



EOS NickelAlloy HAYNES® 282®  
Material Data Sheet

# EOS NickelAlloy HAYNES® 282®

EOS NickelAlloy HAYNES® 282® is a precipitation strengthened nickel-base superalloy with a unique combination of high temperature strength, thermal stability, and fabricability. HAYNES® 282® alloy was developed for high temperature structural applications and is manufactured under license from Haynes International Inc.

EOS NickelAlloy HAYNES® 282® is a nickel alloy powder intended for manufacturing parts on EOS metal systems with EOS DMLS processes.

## Main Characteristics:

- Excellent strength at high temperature
- Good corrosion and oxidation resistance
- Easily fabricated and excellent weldability

## Typical Applications:

- Aerospace and rocket engine components
- Turbomachinery and gas turbine parts
- Energy industry components

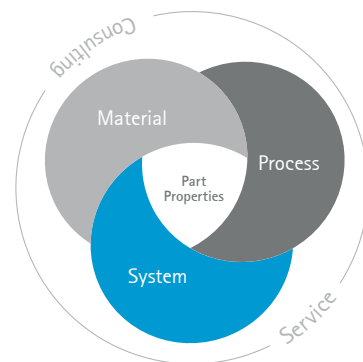
## The EOS Quality Triangle

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 composition is compliant with AMS5951  
Rev. A Section 3.1 and UNS N07208.

### Powder chemical composition (wt.-%)

Element	Min.	Max.
Cr	18.5	20.5
Co	9.0	11.0
Mo	8.0	9.0
Ti	1.9	2.3
Al	1.38	1.65
C	0.04	0.08
B	0.003	0.010
Ni	Balance	
Mn		0.3
Si		0.15
W		0.5
Nb		0.2
Ta		0.1
Fe		1.5
Cu		0.1
S		0.015
P		0.015

### Powder particle size

Generic particle size distribution	20-55 $\mu$ m
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## Heat Treatment

In as-built condition EOS NickelAlloy HAYNES® 282® has low strength and high ductility. Solution and aging heat treatments are required to produce the microstructure and strengthening phases for high temperature performance.

EOS has characterized two heat treatment options, which are described below. Heat treatment Option 1 is recommended for properties closest to wrought HAYNES® 282®.

**Option 1:** Recrystallization solution treatment + standard two-step aging

**Option 2:** Standard solution + standard two-step aging

### Heat Treatment Option 1:

This heat treatment results in a recrystallized microstructure with larger and more equiaxed grains than are typically found in DMLS materials. The resulting mechanical properties are isotropic, with high tensile ductility and good creep-rupture strength.

#### Solution treatment:

**Step 1:** Hold at 1250 °C (2282 °F) for 2 hrs, followed by rapid cooling (110 °C/min (230 °F/min) or faster) to room temperature.

#### Aging treatment:

**Step 2:** Hold at 1010 °C (1850 °F) for 2 hrs, followed by cooling equivalent to air cooling (approx 20 °C/min (68 °F/min) or faster) to room temperature.

**Step 3:** Hold at 788 °C (1450 °F) for 8 hrs, followed by cooling equivalent to air cooling (approx 20 °C/min (68 °F/min) or faster).

### Heat Treatment Option 2:

This heat treatment results in fine grains with high aspect ratio. Higher strength and more anisotropy may be expected relative to heat treatment Option 1.

#### Solution treatment:

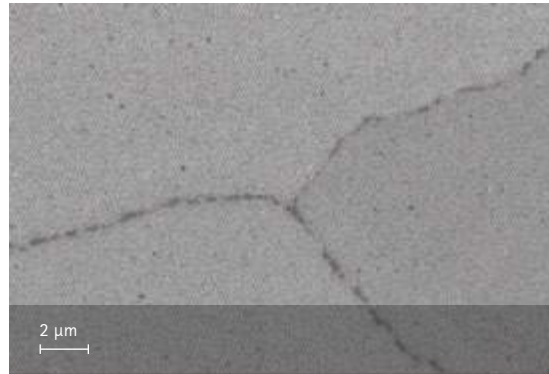
**Step 1:** Hold at 1135 °C (2075 °F) for 2 hrs, followed by rapid cooling (110 °C/min (230 °F/min) or faster) to room temperature.

