Additive Manufacturing LLC
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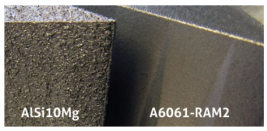
FROM ADDITIVE TO MANUFACTURING

AL6061-RAM2
Materials Data Sheet

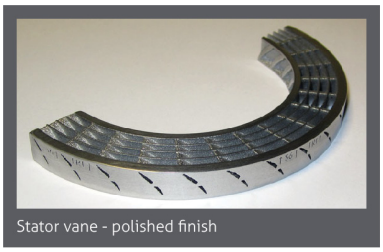
AS BUILT SURFACE FINISH COMPARISON

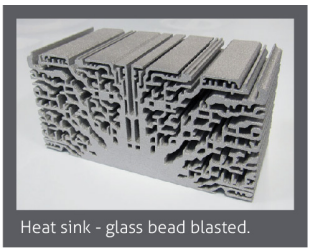


AL6061-RAM2 (Highly Versatile and Cost Effective)

Product Information

AL6061-RAM2 is a general-purpose AM aluminum alloy that features a good combination of excellent ductility, high strength, and good thermal conductivity. An additive printed AL6061 is of particular interest for many applications due to its unique balance of properties and efficient build speed. AL6061-RAM2 builds more than 50% faster than AlSi10Mg on an EOS M290 and has a better "as built" surface finish.


Stator vane - polished finish


Heat sink - glass bead blasted.

Physical and Chemical Properties

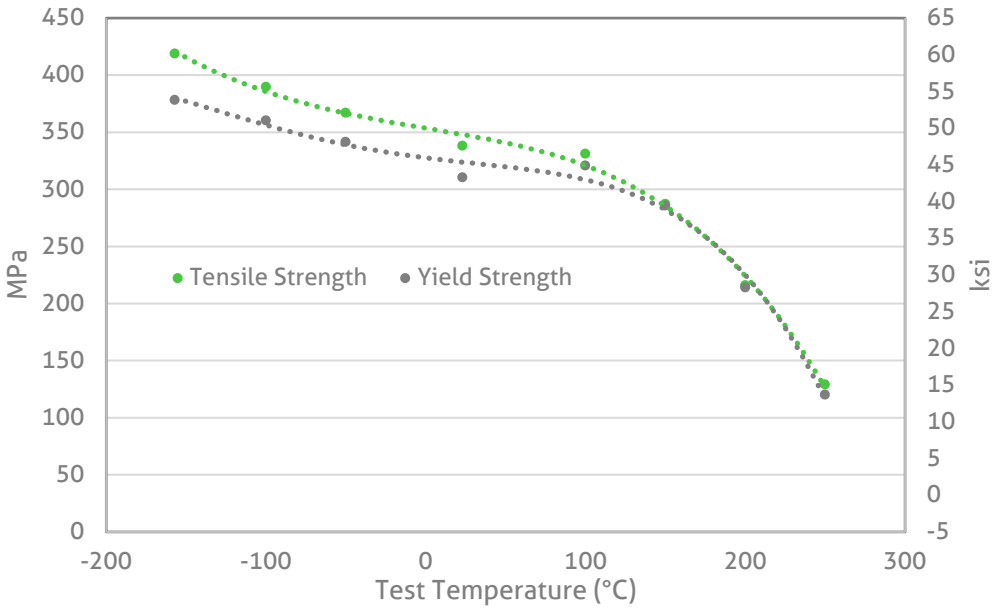
Material composition: Proprietary A6061 w/2% ceramic (E3D-T6 Condition)
Theoretical maximum density: 2.74 g/cm^3
Printed relative density: > 99.7%
Ultimate tensile strength[1]: 48 ± 3.0 ksi (331 MPa)
Yield strength[1]: 43 ± 2.0 ksi (297 MPa)
Elongation[1]: 12 ± 1.5 %
Hardness[2]: 60 ± 2.0 HRB
Modulus of elasticity[3]: 11.0 ± 0.10 Msi (76 GPa)
Deposition rate[4]: 2.3 in^3/hr (10.4 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
Thermal conductivity[8]: 162±3 W/m·K (measured in z)
Coefficient of Thermal Expansion (CTE)[9]: 22.4ppm/°C

Surface roughness as built[10]:

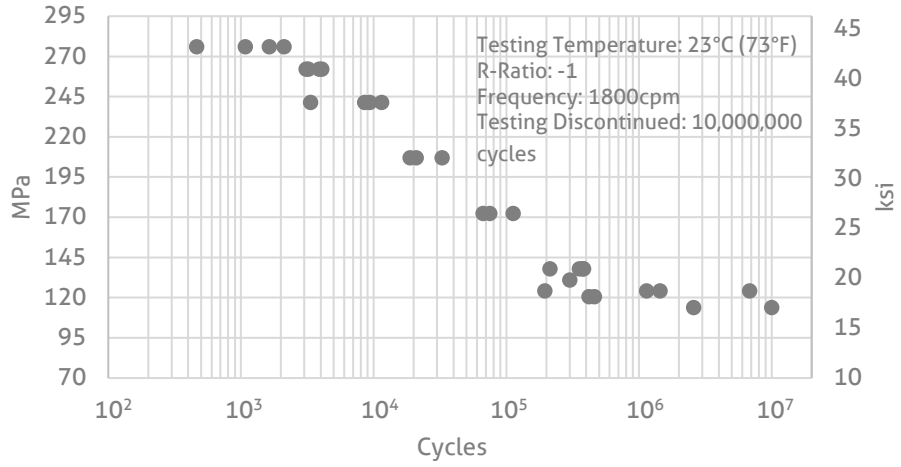
Angle	Upskin		Downskin	
Deg. °	Ra µm	Ra µin	Ra µm	Ra µin
0 (top)	2.27±0.31	89.4±12		
40	7.35±1.72	289±68	18.91±1.0	744±39
45	6.32±1.73	249±68	18.14±2.29	714±90
50	6.74±1.13	265±44	16.97±3.86	668±152
90 (vertical)	7.28±0.31	287±12		

Elevated temperature tensile[11]:

Test temperature		Ultimate tensile strength		Yield strength		Elongation
°C	°F	MPa	ksi	MPa	ksi	%
-157	-251	419±11	60.7±2	378±11	54.8±2	15.1±1
-100	-148	390±11	56.5±2	360±12	52.2±2	13.0±1
-50	-58	367±17	53.2±3	342±17	49.5±3	13.1±1
23	**73**	**338±20**	**49.0±3**	**311±14**	**45.0±2**	**12.9±2**
100	212	331±5	48.0±1	320±7	46.5±1	14.5±1
150	302	287±6	41.6±1	286±5	41.4±0.7	18.4±3
200	392	215±9	31.3±1	214±8	31.0±1	22.0±4
250	482	129±15	18.7±2	120±6	17.4±1	29.6±5



Fatigue[12]:



All stated values are from heat treated samples.
[1]ASTM E8, [2]ASTM E18, [3]ASTM E494-15, [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]ISO/DIS 22007-2.2 (Transient Place Source, TPS), [9] ASTM E228, [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.