












3D PRINTING WITH METALS

In this process, metal powder is fused into a solid object. Our systems achieve very high levels of detail. We can produce your objects using stainless steel, tool steel, aluminium, Inconel, cobalt chrome, brass or copper that features high electrical conductivity and this enables new applications. All products are impermeable and feature high stability. Depending on the material, with PROTIQ you can achieve wall thickness as thin as 0.4 mm.






MATERIAL				MS1 – 1.2709	PH1 – 1.4540	1.4542	316L – 1.4404	CX	Zamak 5
				tool steel	stainless steel				zinc
									
	properties	state	unit						
general properties	density, laser-melted	–	g/cm ³	8 – 8,1	7,8	7,8	7,8	7,7	6,4
mechanical properties**	tensile strength	„as built“	MPa	1.100 ± 100	1.050 ± 50	min. 850	570	1080	218± 40
		„after heat treatment“	MPa	min. 1930	min. 1.310	850	–	1760	–
	yield strength (Rp 0,2%)	„as built“	MPa	1.050 ± 100	1.000 ± 50	530 ± 50	470	840	–
		„after heat treatment“	MPa	min. 1862	min. 1.170	550	–	1670	–
	elongation at break	„as built“	%	9 ± 4	16 ± 4	min. 25	> 15	14	2 ± 0,5
		„after heat treatment“	%	4 ± 2	min. 10	29	–	7	–
	elastic modulus	„as built“	GPa	150 ± 20	–	170 ± 30	200	–	28 ± 3
		„after heat treatment“	GPa	180 ± 20	–	180	–	–	–
hardness	„as built“	HRC	33 – 37	30 – 35	–	20	–	–	
	„after heat treatment“	HRC	50 – 52	40 – 45	–	–	51	–	
Charpy notched impact strength	„as built“	J	45 ± 10	–	–	–	–	–	
	„after heat treatment“	J	11 ± 4	–	–	–	–	–	
thermal properties	thermal conductivity	„as built“	W/(m*K)	15 ± 0,8	13,7 ± 0,8	13	–	–	–
		„after heat treatment“	W/(m*K)	20 ± 1	15,7 ± 0,8	–	–	–	–
	specific heat capacity	„as built“	J/kg*K	450 ± 20	460 ± 20	–	–	–	–
		„after heat treatment“	J/kg*K	450 ± 20	470 ± 20	–	–	–	–
electrical properties	electrical conductivity (edge/core)	„as built“	MS/m	–	–	–	–	–	–
		„after heat treatment“	MS/m	–	–	–	–	–	–
typical process-related properties*	max. operating temperature	–	°C	ca. 400	–	550	–	–	–
	oxidation-resistant to	–	°C	–	–	–	–	–	–
	roughness after sandblasting (Ra/Rz)	–	µm	4 – 6,5/20 – 50	2,5 – 4,5/15 – 40	2,5 – 4,5/15 – 40	3 – 7/20 – 40	–	–
	precision	–	mm	± 0,1	± 0,1	± 0,1	± 0,1	–	± 0,1
	minimum wall thickness	–	mm	0,3 – 0,4	0,3 – 0,4	0,3 – 0,4	0,3 – 0,4	–	0,6

MATERIAL				AlSi10Mg	AlMgSi0,5	AlSi9Cu3	RS-Kupfer	CuNi2SiCr	RS-Messing
				aluminium			copper		brass
									
