Metal Premium
Solutions

ECOPARTS
ADDITIVE METAL SOLUTIONS

EOS NickelAlloy IN718
Material Data Sheet

EOS NickelAlloy IN718

High Temperature Strength and Corrosion Resistance

EOS NickelAlloy IN718 is a precipitation-hardening nickel-chromium alloy that is characterized by having good tensile, fatigue, creep and rupture strength at temperatures up to 700 °C (1 290 °F). Parts built from EOS NickelAlloy IN718 can be easily post-hardened by precipitation-hardening heat treatments.

EOS NickelAlloy IN718 is a nickel alloy powder intended for manufacturing parts on EOS metal systems with EOS DMLS processes.

Main Characteristics:

- Good tensile, fatigue, creep and rupture strength at temperatures up to 700 °C (1 290 °F)
- Parts are easily precipitation hardened
- Parts can be machined, spark-eroded, welded, micro shot-peened, polished and coated in both as-built and age-hardened states

Typical Applications:

- Gas turbine components
- Instrumentation parts
- Power industry parts
- Process industry parts

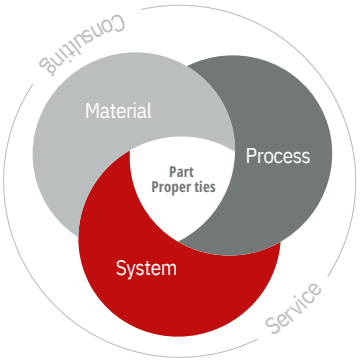
The EOS Quality Triangle

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.



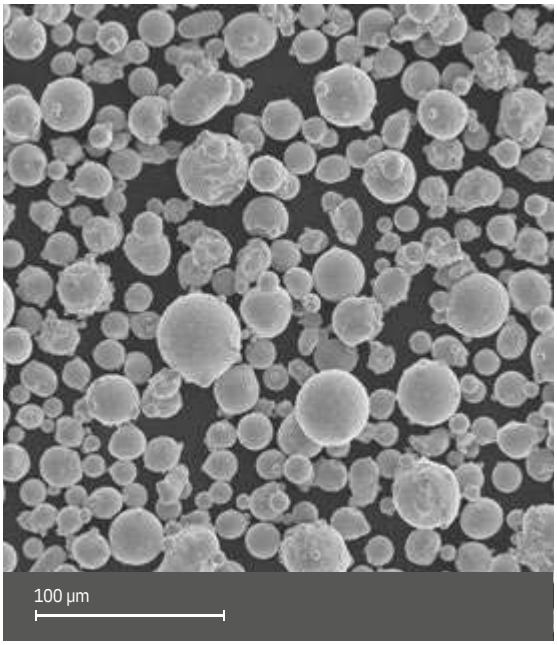
Powder Properties

The chemical composition of
EOS NickelAlloy IN718 is in compliance
with UNS N07718, AMS 5662, AMS 5664,
W.Nr 2.4668, DIN NiCr19Fe19NbMo3.

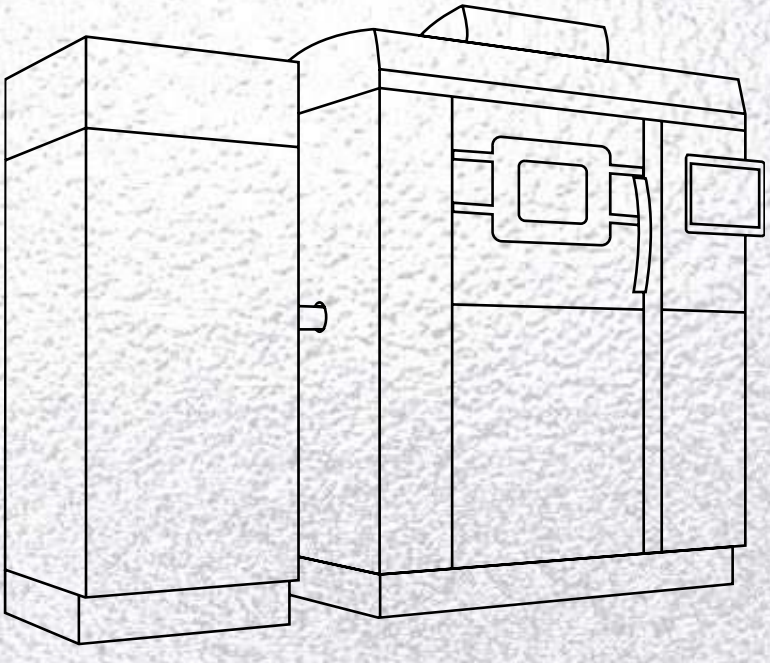
Powder chemical composition (wt.-%)		
Element	**Min.**	**Max.**
Fe	Rem.	
Ni	50.00	55.00
Cr	17. 0 0	21. 0 0
Nb	4.75	5.50
Mo	2.80	3.30
Ti	0.65	1.15
Al	0.20	0.80
Co	-	1.00
Cu	-	0.30
Si	-	0.35
Mn	-	0.35
Ta	-	0.05
C	-	0.08
S	-	0 . 015
P	-	0 . 015
B	-	0.006
Pb	-	0.0005
Se	-	0.0020
Bi		0.00003

Powder particle size	
Generic particle size distribution	20-55 µm

SEM picture of
EOS NickelAlloy IN718 powder.



