AUBERT&DUVAL

Stellar HX

Powder for Additive Manufacturing

STELLAR

CHEMICAL COMPOSITION

Elements	Ni	Co	Cr	Fe	Mo	W	Al	B	Cu	P	Mn	Si	Ti	C	S	O	N
Min	Bal.	0.5	20.5	17	8	0.2	-	-	-	-	-	-	-	-	-	-	-
Max	-	2.5	23	20	10	1.0	0.5	0.01	0.5	0.04	1.0	1.0	0.15	0.1	0.03	0.03	0.03

STANDARDS

- European standards
  - NiCr22Fe18Mo
  - 2.4665
- US Standards
  - UNS N06002

PARTICLE SIZE DISTRIBUTIONS

Laser Beam Melting (powder bed): 10-53 μm

Electron Beam Melting (powder bed): 45-106 μm

Directed energy deposition (LMD): 45-106 μm

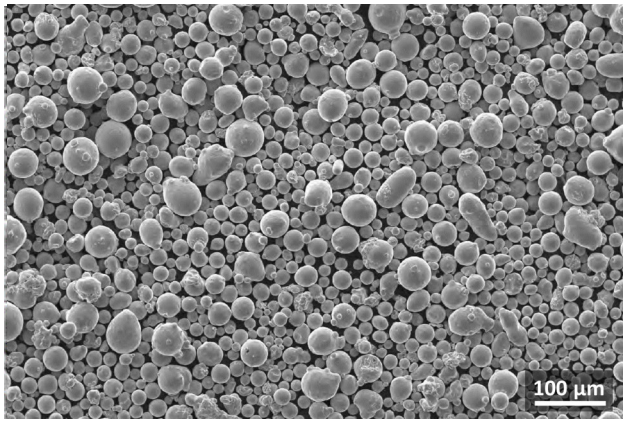
Customized particle size distributions upon request

MATERIAL OVERVIEW

Stellar HX is a solution hardened nickel based superalloy with an excellent resistance to oxidizing, reducing and neutral atmospheres at high temperature. The grade is interesting for applications in the combustion zone of turbines, for industrial furnaces and for the chemical process industry.

Stellar HX has a chemical composition conform to standard NiCr22Fe18Mo, but optimized for additive manufacturing to ensure crack-free parts both after SLM and heat treatment. It is printable using standard parameters.

POWDER MORPHOLOGY



Typical powder morphology.

PHYSICAL PROPERTIES

Property	Unit	20°C	600°C
Density	g/cm^3	8.22	7.7
Thermal conductivity	W/(m*K)	9	21
Thermal expansion	10^{-6} K^{-1}	-	15

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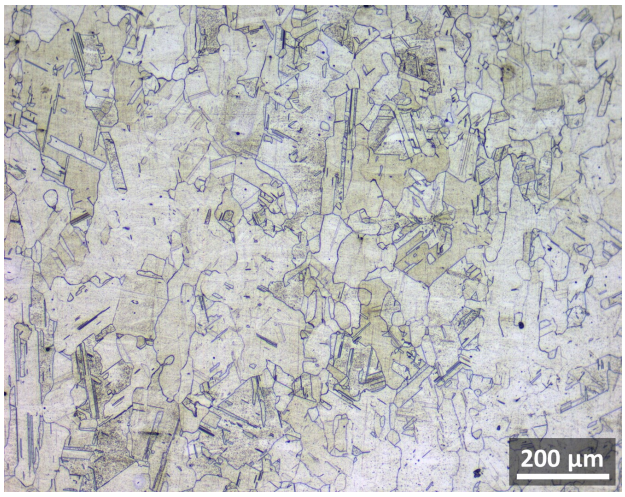
SOLUTION HEAT TREATMENT

Solution treatment by heating to around 1177°C (2150 °F) the time needed to bring the entire part to temperature, followed by rapid cooling. For smaller or thin-walled components air cooling is enough.

There is no aging treatment for the grade.

MICROSTRUCTURE AFTER HT



Microstructure after solution treatment of Stellar HX at 1180°C for 2h with air cooling to room temperature giving a hardness of 160 HV30. Etching made using Kalling reagent.

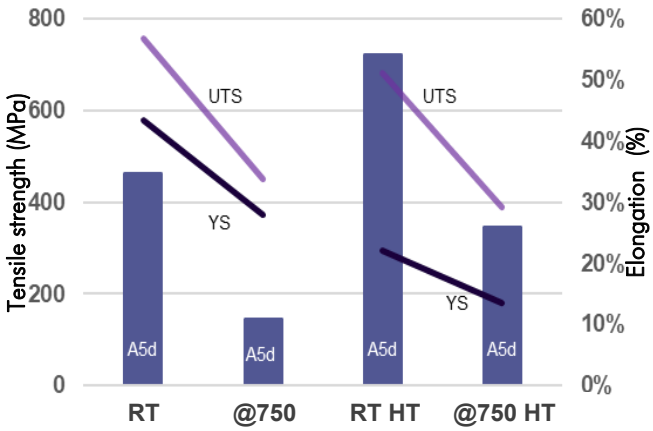
STRESS RUPTURE PROPERTIES

Stress rupture testing according to AMS 5754.

