CARPENTER ADDITIVE®

DATASHEET

PowderRange® GammaPrint®-1100

Patent pending, US20220380867A1

Type analysis

Wt.%. Single figures are nominal except where noted.

Nickel	Balance	**Chromium**	9–11 %	**Tantalum**	7–9 %
Cobalt	4–6 %	**Aluminum**	3–5 %	**Molybdenum**	3–5 %
Tungsten	3–5 %	**Niobium**	2–4 %	**Carbon**	0.005–0.100 %
Hafnium	0.005–0.100 %	**Yttrium**	0.005–0.100 %	**Boron**	0.005–0.040 %
Zirconium	0.005–0.040 %				

Description

PowderRange GammaPrint-1100 is an age-hardenable heat- and corrosion-resistant nickel-base superalloy powder purposefully designed for additive manufacturing.

GammaPrint-1100 has excellent printability and derives its strength and creep resistance from a high-volume fraction of γ'-Ni_3(Al,Nb) precipitates (between 50 vol.% and 60 vol.% in the fully aged condition). With a composition specifically designed to form an alumina (Al_2O_3) layer when exposed to air, it is resistant to oxidation at temperatures up to 1050°C (1922°F).

GammaPrint-1100 can be easily manufactured by laser-powder bed fusion (L-PBF) and electron beam melting (EBM) and resists cracking during printing and post-processing heat treatment.

Key Properties:

- Excellent printability
- Resistance to hot cracking and strain-age cracking
- Alumina forming for oxidation resistance to 1050°C (1922°F)
- 1100 MPa (160 ksi) yield strength until 760°C (1400°F)
- 330 MPa (48 ksi) yield strength at 982°C (1800°F)
- Ductility > 4 El% at all temperatures

Markets:

- Aerospace
- Defense
- Energy

Applications:

- Turbine blades, shrouds, and vanes
- High-temperature heat exchangers
- Combustion chamber components

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> PowderRange GammaPrint-1100

Powder properties

CATEGORY	Product Properties	Alternate Product Properties
APPLICATION	Laser-powder bed fusion (L-PBF)[1]	Electron beam powder bed fusion (EB-PBF)[1]
MAXIMUM PARTICLE SIZE	Max 5 wt% > 53 µm[2]	Max 5 wt% > 150 µm[2]
MINIMUM PARTICLE SIZE	Max 5 vol% < 15 µm[3]	Max 5 wt% < 53 µm[3]
ATOMIZATION	Vacuum atomization with argon gas	Vacuum atomization with argon gas
APPARENT DENSITY (G/CM³)	8.71	8.71

[1] ASTM/ISO 52900: Laser—Powder Bed Fusion (L-PBF), Electron-Beam Powder Bed Fusion (EB-PBF), Directed Energy Deposition (DED)
[2] ASTM B214 Standard Test Method for Sieve Analysis for Metal Powders
[3] ASTM B822 Standard Test Method for Particle Size Distribution of Metal Powders and Related Compounds by Light Scattering
Testing of powder will fulfill certification requirements to Nadcap Materials Testing and ISO/IEC 17025 Chemical, per relevant ASTM procedures

Additive manufacturing process guidance

Laser-Powder Bed Fusion (L-PBF)	GammaPrint-1100 is compatible with all commercial L-PBF equipment. To achieve as-built density >99.5%, we recommend a 30 µm layer thickness and specific energy of 75 J/mm³.
Electron Beam Powder Bed Fusion (EB-PBF)	GammaPrint-1100 is compatible with all commercial EBM equipment.
Post Processing	Hot isostatic pressing (HIP): 1177°C (2150°F) / 103 MPa (15 ksi) / 4 hr.
Heat Treatment	**Subsolvus heat treatment to retain a fine grain microstructure and maximize strength.** Subsolvus solution 1 hr at 1177°C (2150°F) with oil quench + age. **Supersolvus heat treatment to coarsen grains and maximize creep resistance.** Supersolvus solution 1 hr at 1249°C (2280°F) with furnace cool + age 24 hr at 871 °C (1600°C) with air cooling. Note: γ' solvus: ~1180°C (2156°F).