	properties	state	unit						
general properties	density, laser-melted	–	g/cm ³	2,67	2,68	2,7	8,92	8,84	8,20 ± 0,6
mechanical properties**	tensile strength	„as built“	MPa	405 ± 20	80 ± 40	380 ± 40	167 ± 10	251 ± 10	250 ± 50
		„after heat treatment“	MPa	325 ± 20	–	–	219 ± 10	595 ± 10	–
	yield strength (Rp 0,2%)	„as built“	MPa	230 ± 10	75 ± 40	200 ± 40	80 ± 10	190 ± 10	–
		„after heat treatment“	MPa	220 ± 10	–	–	139 ± 10	508 ± 10	–
	elongation at break	„as built“	%	3,5 ± 2	3,3 ± 1	2,5 ± 1	–	34 ± 5	2 ± 1,25
		„after heat treatment“	%	7 ± 2	–	–	–	15 ± 5	–
	elastic modulus	„as built“	GPa	65 ± 5	–	62 ± 10	94 ± 10	89 ± 5	–
		„after heat treatment“	GPa	65 ± 5	–	62 ± 10	70 ± 10	97 ± 5	–
hardness	„as built“	HRC	120 [HBW]	52 [HBW]	–	–	–	–	
	„after heat treatment“	HRC	–	–	–	–	–	–	
Charpy notched impact strength	„as built“	J	–	–	–	–	–	–	
	„after heat treatment“	J	–	–	–	–	–	–	
thermal properties	thermal conductivity	„as built“	W/(m*K)	103 ± 5	103 ± 5	–	–	–	–
		„after heat treatment“	W/(m*K)	–	–	–	265	–	–
	specific heat capacity	„as built“	J/kg*K	–	–	–	–	–	–
„after heat treatment“		J/kg*K	–	–	–	394	–	–	
electrical properties	electrical conductivity (edge/core)	„as built“	MS/m	–	–	–	13/13	–	8/8
		„after heat treatment“	MS/m	–	–	–	50/32	–	–
typical process-related properties*	max. operating temperature	–	°C	–	–	–	–	–	–
	oxidation-resistant to	–	°C	–	–	–	–	–	–
	roughness after sandblasting (Ra/Rz)	–	µm	7 – 10/50 – 60	3 – 5/20 – 30	–	8 – 9/40 – 50	–	6,6/41
	precision	–	mm	± 0,1	± 0,1	–	± 0,1	–	–
	minimum wall thickness	–	mm	0,4	0,4	–	0,6***	–	0,6

* These values can vary, depending on part geometry and dimensions.

** The mechanical properties can vary, depending on x-, y- and z-position of the test object and illumination parameters.

*** minimum wall thickness for media-tight components: 1 mm

MATERIAL				CoCrW	IN625	IN718	TiAl6V4 Gr. 5	TiAl6V4 Gr. 23 Eli
				CobaltChrome	Inconel		titanium	
								
	properties	state	unit					
general properties	density, laser-melted	–	g/cm ³	8,6	8,4	8,15	4,41	4,42
mechanical properties**	tensile strength	„as built“	MPa	–	900 ± 50	980 ± 50	1280 ± 90	1290 ± 80
		„after heat treatment“	MPa	1030	min. 827	min. 1.241	1090 ± 20	1160 ± 20
	yield strength (Rp 0,2%)	„as built“	MPa	–	615 ± 50	634 ± 50	1100 ± 90	1150 ± 80
		„after heat treatment“	MPa	635	min. 414	min. 1.034	1000 ± 20	1060 ± 50
	elongation at break	„as built“	%	–	35 ± 5	27 ± 5	6 ± 4	8 ± 4
		„after heat treatment“	%	10	min. 30	min. 12	13 ± 2	10 ± 3
	elastic modulus	„as built“	GPa	–	140 ± 20	160 ± 20	–	–
		„after heat treatment“	GPa	230	160 ± 20	170 ± 20	–	118 ± 4
hardness	„as built“	HRC	–	–	ca. 30	41 ± 3	320 ± 15 [HV5]	
	„after heat treatment“	HRC	–	–	ca. 43 – 47	–	37 ± 2	
Charpy notched impact strength	„as built“	J	–	–	–	–	–	
	„after heat treatment“	J	–	–	–	–	–	
thermal properties	thermal conductivity	„as built“	W/(m*K)	–	–	–	–	–
		„after heat treatment“	W/(m*K)	–	–	12	–	6,7
specific heat capacity	„as built“	J/kg*K	–	–	–	–	–	
	„after heat treatment“	J/kg*K	–	–	–	–	–	
electrical properties	electrical conductivity (edge/core)	„as built“	MS/m	–	–	–	–	–
		„after heat treatment“	MS/m	–	–	–	–	–
typical process-related properties*	max. operating temperature	–	°C	–	ca. 650	ca. 650	350	–
	oxidation-resistant to	–	°C	–	ca. 980	ca. 980	–	–
	roughness after sandblasting (Ra/Rz)	–	µm	–	4 – 6,5/20 – 50	4 – 6,5/20 – 50	4-9/35-60	4 – 8 (Ra)
	precision	–	mm	–	± 0,1	± 0,1	± 0,2	± 0,1
minimum wall thickness	–	mm	–	0,3 – 0,4	0,3 – 0,4	0,4	0,2	

* These values can vary, depending on part geometry and dimensions.

** The mechanical properties can vary, depending on x-, y- and z-position of the test object and illumination parameters.

*** minimum wall thickness for media-tight components: 1 mm