- The material was solution treated at 1180°C for 2 hours cooled by air cooling.
- The tensile testing was performed at 816°C with a tensile stress of 103 MPa.

Criteria	Requested by AMS 5754	Mean test results
Time to rupture (h)	> 24	29.2
Elongation at rupture (4d) (after prolonged exposure)	>10%	14%

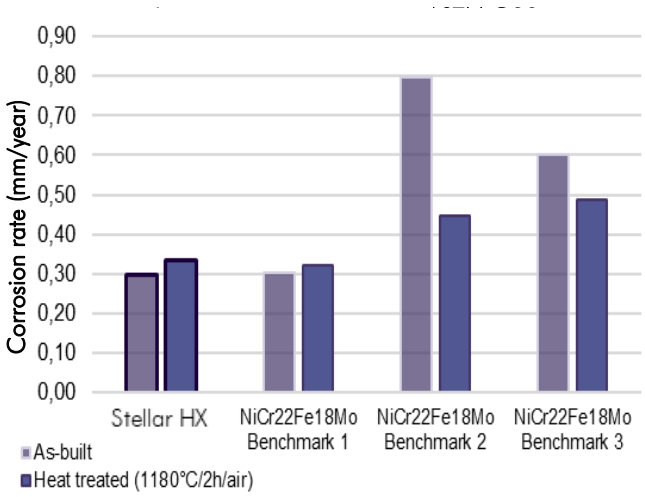
TENSILE PROPERTIES



Properties evaluated at a strain rate of $10^{-4}\,s^{-1}$, all other test conditions in accordance to NF EN 2002-1 and NF EN 2002-2. Yield Strength (YS) shown is Rp0.2% stress, Ultimate Tensile Strength (UTS) is stress at maximum force. Elongation was measured after failure as per the standards.

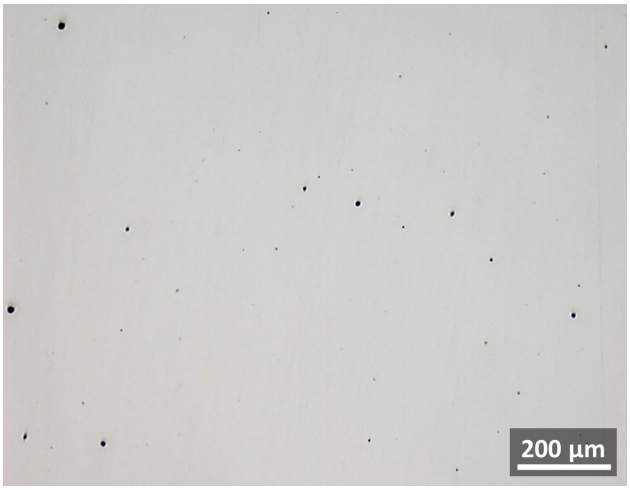
CORROSION RESISTANCE

Intergranular corrosion in ferric sulfate according to ASTM G28 in comparison to benchmark versions of the standard NiCr22Fe18Mo.



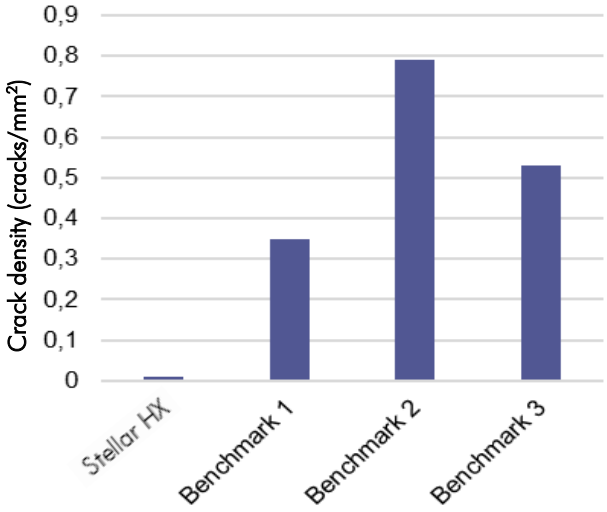
PRINTABILITY

We recommend standard parameters for HX grades when printing Stellar HX. No preheating of the base plate needed for production. The hardness as-printed is around 240 HV30.



Microstructure for Stellar HX by Selective Laser Melting using standard parameters.

No cracks observed in the as-built microstucture.



Comparison of crack density of Stellar HX to benchmark versions of the standard NiCr22Fe18Mo.

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