Material
Data Sheet

EOS NickelAlloy IN625

Nickel Alloy for Various Applications in Cryogenic to Elevated Temperatures

EOS NickelAlloy IN625
High Strength and Corrosion Resistance in Cryogenic to Elevated Temperatures

EOS NickelAlloy IN625 is a solid solution strengthened nickel-chromium-molybdenum-niobium alloy used for diverse applications requiring high strength as well as corrosion and/or oxidation resistance.

EOS NickelAlloy IN625 is a nickel alloy powder intended for manufacturing parts on EOS metal systems with EOS DMLS processes.

Main Characteristics:

- Combination of high strength and ductility at ambient and elevated temperatures
- Good corrosion resistance in a variety of environments
- Oxidation resistance
- Good fabricability

Typical Applications:

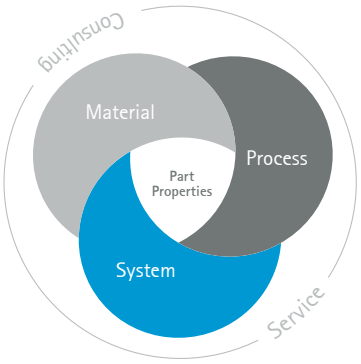
- Various applications, from cryogenic to elevated temperatures
- Parts for chemical processing
- Gas turbine components
- Parts in sea water service
- High performance automotive engine parts

The EOS Quality Triangle

EOS uses an approach that is unique in the AM industry, taking each of the three central technical elements of the production process into account: the system, the material and the process. The data resulting from each combination is assigned a Technology Readiness Level (TRL) which makes the expected performance and production capability of the solution transparent.

EOS incorporates these TRLs into the following two categories:
- Premium products (TRL 7-9): offer highly validated data, proven capability and reproducible part properties.
- Core products (TRL 3 and 5): enable early customer access to newest technology still under development and are therefore less mature with less data.

All of the data stated in this material data sheet is produced according to EOS Quality Management System and international standards.



Powder Properties

Powder and built part compositions meet the chemical composition requirements of UNS N06625, AMS 7000, AMS 7001, ASTM F3055, W.Nr 2.4856, and DIN NiCr22Mo9Nb.

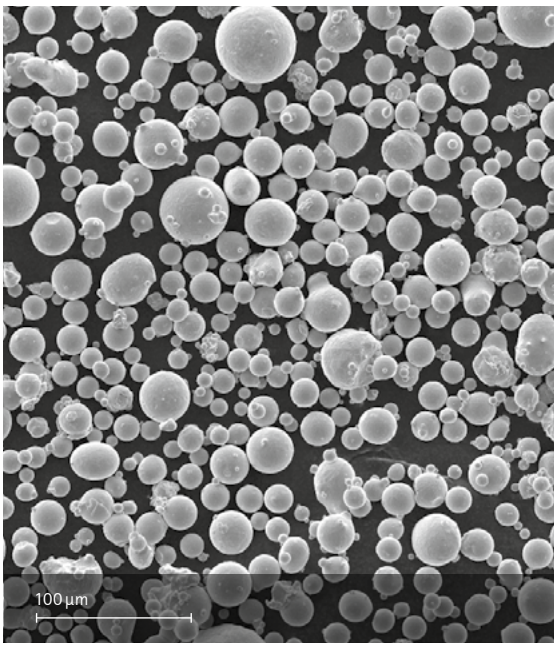
Powder chemical composition (wt.-%)

Element	Min.	Max.
Cr	20.00	23.00
Mo	8.00	10.00
Nb	3.15	4.15
Fe	-	5.00
Ti	-	0.40
Al	-	0.40
Co	-	1.00
Si	-	0.50
Mn	-	0.50
C	-	0.10
Ta	-	0.05
P	-	0.015
S	-	0.015
Ni	Bal	Bal

Powder particle size

Generic particle size distribution	15-60 µm

SEM picture of EOS NickelAlloy IN625 powder.

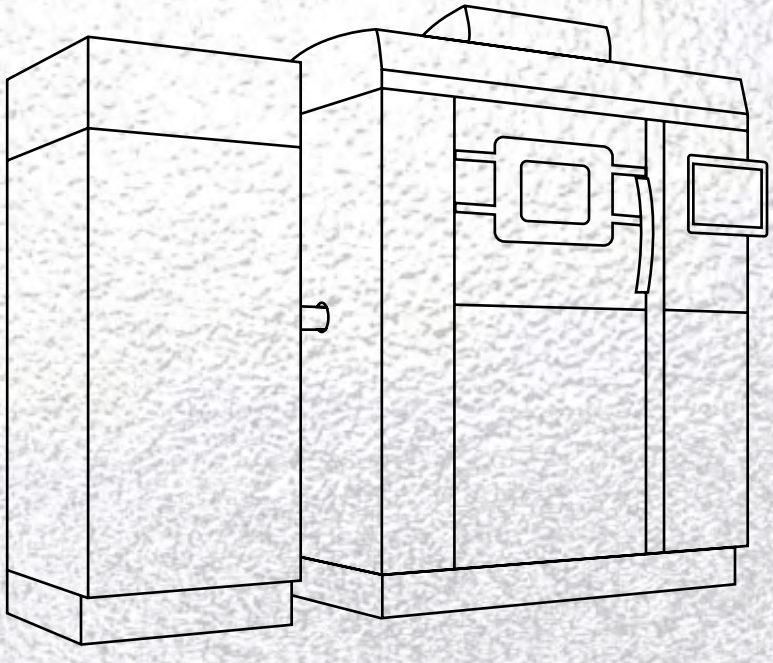


Heat Treatment

EOS NickelAlloy IN625 can be used for many applications in the stress relieved condition, which is typically performed at 870 °C (1 600 °F). Note that this heat treatment does not solutionise the alloy.

Step 1:
Stress relieve at 870 °C (1 600 °F) for 1 hour followed by rapid cooling.

TRL 7
Premium



EOS NickelAlloy IN625
for EOS M 290 | 40 µm

Process Information
Physical Part Properties
Mechanical Properties
Additional Data

EOS NickelAlloy IN625 for EOS M 290 | 40 µm
Process Information

System set-up	EOS M 290
EOSPAR name	IN625_Performance M291 2.00
Software requirements	EOSPRINT 2.5 or newer EOSYSTEM 2.5 or newer
Powder part no.	9011-0022
Recoater blade	EOS HSS Blade
Nozzle	EOS Grid Nozzle
Inert gas	Argon
Sieve	63 µm

Additional information	
Layer thickness	40 µm
Volume rate	4.2 mm³/s

Chemical and Physical Properties of Parts[1]

Micrograph of polished surface. Heat treated.

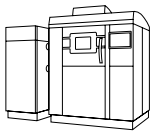
Defects	Result
Average defect percentage	0.011 %

Modulus of Elasticity

EN ISO 6892-1 Method A, Range 1 (0.00007 1/s)

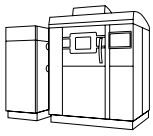
State	Heat treated
Vertical [GPa]	204
Horizontal [GPa]	214