TRL 9
EOS Premium



EOS NickelAlloy IN718
for EOS M 290 | 40 µm

Process Information
Heat Treatment
Physical Part Properties
Mechanical Properties
Additional Data

(V1.0, CR696, 2020-02)

EOS NickelAlloy IN718 for EOS M 290 | 40 µm
Process Information

System set-up	EOS M 290
EOS material set	IN718 Performance 2.0
EOSPAR name	IN718 _ 0 4 0 _ Per f ormanc eM2 91_ 2 x x
Software requirements	EOSPRINT 1.7 or newer, EOSPRINT 2.6 or newer, EOSYSTEM 2.9 or newer
Powder part no.	9011-0020
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
Min. wall thickness	Typical 0.3 - 0.4 mm

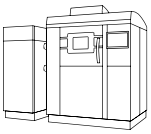
Heat Treatment

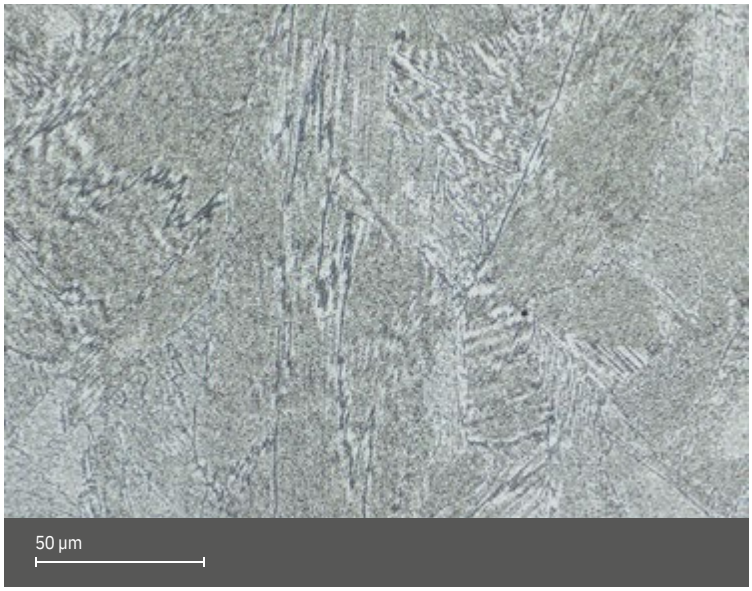
Heat treatment procedure conform to Aerospace Material Specification AMS 2774 and AMS 5662.
As manufactured microstructure for additively manufactured IN718 consists of gamma phase (γ). Heat treatment for IN718 is required to produce desired microstructure and part properties (gamma double prime precipitates, γ“). Heat treatment is also used to relieve stresses.

Step 1:
Solution Annealing: hold at 954 °C (1 750 °F) for 1 hour per 25 mm (0.98 inch) of thickness, air (/argon) cool

Step 2:
Ageing Treatment: hold at 718 °C (1 325 °F) 8 hours, furnace cool to 621 °C (1 150 °F) and hold at 621 °C (1 150 °F) for total precipitation time of 18 hours, air (/argon) cool

Chemical and Physical Properties of Parts1

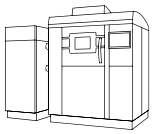




Heat treated microstructure.
Etched according to
ASTM E407-07.

Defects	Result	Number of samples
Average defect percentage	0.03 %	10
Density, ISO3369	**Result**	**Number of samples**
Average density	min 8.15 g/cm3	NA

Mechanical Properties in Heat Treated State1



Tensile properties heat treated (acc. AMS 2774 and AMS 5662)

