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ABD®-900AM

Nickel-based superalloy for additive manufacturing

Material Overview

ABD®-900AM is an age-hardenable nickel-based superalloy designed specifically for use as feedstock in powder bed fusion.

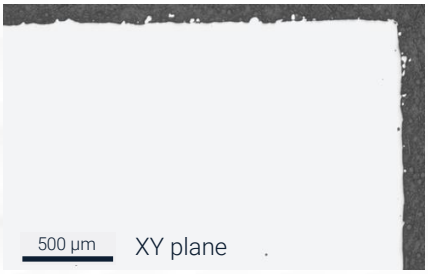
It is optimised for environmental resistance and high-temperature tensile strength, with a working temperature range up to 900°C (1652°F) in its age-hardened state. Compared to alloy 718, ABD®-900AM not only offers a higher operating temperature but also significant long-term stability.

The alloy has excellent creep strength – similar to alloy 939 and alloy 738 – while having superior resistance to cracking during manufacture and heat treatment, enabling complex part design.

ABD®-900AM is suitable for complex components within the Aerospace, Power, Automotive and Space industries (e.g. combustion chamber, left)

Height: 291 mm
Width: 147 mm

Designed to be free of solidification, liquidation, and strain-age cracks, ABD®-900AM showcases exceptional printability for a 40% γ'-phase strengthened alloy.



ABD®-900AM shows high as-printed part density of >99.9% and no cracking when printed with standard alloy 718 parameters.

Key Material Properties

Mechanical [1,2] (900°C)	Yield strength/ MPa	574 Z, 568 XY
	Ultimate tensile strength/ MPa	582 Z, 593 XY
	Elongation at failure/ %	13 Z, 7 XY
	Area reduction at failure/ %	12Z,7XY
Thermophysical [3] (25-1200°C)	Thermal Conductivity/ $W(m°C)^{-1}$	11.0 – 30.1
	CTE (Linear)/ $x10^{-6}$ $°C^{-1}$	11.4 – 19.2
Physical [4]	Density/ g cm^{-3}	8.395
	Melting range[2]/ °C	1305 – 1380

All measurements are for the alloy printed with a layer thickness of 30 µm.
[1]strain rate of 10^{-3} s^{-1}, [2]after recrystallisation anneal and full heat treatment, [3]after full heat treatment, [4]as-printed

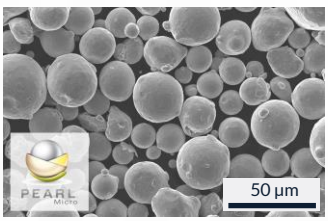
Powder Properties

ABD®-900AM powder is available for laser beam melting in a nominal 15-53 µm size range with the following properties:.

Test	Value	Standard
Carney flow/ s $50g^{-1}$	2 - 3	ASTM B964
Hall flow/ s $50g^{-1}$	12 - 14	ASTM B213
Apparent density/ g cm^{-3}	4.3 - 4.5	ASTM B212
Tapped density/ g cm^{-3}	5.1 - 5.4	ASTM B527

Also available in:

- 45-106 µm (EBM/DED)
- Custom size distributions available on request



Typical powder morphology

ABD®-900AM is available in batch sizes suitable for R&T and full production from our powder partner Aubert & Duval

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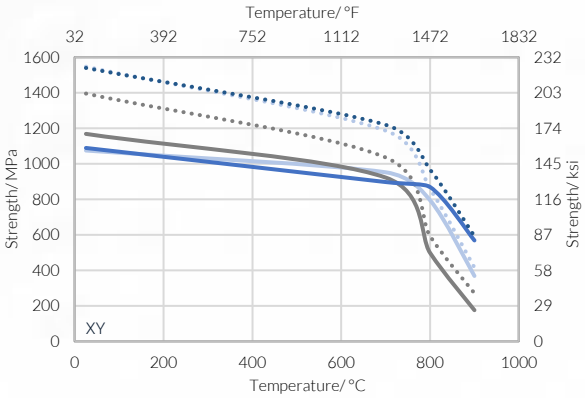
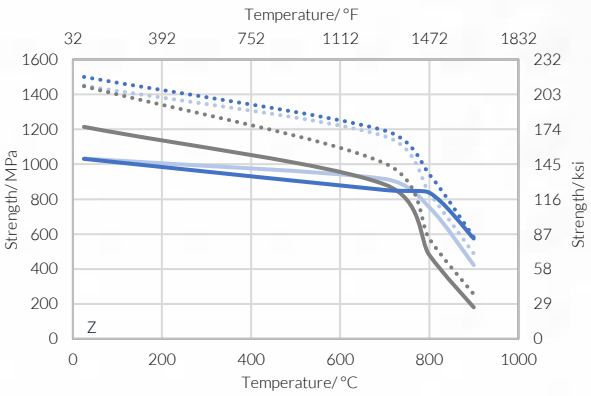
Yield Strength & Ultimate Tensile Strength