Mechanical Properties

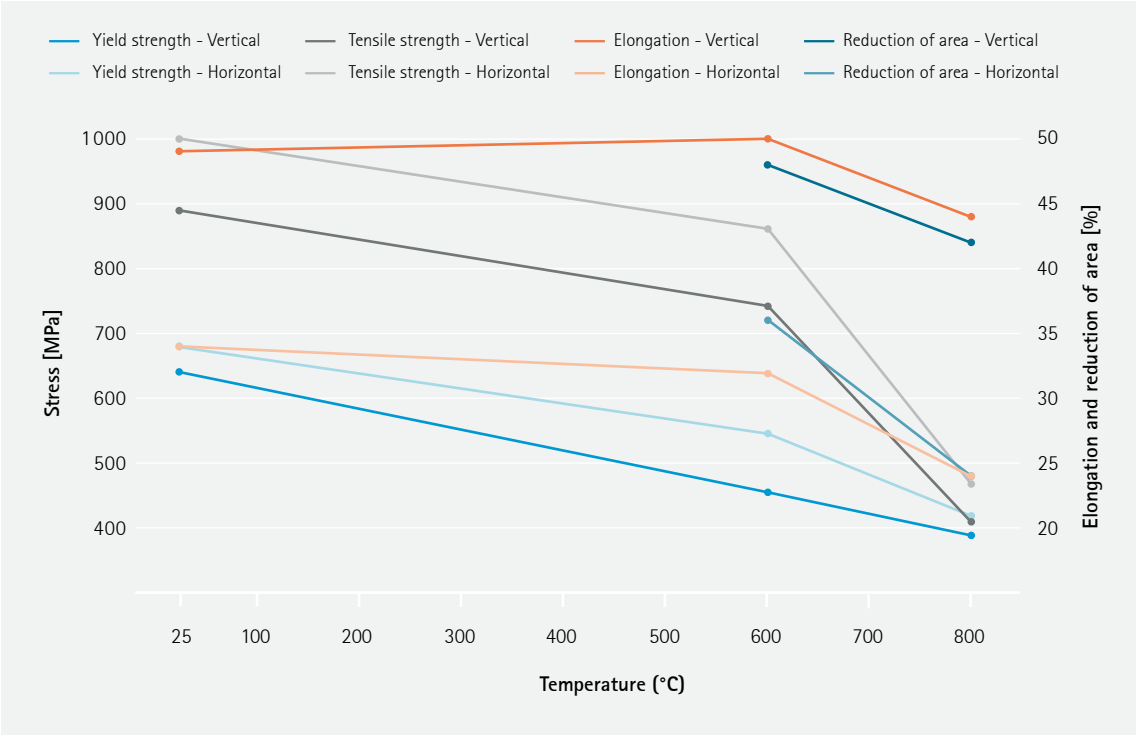


Tensile properties heat treated according to ISO 6892-1, $L_0 = 4.d_0$	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]
Vertical	640	890	49
Horizontal	680	1 000	34

Tolerance intervals provide lower bounds where 90 % of the population falls with 95 % confidence.
Tolerance intervals are based on validation data / QA statistics. Heat treated state.



Tensile Properties at Elevated Temperatures

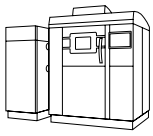


Elevated temperature tensile properties in heat-treated condition. Testing according to ISO 6892-1, $L_0 = 4.d_0$.

Tensile properties as manufactured according to ISO 6892-1, $L_0 = 4.d_0$			
	Yield strength $R_{p0.2}$ [MPa]	**Tensile strength** R_m [MPa]	**Elongation at break** A [%]
Vertical	630	870	48
Horizontal	720	980	33

Hardness as per ISO 6508	
Hardness, HRC	27

Additional Data[1]



Stress Rupture Performance

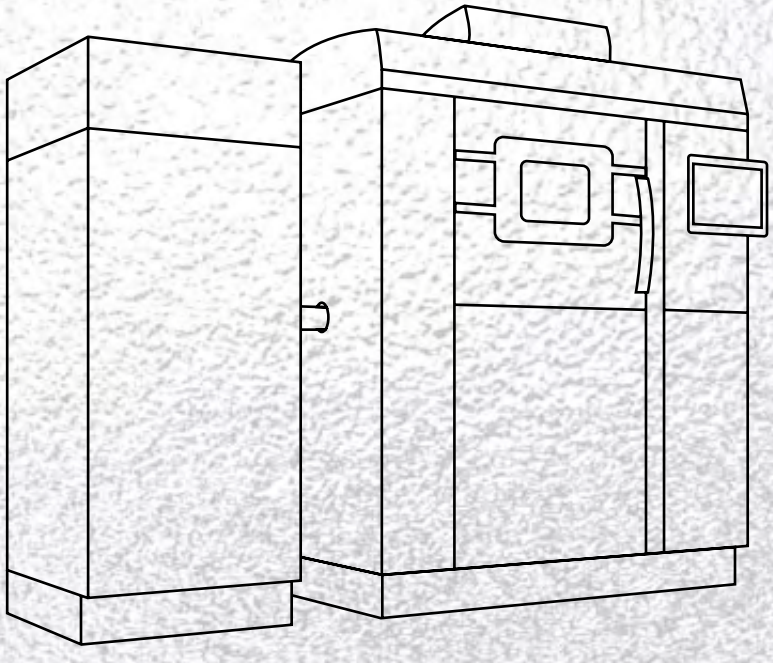
Sample condition: heat treated
ASTM E139, $L_o = 4.d_o$

	Stress [MPa]	Temperature [°C]	Time to rupture [h]	Elongation [%]	RA [%]
Vertical	131	816	231	6.5	4.5
Horizontal	131	816	132	6.5	5

Surface Roughness

Horizontal surface	Ra 1-5 µm
Vertical surface	RA 1-5 µm

TRL 5
EOS Core

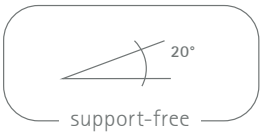


EOS NickelAlloy IN625
for EOS M 290 | 40 µm HiPro

Process Information
Physical Part Properties
Mechanical Properties
Additional Data

EOS NickelAlloy IN625 for EOS M 290 | 40 µm HiPro
Process Information

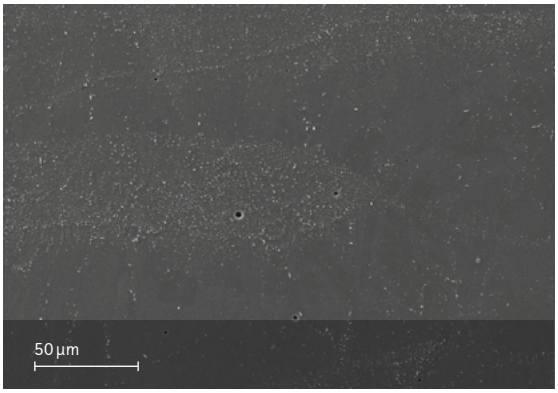
Basic 40 µm exposure set for building parts with good mechanical performance and higher productivity than IN625_040_PerformanceM291_200.



System set-up	EOS M 290
EOSPAR name	IN625_040_080_HiProM291_1xx
Software requirements	EOSPRINT 2.14 or newer EOSYSTEM 2.18 or newer
Powder part no.	9011-0022
Recoater blade	EOS HSS Blade
Nozzle	EOS Grid Nozzle
Inert gas	Argon
Sieve	63 µm

Additional information	
Layer thickness	40 µm
Volume rate	5.7 mm³/s

Chemical and Physical Properties of Parts[1]



Etched microstructure and SEM.
Heat treated.

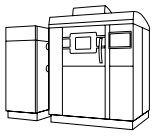
Defects	Result
Average defect percentage	0.05 %

Modulus of Elasticity

EN ISO 6892-1 Method A, Range 1 (0.00007 1/s)

State	Heat treated
Vertical [GPa]	206
Horizontal [GPa]	204

Mechanical Properties[1]