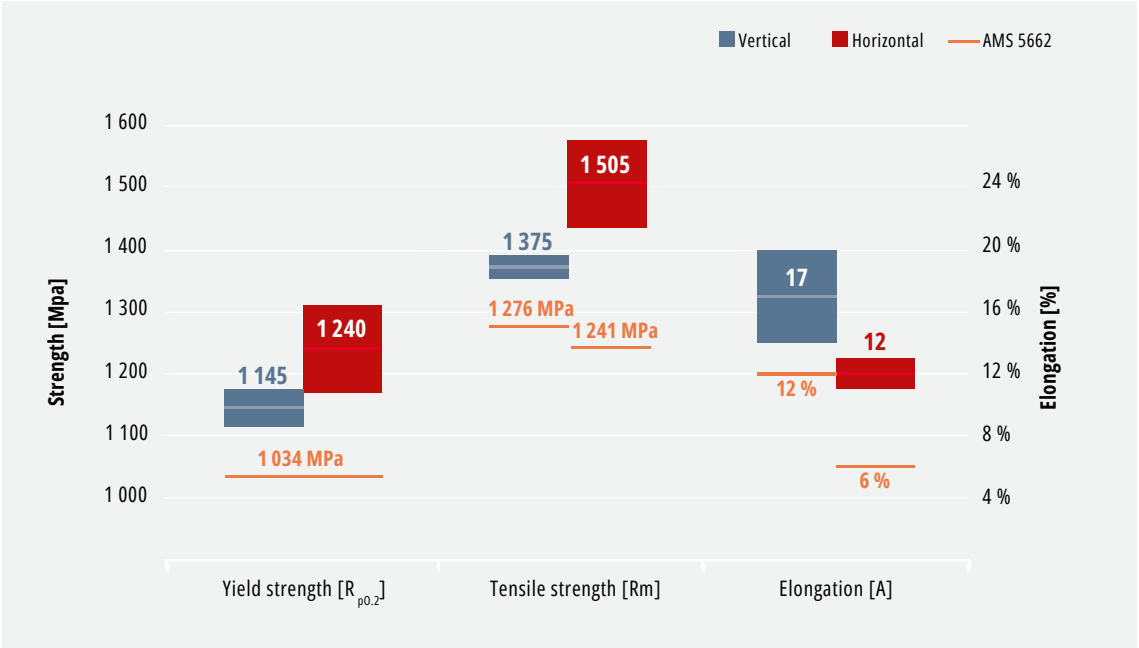
	Yield strength Rp0.2 [MPa]	Tensile strength Rm [MPa]	Elongation at break A [%]	Number of samples
Vertical	1 145	1 375	17	54
Horizontal	1 240	1 505	12	26

Hardness as per ISO 6508-1

Hardness, HRC	47
Number of samples	45

Hardness as per DIN EN ISO 6506-1:2014

Hardness, HB	466
Number of samples	10

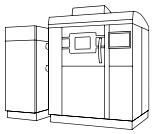


* T90: Tolerance intervals provide upper and lower bounds where 90 % of the population falls with 95 % confidence. Tolerance intervals are based on validation data / QA statistics and are not directly transferrable to other systems.

Tensile properties as manufactured

	Yield strength Rp0.2 [MPa]	Tensile strength Rm [MPa]	Elongation at break A [%]	Number of samples
Vertical	650	970	32	41
Horizontal	800	1 090	25	36

