Material Data Sheet

Ni-Alloy IN718 / 2.4668

General

IN718 is a precipitation-hardenable nickel-chromium alloy with a density of circa 8.2 g/cm^3 [2]. Developed in the early 1960‘s, this alloy is still considered the material of choice for the majority of aircraft engine components with service temperatures below 700 °C. IN718 combines a very good corrosion resistance at high and low temperatures and a good corrosion resistance at temperatures to 1000 °C with outstanding weldability including resistance to postweld cracking. Furthermore, the alloy has excellent tensile, fatigue, creep, and rupture strength at temperatures up to 700 °C. Besides components for (gas) turbines, IN718 can be used for engine components, rocket parts, and in high temperature environments in general.

Material Structure

SLM®-processed components out of IN718 show a homogenous, nearly non-porous structure. The mechanical properties are in the range of material specifications. Through subsequent processing such as heat treatment (e.g. precipitation hardening), material properties can be adjusted to the individual required conditions.

Chemical composition [Mass fraction in %][7]

Ni	Cr	Fe	Ta + Nb	Mo	Ti	Al	Cu	C	Si	Mn	B
50.00 – 55.00	17.00 – 21.00	Balance	4.75 – 5.50	2.80 – 3.30	0.65 – 1.15	0.20 – 0.80	0.30	0.08	0.35	0.35	0.006
Co	**P**	**S**									
1.00	0.015	0.015									

Powder properties

Particle size[7]	10 – 45 µm	Particle shape[8]	Spherical
Mass density[2]	8.2 g/cm^3	Thermal conductivity	11.2 W/(m·K)

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Layer thickness 30 µm [3]				As-built		Heat-treated [12]	
Build-up rate [6]	[cm³/h]			16.85 cm³/h			
Component density[5]	[%]			>99.5 %			

Tensile test[9]				M	SD	M	SD
Tensile strength	R_m	[MPa]	H	1098	10	1507	15
			V	1027	10	1412	86
Offset yield strength	$R_{p0,2}$	[MPa]	H	764	14	1281	32
			V	684	6	1225	68
Elongation at break	A	[%]	H	27	5	9	5
			V	29	5	11	5
Reduction of area	Z	[%]	H	39	3	17	2
			V	40	5	25	6
Young's modulus	E	[GPa]	H	183	24	230	33
			V	168	10	186	15

Hardness test[10]		M	SD	M	SD
Vickers hardness	HV10	303	7	470	4

Tenacity test[10]				M	SD	M	SD
Impact energy	KV	[J]	H	70	5	23	2
			V	80	8	28	3

Roughness measurement[11]			As-built	
			M	SD
Roughness average	Ra	[µm]	6	2
Mean roughness depth	Rz	[µm]	47	5

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Layer thickness 60 µm [4]				As-built		Heat-treated [12]	
Build-up rate [6]	[cm³/h]			25.92 cm³/h			
Component density[5]	[%]			>99.5 %			

Tensile test[9]				M	SD	M	SD
Tensile strength	R_m	[MPa]	H	1037	20	1467	22
			V	942	15	1369	20
Offset yield strength	$R_{p0,2}$	[MPa]	H	665	29	1248	24
			V	606	8	1206	12
Elongation at break	A	[%]	H	38	5	13	5
			V	31	5	15	5
Reduction of area	Z	[%]	H	35	3	18	4
			V	36	6	22	4
Young's modulus	E	[GPa]	H	172	48	182	10
			V	154	13	194	7

Hardness test[10]		M	SD	M	SD
Vickers hardness	HV10	292	6	458	9

Tenacity test[10]				M	SD	M	SD
Impact energy	KV	[J]	H	74	3	22	2
			V	80	12	25	2

Roughness measurement[11]			As-built	
			M	SD
Roughness average	Ra	[µm]	8	2
Mean roughness depth	Rz	[µm]	50	8

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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 B637.

[2] Material density varies within the range of possible chemical composition variations.

[3] Material data file: IN 718_SLM_MBP3.0_30_CE2_400W_Stripes_V2.0

[4] Material data file: IN 718_SLM_MBP3.0_60_CE2_400W_Stripes_V2.0

[5] Optical density determination at test specimens by light microscopy.

[6] Theoretical build-up rate for each laser = layer thickness x scan speed x track distance.

[7] With respect to powder material.

[8] According to DIN EN ISO 3252:2001.

[9] Tensile test according to DIN EN ISO 6892-1:2017 B (DIN 50125:2016 – D6x30); orientation: 0° and 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.

[10] Hardness testing according to DIN EN ISO 6507-1:2018.

[11] Roughness measurement according to DIN EN ISO 4288:1998; λc = 2,5 mm.

[12] Specimens were heated up to 980 °C in a furnace, held for 1 h, followed by air-cooling. Then anew heating up to 720 °C, hold for 8h, then cool down to 620 °C in furnace with 50 °C/h. Hold at 620 °C for 8 h, then air-cooling.

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