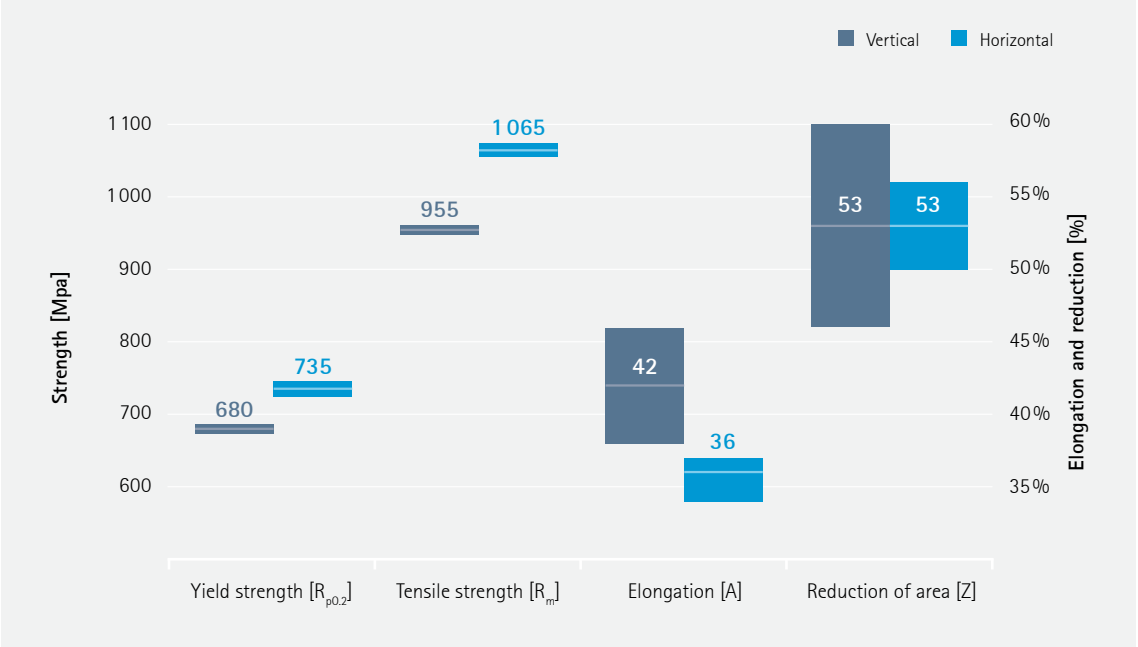


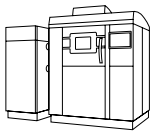
Tensile properties heat treated
according to ISO6892-1, $L_0 = 4.d_0$

	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]	Reduction of area Z [%]
Vertical	680	955	42	53
Horizontal	735	1065	36	53

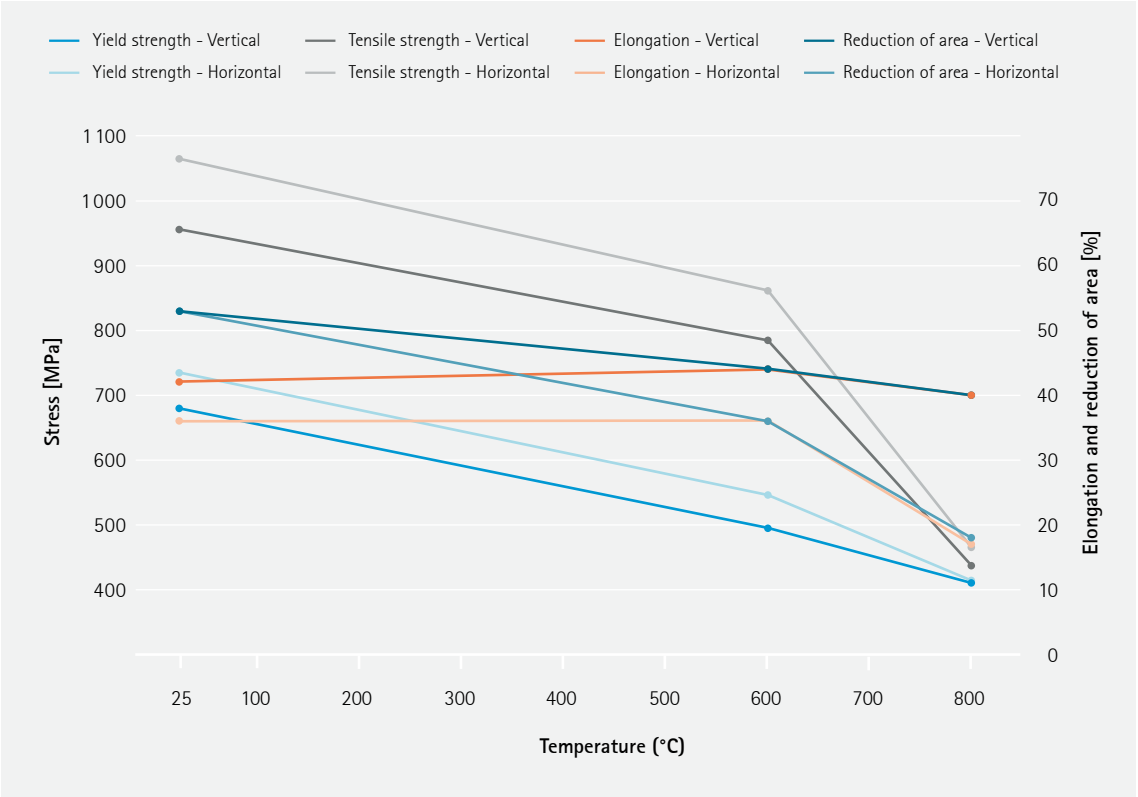
Hardness as per ISO 6508

Hardness, HRC	28





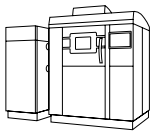
Tensile Properties at Elevated Temperatures



Elevated temperature tensile properties in heat-treated condition. Testing according to ISO 6892-1, $L_0 = 4.d_0$.

Tensile properties as manufactured according to ISO 6892-1, $L_0 = 4.d_0$				
	Yield strength $R_{p0.2}$ [MPa]	**Tensile strength** R_m [MPa]	**Elongation at break** A [%]	**Reduction of area** [%]
Vertical	645	900	43	62
Horizontal	750	1020	36	55

Additional Data[1]

