SLM SOLUTIONS

3D METALS

Discover the variety of Metal Powders

The range of our standard metal powders

Non Ferrous, Tool Steel,
Stainless Steel and
Light Alloys

SLM® – The Industrial Manufacturing Revolution

PIONEERS in metal-based 3D printing

SLM Solutions, headquartered in Luebeck, Germany, is a leading provider of metal-based additive manufacturing technology (also commonly referred to as „3D printing“). The company‘s shares are traded on the Prime Standard of the Frankfurt Stock Exchange. SLM Solutions focuses on the development, assembly and sale of machines and integrated system solutions in the field of selective laser melting.

The properties of the metal powder utilised by SLM® machines - including its prurity, fluidity and bulk density - significantly affect the achievable results. For this reason, SLM Solutions has been active in the metal powder manufacturing area since 2016, to supply customers with materials that ideally fit SLM® machines for the respective application cases.

SLM Solutions stands for technologically advanced, innovative and highly efficient integrated system solutions.

Memberships for Industry Development:

AMUG ADDITIVE MANUFACTURING USERS GROUP

ISO

ASTM INTERNATIONAL

DIN

EPMA european powder metallurgy association

Metal Variety

from dental prostheses to turbine blades

Customers from highly varied sectors utilise our machines to produce complex metal parts for a large number of applications – from dental prostheses through to turbine blades. All of these products have one thing in common: they must meet the highest standards in terms of stability, surface structure or biocompatibility. And the number of utilisation scenarios is on the rise: almost all geometric forms are possible.

Aerospace

This air duct made of titanium is produced in high precision without major rework.

Automotive

Only two days pass from the flexible design to the real-time test for this shaft flange.

Dental prostheses

Individualized brackets and palatal plates are manufactured after a 3D scan; no dental impression or casting is needed.

Medical technology

The freedom of design for individual titanium implants allows for a better ingrowth for the benefit of the patients.

Mechanical engineering

Pump impellers made of aluminum and stainless steel with a streamlined shape geometry are made without molding costs.

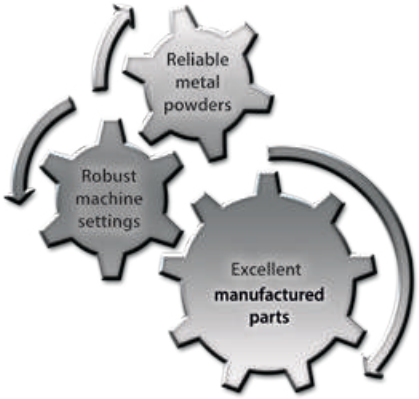
Universities and Institutes

Modern engineers will find new solutions to the problems of traditional manufacturing on a daily basis.

Energy sector

Small hydro stainless steel wheels are innovative build parts of a decentralized energy supply.

Core Competencies



- Special metal powder selection for our 3D metal printing process
- Extended Quality Assurance
- Skilled Technical Staff for customer support
- Deep Machine and Process understanding

Al-Alloys

AlSi10Mg

SLM Solutions' Al-Alloy AlSi10Mg is an aluminum-based alloy that is widely used in the additive manufacturing industry for production of functional parts as well as prototypes. AlSi10Mg is often used in applications requiring good mechanical properties and low weight.

Chemical Composition (nominal), %

Element / Material	Al	Si	Mg	Cu	Fe	Mn	Zn	Ti	Ni	Pb	Sn	Others	Total Others
AlSi10Mg 20-63 µm	Bal.	9.00-11.00	0.20 - 0.45	0.05	0.55	0.45	0.10	0.15	0.05	0.05	0.05	0.05	0.15

Mechanical Data[5]	Formula Symbol and Unit	AlSi10Mg[2,3]
Tensile strength	R_m [MPa]	386 ± 42
Offset yield stress	$R_{p0,2}$ [MPa]	268 ± 8
Break strain	A [%]	6 ± 1
Reduction of area	Z [%]	7 ± 1
E-Modul	E [GPa]	61 ± 9
Hardness by Vickers	[HV10]	122 ± 2
Surface roughness	R_a [µm]	8 ± 1
Surface roughness	R_z [µm]	63 ± 10

Material Characteristics

- Very good corrosion resistance
- Good electrical conductivity
- High dynamic toughness
- Excellent thermal conductivity

Typical Application Areas

- Aerospace
- Automotive
- Engineering
- Heat exchangers

AlSi12

SLM Solutions' Al-Alloy AlSi12 is an aluminum-based alloy that has been optimized for processing of SLM Solutions additive manufacturing machines. AlSi12 is especially suitable for applications requiring excellent thermal conductivity and resistance to strain.