Additional Data1

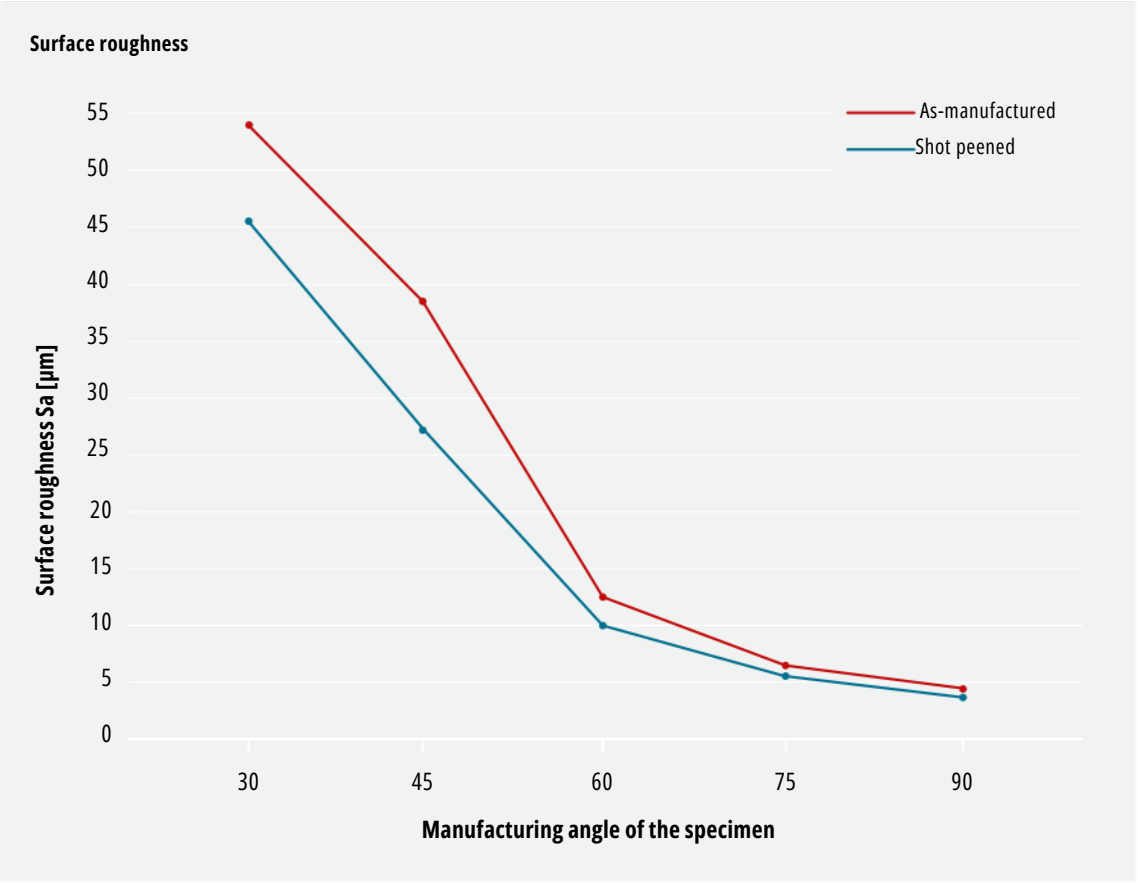


Coefficient of Thermal Expansion ASTM E228-17

Temperature	25-100 °C	25-200 °C	25-300 °C	25-400 °C	25-500 °C	25-600 °C	25-700 °C
CTE	13.1*10-6/K	13.7*10-6/K	14.1*10-6/K	14.4*10-6/K	14.7*10-6/K	15.0*10-6/K	15.5*10-6/K

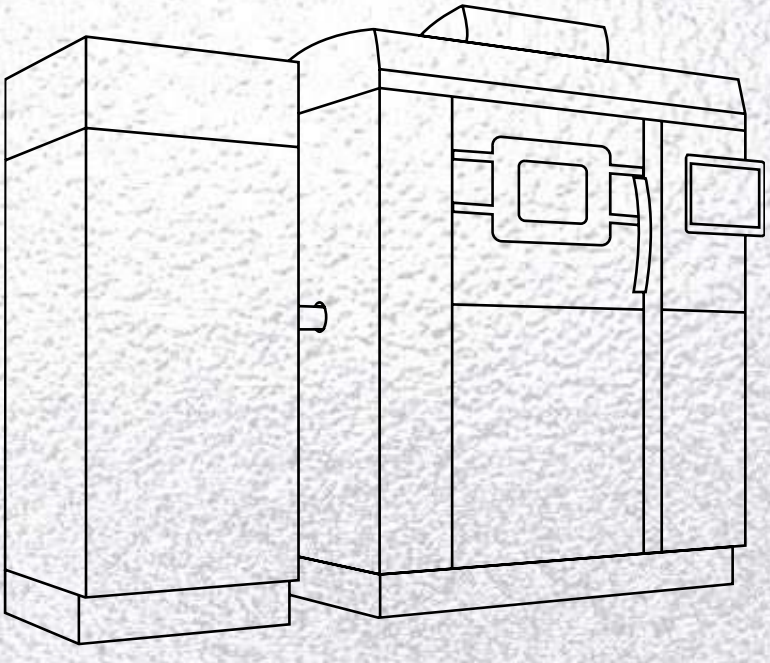
Surface Roughness

Horizontal surface	As-manufactured Sa 4.5 µm	Shot Peened Sa 3.8 µm
Vertical and angled surfaces according to figure		



The surface quality was characterized by optical measurement method according to internal procedure.
The 90 degree angle corresponds to vertical surface.

TRL 5
EOS Core



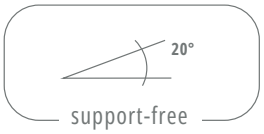
EOS NickelAlloy IN718
for EOS M 290 | 40 µm HiPro

Process Information
Heat Treatment
Physical Part Properties
Mechanical Properties
Additional Data

EOS NickelAlloy IN718 for EOS M 290 | 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 least1. The low angle buildability can be optimized further through the part geometry and the length of overhang.



System set-up	EOS M 290
EOS material set	IN718 40µm HiPro
EOSPAR name	IN718_040_080_HiProM291_1xx
Software requirements	EOSPRINT 2.11 or newer EOSYSTEM 2.15 or newer
Powder part no.	9011-0020
Recoater blade	EOS HSS Blade
Nozzle	EOS Grid Nozzle
Inert gas	Argon
Sieve	63 µm

Additional information	
Layer thickness	40 µm
Volume rate	5.2 mm^3/s
Min. wall thickness	Typical 0.3 - 0.4 mm

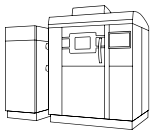
Heat Treatment

Heat treatment procedure conform to Aerospace Material Specification AMS 2774 and AMS 5662.
As manufactured microstructure for additively manufactured IN718 consists of gamma phase (γ). Heat treatment for IN718 is required to produce desired microstructure and part properties (gamma double prime precipitates, γ“). Heat treatment is also used to relieve stresses.