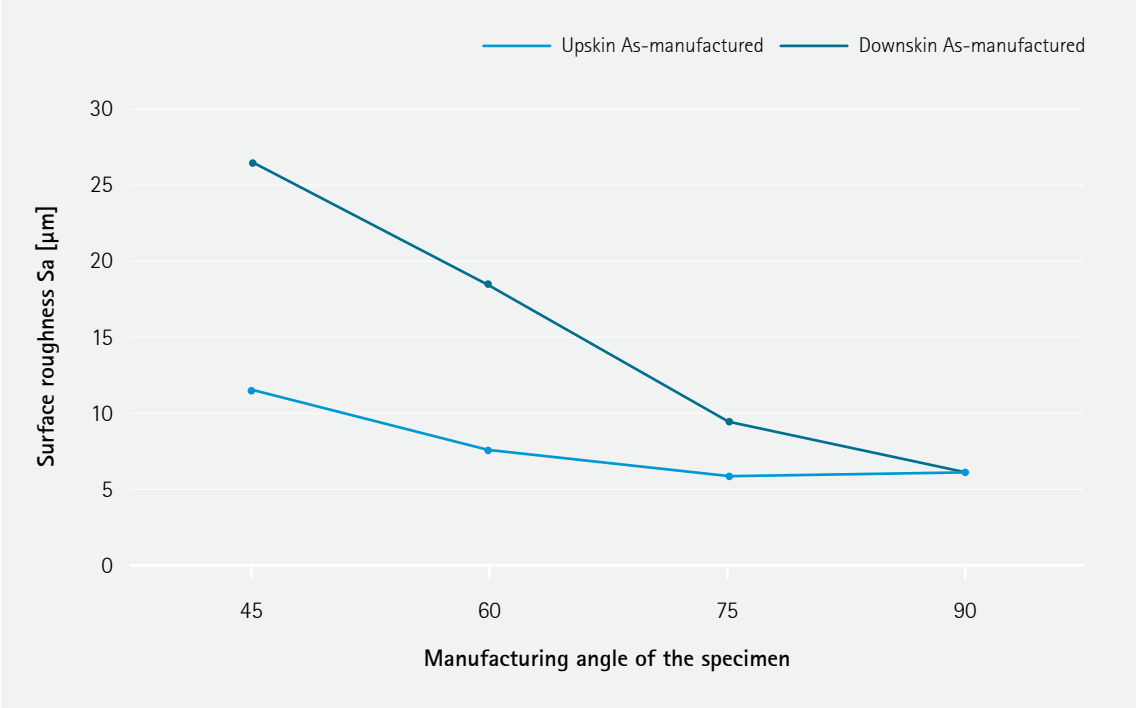


Stress Rupture Performance

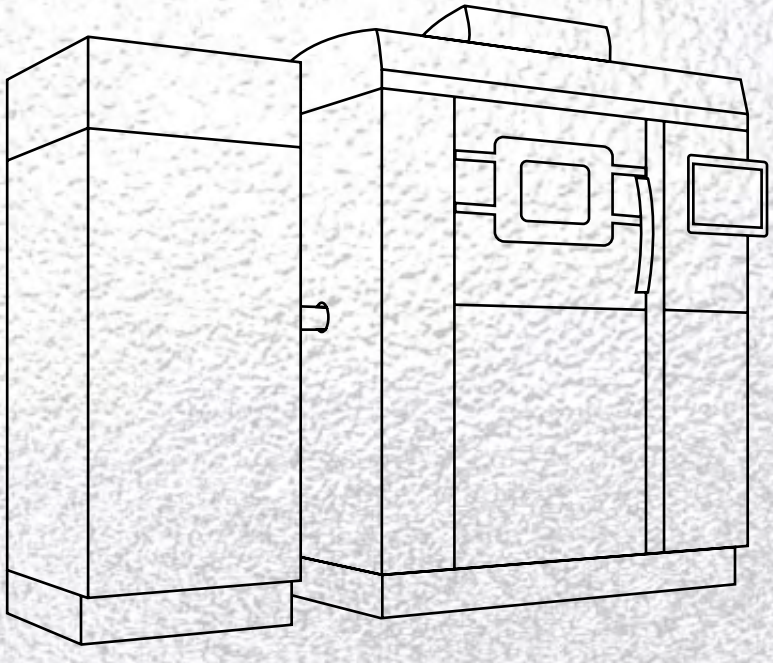
Sample condition: heat treated
ASTM E139, $L_o = 4.d_o$

	Stress [MPa]	Temperature [°C]	Time to rupture [h]	Elongation [%]	RA [%]
Vertical	131	816	134	9	6,5
Horizontal	131	816	92	11	5

Surface Roughness



TRL 5
EOS Core



EOS NickelAlloy IN625
for EOS M 290 | 80 µm HiPro

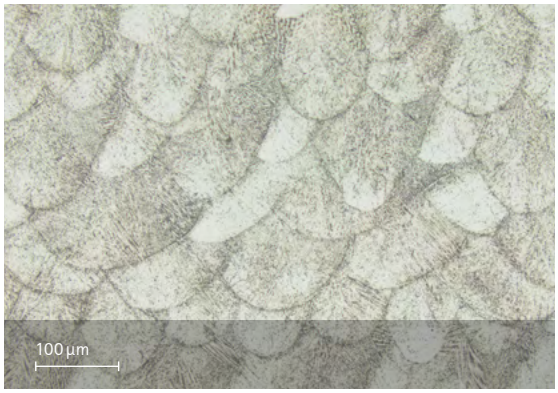
Process Information
Physical Part Properties
Mechanical Properties
Additional Data

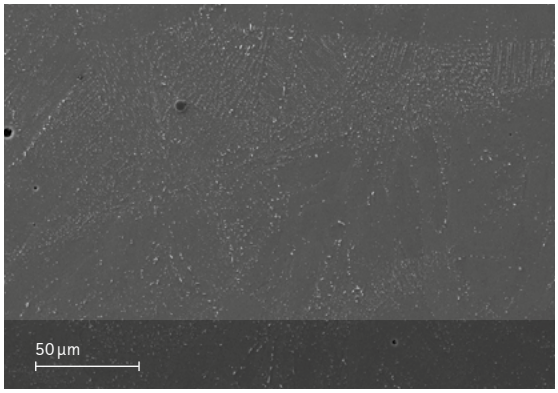
EOS NickelAlloy IN625 for EOS M 290 | 80µm HiPro
Process Information

System set-up	EOS M 290
EOSPAR name	IN625_040_080_HiProM291_1xx
Software requirements	EOSPRINT 2.14 or newer EOSYSTEM 2.18 or newer
Powder part no.	9011-0022
Recoater blade	EOS HSS Blade
Nozzle	EOS Grid Nozzle
Inert gas	Argon
Sieve	63 µm

Additional information	
Layer thickness	80 µm
Volume rate	9.2 mm^3/s

Chemical and Physical Properties of Parts[1]





Etched microstructure and SEM.
Heat treated.

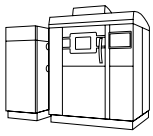
Defects	Result
Average defect percentage	0.03 %

Modulus of Elasticity

EN ISO 6892-1 Method A, Range 1 (0.00007 1/s)

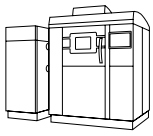
State	Heat treated
Vertical [GPa]	212
Horizontal [GPa]	200

Mechanical Properties[1]

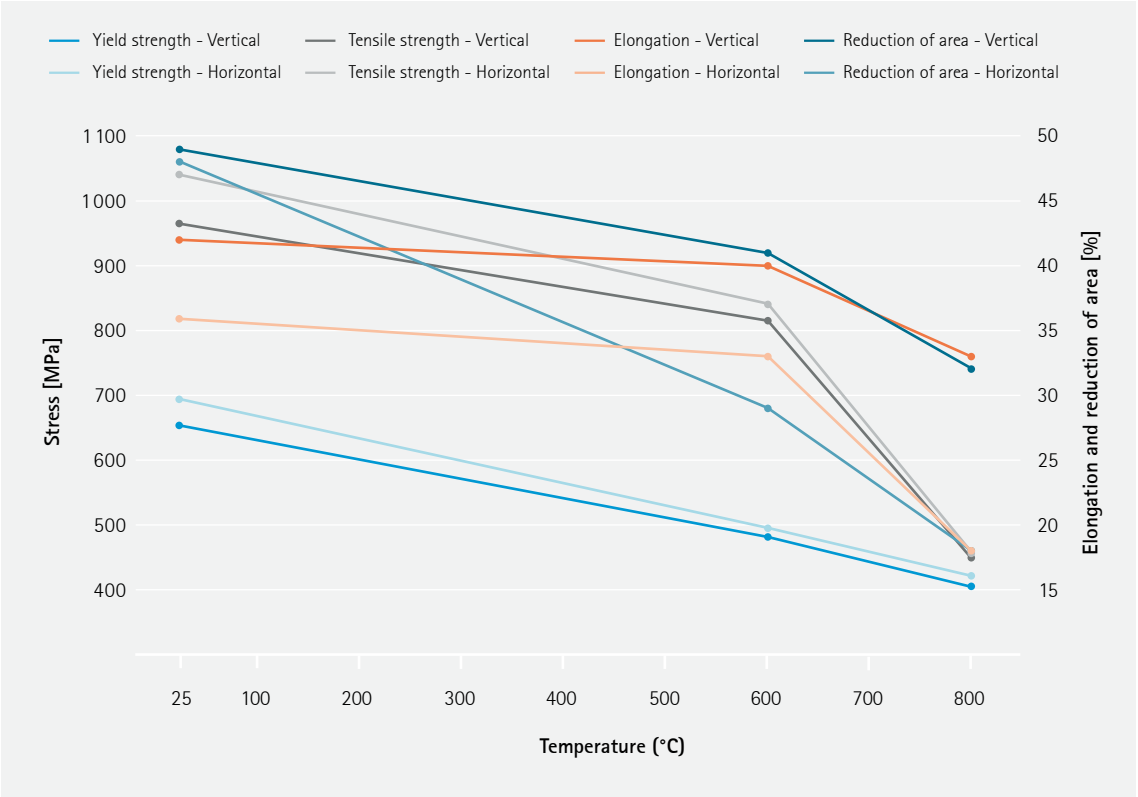


Tensile properties heat treated according to ISO6892-1, $L_0 = 4.d_0$	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]	Reduction of area Z [%]
Vertical	655	965	42	49
Horizontal	695	1 040	36	48

Hardness as per ISO 6508	
Hardness, HRC	27



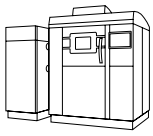
Tensile Properties at Elevated Temperatures



Elevated temperature tensile properties in heat-treated condition. Testing according to ISO 6892-1, $L_0 = 4.d_0$.