Chemical Composition (nominal), %

Element / Material	Al	Si	Cu	Fe	Mn	Zn	Ti	Others	Total Others
AlSi12 20-63 µm	Bal.	10.50 - 13.50	0.05	0.55	0.35	0.10	0.15	0.05	0.15

Mechanical Data[5]	Formula Symbol and Unit	AlSi12[2,3]
Tensile strength	R_m [MPa]	409 ± 20
Offset yield stress	$R_{p0,2}$ [MPa]	211 ± 20
Break strain	A [%]	5 ± 3
Reduction of area	Z [%]	-
E-Modul	E [GPa]	-
Hardness by Vickers	[HV10]	110
Surface roughness	R_a [µm]	-
Surface roughness	R_z [µm]	34 ± 4

Material Characteristics

- Very good corrosion resistance
- Good electrical conductivity
- Excellent thermal conductivity

Typical Application Areas

- Aerospace
- Automotive
- Engineering
- Heat exchangers

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

AlSi7Mg0.6

SLM Solutions' Al-Alloy AlSi7Mg0.6 is an aluminum-based alloy. AlSi7Mg0.6 is often used in applications requiring excellent thermal conductivity, good corrosion resistance or tolerance to strain.

Chemical Composition (nominal), %

Element / Material	Al	Si	Mg	Cu	Fe	Mn	Zn	Ti	Others	Total Others
AlSi7Mg0.6 20-63 µm	Bal.	6.50 - 7.50	0.45 - 0.70	0.05	0.19	0.10	0.07	0.25	0.03	0.10

Mechanical Data[5]	Formula Symbol and Unit	AlSi7Mg[2,3]
Tensile strength	R_m [MPa]	375 ± 17
Offset yield stress	$R_{p0,2}$ [MPa]	211 ± 18
Break strain	A [%]	8 ± 2
Reduction of area	Z [%]	8 ± 2
E-Modul	E [GPa]	59 ± 21
Hardness by Vickers	[HV10]	112 ± 3
Surface roughness	R_a [µm]	6 ± 1
Surface roughness	R_z [µm]	45 ± 1

Material Characteristics

- Good electrical conductivity
- Excellent SLM® processability
- Good corrosion resistance
- Good tolerance against strain
- Excellent thermal conductivity

Typical Application Areas

- Aerospace
- Automotive
- Heat exchangers
- Research
- Prototyping

AlSi9Cu3

SLM Solutions' Al-Alloy AlSi9Cu3 is an aluminum, silicon, copper based alloy. AlSi9Cu3 is used in applications requiring good high temperature strength, low density and good corrosion resistance.

Chemical Composition (nominal), %

Element / Material	Al	Si	Mg	Cu	Fe	Mn	Zn	Ti	Ni	Pb	Sn	Cr	Others	Total Others
AlSi9Cu3 20-63 µm	Bal.	8.00 - 11.00	0.05 - 0.55	2.00 - 4.00	1.30	0.55	1.20	0.25	0.55	0.35	0.25	0.15	0.05	0.15

Mechanical Data[5]	Formula Symbol and Unit	AlSi9Cu3[2,3]
Tensile strength	R_m [MPa]	415 ± 15
Offset yield stress	$R_{p0,2}$ [MPa]	236 ± 8
Break strain	A [%]	5 ± 1
Reduction of area	Z [%]	11 ± 1
E-Modul	E [GPa]	57 ± 5
Hardness by Vickers	[HV10]	129 ± 1
Surface roughness	R_a [µm]	7 ± 1
Surface roughness	R_z [µm]	46 ± 7

Material Characteristics

- Excellent SLM® processability
- Good electrical conductivity
- Good high temperature strength
- High thermal conductivity

Typical Application Areas

- Aerospace
- Automotive
- Heat exchangers
- Research
- Prototyping

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

Ni-Alloys

HX

SLM Solutions' Nickel-Alloy HX is a Ni-based alloy with high chromium, molybdenum, and iron. HX is an important alloy for high temperature applications in corrosive environments for a number of industries.

