

# DIRECT METAL PRINTERS

Metal Additive Manufacturing with the ProX™ DMP 3D printers



**ProX DMP 100**



**ProX DMP 200**



**ProX DMP 300**



**ProX DMP 320**

Specifications				
Laser Power Type	50 W/Fiber laser	300 W/Fiber laser	500 W/Fiber laser	500 W/Fiber laser
Laser Wavelength	1070 nm	1070 nm	1070 nm	1070 nm
Layer Thickness Range Preset	Adjustable, min 10 µm, no max			Adjustable, min 2 µm, no max
	30 and 40 µm, dependent on material			30 and 60 µm
Build Envelope Capacity (X x Y x Z)	3.94 x 3.94 x 3.94 in (100 x 100 x 100 mm) <sup>1</sup>	5.51 x 5.51 x 4.92 in (140 x 140 x 125 mm) <sup>1</sup>	9.84 x 9.84 x 12.99 in (250 x 250 x 330 mm) <sup>1</sup>	10.82 x 10.82 x 16.53 in (275 x 275 x 420 mm) <sup>1</sup>
Ready-to-run materials with developed print parameters:	Cobalt-Chrome CoCr Stainless Steel 17-4 PH	Cobalt-Chrome CoCr Stainless Steel 17-4 PH Maraging Steel Aluminum Alloy AlSi12	Cobalt-Chrome CoCr Stainless Steel 17-4 PH Maraging Steel Aluminum Alloy AlSi12	LaserForm™ Ti Gr. 1 <sup>2</sup> LaserForm™ Ti Gr. 5 <sup>2</sup> LaserForm™ Ti Gr. 23 <sup>2</sup> LaserForm™ Ni718 <sup>3</sup> LaserForm™ Stainless 316L <sup>3</sup>
Material Deposition	Roller	Roller	Roller	Scraper
Repeatability	x=20 µm, y=20 µm, z=20 µm			
Minimum Feature Size	x=100 µm, y=100 µm, z=20 µm			100 µm
Typical Accuracy	± 0.1-0.2% with ± 50 µm minimum	± 0.1-0.2% with ± 50 µm minimum	± 0.1-0.2% with ± 50 µm minimum	± 0.1-0.2% with ± 50 µm minimum
Space Requirements				
Dimensions, uncrated (WxDxH)	48 x 31 x 77 in (120 x 77 x 195 cm)	48 x 59 x 77 in (120 x 150 x 195 cm)	95 x 87 x 95 in (240 x 220 x 240 cm)	93 x 91 x 91 in (235 x 230 x 230 cm)
Weight, uncrated	1000 kg (2200 lbs)	Approx. 1500 kg (3300 lbs)	Approx. 5000 kg (11000 lbs)	Approx. 4700 kg (10500 lbs)
Facility Requirements				
Electrical Requirements	230 V / 2.7 KVA / single phase	400 V / 8 KVA / 3 phase	400 V / 15 KVA / 3 phase	400V / 10 KVA / 3 phase
Compressed Air Requirements	6-8 bar	6-8 bar	6-8 bar	4-8 bar
Gas Requirements	Nitrogen or Argon, 6-8 bar	Nitrogen or Argon, 6-8 bar	Nitrogen or Argon, 6-8 bar	Argon, 1.5-4 bar
Water Cooling	Not required	Chiller included in printer	Chiller included in printer	Chiller supplied with printer
Control System and Software				
Software Tools	ProX DMP Manufacturing, ProX DMP Dental for dental applications			DMP Software suite
Control Software	ProX Control v2			DMP Software suite
Operating System	Windows 7	Windows 7	Windows 7	Windows 7, 64 bit
Input Data File Formats	STL	STL	STL	STL
Network Type and Protocol	Ethernet 1 Gbps, RJ-45 Plug			Ethernet 1 Gbps, RJ-45 plug
Accessories				
Recycling System	Optional external system	Optional external system	Automatic	Optional external system
Optional Accessories				Optional secondary module for fast material exchange
Handling				
Material Loading	Manual	Semiautomatic	Automatic	Manual
Interchangeable Build Modules	No	No	No	Yes
Certification	CE marked, TUV	CE marked, TUV	CE marked, TUV	CE marked, TUV