Tensile properties as manufactured according to ISO 6892-1, $L_0 = 4.d_0$	**Yield strength** $R_{p0.2}$ [MPa]	**Tensile strength** R_m [MPa]	**Elongation at break** A [%]	**Reduction of area** [%]
Vertical	645	940	44	63
Horizontal	720	995	39	56

Additional Data[1]

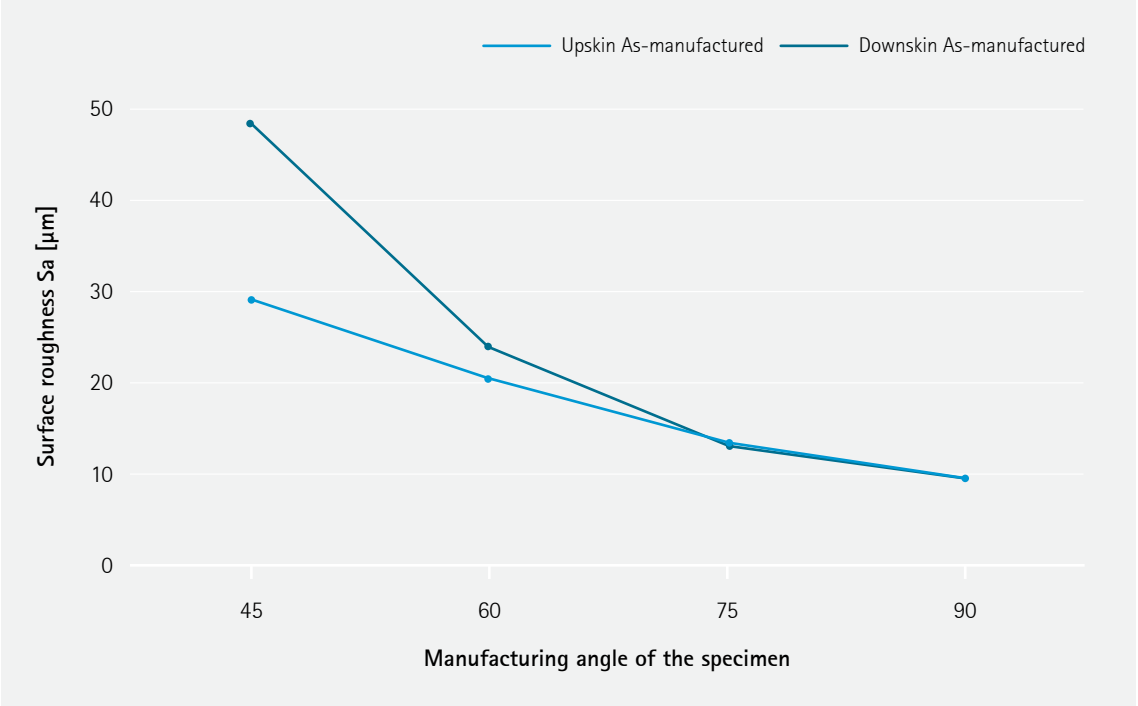


Stress Rupture Performance

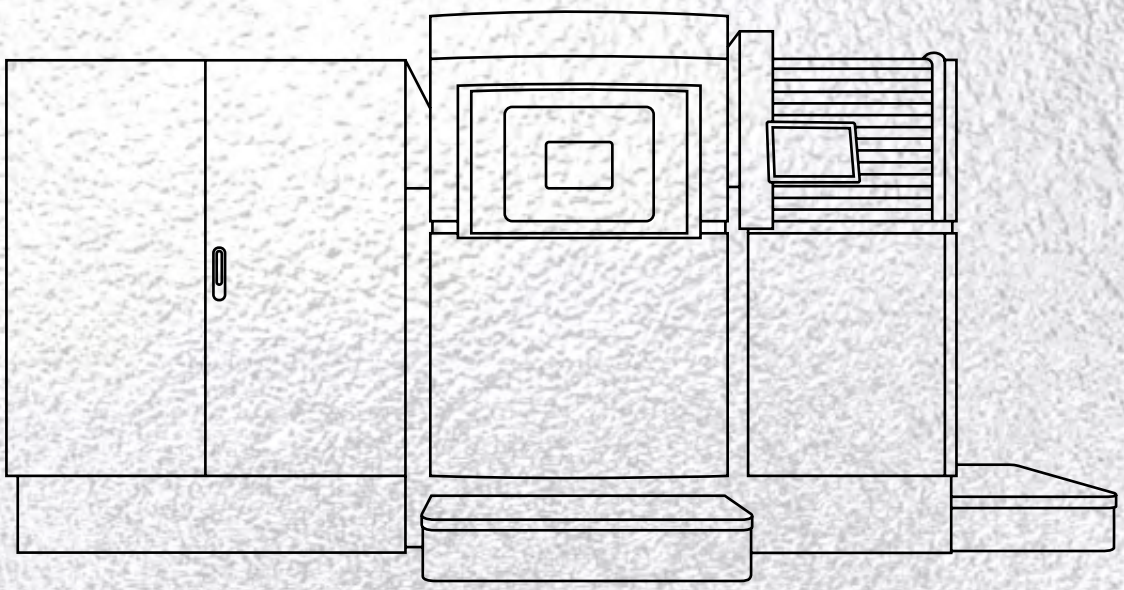
Sample condition: heat treated
ASTM E139, $L_o = 4.d_o$

	Stress [MPa]	Temperature [°C]	Time to rupture [h]	Elongation [%]	RA [%]
Vertical	131	816	54	9	6
Horizontal	131	816	28	9,5	7,5

Surface Roughness



TRL 5
EOS Core

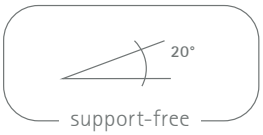


EOS NickelAlloy IN625
for EOS M 400-4 | 40 µm HiPro

Process Information
Physical Part Properties
Mechanical Properties
Additional Data

EOS NickelAlloy IN625 for EOS M 400-4 | 40 µm HiPro
Process Information

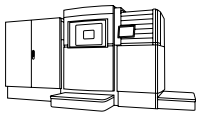
This process parameter includes two variations of the exposure set: the first one provides better productivity while the second one enables low angle buildability down to 20° at least[1]. The low angle buildability can be optimized further through the part geometry and the length of overhang.

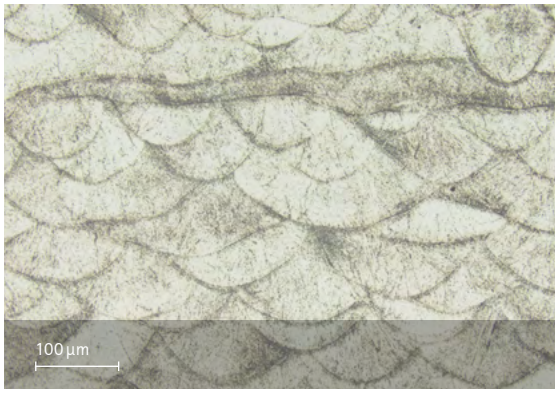


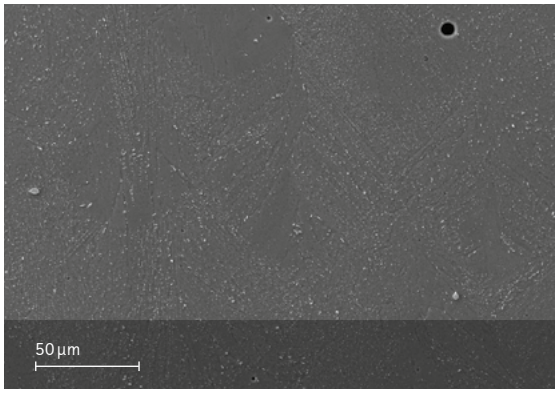
System set-up	EOS M 400-4
EOSPAR name	IN625_040_080_HiProM404_1xx
Software requirements	EOSPRINT 2.14 or newer EOSYSTEM 2.18 or newer
Powder part no.	9011-0022
Recoater blade	EOS HSS Blade
Nozzle	Aerospike V2
Inert gas	Argon
Sieve	63 µm

Additional information	
Layer thickness	40 µm
Volume rate	4 x 5.7 mm³/s

Chemical and Physical Properties of Parts[1]







Etched microstructure and SEM.
Heat treated.