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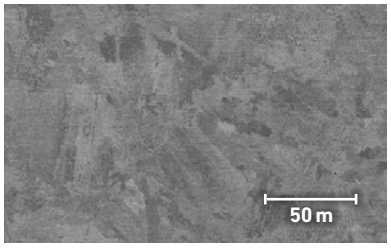
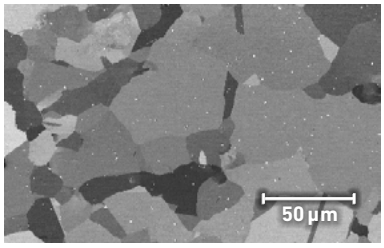
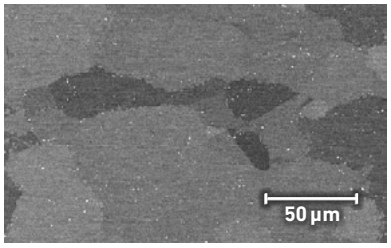
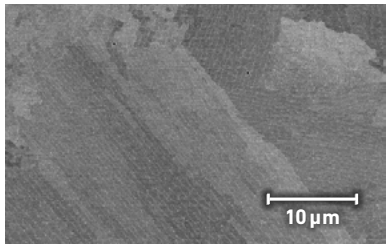
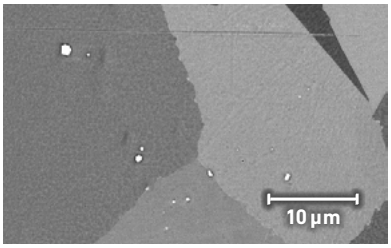
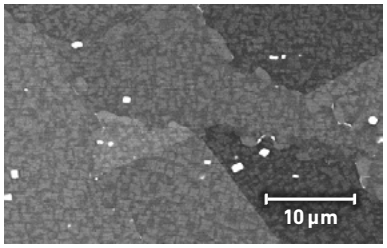
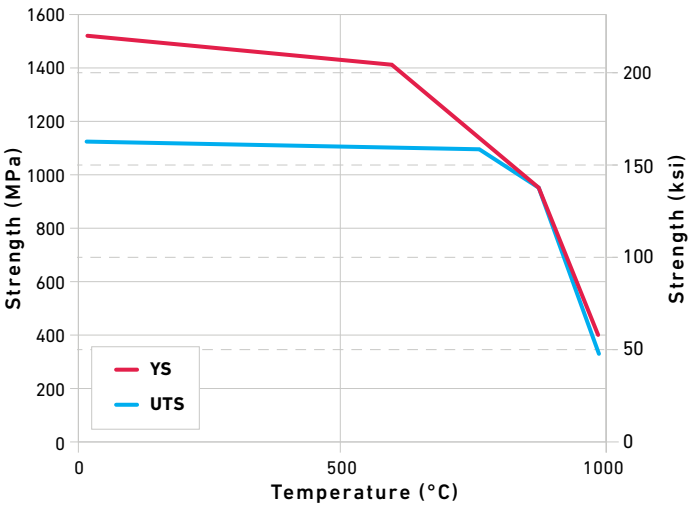
Typical microstructure

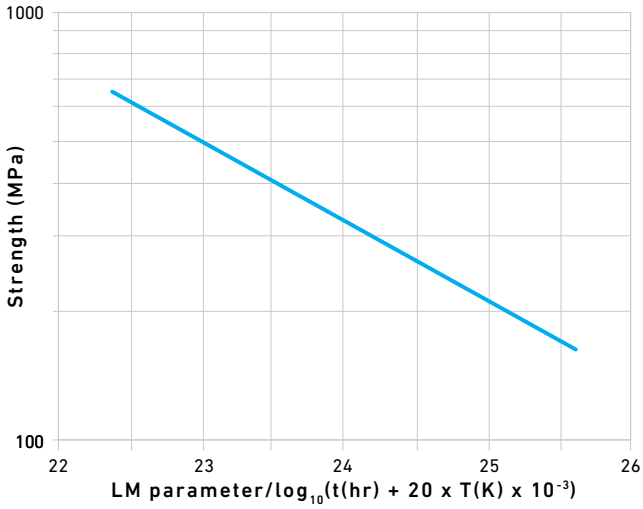
HEAT TREATMENT STATUS			
MAGNIFICATION	L-PBF AS-BUILT	HIP/SUBSOLVUS SOLUTION/AGE	HIP/SUPERSOLVUS SOLUTION/AGE
Low			
High			

Typical mechanical properties

HIGH-TEMPERATURE STRENGTH

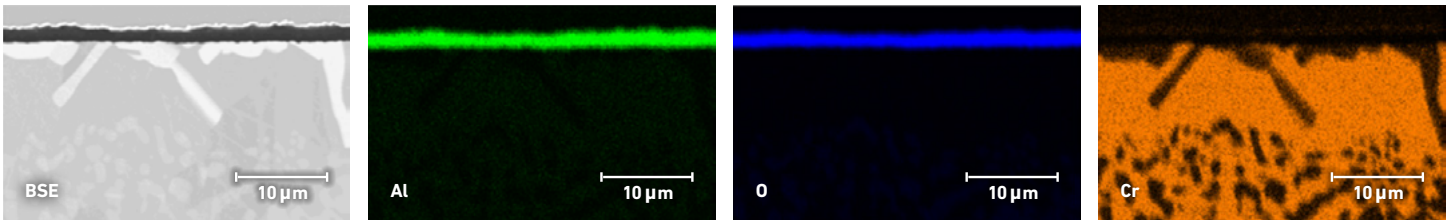


STRESS RUPTURE



Oxidation resistance

Protective alumina layer formed after exposure at 982°C (1800°F)



For additional information, please contact your nearest sales office:
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The mechanical and physical properties of any additively-manufactured material are strongly dependent on the processing conditions used to produce the final part. Significantly differing properties can be obtained by utilizing different equipment, different process parameters, different build rates and different geometries. The properties listed are intended as a guide only and should not be used as design data.

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