Chemical Composition (nominal), %

Element / Material	Ni	Cr	Co	Mo	Fe	W	C	Mn	P	S	Si
HX 10-45 µm	Bal.	20.50 - 23.00	0.50 - 2.50	8.00 - 10.00	17.00 - 20.00	0.20 - 1.00	0.05 - 0.15	1.00	0.04	0.03	1.00

Mechanical Data[5]	Formula Symbol and Unit	HX[1,3]
Tensile strength	R_m [MPa]	772 ± 24
Offset yield stress	$R_{p0,2}$ [MPa]	595 ± 28
Break strain	A [%]	20 ± 6
Reduction of area	Z [%]	21 ± 7
E-Modul	E [GPa]	162 ± 11
Hardness by Vickers	[HV10]	248 ± 4
Surface roughness	R_a [µm]	9 ± 1
Surface roughness	R_z [µm]	60 ± 6

Material Characteristics

- High strength
- Good ductility
- Excellent oxidation resistance at high temperature
- High creep strength up to 850°C

Typical Application Areas

- Aerospace
- Energy
- Chemical industry
- Turbine parts

IN625

SLM Solutions' Nickel-Alloy IN625 is a precipitation-hardenable nickel-based material alloyed with chromium, molybdenum, and niobium. IN625 is a typcial material for construction of aircraft engine components with service temperatures below 650°C.

Chemical Composition (nominal), %

Element / Material	Ni	Cr	Co	Mo	Al	Fe	Ti	Nb	C	Mn	P	S	Si
IN625 10-45 µm	Bal.	20 - 23	1.0	8 -10	0.4	5	0.4	3.15 - 4.15	0.1	0.5	0.015	0.015	0.5

Mechanical Data[5]	Formula Symbol and Unit	IN625[1,3]
Tensile strength	R_m [MPa]	961 ± 41
Offset yield stress	$R_{p0,2}$ [MPa]	707 ± 41
Break strain	A [%]	33 ± 2
Reduction of area	Z [%]	51 ± 5
E-Modul	E [GPa]	182 ± 9
Hardness by Vickers	[HV10]	285 ± 3
Surface roughness	R_a [µm]	7 ± 2
Surface roughness	R_z [µm]	40 ± 10

Material Characteristics

- High strength
- Good ductility
- Excellent creep-repture strength below 700°C
- Excellent corrosion resistance

Typical Application Areas

- Aerospace
- Energy
- Chemical industry
- Turbine parts

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

IN718

SLM Solutions' Nickel-Alloy IN718 is a precipitation-hardenable nickel, chromium alloy. With excellent tensile, fatigue, creep, and rupture strength up to 700°C, IN718 is an important alloy for production of parts for aircraft engines, (gas) turbines, and other high temperature applications.

Chemical Composition (nominal), %

Element / Material	Ni	Cr	Co	Mo	Al	Fe	Ti	Nb + Ta	C	B	Cu	Mn	P	S	Si
IN718 10-45 µm	50.00 - 55.00	17.00 - 21.00	1.0	2.80 - 3.30	0.20 - 0.80	Bal.	0.65 - 1.15	4.75 - 5.50	0.08	0.006	0.30	0.35	0.015	0.015	0.35

Mechanical Data[5]	Formula Symbol and Unit	IN718[2,3]
Tensile strength	R_m [MPa]	994 ± 40
Offset yield stress	$R_{p0,2}$ [MPa]	702 ± 65
Break strain	A [%]	24 ± 1
Reduction of area	Z [%]	40 ± 7
E-Modul	E [GPa]	166 ± 12
Hardness by Vickers	[HV10]	293 ± 3
Surface roughness	R_a [µm]	7 ± 2
Surface roughness	R_z [µm]	36 ± 8