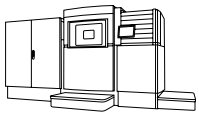
Defects	Result
Average defect percentage	0.04 %

Modulus of Elasticity

EN ISO 6892-1 Method A, Range 1 (0.00007 1/s)

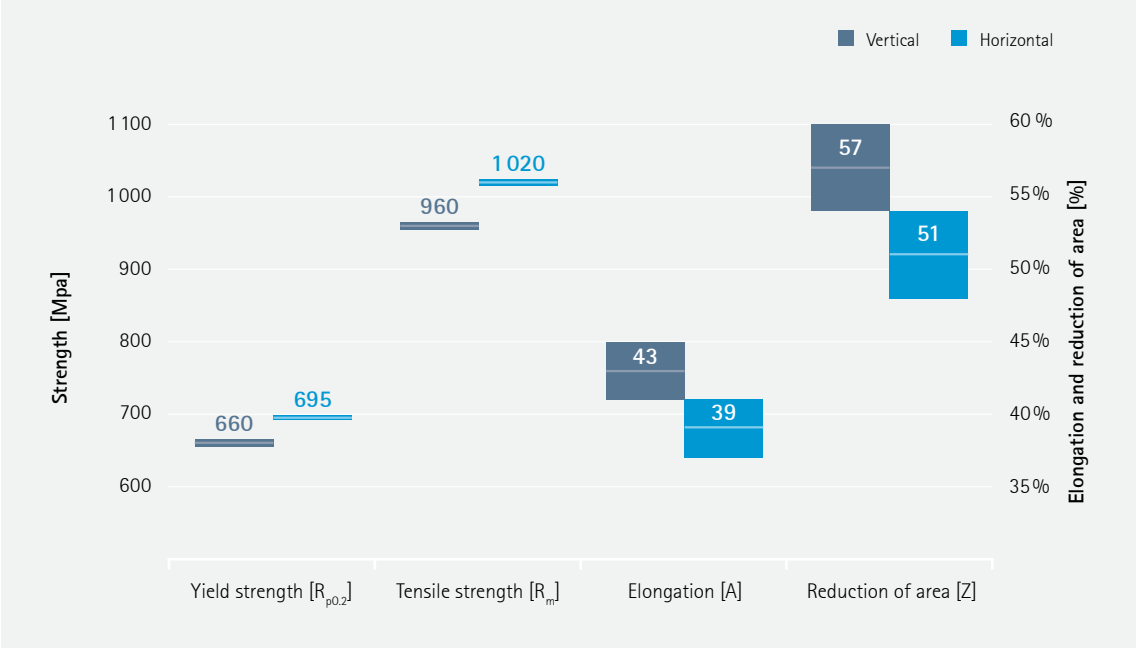
State	Heat treated
Vertical [GPa]	201
Horizontal [GPa]	213

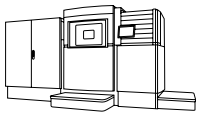
Mechanical Properties[1]



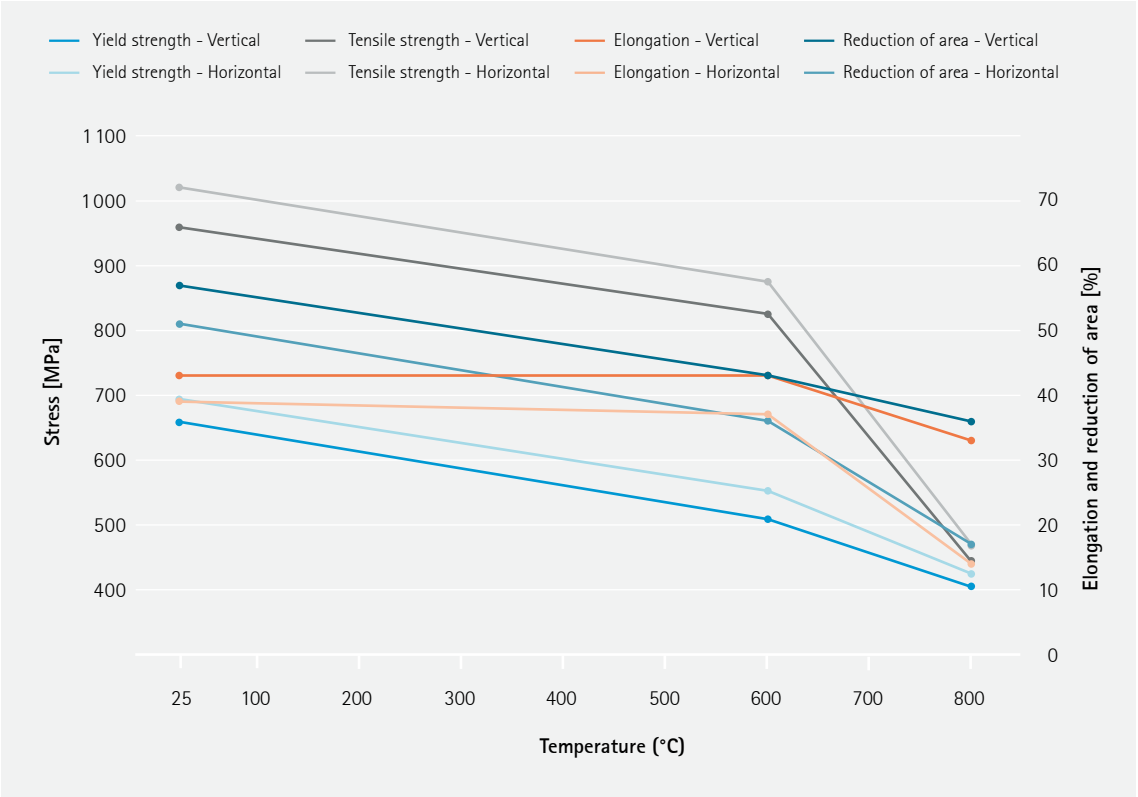
Tensile properties heat treated according to ISO6892-1, $L_0 = 4.d_0$	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]	Reduction of area Z [%]
Vertical	660	960	43	57
Horizontal	695	1 020	39	51

Hardness as per ISO 6508	
Hardness, HRC	26





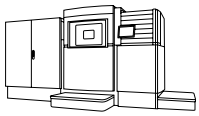
Tensile Properties at Elevated Temperatures



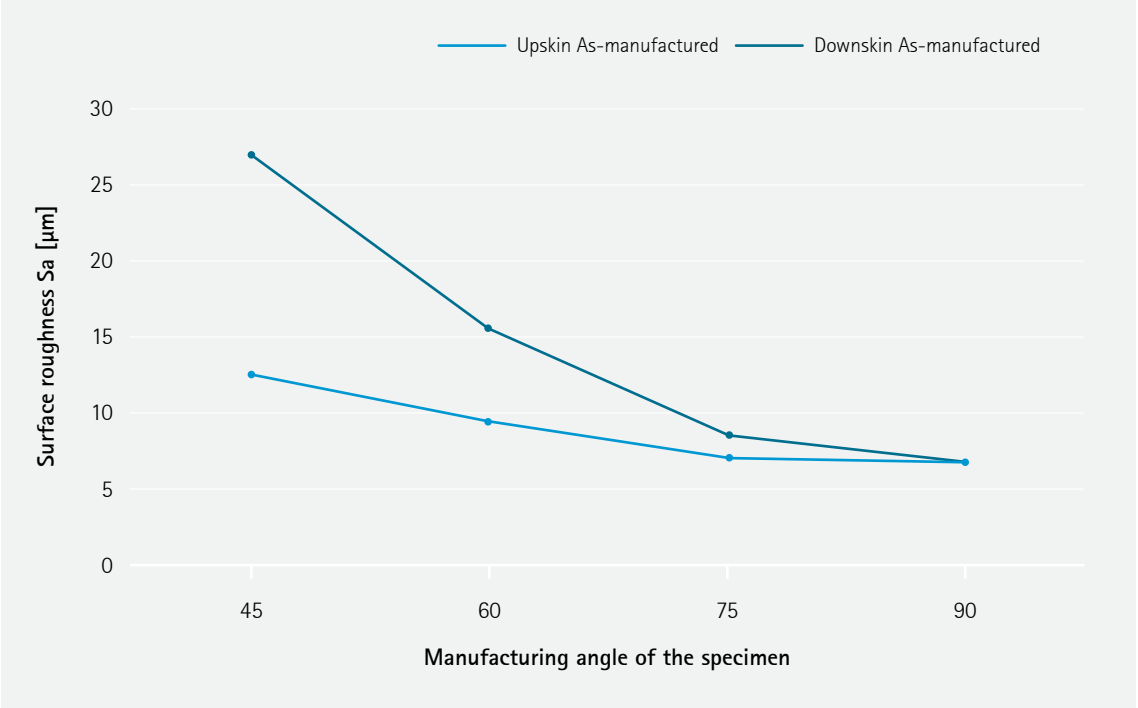
Elevated temperature tensile properties in heat-treated condition. Testing according to ISO 6892-1, $L_0 = 4.d_0$.