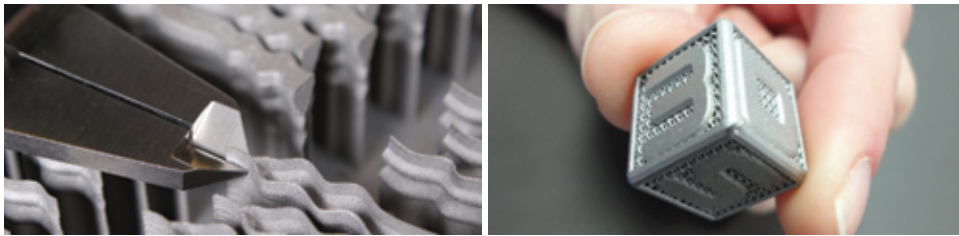
<sup>1</sup> Including build plate. Maximum part size is dependent on geometry, among other factors.

<sup>2</sup> Set up A

<sup>3</sup> Set up B

# METAL ALLOYS FOR THE PROX™ DMP 100, 200, 300

Achieve the best part quality and mechanical properties with 3D Systems' ready-to-run materials with extensively developed print parameters.



Properties	Aluminium Alloy AISi12	CoCrMo Alloy <sup>4</sup>	Maraging Steel	Stainless Steel 17-4 PH
Printer Availability	ProX DMP 200, 300	ProX DMP 100, 200, 300	ProX DMP 200, 300	ProX DMP 100, 200, 300
<b>Chemical Composition</b>				
Al	Balance	-	-	-
C	-	0.0 - 0.02%	≤ 0.03%	-
Co	-	Balance	9.0 - 11.0%	-
Cr	-	28.0 - 30.0%	-	15.0 - 17.5%
Cu	-	-	-	3.0 - 5.0%
Fe	-	0.0 - 0.5%	Balance	Balance
Mn	-	0.0 - 1.0%	≤ 1.0%	< 1.0%
Mo	-	5.0 - 6.0%	4.0 - 6.0%	-
Nb	-	-	-	0.15 - 0.45%
Ni	-	-	17.0 - 19.0%	3.0 - 5.0%
Si	11.0 - 13.0%	0.0 - 1.0%	≤ 1.0%	< 1.0%
Ti	-	-	0.9 - 1.0%	-
Residuals	< 0.6%	-	-	-
<b>Mechanical Properties<sup>1</sup> Condition</b>				
<b>Ultimate Tensile Strength</b>	ASTM E8			
As-built <sup>2</sup>	480 MPa ± 20	1200 MPa ± 100	1110 MPa ± 50	1100 MPa ± 50
After post heat treatment <sup>3</sup>	240 MPa ± 20	1260 MPa ± 100	-	1300 MPa ± 50
<b>Yield Strength</b>	ASTM E8			
As-built <sup>2</sup>	270 MPa ± 20	850 MPa ± 100	860 MPa ± 50	620 MPa ± 50
After post heat treatment <sup>3</sup>	180 MPa ± 20	900 MPa ± 100	-	1100 MPa ± 50
<b>Elongation at Break</b>	ASTM E8			
As-built <sup>2</sup>	5.5% ± 1.0	10% ± 2	11% ± 3	16% ± 2.0
After post heat treatment <sup>3</sup>	20% ± 4.0	15% ± 2	-	10% ± 2.0
<b>Hardness</b>				
As-built <sup>2</sup>	137 ± 1.5 HB	-	37 ± 2 HRC	300 ± 20 HV5
After post heat treatment <sup>3</sup>	90 - 95 HB	500 ± 20 HV5	55 ± 2 HRC	400 ± 20 HV5
<b>Density</b>	Approx. 100%	Approx. 100%	Approx. 100%	Approx. 100%

<sup>1</sup> Parts built on a ProX DMP 200 Printer

<sup>2</sup> As-built refers to the state of components built on the ProX DMP 200 before any post processing except removal from the build platform

<sup>3</sup> Different post heat treatments might be applied for this type of alloy

<sup>4</sup> Ni-free alloy: this chemical composition is suitable for biomedical applications

ProX DMP 100, 200 and 300 printers feature the most flexible build parameter control settings in the industry. These open systems offer you the option to develop parameters and run any material in addition to 3D Systems' ready-to-run alloys.

# METAL ALLOYS FOR THE PROX™ DMP 320

Achieve the best part quality and mechanical properties with 3D Systems' ready-to-run materials with extensively developed print parameters.