Material Characteristics

- High strength
- Good ductility
- Excellent mechanical properties up to 700 °C
- Excellent oxidation resistance

Typical Application Areas

- Aerospace
- Energy
- Chemical industry
- Turbine parts

IN939

SLM Solutions' Nickel-Alloy IN939 is a highly alloyed material containing amounts of chromium, cobalt, titanium, tungsten, aluminum, tantallum, and niobium. Owing to IN939's high temperature mechanical properties, the alloy is widely used in turbine component construction.

Chemical Composition (nominal), %

Element / Material	Ni	Cr	Co	Al	Ti	W	Nb	Ta	C	Zr	Mn	Si
IN939 10-45 µm	Bal.	22.00 - 23.00	18.00 - 20.00	1.00 - 3.00	3.00 - 4.50	1.00 - 3.00	0.50 - 1.50	1.00 - 1.80	0.15	0.10	0.50	0,50

Mechanical Data[5]	Formula Symbol and Unit	IN939[1,3]	IN939[1,4]
Tensile strength	R_m [MPa]	1009 ± 35	1348 ± 57
Offset yield stress	$R_{p0,2}$ [MPa]	735* ± 41	957* ± 18
Break strain	A [%]	30 ± 4	11 ± 2
Reduction of area	Z [%]	45 ± 7	12 ± 2
E-Modul	E [GPa]	177 ± 8	195 ± 6
Hardness by Vickers	[HV10]	302 ± 3	-
Surface roughness	R_a [µm]	6 ± 1	-
Surface roughness	R_z [µm]	42 ± 6	-

Material Characteristics

- High strength
- Good ductility
- Excellent high temperature mechanical properties
- Excellent corrosion resistance

Typical Application Areas

- Aerospace
- Energy
- Chemical industry
- Turbine parts

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
*Yield strength R_e

4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

Ti-Alloys

Ti6Al4V Gd. 23

SLM Solutions' Ti-Alloy Ti6Al4V ELI (Grade 23) is the high purity version of Ti6Al4V (Grade 5), the most widely used titanium-based alloy in the world. Due to its high strength, low density, and good corrosion resistance, Ti6Al4V is highly suited for production parts in the aerospace and automotive industries as well as in biomedical applications.

Chemical Composition (nominal), %

Element / Material	Ti	Al	V	Fe	C	N	O	H	Others	Total Others
Ti6Al4V ELI (grade 23) 20-63 µm [1]	Bal.	5.50 - 6.50	3.50 - 4.50	0.25	0.08	0.03	0.13	0.0125	0.10	0.40

1 Chemistry acc. to F136, B348

Mechanical Data[5]	Formula Symbol and Unit	Ti6Al4V[2,3]	Ti6Al4V[2,4]
Tensile strength	R_m [MPa]	1301 ± 18	1031 ± 5
Offset yield stress	$R_{p0,2}$ [MPa]	1158 ± 16	970 ± 6
Break strain	A [%]	3 ± 1	12 ± 1
Reduction of area	Z [%]	5 ± 2	28 ± 7
E-Modul	E [GPa]	113 ± 9	118 ± 2
Hardness by Vickers	[HV10]	380 ± 8	-
Surface roughness	R_a [µm]	14 ± 1	-
Surface roughness	R_z [µm]	86 ± 11	-

Material Characteristics

- Good corrosion resistance
- High specific strength
- High cycle fatigue strength
- High toughness

Typical Application Areas

- Aerospace
- Automotive
- Medical
- Energy

Ti Gd. II

SLM Solutions' Ti-Alloy Ti (Grade 2) is a commercially pure titanium grade with excellent bio-compatibility and good mechanical properties. Ti (Grade 2) is widely used in many different applications that require excellent corrosion resistance, strength, ductility, and low density.

