



LaserForm[®] 316L (A)

Extra low-carbon grade Stainless Steel which is fine-tuned for use with the ProX[®] DMP 320, producing parts with high corrosion resistance and sterilisability. LaserForm 316L (A) yields crack free and completely dense parts for all your applications.

LaserForm 316L (A) is formulated and fine-tuned specifically for 3D Systems DMP 320 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. Based on over 1000 test samples the below listed part quality data and mechanical properties give you high planning security. 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 DIN X2CrNiMo 17-12-2 or Werkstoff Nr. 1.4404.

Mechanical Properties^{1,3}

MEASUREMENT	CONDITION	METRIC		U.S.	
		AFTER STRESS RELIEF	FULL ANNEAL	AFTER STRESS RELIEF	FULL ANNEAL
Youngs modulus (GPa ksi)					
Horizontal direction — XY		180 ± 15	180 ± 15	27600 ± 1500	27600 ± 1500
Ultimate Strength (MPa ksi)	ASTM E8M				
Horizontal direction — XY		660 ± 20	610 ± 30	96 ± 3	89 ± 5
Vertical direction — Z		570 ± 30	540 ± 30	83 ± 5	78 ± 5
Yield strength Rp0.2% (MPa ksi)	ASTM E8M				
Horizontal direction — XY		530 ± 20	370 ± 30	77 ± 3	54 ± 5
Vertical direction — Z		440 ± 20	320 ± 20	63 ± 3	47 ± 3
Elongation at break (%)	ASTM E8M				
Horizontal direction — XY		39 ± 5	51 ± 5	39 ± 5	51 ± 5
Vertical direction — Z		49 ± 5	66 ± 5	49 ± 5	66 ± 5
Reduction of area (%)	ASTM E8M				
Horizontal direction — XY		65 ± 5	61 ± 5	65 ± 5	61 ± 5
Vertical direction — Z		65 ± 5	62 ± 5	65 ± 5	62 ± 5
Hardness, Rockwell B (HRB)	ASTM E18	90 ± 6	83 ± 4	90 ± 6	83 ± 4
Impact toughness ² (J/cm ² lb.ft)	ASTM E23	215 ± 15	220 ± 15	158 ± 10	162 ± 10

Thermal Properties⁴

MEASUREMENT	CONDITION	METRIC	U.S.
Thermal conductivity (W/(m.K) Btu/(h.ft ² .°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

¹ Parts manufactured with standard parameters on a ProX DMP 320, Config B

² Tested with charpy V-notch toughness test, DMV probe

³ Values based on average and standard deviation

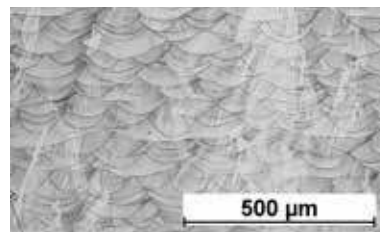
⁴ Values based on literature



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Physical Properties⁴

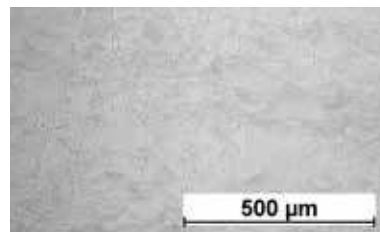
MEASUREMENT	METRIC		U.S.	
	AS BUILT AND AFTER STRESS RELIEF	AFTER FULL ANNEAL	AS BUILT AND AFTER STRESS RELIEF	AFTER FULL ANNEAL
Density — Absolute theoretical ⁵ (g/cm ³ lb/in ³)	8.0		0.286	



Microstructure after stress relief

Surface Quality

MEASUREMENT	METRIC	U.S.
	SANDBLASTED	SANDBLASTED
Surface Roughness Vertical direction (Z) (μm μin)	5-10	200-400



Microstructure after full anneal

Chemical Composition

ELEMENT	% OF WEIGHT
Fe	bal.
Cr	16.50-18.50
Ni	10.00-13.00
C	≤0.030
Mn	≤2.00
Mo	2.00-2.50
N	≤0.11
Si	≤1.00
P	≤0.045
S	≤0.030



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⁴ Values based on literature