Step 1:
Solution Annealing: hold at 954 °C (1 750 °F) for 1 hour per 25 mm (0.98 inch) of thickness, air (/argon) cool

Step 2:
Ageing Treatment: hold at 718 °C (1 325 °F) 8 hours, furnace cool to 621 °C (1 150 °F) and hold at 621 °C (1 150 °F) for total precipitation time of 18 hours, air (/argon) cool

Chemical and Physical Properties of Parts1

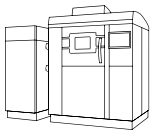


As manufactured microstructure.
Etchant: Kalling's II

Defects	Result	Number of samples
Average defect percentage	0.03 %	5
Density, ISO3369	**Result**	**Number of samples**
Average density	min 8.15 g/cm3	NA

The areal defect percentage was determined from cross-sections of built parts using an optical microscope fitted with a camera and analysis software. The analysis was carried out for sample area of 15 x 15 mm. The defects were detected and analyzed with an image capture/analysis software with an automatic histogram based filtering procedure on monochrome images.

Mechanical Properties in Heat Treated State1

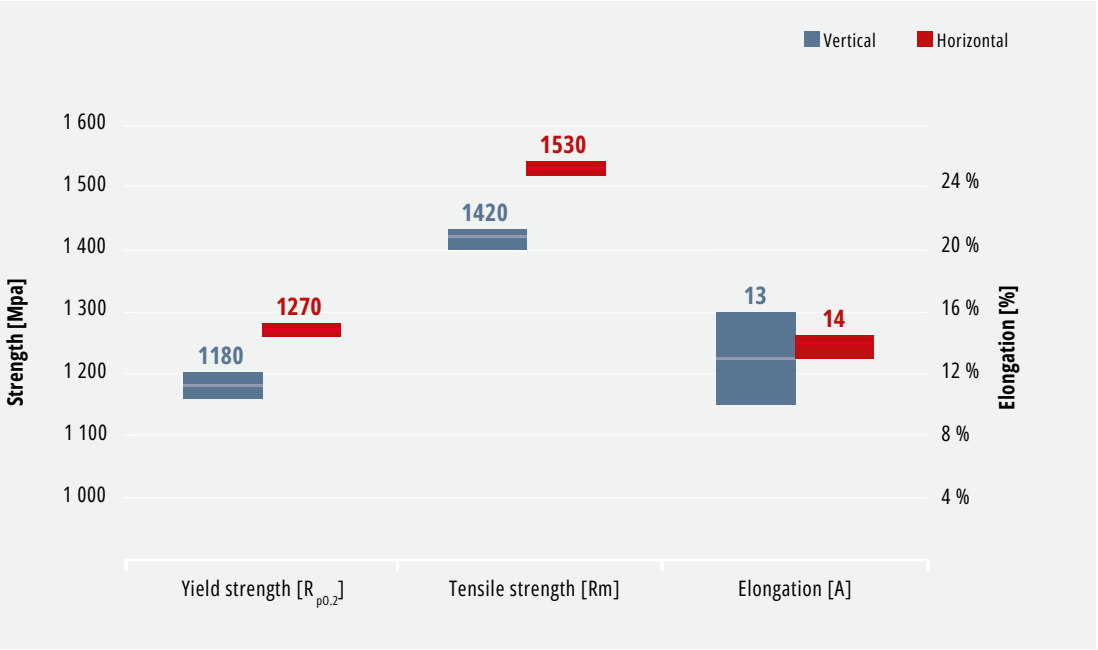


Tensile properties heat treated
ISO6892-1

	Yield strength Rp0.2 [MPa]	**Tensile strength** Rm [MPa]	**Elongation at break** A [%]
Vertical	1 180	1 420	13
Horizontal	1 270	1 530	14

