PROTIQ
A Phoenix Contact Company

MATERIAL DATASHEET
LASER MELTING OF METALS

3D PRINTING WITH METALS

In this process, metal powder is fused into an 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 inpermeable 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/cm³	8 – 8,1	7,7	7,7 – 7,8	7,9	7,7	6,2 – 6,4
mechanical properties**	tensile strength	„as built“	MPa	1.100 ± 100	1.200 ± 50	1.100 ± 50	620 ± 50	1080	218± 40
		„after heat treatment“	MPa	2.030 ± 70	min. 1.340	1.150 ± 150	–	1.730 ± 10	
	yield strength (Rp 0,2%)	„as built“	MPa	1.000 ± 100	950 ± 150	750 ± 80	490 ± 65	840	185 ± 15
		„after heat treatment“	MPa	1.950 ± 70	min. 1.200	1050 ± 150	–	1.660 ± 10	
	elongation at break	„as built“	%	9 ± 4	17 ± 4	13 ± 2	min. 30	14	1,5 ± 0,5
		„after heat treatment“	%	4 ± 2	min. 10	18 ± 3	–	6	
	elastic modulus	„as built“	GPa	–	–	–	–	–	28 ± 3
		„after heat treatment“	GPa	–	–	–	–	–	
	hardness	„as built“	HRC	33 – 37	30 – 35	35	85 [HRB]	–	61 – 64 [HV10]
		„after heat treatment“	HRC	53 ± 2	min. 40	ca. 40	–	50	
thermal properties	thermal conductivity	„as built“	W/(m*K)	–	13,7 ± 0,8	–	–	–	85
		„after heat treatment“	W/(m*K)	–	15,7 ± 0,8	–	–	–	
	specific heat capacity	„as built“	J/kg*K	450 ± 20	460 ± 20	–	–	–	389
		„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*	roughness after sandblasting (Ra/Rz)	–	µm	4 – 6,5/20 – 50	5 /25	2,5 – 4,5/15 – 40	3 – 7/20 – 40	5/26	4 – 6 / 25 – 35
	precision	–	mm	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %
	minimum wall thickness	–	mm	0,4	0,4	0,4	0,4	0,4	0,6

Dear PROTIQ customer, all information given is based on our knowledge and experience at the time of publication. In addition, the material properties can be influenced by component geometry, environmental influences and material additives. The stated material or component properties, as well as their suitability for specific applications, are neither agreed nor guaranteed, despite regular quality controls. The customer is responsible for checking the component properties and suitability for a specific application.

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MATERIAL				AlSi10Mg	AlMgSi0,5	AlSi9Cu3	RS-Kupfer	CuNi2SiCr	Pure-Copper
				aluminium			copper		
									
	properties	state	unit						
general properties	density, laser-melted	–	g/cm³	2,67	2,68	2,7	8,7 – 8,9	–	8,9
mechanical properties**	tensile strength	„as built“	MPa	410 ± 20	80 ± 40	380 ± 40	220 ± 30	251 ± 10	220 ± 10
		„after heat treatment“	MPa	340 ± 20	–	–		595 ± 10	
	yield strength (Rp 0,2%)	„as built“	MPa	250 ± 20	75 ± 40	200 ± 40	165 ± 20	190 ± 10	140 ± 20
		„after heat treatment“	MPa	220 ± 10	–	–		508 ± 10	
	elongation at break	„as built“	%	6 ± 2	3,3 ± 1	2,5 ± 1	20 ± 5	34 ± 5	50 ± 10
		„after heat treatment“	%	7 ± 2	–	–		15 ± 5	
	elastic modulus	„as built“	GPa	65 ± 5	–	62 ± 10	95 ± 15	89 ± 5	–
		„after heat treatment“	GPa	65 ± 5	–	62 ± 10		97 ± 5	
	hardness	„as built“	HRC	120 [HBW]	52 [HBW]	–	62 – 71 [HV10]	–	61 – 66 [HV10]
		„after heat treatment“	HRC	–	–	–		–	
thermal properties	thermal conductivity	„as built“	W/(m*K)	103 ± 5	103 ± 5	–	265	–	415 ± 10
		„after heat treatment“	W/(m*K)	–	–	–		–	
	specific heat capacity	„as built“	J/kg*K	–	–	–	394	–	–
		„after heat treatment“	J/kg*K	–	–	–		–	
electrical properties	electrical conductivity (edge/core)	„as built“	MS/m	15 – 16	–	–	50/32	–	57
		„after heat treatment“	MS/m	–	–	–		–	
typical process-related properties*	roughness after sandblasting (Ra/Rz)	–	µm	7 – 10/50 – 60	3 – 5/20 – 30	–	8 – 9/40 – 50	–	8 – 9/40 – 50
	precision	–	mm	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %
	minimum wall thickness	–	mm	0,6	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

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MATERIAL				CoCrW	IN625	IN718	TiAl6V4 Gr. 5	TiAl6V4 Gr.23 Eli	RS-Messing
				CobaltChrome	Inconel		titanium		brass
									
	properties	state	unit						
general properties	density, laser-melted	–	g/cm³	8,6	8,4	8,15	4,41	4,42	8,2
mechanical properties**	tensile strength	„as built“	MPa	–	900 ± 50	1.000 ± 100	1280 ± 90	1290 ± 80	310 ± 30
		„after heat treatment“	MPa	1030	min. 827	min. 1.241	1090 ± 20	1160 ± 20	–
	yield strength (Rp 0,2%)	„as built“	MPa	-	615 ± 50	700 ± 150	1100 ± 90	1150 ± 80	260 ± 10
		„after heat treatment“	MPa	635	min. 414	min. 1.034	1000 ± 20	1060 ± 50	–
	elongation at break	„as built“	%	–	35 ± 5	17 ± 4	6 ± 4	8 ± 4	8 ± 3
		„after heat treatment“	%	10	min. 30	min. 12	13 ± 2	10 ± 3	–
	elastic modulus	„as built“	GPa	–	140 ± 20	160 ± 20	–	–	80 ± 5
		„after heat treatment“	GPa	230	160 ± 20	170 ± 20	–	118 ± 4	–
	hardness	„as built“	HRC	–	–	30	41 ± 3	320 ± 15 [HV5]	100 – 109 [HV10]
		„after heat treatment“	HRC	–	–	43 – 47	–	37 ± 2	–
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	–	–	–	–	–	8/8
		„after heat treatment“	MS/m	–	–	–	–	–	–
typical process-related properties*	roughness after sandblasting (Ra/Rz)	–	µm	–	4 – 6,5/20 – 50	4 – 6,5/20 – 50	4-9/35-60	4 – 8 (Ra)	7– 9 / 40 – 50
	precision	–	mm	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,2 / ± 0,7 %	± 0,1 / ± 0,7 %	± 0,1 / ± 0,7 %
	minimum wall thickness	–	mm	–	0,3 – 0,4	0,4	0,4	0,2	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