Chemical Composition (nominal), %

Element / Material	Ti	Fe	C	N	O	H	Others	Total Others
Ti Gd II 20-63 µm [2]	Bal.	0.30	0.08	0.03	0.25	0.015	0.10	0.40

2 Chemistry acc. to F67, B348

Mechanical Data[5]	Formula Symbol and Unit	Ti Gd II[1,3]
Tensile strength	R_m [MPa]	> 290
Offset yield stress	$R_{p0,2}$ [MPa]	> 180
Break strain	A [%]	> 20
Reduction of area	Z [%]	-
E-Modul	E [GPa]	105
Hardness by Vickers	[HV10]	130 - 210
Surface roughness	R_a [µm]	-
Surface roughness	R_z [µm]	36 ± 4

Material Characteristics

- Excellent biocompatibility
- Excellent corrosion resistance to sea water
- Good ductility
- Moderate strength

Typical Application Areas

- Medical
- Aerospace
- Energy
- Chemical / Petrochemical
- Heat exchangers

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

Co-Alloys

CoCr28Mo6

SLM Solutions' Co-Alloy CoCr28Mo6 is a cobalt, chromium, molybdenum alloy with versatile applications. Owing to its' exceptional biocompatibility, CoCr28Mo6 is used in the medical industry for the production of implants and prostheses. The material is also used to produce components for application in high temperature environments, such as in jet-engines.

Chemical Composition (nominal), %

Element / Material	Co	Cr	Mo	W	Al	Si	Fe	Mn	Ti	Ni	C	B	N	P	S
CoCr28Mo6 10-45 µm[1]	Bal.	27.00 - 30.00	5.00 - 7.00	0.20	0.10	1.00	0.75	1.00	0.10	0.50	0.35	0.010	0.25	0.02	0.01

1 Chemistry acc. to F75

Mechanical Data[5]	Formula Symbol and Unit	CoCr[1, 3]		CoCr[2, 3]	
Tensile strength	R_m [MPa]	1101	± 78	1039	± 91
Offset yield stress	R_e [MPa]	720	± 18	705	± 73
Break strain	A [%]	10	± 4	10	± 4
Reduction of area	Z [%]	11	± 4	11	± 3
E-Modul	E [GPa]	194	± 9	191	± 10
Hardness byVickers	[HV10]	375	± 2	372	± 7
Surface roughness	R_a [µm]	10	± 1	10	± 2
Surface roughness	R_z [µm]	64	± 6	65	± 12

Material Characteristics

- Exceptional biocompatibility
- Heat resistant
- Resistance to thermal fatigue
- Oxidation resistance

Typical Application Areas

- Medical
- Aerospace
- Energy
- Turbine parts

SLM® MediDent

SLM Solutions' SLM® MediDent is a cobalt, chromium, molybdenum, tungsten alloy, specially designed for application in the dental industry. SLM® MediDent is used primarily for the production of biocompatible dental implants and prostheses.

Chemical Composition (nominal), %

Element / Material	Co	Cr	Mo	W	Si	Fe	Mn	Ni	Pb	C	B	P	S	Be	Cd	Others	Total Others
SLM® MediDent 10-45 µm	Bal.	22.7 - 26.7	4.0 - 6.0	4.4 - 6.4	2.0	0.50	0.10	0.10	0.02	0.02	0.10	0.10	0.10	0.02	0.02	0.50	0.50

Mechanical Data[5]	Formula Symbol and Unit	SLM® MediDent	
Tensile strength	R_m [MPa]	1062	± 46
Offset yield stress	R_e [MPa]	319*	± 18
Break strain	A [%]		-
Reduction of area	Z [%]		-
E-Modul	E [GPa]	114	± 5
Hardness byVickers	[HV10]		-
Surface roughness	R_a [µm]	7	± 1
Surface roughness	R_z [µm]	43	± 2

Material Characteristics

- Biocompatible
- Corrosion resistant

Typical Application Areas

- Dental
- Medical

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
*Yield strength $R_{p0,2}$

4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

Tool and Stainless Steel

316L

SLM Solutions' Stainless Steel 316L is an austenitic high chromium steel with excellent processability on SLM Solutions' additive manufacturing machines. 316L is often used in applications requiring good mechanical properties and excellent corrosion resistance, especially in chloride environments.