Hardness as per ISO 6507

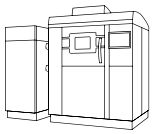
Hardness, HV	479
Number of samples	12

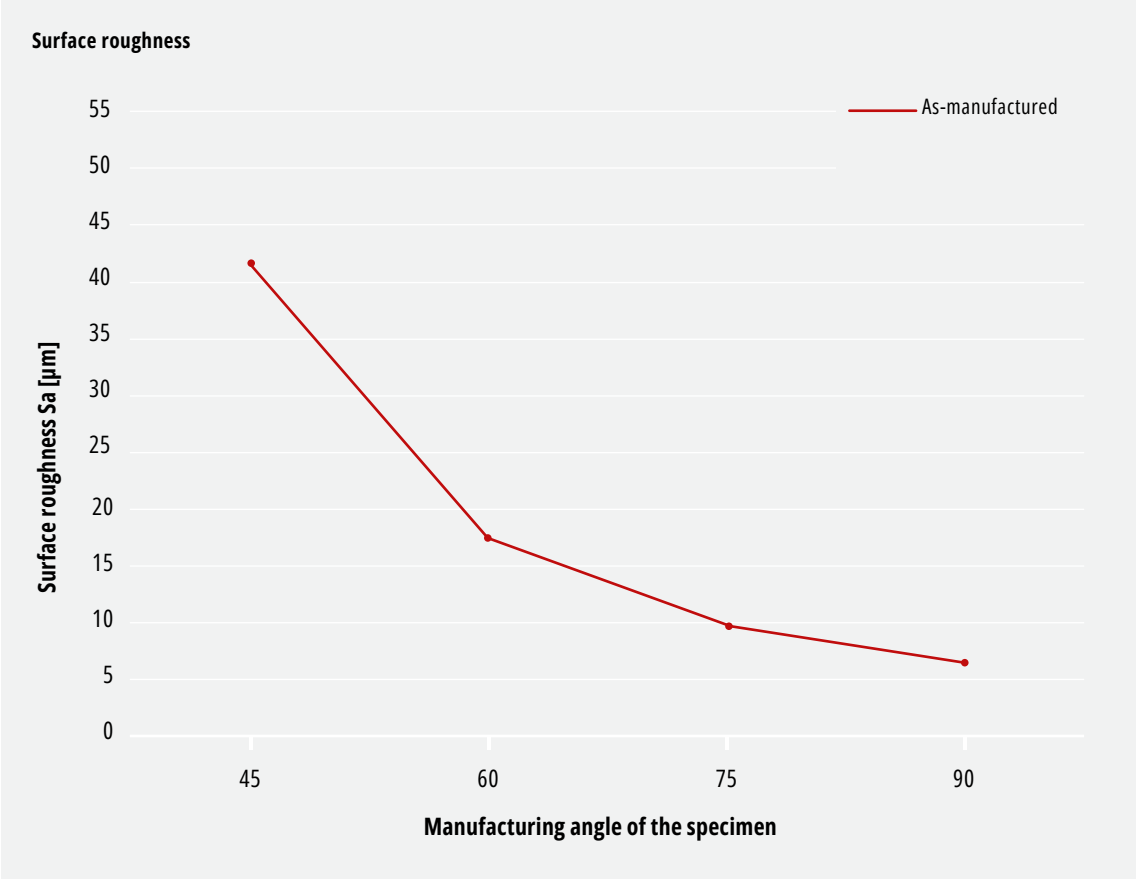


Tensile properties as manufactured

	Yield strength Rp0.2 [MPa]	**Tensile strength** Rm [MPa]	**Elongation at break** A [%]	**Number of samples**
Vertical	650	990	32	7
Horizontal	790	1 080	26	4

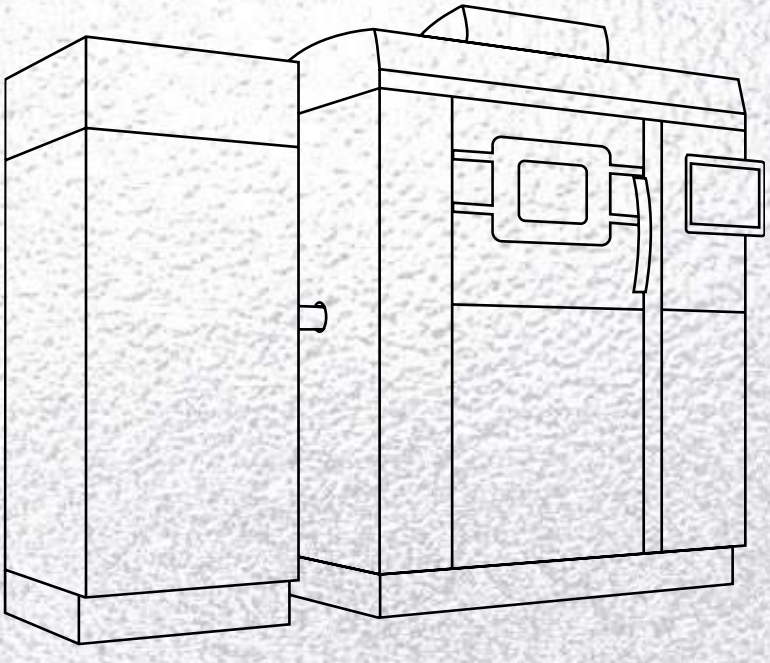
Additional Data1





The surface quality was characterized by optical measurement method according to internal procedure.
The 90 degree angle corresponds to vertical surface.

