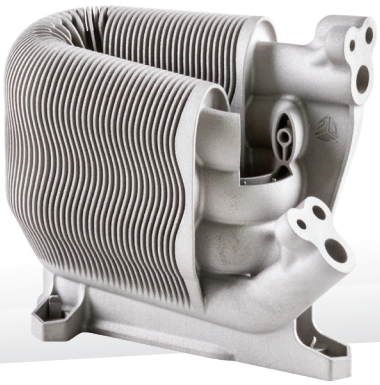


LaserForm® 316L (B)

Extra low-carbon grade Stainless Steel which is fine-tuned for use with the DMP Flex 100 and the ProX® DMP 200, producing parts with high corrosion resistance and sterilisability. LaserForm 316L (B) yields crack free and completely dense parts for all your applications.

LaserForm 316L (B) is formulated and fine-tuned specifically for 3D Systems DMP Flex 100 and DMP 200 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 500,000 challenging production parts year over year. And for a 24/7 production 3D Systems' thorough Supplier Quality Management System guarantees consistent, monitored material quality for reliable process results.

Material Description

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

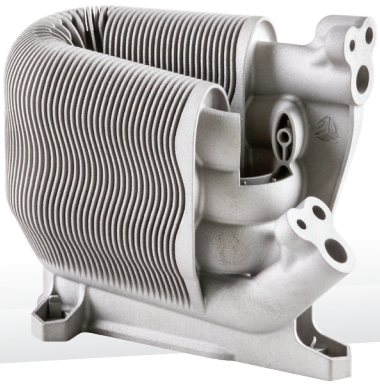
Classification

Parts built with LaserForm 316L alloy have a chemical composition that conforms to the compositional requirements of ASTM A276 - UNS S31603.

Mechanical Properties [1,2]

MEASUREMENT	CONDITION	METRIC			U.S.		
		AS BUILT	AFTER STRESS RELIEF	FULL ANNEAL	AS BUILT	AFTER STRESS RELIEF	FULL ANNEAL
Youngs modulus (GPa | ksi)							
Horizontal direction — XY Vertical direction — Z		200 ± 30 145 ± 30	200 ± 30 160 ± 30	200 ± 30 160 ± 30	29000 ± 4400 21000 ± 4400	29000 ± 4400 23200 ± 4400	29000 ± 4400 23200 ± 4400
Ultimate Strength (MPa | ksi)	ASTM E8M						
Horizontal direction — XY Vertical direction — Z		710 ± 50 630 ± 50	740 ± 50 660 ± 50	670 ± 50 600 ± 50	103 ± 7 91 ± 7	107 ± 7 96 ± 7	97 ± 7 87 ± 7
Yield strength Rp0.2% (MPa | ksi)	ASTM E8M						
Horizontal direction — XY Vertical direction — Z		590 ± 50 520 ± 50	610 ± 60 530 ± 60	440 ± 60 410 ± 60	86 ± 7 75 ± 7	88 ± 9 77 ± 9	64 ± 9 59 ± 9
Elongation at break (%)	ASTM E8M						
Horizontal direction — XY Vertical direction — Z		41 ± 5 37 ± 5	37 ± 5 34 ± 5	44 ± 5 42 ± 5	41 ± 5 37 ± 5	37 ± 5 34 ± 5	44 ± 5 42 ± 5
Reduction of area (%)	ASTM E8M						
Horizontal direction — XY Vertical direction — Z		65 ± 5 65 ± 10	65 ± 5 59 ± 10	58 ± 5 54 ± 10	65 ± 5 65 ± 10	65 ± 5 59 ± 10	58 ± 5 54 ± 10
Hardness, Vickers (HV30)	ISO 6507-1	227 ± 10	230 ± 10	200 ± 10	227 ± 10	230 ± 10	200 ± 10

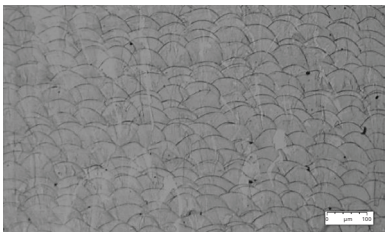
[1] Parts manufactured with standard parameters on a DMP Flex 100 and ProX® DMP 200
[2] Values based on average and double standard deviation



LaserForm® 316L (B)

Thermal Properties [1]

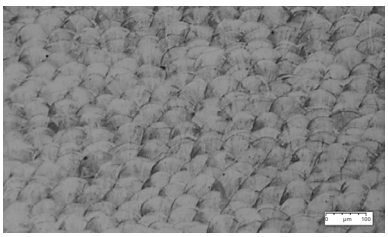
MEASUREMENT	CONDITION	METRIC	U.S.
Thermal conductivity (W/(m.K) | Btu/(h.ft.°F))	At 20 °C/ 68 °F	15	9
Coefficient of Thermal Expansion (µm/(m.°C) | µinch/(inch.°F))	In the range of 20 - 600°C / 68-1112°F	19.0	10.6
Melting range (°C | °F)		1370-1400	2500-2550



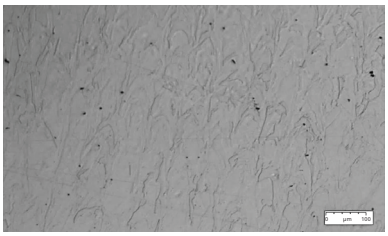
Microstructure as built

Physical Properties [1]

MEASUREMENT	CONDITION	METRIC		U.S.	
		AS BUILT AND AFTER STRESS RELIEF	AFTER FULL ANNEAL	AS BUILT AND AFTER STRESS RELIEF	AFTER FULL ANNEAL
Density					
Relative, based on pixelcount (%)	Optical method	> 99.7		> 99.7	
Absolute theoretical (g/cm³ | lb/in³)		7.95		0.287	



Microstructure after stress relief



Microstructure after full anneal

Chemical Composition

ELEMENT	% OF WEIGHT
Fe	bal.
Cr	16.50-18.00
Ni	10.00-13.00
C	≤0.030
Mn	≤2.00
Mo	2.00-2.50
Si	≤1.00
P	≤0.040
S	≤0.030

[1] Values based on literature

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