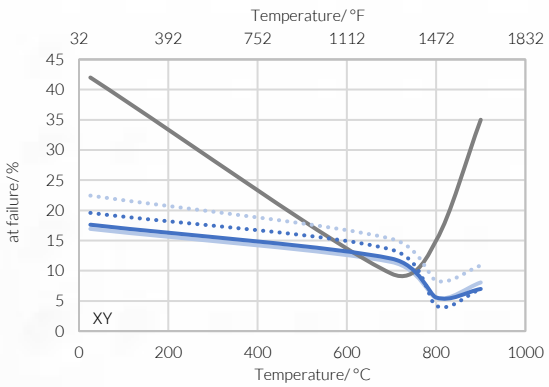


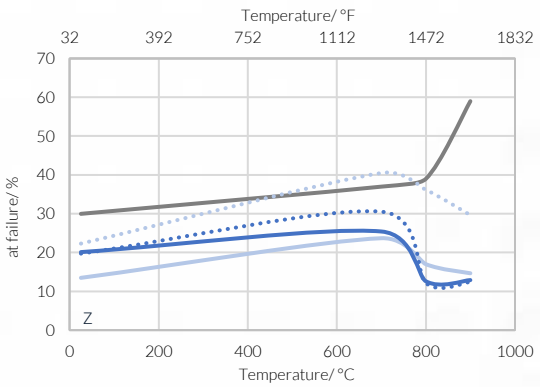


- ABD®-900AM – YS – full heat treatment
- ABD®-900AM – YS – recrystallisation anneal and full heat treatment
- Alloy 718 – YS – standard full heat treatment
- ABD®-900AM – UTS – full heat treatment
- ABD®-900AM – UTS – recrystallisation anneal and full heat treatment
- Alloy 718 – UTS – standard full heat treatment

Tensile properties of additively manufactured ABD®-900AM and Alloy 718, evaluated at a strain rate of 10^{-3} s^{-1}, all other test conditions in accordance to ASTM E8/E8M-16a/E21. No HIP applied. Yield Strength (YS) shown is $R_{p0.2\%}$ stress, Ultimate Tensile Strength (UTS) is stress at maximum force.

Tensile Ductility & Reduction Of Area





- ABD®-900AM – Elongation – full heat treatment
- ABD®-900AM – Elongation – recrystallisation anneal & full heat treatment
- Alloy 718 – Elongation – standard full heat treatment
- ABD®-900AM – Area Reduction – full heat treatment
- ABD®-900AM – Area Reduction – recrystallisation anneal and full heat treatment

Tensile properties of additively manufactured ABD®-900AM and Alloy 718, evaluated at a strain rate of 10^{-3} s^{-1}, all other test conditions in accordance to ASTM E8/E8M-16a/E21. No HIP applied. Elongation and Area Reduction were measured after failure as per the standards.

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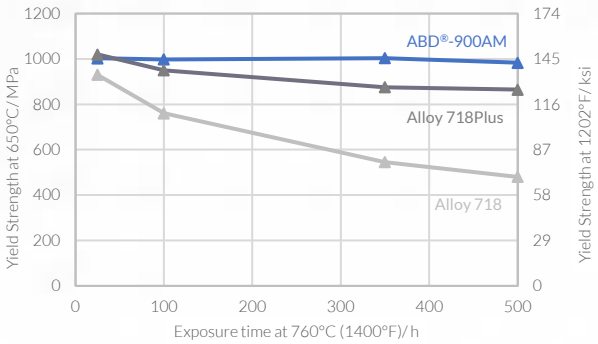
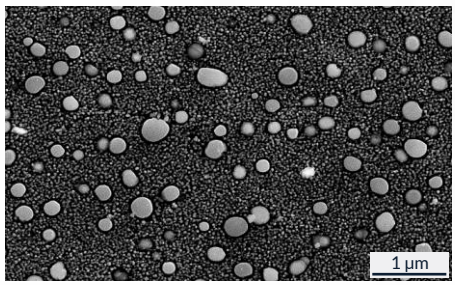
Long Term Stability