Properties	LaserForm™ Ti Gr. 1	LaserForm™ Ti Gr. 5	LaserForm™ Ti Gr. 23	LaserForm™ Ni718	LaserForm™ Stainless 316L
<b>Chemical Composition</b>					
Al	-	5.50-6.75%	5.50-6.50%	0.2-0.8%	-
B	-	-	-	≤0.006%	-
C	≤ 0.08%	≤0.08%	≤0.08%	≤0.08%	≤0.030%
Co	-	-	-	≤1.00%	-
Cr	-	-	-	17.00-21.00%	16.5-18.5%
Cu	-	-	-	≤0.30%	-
Fe	≤ 0.20%	≤0.30%	≤0.25%	Balance	Balance
H	≤ 0.015%	≤0.015%	≤0.012%	-	-
Mn	-	-	-	≤0.35%	≤2.00%
Mo	-	-	-	2.80-3.30%	2.00-2.50%
N	≤ 0.03%	≤0.05%	≤0.03%	-	≤0.11%
Nb+Ta	-	-	-	4.75-5.50%	-
Ni	-	-	-	50.00-55.00%	10.00-13.00%
O	≤ 0.18%	≤0.20%	≤0.13%	-	-
P	-	-	-	≤0.015%	≤0.045%
S	-	-	-	≤0.015%	≤0.030%
Si	-	-	-	≤0.35%	≤1.00%
Ti	Balance	Balance	Balance	0.65-1.15%	-
V	-	3.50-4.50%	3.50-4.50%	-	-
Y	-	≤0.005%	≤0.005%	-	-
Residuals each	≤ 0.10%	≤0.10%	≤0.10%	-	-
Residuals total	≤ 0.40%	≤0.40%	≤0.40%	-	-
Traces	-	-	-	≤0.001% Pb, Se each	-

Specifications	Condition	LaserForm™ Ti Gr. 1	LaserForm™ Ti Gr. 5	LaserForm™ Ti Gr. 23	LaserForm™ Ni718	LaserForm™ Stainless 316L
<b>Young's Modulus</b>	ASTM E8M	105 - 120 GPa	105 - 120 GPa	105 - 120 GPa	170 GPa ± 20 GPa	190 GPa
<b>Yield Strength (Rp 0.2 %)</b>	ASTM E8M	350 MPa ± 30 MPa	950 MPa ± 30 MPa <sup>3</sup> 1100 MPa ± 100 MPa <sup>4</sup>	850 MPa ± 100 MPa <sup>3</sup> 1000 MPa ± 100 MPa <sup>4</sup>	1075 MPa ± 100 MPa <sup>5</sup>	330 MPa ± 50 MPa <sup>6</sup> 470 MPa ± 70 MPa <sup>4</sup>
<b>Ultimate Tensile Strength</b>	ASTM E8M	450 MPa ± 30 MPa	1030 MPa ± 20 MPa <sup>3</sup> 1190 MPa ± 100 MPa <sup>4</sup>	940 MPa ± 50 MPa <sup>3</sup> 1080 MPa ± 100 MPa <sup>4</sup>	1350 MPa ± 100 MPa <sup>5</sup>	550 MPa ± 50 MPa <sup>6</sup> 600 MPa ± 100 MPa <sup>4</sup>
<b>Elongation at Break</b>	ASTM E8M	30% ± 5%	12% ± 2 % <sup>3</sup> 8% ± 2% <sup>4</sup>	15% ± 5 % <sup>3</sup> 11% ± 3 % <sup>4</sup>	15% ± 5% <sup>5</sup>	50% ± 10 % <sup>6</sup> 40% ± 20 % <sup>4</sup>

<sup>1</sup> Values based on literature

<sup>2</sup> Dependent on surface orientation and part geometry

<sup>3</sup> After Hot isostatic pressing (HIP) post-processing

<sup>4</sup> After stress relief post-processing

<sup>5</sup> After hardening

<sup>6</sup> After full annealing

The ProX DMP 320 offers exchangeable manufacturing modules that support rapid material change or replenishment, in line with the printer configuration selected.

