LaserForm Ni718 (A)

A Nickel-based alloy fine-tuned for use with ProX® DMP 320, DMP Flex 350, DMP Factory 350 and DMP Factory 500 metal printers, producing parts for high temperature applications. LaserForm Ni718 (A) has outstanding corrosion resistance in various corrosive environments and excellent cryogenic properties.

LaserForm Ni718 (A) is formulated and fine-tuned specifically for 3D Systems ProX DMP 320, DMP Flex 350, DMP Factory 350 and DMP Factory 500 metal 3D printers to deliver highest part quality and best part properties. The print parameter database that 3D Systems provides together with the material has been extensively developed, tested and optimized in 3D Systems' part production facilities that hold the unique expertise of printing more than 1,000,000 challenging production parts year over year. Based on a multitude of test samples, the properties listed below provide high confidence to the user in terms of job-to-job and machine-to-machine repeatability. Using the LaserForm material enables the user to experience consistent and reliable part quality.

Material Description

LaserForm Ni718 (A) is a nickel-based heat resistant alloy. This precipitation-hardening nickel-chromium alloy is characterized by good tensile, fatigue, creep and rupture strength at temperatures up to 700°C. Moreover it has outstanding corrosion resistance in various corrosive environments as well as excellent cryogenic properties.

These benefits make LaserForm Ni718 (A) ideal for many high temperature applications such as gas turbine parts, instrumentation parts, power and process industry parts etc. Parts can be post-hardened over 1400 MPa Ultimate Tensile Strength (UTS) by precipitation-hardening heat treatments. The parts can be machined, spark-eroded, welded, shot-peened, polished and coated if required.

Classification

Parts built with LaserForm Ni718 Type (A) have a chemical composition that complies with ASTM F3055.

Mechanical Properties

PROX DMP 320, DMP FLEX 350, DMP FACTORY 350 – LT 30, 60[1, 2, 3, 4]	TEST METHOD	METRIC		U.S.	
		NHT	HSAA	NHT	HSAA
Ultimate Tensile Strength (MPa | ksi) Horizontal direction — XY Vertical direction — Z	ASTM E8/E8M	 NA 930 ± 20	 1400 ± 60 1340 ± 40	 NA 135 ± 6	 203 ± 10 194 ± 6
Yield strength Rp0.2% (MPa | ksi) Horizontal direction — XY Vertical direction — Z	ASTM E8/E8M	 NA 660 ± 20	 1230 ± 60 1200 ± 40	 NA 96 ± 6	 178 ± 10 174 ± 10
Elongation at break (%) Horizontal direction — XY Vertical direction — Z	ASTM E8/E8M	 NA 30 ± 4	 15 ± 4 14 ± 8	 NA 30 ± 4	 15 ± 4 14 ± 8

DMP FACTORY 500 – LT 60[5, 6, 7, 8]	TEST METHOD	METRIC		U.S.	
		NHT	HAA	NHT	HAA
Ultimate Tensile Strength (MPa | ksi) Horizontal direction — XY Vertical direction — Z	ASTM E8	 1080 ± 20 1010 ± 25	 1520 -40/+20 1440 -40/+20	 157 ± 3 146 ± 4	 220 -6/+3 209 -6/+3
Yield strength Rp0.2% (MPa | ksi) Horizontal direction — XY Vertical direction — Z	ASTM E8	 790 ± 25 660 ± 30	 1350 -40/+30 1280 ± 50	 115 ± 4 96 ± 4	 196 -6/+4 186 ± 7
Plastic elongation (%) Horizontal direction — XY Vertical direction — Z	ASTM E8	 29 ± 6 32 ± 4	 16 ± 4 18 ± 5	 29 ± 6 32 ± 4	 16 ± 4 18 ± 5

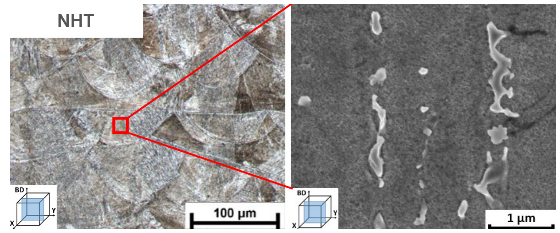
HIGH TEMPERATURE TENSILE PROPERTIES DMP FACTORY 500 – LT60[9]	TEST METHOD	METRIC		U.S.	
		NHT	HAA	NHT	HAA
Ultimate Tensile Strength (MPA | ksi) Vertical direction – Z	ASTM E21, at 650°C	NA	1185 ± 25	NA	172 ± 4
Yield strength Rp0.2% (MPa| ksi) Vertical direction – Z		NA	1055 ± 20	NA	153 ± 3
Plastic elongation (%) Vertical direction – Z		NA	20 ± 3	NA	20 ± 3