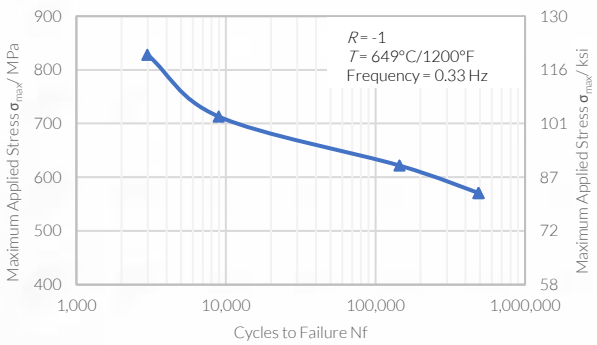


Tensile properties of additively manufactured ABD®-900AM after full heat treatment cycle followed by long term heat exposure. Yield strength evaluated at 650°C with a strain rate of 10^{-4} s^{-1}. Data for cast Alloy 718 and Alloy 718Plus taken from *"Advanced Materials and Processes, December 2006"*



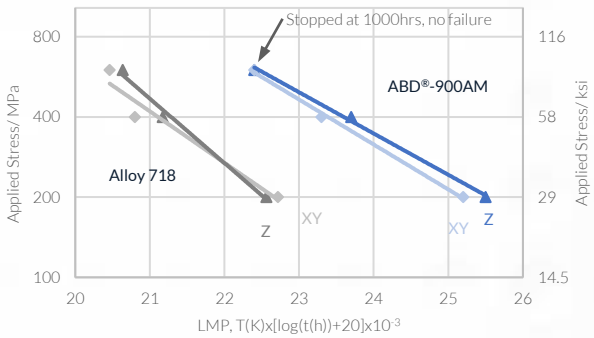
SEM image of fully heat-treated ABD®-900AM after electro-chemical etching in 10% phosphoric acid showing the bi-modal γ'-phase distribution: 50 and 200 nm

Fatigue Properties



Fatigue properties of additively manufactured ABD®-900AM after full heat treatment cycle. Tested in accordance to ASTM E606.

Stress Rupture Properties



Stress rupture properties of additively manufactured ABD®-900AM after recrystallisation anneal and full heat treatment cycle. Tested in accordance to ASTM E139. Larson-Miller Parameter evaluated with Temperature (T) in Kelvin and Time (t) in hours. Alloy 718 is additively manufactured and fully heat treated.

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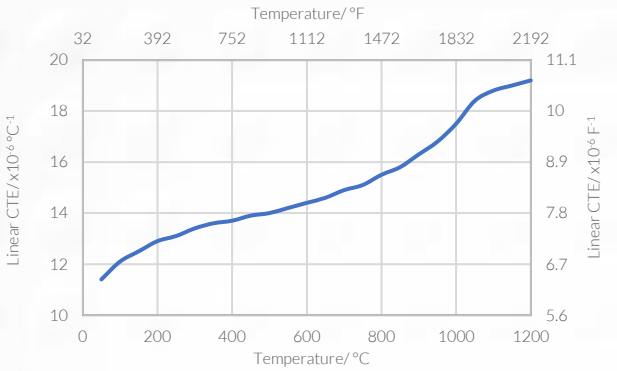
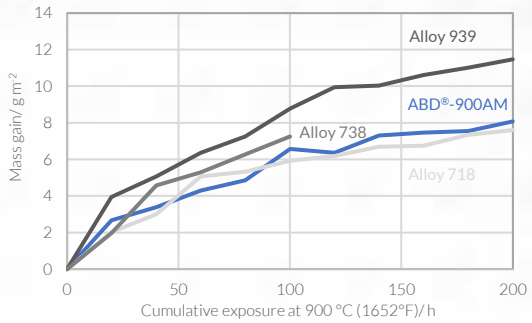
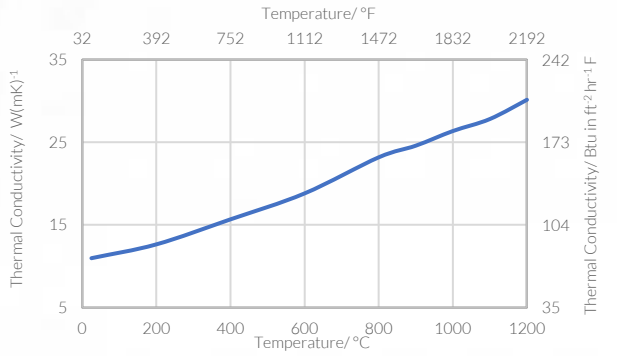
Thermophysical Properties