#### Aging treatment:

**Step 2:** Hold at 1010 °C (1850 °F) for 2 hrs, followed by cooling equivalent to air cooling (approx 20 °C/min (68 °F/min) or faster) to room temperature.

**Step 3:** Hold at 788 °C (1450 °F) for 8 hrs, followed by cooling equivalent to air cooling (approx 20 °C/min (68 °F/min) or faster).

## Heat Treatment Option 1



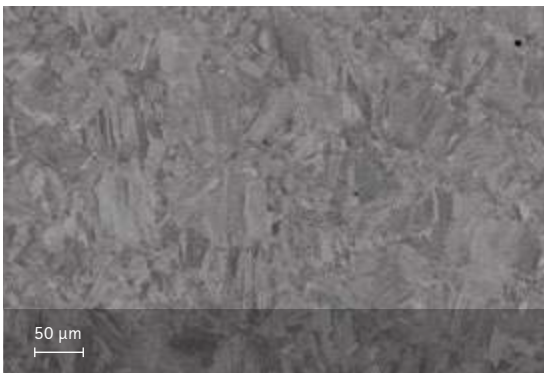
Microstructure from Heat Treatment Option 1. Oxalic acid etch, section perpendicular to building direction.

### Tensile properties<sup>1</sup>

		Yield Strength		Ultimate Tensile Strength		Elongation 5D
		MPa	ksi	MPa	ksi	%
25 °C (75 °F)	Horizontal	771	111.8	1229	178.2	23.6
	Vertical	751	108.9	1200	174.0	26.2
760 °C (1400 °F)	Horizontal	653	94.7	861	124.9	23.3
	Vertical	634	91.9	852	123.6	29.2

Tensile testing as per ISO 6892-1 with test parts printed on an EOS M 290.

## Heat Treatment Option 2



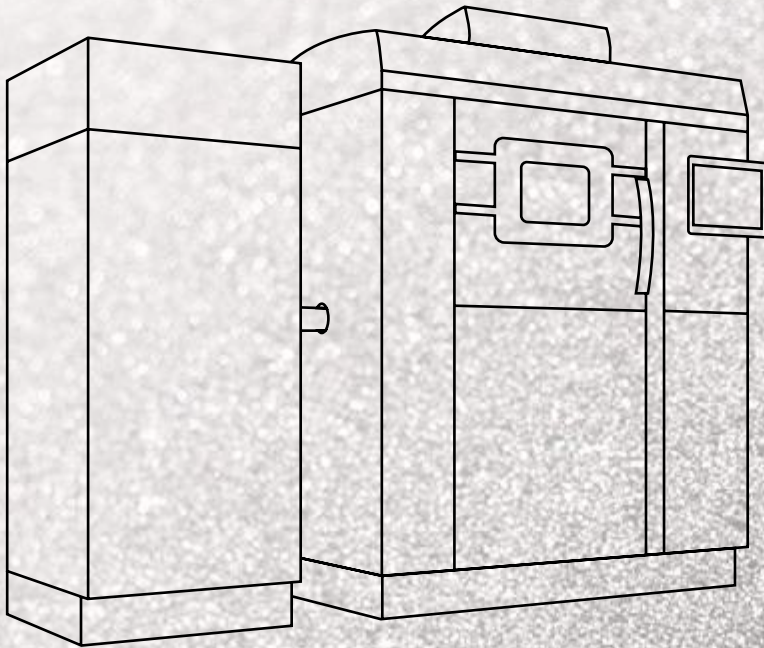
Microstructure from Heat treatment Option 2. Oxalic acid etch, section perpendicular to building direction.