TRL 7
EOS Premium



EOS NickelAlloy IN718
for EOS M 290 | 80 µm HiPro

Process Information
Heat Treatment
Physical Part Properties
Mechanical Properties
Additional Data

EOS NickelAlloy IN718 for EOS M 290 | 80µm HiPro
Process Information

System set-up	EOS M 290
EOS material set	IN718 80 µm HiPro
EOSPAR name	IN718_040_080_HiProM291_1xx
Software requirements	EOSPRINT 2.11 or newer EOSYSTEM 2.15 or newer
Powder part no.	9011-0020
Recoater blade	EOS HSS Blade
Nozzle	EOS Grid Nozzle
Inert gas	Argon
Sieve	63 µm

Additional information	
Layer thickness	80 µm
Volume rate	8.2 mm^3/s
Min. wall thickness	Typical 0.3 - 0.4 mm

Heat Treatment

Heat treatment procedure conform to Aerospace Material Specification AMS 2774 and AMS 5662.
As manufactured microstructure for additively manufactured IN718 consists of gamma phase (γ). Heat treatment for IN718 is required to produce desired microstructure and part properties (gamma double prime precipitates, γ“). Heat treatment is also used to relieve stresses.

Step 1:
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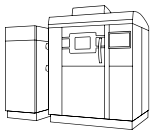
Step 2:
Ageing Treatment: hold at 718 °C (1 325 °F) 8 hours, furnace cool to 621 °C (1 150 °F) and hold at 621 °C (1 150 °F) for total precipitation time of 18 hours, air (/argon) cool

Chemical and Physical Properties of Parts1

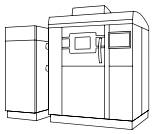


Heat treated microstructure.
Etchant: Kalling‘s II

Defects	Result	Number of samples
Average defect percentage	0.02 %	10
Density, ISO3369	**Result**	**Number of samples**
Average density	min 8.15 g/cm3	NA

The areal defect percentage was determined from cross-sections of built parts using an optical microscope fitted with a camera and analysis software. The analysis was carried out for sample area of 15 x 15 mm. The defects were detected and analyzed with an image capture/analysis software with an automatic histogram based filtering procedure on monochrome images.

Mechanical Properties in Heat Treated State1

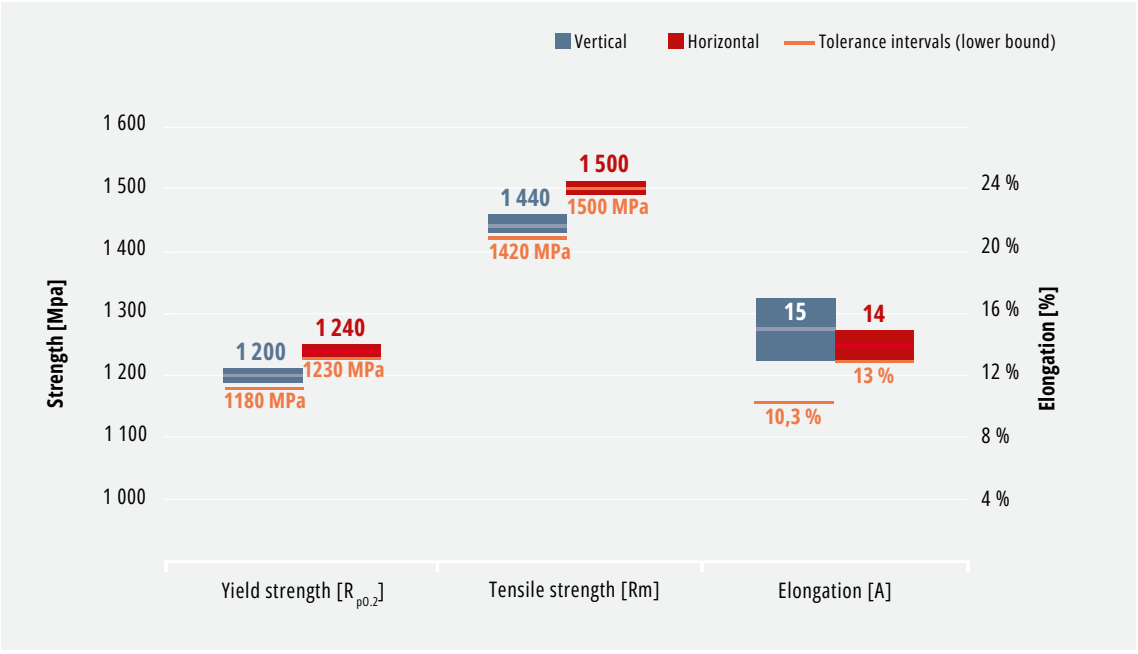


Tensile properties heat treated
ISO6892-1

	Yield strength Rp0.2 [MPa]	**Tensile strength** Rm [MPa]	**Elongation at break** A [%]
Vertical	1 200	1 440	15
Horizontal	1 240	1 500	14