Tensile properties as manufactured according to ISO 6892-1, $L_0 = 4.d_0$	**Yield strength** $R_{p0.2}$ [MPa]	**Tensile strength** R_m [MPa]	**Elongation at break** A [%]	**Reduction of area** [%]
Vertical	655	945	40	55
Horizontal	760	1030	34	46

Additional Data[1]



Surface Roughness

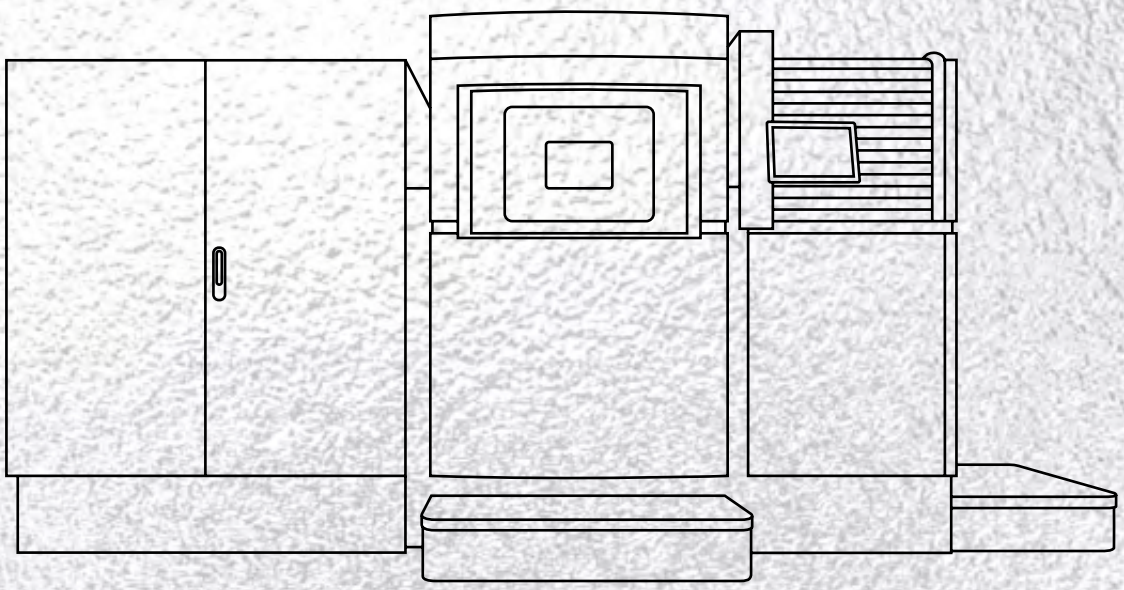


Creep Performance According to ASTM E139, $L_o = 4.d_o$

Sample condition: heat treated
ASTM E139, $L_o = 4.d_o$

	Stress [MPa]	Temperature [°C]	Time to rupture [h]	Elongation [%]	RA [%]
Vertical	131	816	134	9	6.5
Horizontal	131	816	92	11	5

TRL 5
EOS Core



EOS NickelAlloy IN625
for EOS M 400-4 | 80 µm HiPro

Process Information
Physical Part Properties
Mechanical Properties
Additional Data

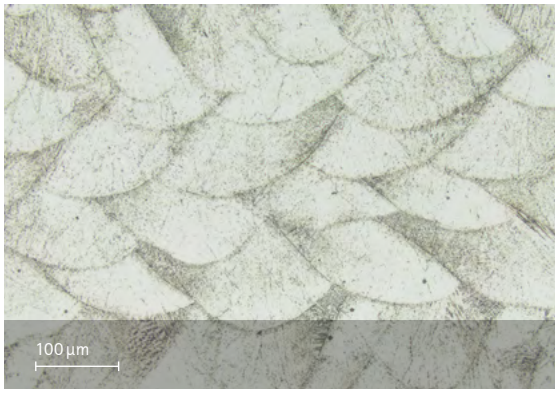
EOS NickelAlloy IN625 for EOS M 400-4 | 80 µm HiPro
Process Information

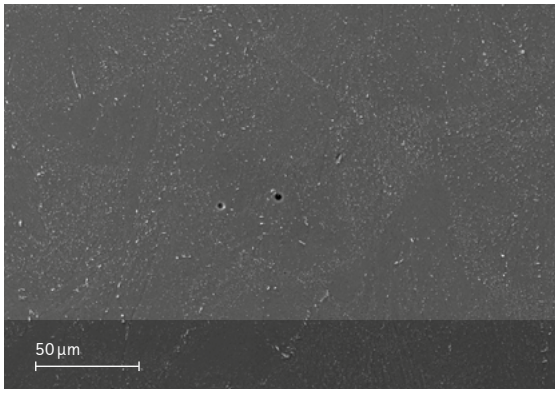
This process provides high productivity with a volume rate that is 61 % faster than IN625 40 µm HiPro process.

System set-up	EOS M 400-4
EOSPAR name	IN625_040_080_HiProM404_1xx
Software requirements	EOSPRINT 2.14 or newer EOSYSTEM 2.18 or newer
Powder part no.	9011-0022
Recoater blade	EOS HSS Blade
Nozzle	Aerospike V2
Inert gas	Argon
Sieve	63 µm

Additional information	
Layer thickness	80 µm
Volume rate	up to 4 x 9.2 mm^3/s

Chemical and Physical Properties of Parts[1]

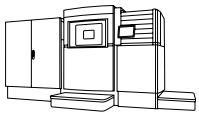




Etched microstructure and SEM.
Heat treated.