### Tensile properties<sup>1</sup>

		Yield Strength		Ultimate Tensile Strength		Elongation 5D
		MPa	ksi	MPa	ksi	%
25 °C (75 °F)	Horizontal	982	142.4	1293	187.5	20.6
	Vertical	937	135.9	1169	169.5	25.9
760 °C (1400 °F)	Horizontal	737	106.9	831	120.5	9
	Vertical	754	109.3	821	119.1	23.5

Tensile testing as per ISO 6892-1 with test parts printed on an EOS M 290.



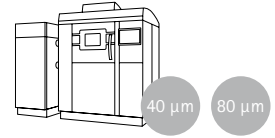


## EOS NickelAlloy HAYNES® 282® for EOS M 290 | 40/80 µm

Process Information  
Heat Treatment  
Physical Part Properties  
Mechanical Properties  
Additional Data



## EOS NickelAlloy HAYNES® 282® for EOS M 290 | 40/80 µm Process Information



System set-up	EOS M 290
EOS MaterialSet	HAYNES282_040_080_CoreM291_111
Software requirements	EOSPRINT 2.10 or newer EOSYSTEM 2.14 or newer
Powder part no.	9030-0010
Recoater blade	EOS HSS Blade
Nozzle	EOS Grid Nozzle
Inert gas	Argon
Sieve	63 µm

### Additional information

Layer thickness	40 µm, 80 µm
Volume rate	4.8 mm <sup>3</sup> /s (40 µm) 8.4 mm <sup>3</sup> /s (80 µm)

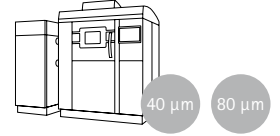
## Heat Treatment

For information on the heat treatment procedures please refer to pages 4 and 5.

## Physical Properties of Parts<sup>1</sup>

Defects	Result
Porosity, 40 µm	0.02 - 0.05 %
Porosity, 80 µm	0.04 - 0.10 %
Density (ISO3369)	≥ 8.20 g/cm <sup>3</sup>

# Mechanical Properties<sup>1</sup>



## Tensile properties – 40 μm As manufactured

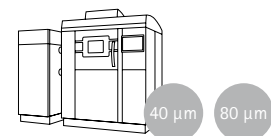
		Yield Strength		Ultimate Tensile Strength		Elongation 4D	Area Reduction
		MPa	ksi	MPa	ksi	%	%
25 °C (75 °F)	Horizontal	729	105.3	1010	146.5	33.9	60.3
	Vertical	623	90.3	915	132.7	36.3	57.9

## Tensile properties – 40 μm Heat treated (Option 1)

		Yield Strength		Ultimate Tensile Strength		Elongation 4D	Area Reduction
		MPa	ksi	MPa	ksi	%	%
25 °C (75 °F)	Horizontal	726	105.3	1207	175.1	26.6	28.0
	Vertical	695	100.8	1166	169.0	27.1	29.5
650 °C (1200 °F)	Horizontal	658	95.5	1029	149.3	10.0	11.6
	Vertical	632	91.7	1039	15.6	16.0	17.5
760 °C (1400 °F)	Horizontal	622	90.3	838	121.5	27.8	30.0
	Vertical	601	87.1	831	120.5	32.8	35.0
870 °C (1600 °F)	Horizontal	494	71.7	496	71.9	12.1	12.1
	Vertical	491	71.2	498	72.2	18.9	20.0
927 °C (1700 °F)	Horizontal	337	48.9	339	49.2	11.5	12.3
	Vertical	341	49.4	339	49.2	17.5	20.9