Hardness as per ISO 6507

Hardness, HV	465
Number of samples	12

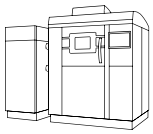


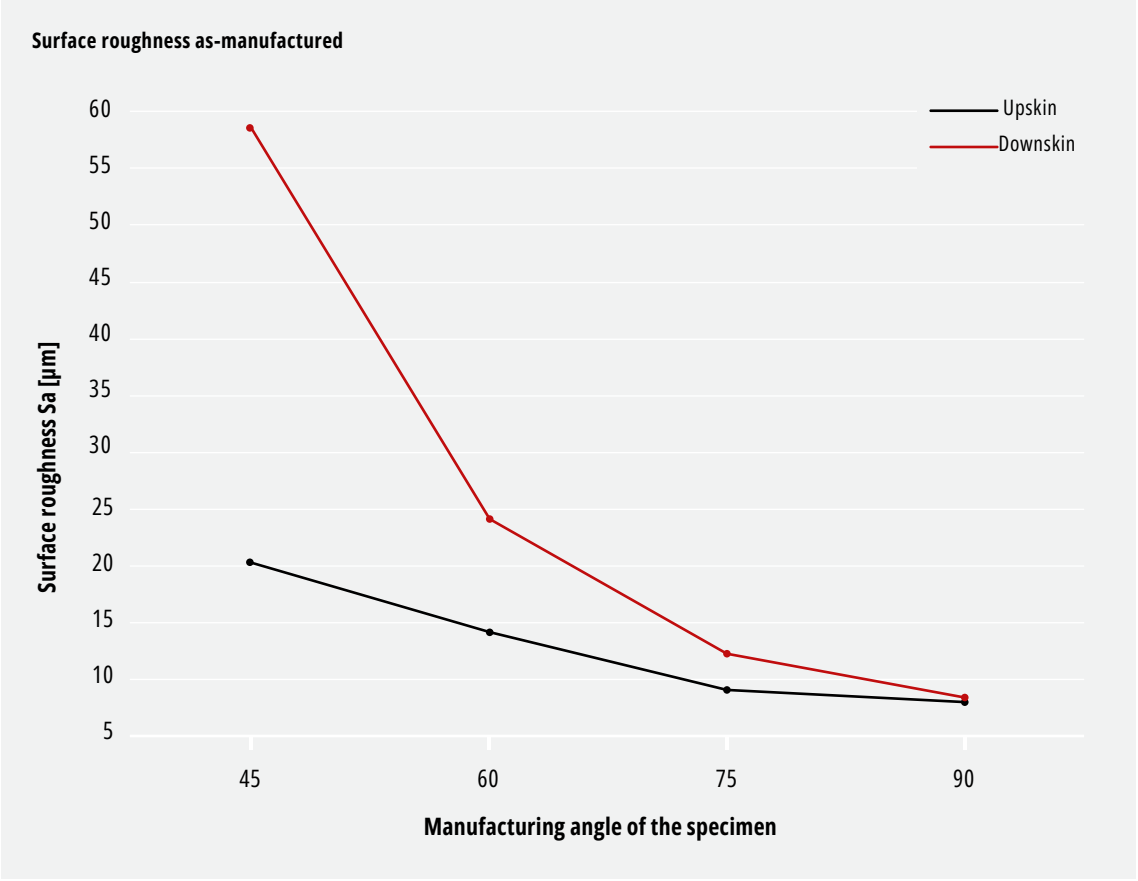
* T90: Tolerance intervals provide lower bounds where 90 % of the population falls with 95 % confidence. Tolerance intervals are based on validation data / QA statistics and are not directly transferable to other systems.

Tensile properties as manufactured

	Yield strength Rp0.2 [MPa]	**Tensile strength** Rm [MPa]	**Elongation at break** A [%]	**Number of samples**
Vertical	660	1 010	32	7
Horizontal	770	1 070	27	5

Additional Data1





The surface quality was characterized by optical measurement method according to internal procedure.
The 90 degree angle corresponds to vertical surface.

IHR INDUSTRIEPARTNER FÜR ADDITIV GEFERTIGTE BAUTEILE

Wir «drucken» (3D Druck von Metall) Ihre Bauteile und liefern Ihnen diese inklusive der kompletten mechanischen Nacharbeit. Unser Fertigungsprozess garantiert eine hohe Qualität und Reproduzierbarkeit. Mit unserer Erfahrung unterstützen und beraten wir Sie gerne in der Konstruktion für den additiven Fertigungsprozess.

ECOPARTS

ADDITIVE METAL SOLUTIONS

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