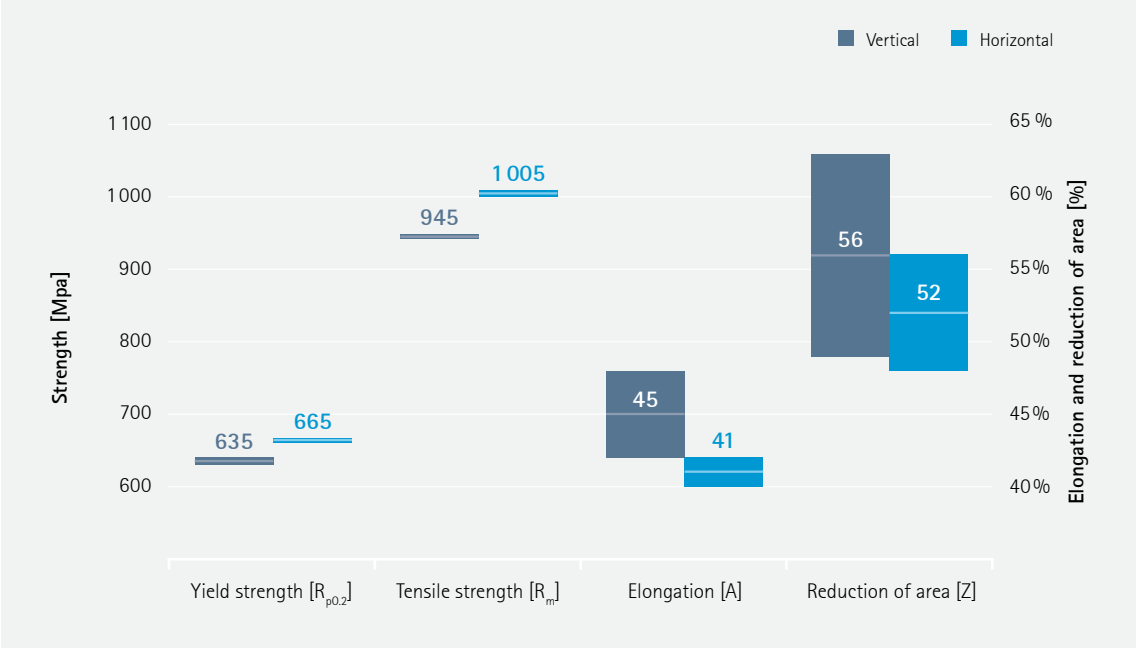
Defects	Result
Average defect percentage	0.02 %

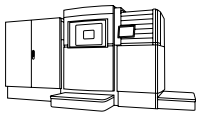
Mechanical Properties[1]



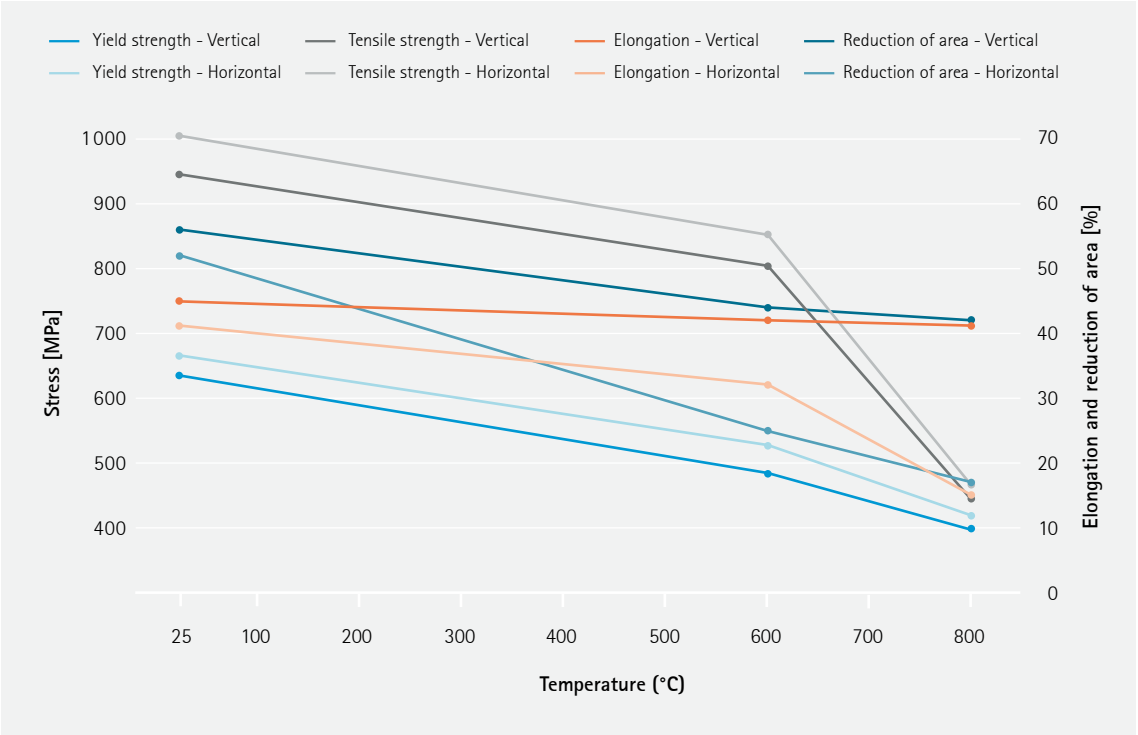
Tensile properties heat treated according to ISO6892-1, $L_0 = 4.d_0$	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]	Reduction of area Z [%]
Vertical	635	945	45	56
Horizontal	665	1 005	41	52

Hardness as per ISO 6508	
Hardness, HRC	27





Tensile Properties at Elevated Temperatures

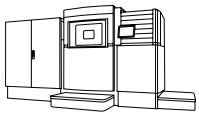


Elevated temperature tensile properties in heat-treated condition. Testing according to ISO 6892-1, $L_0 = 4.d_0$.

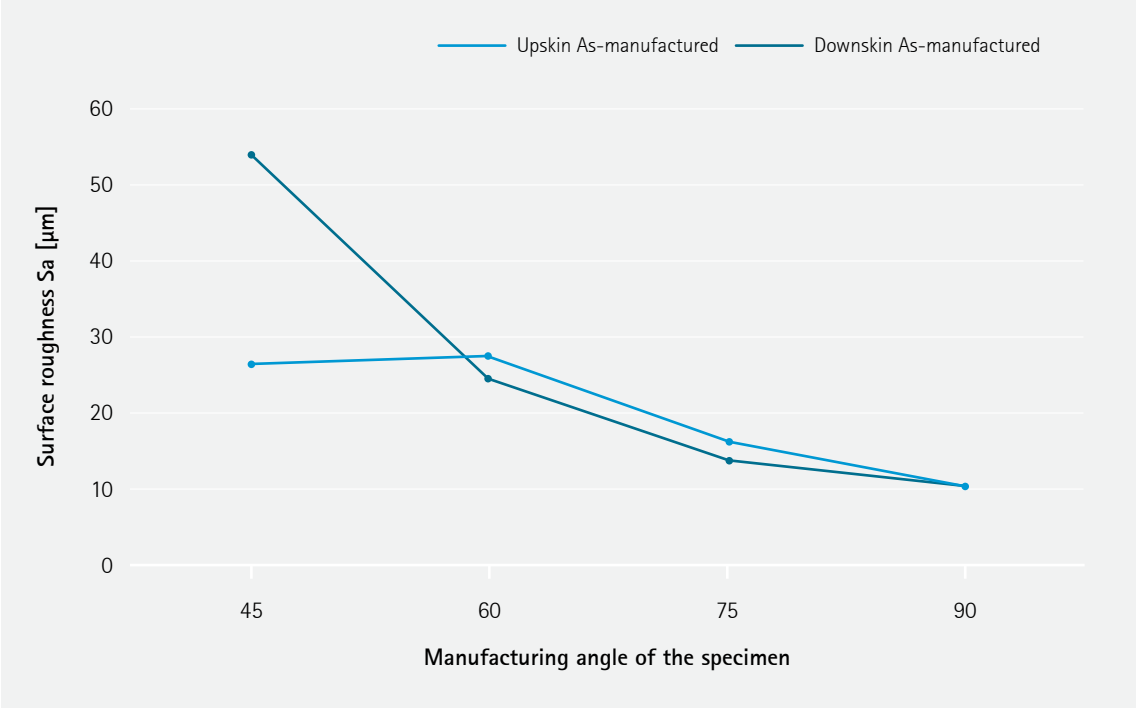
Tensile properties as manufactured according to ISO 6892-1, $L_0 = 4.d_0$

	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]	Reduction of Area [%]
Vertical	630	930	45	60
Horizontal	715	1005	37	48

Additional Data[1]



Surface Roughness



Creep Performance According to ASTM E139, $L_o = 4.d_o$

Sample condition: heat treated
ASTM E139, $L_o = 4.d_o$

	Stress [MPa]	Temperature [°C]	Time to rupture [h]	Elongation [%]	RA [%]
Vertical	131	816	105	8	6.5
Horizontal	131	816	63	12.5	12

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Status 10/2024

Cover: This image shows a possible application.