<sup>1</sup>Tensile testing as per ISO 6892-1





**Tensile properties – 80 μm  
Heat treated (Option 1)**

		Yield Strength		Ultimate Tensile Strength		Elongation 4D	Area Reduction
		MPa	ksi	MPa	ksi	%	%
25 °C (75 °F)	Horizontal	724	105.0	1204	174.5	26.5	25.5
	Vertical	699	101.3	1162	168.5	25.6	24.0
650 °C (1200 °F)	Horizontal	644	93.3	1093	158.4	19.8	20.1
	Vertical	622	90.2	1028	149.1	17.0	20.1
760 °C (1400 °F)	Horizontal	616	89.3	850	123.2	26.8	29.0
	Vertical	591	85.7	832	120.7	30.0	31.5
870 °C (1600 °F)	Horizontal	488	70.8	493	71.5	13.6	16.8
	Vertical	488	70.8	492	71.4	14.0	16.5
927 °C (1700 °F)	Horizontal	340	49.3	340	49.3	9.6	13.9
	Vertical	334	48.4	334	48.4	14.8	16.5

Tensile testing as per ISO 6892-1

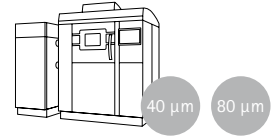
**Stress rupture performance – 40 μm  
Heat treated (Option 1)**

	Temperature		Stress		Time to rupture	Elongation 4D
	°C	°F	MPa	ksi	hrs	%
Horizontal	927	1700	89	12.9	200	11.5
Vertical					334	27.8

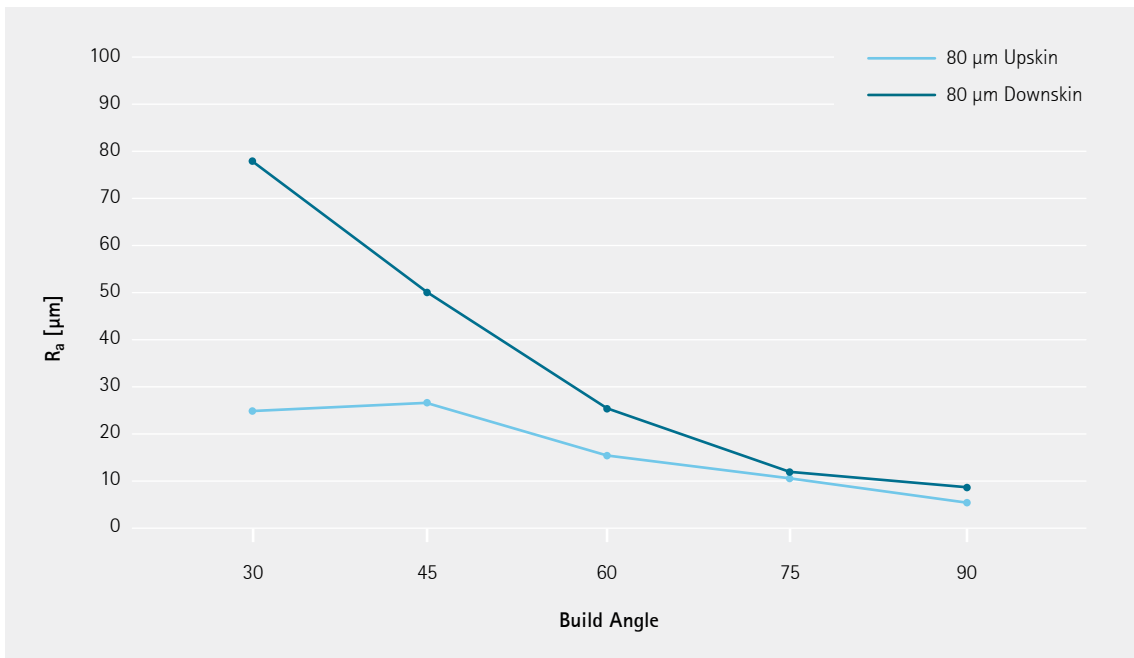
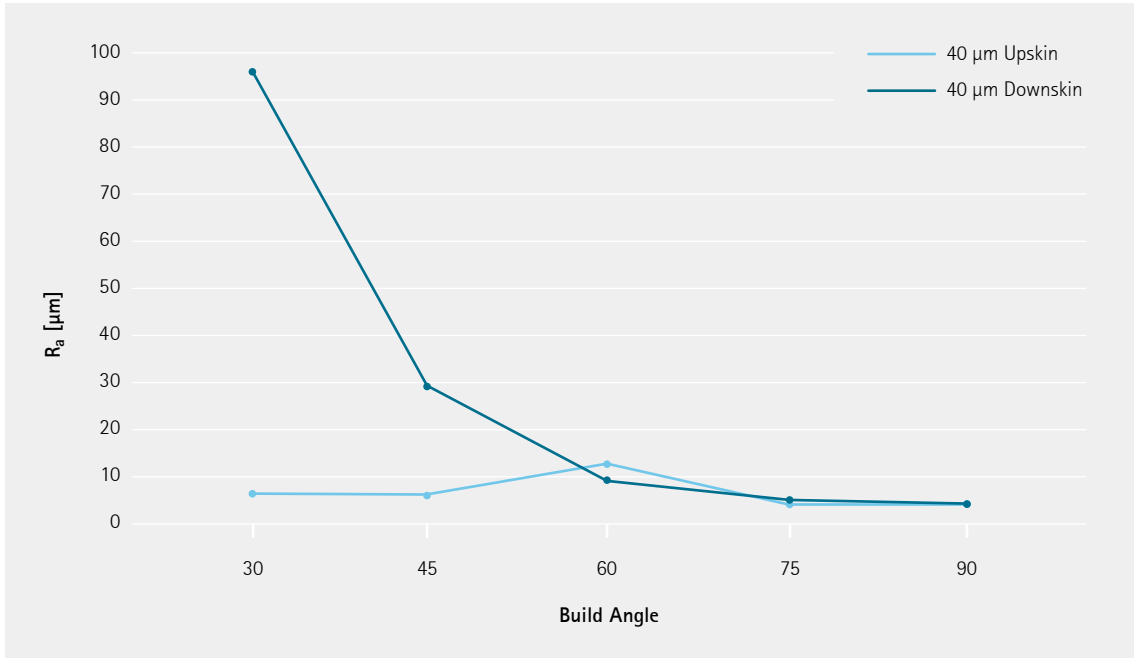
Stress rupture testing as per ASTM E139.