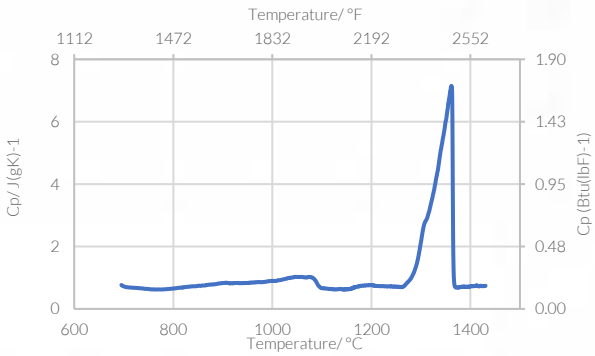
Linear coefficient of thermal expansion measured according to ASTM E228. Average of heating and cooling curves. [1]



Mass gain of ABD®-900AM and other alloys during the course of cyclic oxidation in laboratory air over 200 hrs. [1]



Thermal conductivity (λ) of ABD®-900AM is calculated using ASTM standards from measured values of density (ρ), specific heat capacity (C_p), and thermal diffusivity (a): $\lambda = \rho\ C_p\ a$. [1]



Specific heat (C_p) of ABD®-900AM, measured according to ASTM E1269. [2]

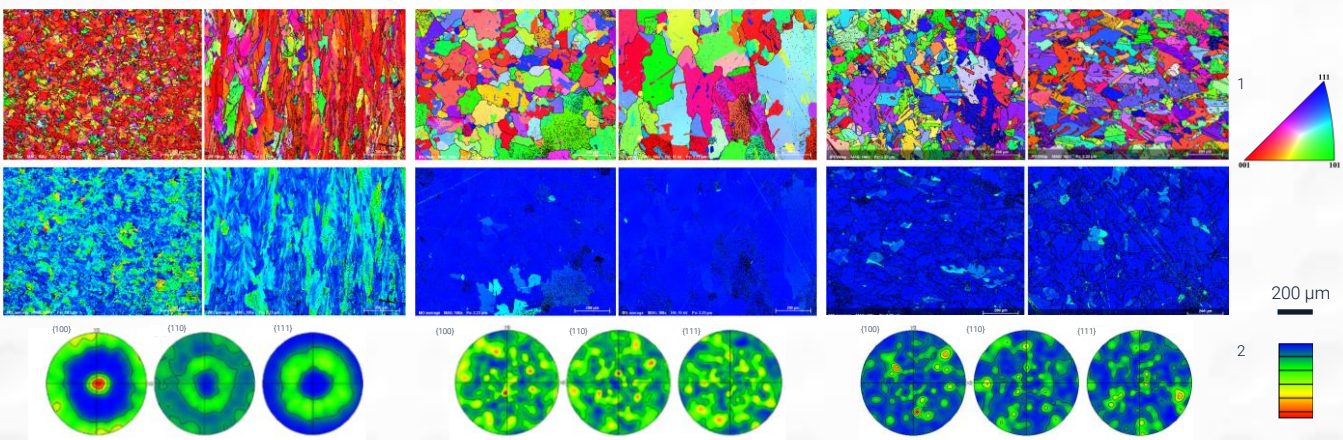
[1]ABD®-900AM after full heat treatment, [2]ABD®-900AM in an as-printed condition

Microstructure & Heat Treatment

Full heat treatment: 1060°C / 2hrs + 850°C/4 hrs + 760°C / 16 hrs

Recrystallisation anneal: 1240°C/ 2hrs, followed by full heat treatment

HIP parameter: 1160°C / 100 MPa / 3hrs



Typical EBSD maps and grain structures of ABD®-900AM after the corresponding heat treatments.

[1]Crystallographic misalignment scale, [2]Scale for pole figures, blue-red = increasing grain density in given direction

made with ABD®

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