# METAL ALLOYS FOR THE PROX™ DMP 320 Continued

Specifications	Condition	LaserForm™ Ti Gr. 1	LaserForm™ Ti Gr. 5	LaserForm™ Ti Gr. 23	LaserForm™ Ni718	LaserForm™ Stainless 316L
Micro Vickers Hardness		195 ± 15 Hv0.3	-	-	-	210 - 215 Hv
Macro Rockwell C Hardness		-	> 30 HRC <sup>3</sup> > 33 HRC <sup>4</sup>	> 30 HRC <sup>3</sup> > 33 HRC <sup>4</sup>	47 HRC <sup>5</sup>	-
Thermal Conductivity <sup>1</sup>	at 50 °C	16 W/m.K	6.7 W/m.K	6.7 W/m.K	11.4 W/m.K	at 20°C: 15 W/m.K at 100°C: 16.3 W/m.K at 500°C: 21.5 W/m.K
Coeff. of Thermal Expansion <sup>1</sup>	20 - 100 °C	7.17 x 10 <sup>-6</sup> /°C	8.6 x 10 <sup>-6</sup> /°C	8.6 x 10 <sup>-6</sup> /°C	-	0 - 100 °C: 16.4 x 10 <sup>-6</sup> /°C
	20 - 300 °C	9.4 x 10 <sup>-6</sup> /°C	9.2 x 10 <sup>-6</sup> /°C	9.2 x 10 <sup>-6</sup> /°C	-	0 - 300 °C: 18.6 x 10 <sup>-6</sup> /°C
	20 - 700 °C	10.1 x 10 <sup>-6</sup> /°C	9.7 x 10 <sup>-6</sup> /°C	9.7 x 10 <sup>-6</sup> /°C	-	-
Specific Heat Capacity <sup>1</sup>	0-100°C	-	-	-	-	500J/kg.K
	20-200	-	-	-	-	520 J/kg.K
	at 20 °C	-	580 J/kg.K	580 J/kg.K	435 J/kg.K	-
	at 205 °C	-	610 J/kg.K	610 J/kg.K	-	-
	at 260 °C	-	-	-	520 J/kg.K	-
	at 300 °C	-	-	-	-	550 J/kg.K
	at 399 °C	-	-	-	725 J/kg.K	-
	at 425 °C	-	670 J/kg.K	670 J/kg.K	-	-
	at 468 °C	-	-	-	900 J/kg.K	-
	at 500 °C	-	-	-	-	590 J/kg.K
	at 538 °C	-	-	-	700 J/kg.K	-
	at 650 °C	-	760 J/kg.K	760 J/kg.K	-	-
	at 700 °C	-	-	-	-	630 J/kg.K
at 870 °C	-	930 J/kg.K	930 J/kg.K	-	-	
Maximum Operating Temp. <sup>1</sup>	425 °C (continuous) 540 °C (intermittent)	- -	- -	- -	650 °C (loaded) 980 °C (oxidation resistance)	- -
Melting Point <sup>1</sup>		1668 °C	1692 - 1698 °C	1692 - 1698 °C	1260 - 1335 °C	1375 - 1400 °C
α/β Transus Temperature <sup>1</sup>		882 °C	995 °C	995 °C	-	-
Magnetic Permeability <sup>1</sup>		-	1.00005	1.00005	1.0011	1.008
Electrical Resistivity		-	-	-	-	740 nΩ.m
Cytotoxicity (ISO 10993-5)		Grade 0 (non cytotoxic)	-	Grade 0 (non cytotoxic)	-	-
Relative Density		Approx. 100%	Approx. 100%	Approx. 100%	Approx. 100%	Approx. 100%
Absolute Density <sup>1</sup>		4.51 g/cm <sup>3</sup>	4.41 g/cm <sup>3</sup>	4.42 g/cm <sup>3</sup>	8.2 g/cm <sup>3</sup>	7.92 g/cm <sup>3</sup>
Typical Surface Roughness <sup>2</sup>						
	Ra	4 - 8 μm	4 - 8 μm	4 - 8 μm	4 - 10 μm	4 - 6.5 μm
	Ry	25 - 35 μm	25 - 35 μm	25 - 35 μm	20 - 50 μm	25 - 50 μm

<sup>1</sup> Values based on literature

<sup>2</sup> Dependent on surface orientation and part geometry

<sup>3</sup> After Hot isostatic pressing (HIP) post-processing

<sup>4</sup> After stress relief post-processing

<sup>5</sup> After hardening

<sup>6</sup> After full annealing

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