*Additional data on mechanical properties  
after HIP or various aging heat treatments  
available on request.*

# Additional Data<sup>1</sup>

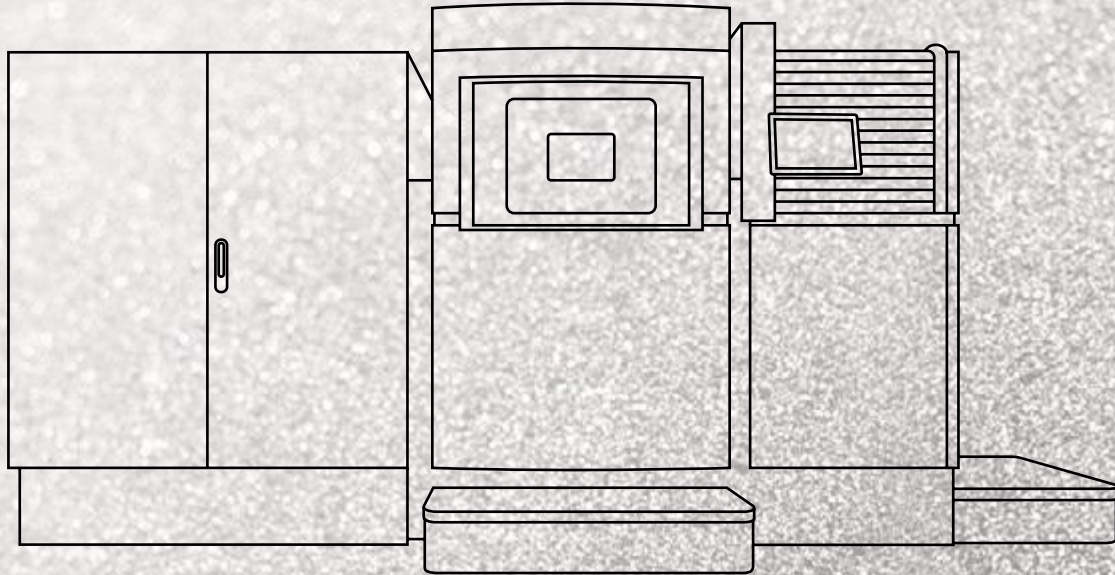


## Surface roughness



*As-manufactured surface roughness with downskin exposure enabled. Note: "NoDS" exposure sets may be used for smoother down-facing surfaces. Surface roughness measurements according to ISO 25178.*



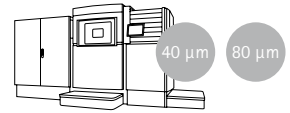


## EOS NickelAlloy HAYNES® 282® for EOS M 400-4 | 40/80 µm

Process Information  
Heat Treatment  
Physical Part Properties  
Mechanical Properties



## EOS NickelAlloy HAYNES® 282® for EOS M 400-4 | 40/80 µm Process Information



System set-up	EOS M 400-4
EOS MaterialSet	HAYNES282_040_080_CoreM404_101
Software requirements	EOSPRINT 2.10 or newer EOSYSTEM 2.14 or newer
Powder part no.	9030-0010
Recoater blade	EOS HSS Blade
Nozzle	EOS Standard Nozzle
Inert gas	Argon
Sieve	63 µm

### Additional information

Layer thickness	40 µm, 80 µm
Volume rate	up to 4x 4.8 mm <sup>3</sup> /s (40 µm) up to 4x 8.4 mm <sup>3</sup> /s (80 µm)

## Heat Treatment

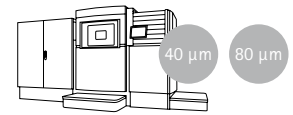
For information on the heat treatment procedures please refer to pages 4 and 5.

## Physical Properties of Parts<sup>1</sup>

Defects	Result
Porosity, 40 µm	0.02 - 0.06 %
Porosity, 80 µm	0.04 - 0.10 %
Density (ISO3369)	≥ 8.20 g/cm <sup>3</sup>



# Mechanical Properties<sup>1</sup>



## Tensile properties – 40 μm As manufactured

		Yield Strength		Ultimate Tensile Strength		Elongation 4D	Area Reduction
		MPa	ksi	MPa	ksi	%	%
25 °C (75 °F)	Horizontal	729	105.7	1010	146.5	33.9	60.3
	Vertical	623	90.3	916	132.8	36.3	57.9

## Tensile properties – 40 μm Heat treated (Option 1)

		Yield Strength		Ultimate Tensile Strength		Elongation 4D	Area Reduction
		MPa	ksi	MPa	ksi	%	%
25 °C (75 °F)	Horizontal	748	108.5	1223	177.4	23.5	26.6
	Vertical	715	103.7	1179	171.0	27.5	33.0

## Tensile properties – 80 μm As manufactured

		Yield Strength		Ultimate Tensile Strength		Elongation 4D	Area Reduction
		MPa	ksi	MPa	ksi	%	%
25 °C (75 °F)	Horizontal	678	98.3	972	141.0	35.4	61.1
	Vertical	585	84.8	910	132.0	39.7	61.9

## Tensile properties – 80 μm Heat treated (Option 1)

		Yield Strength		Ultimate Tensile Strength		Elongation 4D	Area Reduction
		MPa	ksi	MPa	ksi	%	%
25 °C (75 °F)	Horizontal	728	105.6	1198	173.7	21.0	21.8
	Vertical	701	101.7	1141	165.5	19.2	20.3

Tensile testing as per ISO 6892-1

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Cover: This image shows a possible application.



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Cover: This image shows a possible application.

