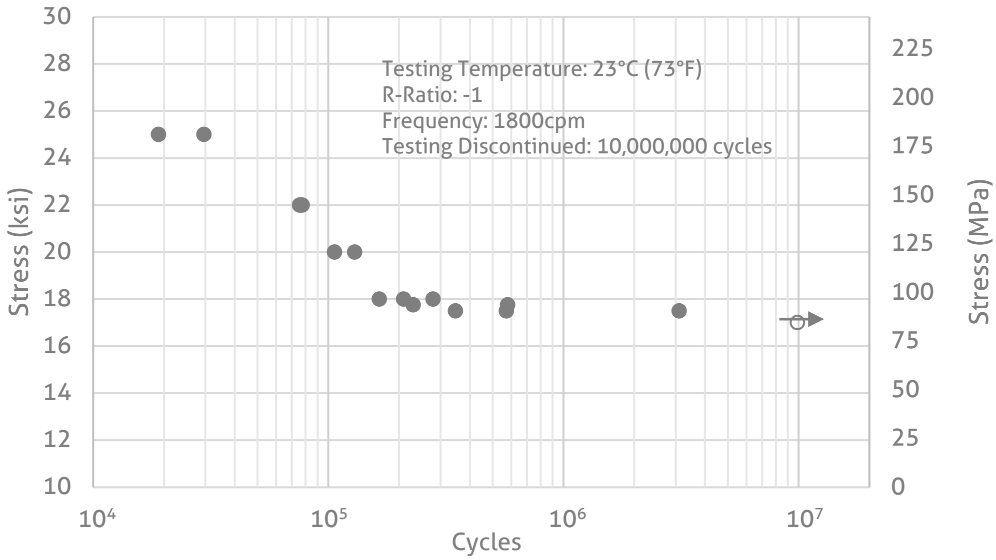
Elevated temperature tensile [11]:

Testing temperature		Ultimate tensile strength		Yield strength		Elongation
°C	°F	MPa	ksi	MPa	ksi	%
-173	-280	505±5	73.2±0.7	351±5	50.9±0.7	38±2.5
-100	-148	422±5	61.2±0.7	275±5	39.9±0.7	27±2.5
-50	-58	377±5	54.6±0.7	273±5	39.5±0.7	35±2.5
23	**73**	**321±13**	**46.6±1.9**	**259±5**	**37.5±0.7**	**12±1.3**
100	212	297±5	43.0±0.7	263±11	38.1±1.6	12±3.3
200	392	204±16	29.6±2.3	198±3	28.7±0.44	27±6.3
250	482	167±3	24.3±0.4	153±2	22.1±0.3	24±3.0
300	572	118±7	17.1±1.0	96.6±3	14.0±0.4	32±8.0
400	752	57.7±10	8.4±1.5	44.4±2	6.4±0.3	47±6.0



Fatigue[12]:



[1]ASTM E8, [2]ASTM E18, [3]ASTM E494-20 (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, [6]Suthar et al. (2015). Comparative evaluation of abrasive wear 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, [8]ASTM E228, [9] ASTM E1461, [10]Surface roughness determined by stylus profilometry, [11]ASTM E21, [12]ASTM E466.

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.