[1] Parts manufactured with standard parameters on a DMP Flex 350 and DMP Factory 350, Config B using layer thickness 30 µm and layer thickness 60 µm
[2] Values based on average and double standard deviation
[3] NHT refers to non-heat-treated sample condition; HSAA refers to a modified homogenization followed with solutioning and double aging as prescribed in ASTM F3055
[4] NHT samples tested according to ASTM E8M using round tensile test specimen type 4. HSAA samples tested according to ASTM E8 using rectangular tensile test specimen type 8
[5] Parts manufactured with standard parameters on a DMP Factory 500, using layer thickness 60 µm (LT60)
[6] Values based on average and 95% tolerance interval with 95% confidence
[7] Tested according to ASTM E8 using round tensile test specimen type 4
[8] NHT refers to non-heat-treated sample condition; HAA refers to the homogenization with double aging (HAA) heat treatment as prescribed in ASTM F3055
[9] High temperature tensile properties based on limited sample size. For information only. Values based on average and double standard deviation

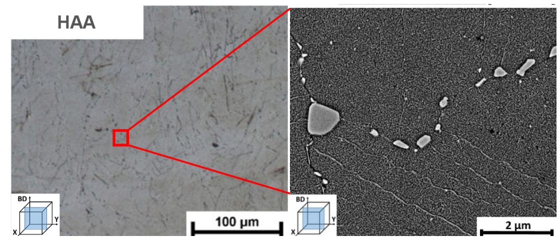
Printed Part Properties[10]

DENSITY	TEST METHOD	METRIC	U.S.
Theoretical density[11] (g/cm^3 | lb/in^3)	Value from literature	8.2	0.296
Relative density (%), ProX DMP 320, DMP Flex 350, DMP Factory 350[12, 13]	Optical method (pixel count)	≥ 99.6 Typical 99.9	≥ 99.6 Typical 99.9
Relative density (%), DMP Factory 500[12, 13]	Optical method (pixel count)	≥ 99.7 Typical 99.9	≥ 99.7 Typical 99.9

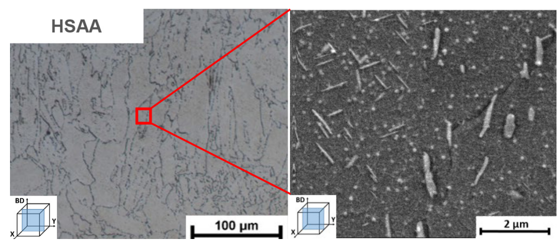
SURFACE ROUGHNESS R_a [12, 13, 14, 15]	TEST METHOD	METRIC	U.S.
Vertical side surface (µm | µin) ProX DMP 320, DMP Flex 350, DMP Factory 350	ISO 25178	Typically, around 5	Typically, around 197
Vertical side surface (µm | µin) DMP Factory 500	ISO 25178	Typically, around 5	Typically, around 197



Microstructure NHT



Microstructure after HAA



Microstructure after HSAA

Thermal Properties[11]

MEASUREMENT	CONDITION	METRIC	U.S.
Thermal conductivity (W/(m.K) | BTU·in/h·ft^2·°F)	At 21 °C/ 69.8 °F	11.4	79
	At 100°C / 212°F	18.3	127
Coefficient of Thermal Expansion (µm/m-°C | µinch/(inch.°F)	At 200°C / 392°F	13.2	7.33
	At 600°C / 1112°F	13.9	7.72
Melting range (°C | °F)		1260-1335	2300-2435

Chemical Composition

ELEMENT	% OF WEIGHT
Al	0.20-0.8
B	≤0.006
C	≤0.08
Co	≤1.00
Cr	17.00-21.00
Cu	≤0.30
Fe	Bal.
Mn,Si	≤0.35
Mo	2.80-3.30
Nb+Ta	4.75-5.50
Ni	50.00-55.00
P,S	≤0.015
Ti	0.65-1.15

[10] May deviate depending on specific part geometry
[11] Values based on literature
[12] Parts manufactured with standard parameters on a DMP Flex and Factory 350, Config B using layer thickness 30 µm and 60 µm. Parts manufactured on a DMP Factory 500, using layer thickness 60 µm
[13] Minimum values based on 95% tolerance interval with a 95% confidence. Tested on specific 3DS test coupons
[14] Surface treatment performed with Finox zirconia blasting medium at 5 bar
[15] Vertical side surface measurement along the building direction

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