Material Data Sheet

Ni-Alloy IN625 / 2.4856 / B446[1]

General

Developed in the early 1960's, IN625 is still considered the material of choice for the majority of aircraft engine components with service temperatures below 650 °C. IN625 is a precipitation-hardenable nickel-chromium alloy containing also significant amounts of iron, niobium, and molybdenum along with lesser amounts of aluminum and titanium. It combines corrosion resistance and high strength with outstanding weldability including resistance to postweld cracking. This alloy has excellent creep-rupture strength at temperatures to 700 °C.

Material Structure

SLM®-processed components out of IN625 show a homogenous, nearly void free structure. The mechanical properties are in the range of material specifications. Through subsequent processing such as heat treatment (e.g. stress-relief annealing, solution annealing) or hot isostatic pressing (HIP), the material properties can be adjusted to individual required conditions.

Chemical composition [Mass fraction in %][8]

Ni	Cr	Mo	Nb	Fe	Co	Si	Mn	Ti	Al	C	S	P
Balance	20.00 – 23.00	8.00 – 10.00	3.15 – 4.15	5.00	1.00	0.50	0.50	0.40	0.40	0.1	0.015	0.015

Powder properties

Particle size[8]	10 – 45 µm	Particle shape[9]	Spherical
Mass density[2]	8.44 g/cm³	Thermal conductivity	9.8 W/(m·K)

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20 µm / 400 W[3]				As-built		Heat-treated [13]	
Build-up rate [7]	[cm³/h]			6.48 cm³/h			
Component density[6]	[%]			> 99.5 %			

Tensile test[10]				M	SD	M	SD
Tensile strength	R_m	[MPa]	H	1103	14	1085	11
			V	965	14	971	6
Offset yield strength	$R_{p0,2}$	[MPa]	H	784	32	704	24
			V	705	12	685	5
Elongation at break	A	[%]	H	28	1	31	1
			V	40	2	43	1
Reduction of area	Z	[%]	H	43	3	36	3
			V	43	3	47	5
Young's modulus	E	[GPa]	H	170	36	188	31
			V	162	18	196	10

Hardness test[11]		M	SD	M	SD
Vickers hardness	HV10	310	5	299	3

Roughness measurement[12]			As-built		Corundum blasted		Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	Ra	[µm]	4	1	3	1	2	1
Mean roughness depth	Rz	[µm]	37	3	21	1	14	1

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30 µm / 400 W[4]				As-built		Heat-treated [13]	
Build-up rate [7]	[cm³/h]			10.37 cm³/h			
Component density[6]	[%]			> 99.5 %			

Tensile test[10]				M	SD	M	SD
Tensile strength	R_m	[MPa]	H	1072	20	1069	16
			V	945	10	938	7
Offset yield strength	$R_{p0,2}$	[MPa]	H	737	28	699	20
			V	686	11	649	4
Elongation at break	A	[%]	H	31	1	33	1
			V	42	5	45	1
Reduction of area	Z	[%]	H	35	4	36	3
			V	44	8	49	3
Young's modulus	E	[GPa]	H	178	27	172	19
			V	153	18	190	9

Hardness test[11]		M	SD	M	SD
Vickers hardness	HV10	303	7	297	4

Roughness measurement[12]			As-built		Corundum blasted		Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	Ra	[µm]	4	1	3	1	2	1
Mean roughness depth	Rz	[µm]	37	3	21	1	14	1

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60 µm / 400 W[5]			As-built	Heat-treated [13]
Build-up rate [7]	[cm³/h]		23.33 cm³/h	
Component density[6]	[%]		> 99.5 %	

Tensile test[10]				M	SD	M	SD
Tensile strength	R_m	[MPa]	H	1057	5	1063	7
			V	995	8	1006	7
Offset yield strength	$R_{p0,2}$	[MPa]	H	708	15	664	9
			V	674	23	653	6
Elongation at break	A	[%]	H	33	1	34	1
			V	37	4	40	2
Reduction of area	Z	[%]	H	41	4	39	1
			V	36	5	43	4
Young's modulus	E	[GPa]	H	191	47	179	28
			V	166	30	208	7

Hardness test[11]		M	SD	M	SD
Vickers hardness	HV10	291	4	284	5

Roughness measurement[12]			As-built		Corundum blasted		Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	Ra	[µm]	8	1	5	1	4	1
Mean roughness depth	Rz	[µm]	56	6	34	4	24	3

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The properties and mechanical characteristics apply to powder that is tested and sold by SLM Solutions, and that has been processed on SLM Solutions machines using the original SLM Solutions parameters in compliance with the applicable operating instructions (including installation conditions and maintenance). The part properties are determined based on specified procedures. More details about the procedures used by SLM Solutions are available upon request.

The specifications correspond to the most recent knowledge and experience available to us at the time of publication and do not form a sufficient basis for component design on their own. Certain properties of products or parts or the suitability of products or parts for specific applications are not guaranteed. The manufacturer of the products or parts is responsible for the qualified verification of the properties and their suitability for specific applications. The manufacturer of the products or parts is responsible for protecting any third-party proprietary rights as well as existing laws and regulations.

[1] Material according to DIN 17744:2002, ASTM B446.
[2] Material density varies within the range of possible chemical composition variations.
[3] Material data file: IN625_SLM_MBP3.0_20_CE2_400W_Stripes_V2.2
[4] Material data file: IN625_SLM_MBP3.0_30_CE2_400W_Stripes_V2.1
[5] Material data file: IN625_SLM_MBP3.0_60_CE2_400W_Stripes_V2.1
[6] Optical density determination by light microscopy.
[7] Theoretical build-up rate for each laser = layer thickness x scan speed x track distance.
[8] With respect to powder material.
[9] According to DIN EN ISO 3252:2001.
[10] Tensile test according to DIN EN ISO 6892-1:2017 B (DIN 50125:2016 – B6x30); orientation: 0°, 90°; heat treatment: none; testing machine: Zwick 1484; load range: 200 kN; testing speed: 0,008 1/s; testing temperature: room temperature; test laboratory: EWIS GmbH. Test samples were turned before tensile test.
[11] Hardness testing according to DIN EN ISO 6507-1:2018.
[12] Roughness measurement according to DIN EN ISO 4288:1998; λc = 2,5 mm.
[13[Specimens were heated up to 870 °C with subsequent holding for 1 h, followed by air-cooling. According to AMS 5599.

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