LaserForm 316L (A)

Extra low-carbon grade stainless steel fine-tuned for use with the DMP Flex/Factory 350, DMP Flex/Factory 350 Dual and DMP Flex 350 Triple producing parts with high corrosion resistance and sterilisability. LaserForm 316L (A) yields crack-free, dense parts for all your applications.

LaserForm 316L (A) is formulated and fine-tuned specifically for 3D Systems' 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

Austenitic stainless steel type LaserForm 316L (A) is the extra low carbon grade of 316. This steel is used as a general purpose material with excellent mechanical and corrosion properties at room temperature. Its chloride resistance makes this specific grade of stainless steel suitable for marine applications.

LaserForm 316L stainless steel is also the preferred material for use in hydrogen atmospheres or for hydrogen piping / cooling applications. It retains good mechanical properties at sub-zero and even cryogenic temperatures and is suitable for structural components in low-temperature applications.

Mechanical properties[1,2]

DMP FLEX/FACTORY 350[3] PROX DMP 320	TEST METHOD	METRIC		U.S.	
		SR	FA	SR	FA
Ultimate tensile strength (MPa | ksi) Horizontal direction — XY Vertical direction — Z	ASTM E8M	 660 ± 20 570 ± 30	 610 ± 30 540 ± 30	 96 ± 3 83 ± 5	 89 ± 5 78 ± 5
Yield strength Rp0.2% (MPa | ksi) Horizontal direction — XY Vertical direction — Z		 530 ± 20 440 ± 20	 370 ± 30 320 ± 20	 77± 3 63 ± 3	 54 ± 5 47 ± 3
Elongation at break (%) Horizontal direction — XY Vertical direction — Z		 39 ± 5 49 ± 5	 51 ± 5 66 ± 5	 39 ± 5 49 ± 5	 51 ± 5 66 ± 5
Reduction of area (%) Horizontal direction — XY Vertical direction — Z		 65 ± 5 65 ± 5	 61 ± 5 62 ± 5	 65 ± 5 65 ± 5	 61 ± 5 62 ± 5
Hardness, Rockwell B	ASTM E18	90 ± 6	83 ± 4	90 ± 6	83 ± 4
Impact toughness[4] (J/cm² | lb.ft)	ASTM E23	215 ± 15	220 ± 15	158 ± 10	162 ± 10

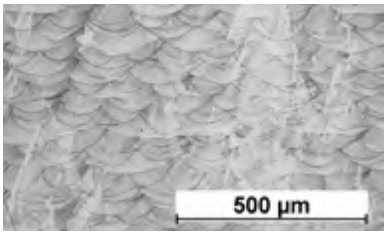
DMP FLEX / FACTORY 350 DUAL[5,6]	TEST METHOD	FA			
		METRIC		U.S.	
		LT30	LT60	LT30	LT60
Ultimate tensile strength (MPa | ksi) Horizontal direction — XY Vertical direction — Z	ASTM E8	 660 ± 20 570 ± 20	 640 ± 20 590 ± 20	 99 ± 3 85 ± 2	 93 ± 3 85 ± 2
Yield strength Rp0.2% (MPa | ksi) Horizontal direction — XY Vertical direction — Z		 405 ± 5 390 ± 5	 390 ± 30 360 ± 20	 59± 5 56 ± 3	 56 ± 5 52 ± 3
Elongation at break (%) Horizontal direction — XY Vertical direction — Z		 48 ± 5 62 ± 5	 50 ± 5 56 ± 5	 39 ± 5 49 ± 5	 51 ± 5 66 ± 5
Reduction of area (%) Horizontal direction — XY Vertical direction — Z		 63 ± 5 76 ± 5	 64 ± 5 70 ± 5	 65 ± 5 65 ± 5	 61 ± 5 62 ± 5

[1] Values based on average and standard deviation
[2] NHT SR refers to a stress relief heat treatment ; FA refers to a full annealing
[3] Parts manufactured with standard parameters on a ProX DMP 320
[4] Tested with charpy V-notch toughness test, DMV probe
[5] Parts manufactured with standard parameters on DMP Flex / Factory 350 Dual, config B, using layer thickness 30 µm (LT30) and 60 µm (LT60)
[6] Tested according ASTM E8 using round testing test specimen type 4
[7] For each condition, values based on a limited sample population (<10)

DMP FLEX 350 TRIPLE - LT60[6,7,8]	TEST METHOD	METRIC		U.S.	
		NHT	FA	NHT	FA
Ultimate tensile strength (MPa | ksi) Horizontal direction — XY Vertical direction — Z	ASTM E8	 705 ± 5 655 ± 10	 665 ± 5 625 ± 10	 102 ± 1 95 ± 1	 97 ± 1 91 ± 1
Yield strength Rp0.2% (MPa | ksi) Horizontal direction — XY Vertical direction — Z		 580 ± 10 525 ± 15	 395 ± 30 380 ± 30	 84 ± 1 76 ± 2	 57 ± 4 55 ± 4
Elongation at break (%) Horizontal direction — XY Vertical direction — Z		 40 ± 5 45 ± 5	 45 ± 5 55 ± 5	 40 ± 5 45 ± 5	 45 ± 5 55 ± 5
Reduction of area (%) Horizontal direction — XY Vertical direction — Z		 68 ± 5 74 ± 5	 63 ± 5 69 ± 5	 68 ± 5 74 ± 5	 63 ± 5 69 ± 5

Thermal properties[9]

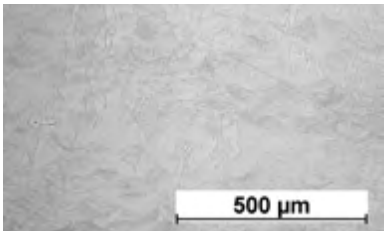
MEASUREMENT	CONDITION	METRIC	U.S.
Thermal conductivity (W/(m.K) | Btu.in/(h.ft.°F))	At 20 °C/ 68 °F	15	9
Coefficient of thermal expansion (µm/m-°C | µin/in-°F)	In the range of 20 - 600°C / 68-1112°F	19.0	10.6
Melting range (°C | °F)		1370-1400	2500-2550



Microstructure after SR

Density[3,8]

MEASUREMENT	TEST METHOD	METRIC	U.S.
Theoretical density (g/cm³ J lb/in³)	Value from literature	8.0	0.286
Relative density (%)	Optical method (pixel count)	≥ 99.9 Typical 99.95	≥ 99.9 Typical 99.95



Microstructure after FA

Chemical composition

Parts built with LaserForm 316L (A) have a chemical composition that complies to the compositional requirements of ASTM F3184-16.

ELEMENT	% OF WEIGHT
Fe	Bal.
Cr	16.00-18.00
Ni	10.00-14.00
C	≤0.030
Mn	≤2.00
Mo	2.00-3.00
Si	≤1.00
P	≤0.045
S	≤0.030

[8] Parts manufactured with standard parameters on a DMP Flex 350 Triple, using layer thickness 60 µm (LT60)
[9] Values based on literature