Chemical Composition (nominal), %

Element / Material	Fe	Cr	Ni	Mo	Si	Mn	C	N	P	S	O
316L (1.4404) 10-45 µm	Bal.	16.00 - 18.00	10.00 - 14.00	2.00 - 3.00	1.00	2.00	0.030	0.10	0.045	0.030	0.10

Mechanical Data[5]	Formula Symbol and Unit	1.4404 / 316L[2,3]
Tensile strength	R_m [MPa]	633 ± 28
Offset yield stress	$R_{P0,2}$ [MPa]	519 ± 25
Break strain	A [%]	31 ± 6
Reduction of area	Z [%]	49 ± 11
E-Modul	E [GPa]	184 ± 20
Hardness by Vickers	[HV10]	209 ± 2
Surface roughness	R_a [µm]	10 ± 2
Surface roughness	R_z [µm]	50 ± 12

Material Characteristics

- Very good corrosion resistance
- High strength under elevated temperatures
- High ductility

Typical Application Areas

- Aerospace /Automotive
- Surgical Instruments
- Food Industry
- Maritime

15-5PH

SLM Solutions' Stainless Steel 15-5PH is a martensitic precipitation-hardening stainless steel that has excellent processability on SLM Solutions' additive manufacturing machines. 15-5PH is suitable for applications requiring high strength and hardness combined with moderate corrosion resistance. The alloy is the ferrite-free version of 17-4PH.

Chemical Composition (nominal), %

Element / Material	Fe	Cr	Ni	Cu	Nb + Ta	Si	Mn	C	N	P	S	O
15-5PH (1.4545) 10-45 µm	Bal.	14.00 - 15.50	3.50 -5.50	2.50 - 4.50	0.15 -0.45	1.00	1.00	0.07	0.10	0.04	0.03	0.10

Mechanical Data[5]	Formula Symbol and Unit	1.4545 / 15-5PH[1,3]
Tensile strength	R_m [MPa]	1194 ± 28
Offset yield stress	$R_{P0,2}$ [MPa]	668 ± 29
Break strain	A [%]	14 ± 0
Reduction of area	Z [%]	48 ± 1
E-Modul	E [GPa]	184 ± 23
Hardness by Vickers	[HV10]	353 ± 2
Surface roughness	R_a [µm]	10 ± 2
Surface roughness	R_z [µm]	62 ± 11

Material Characteristics

- Precipitation hardenable
- Excellent tensile strength
- Moderate corrosion resistance

Typical Application Areas

- Aerospace
- Medical
- Chemical / Petrochemical
- Paper / Metalworking industries

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

17-4PH

SLM Solutions' Stainless Steel 17-4PH is a martensitic precipitation-hardening stainless steel. 17-4PH is suitable for applications requiring high strength and hardness combined with moderate corrosion resistance.

Chemical Composition (nominal), %

Element / Material	Fe	Cr	Ni	Cu	Nb + Ta	Si	Mn	C	N	P	S	O
17-4 PH (1.4542) 10-45 µm	Bal.	15.00 - 17.50	3.00 - 5.00	3.00 - 5.00	0.15 - 0.45	1.00	1.00	0.07	0.10	0.04	0.03	0.10

Mechanical Data[5]	Formula Symbol and Unit	17-4PH[2,3]
Tensile strength	R_m [MPa]	832 ± 87
Offset yield stress	$R_{P0,2}$ [MPa]	572 ± 25
Break strain	A [%]	31 ± 3
Reduction of area	Z [%]	55 ± 4
E-Modul	E [GPa]	155 ± 22
Hardness by Vickers	[HV10]	221 ± 4
Surface roughness	R_a [µm]	9 ± 2
Surface roughness	R_z [µm]	54 ± 15

Material Characteristics

- Precipitation hardenable
- Excellent tensile strength
- Moderate corrosion resistance

Typical Application Areas

- Aerospace
- Medical
- Chemical / Petrochemical
- Paper / Metalworking industries

1.2709

SLM Solutions' Tool Steel 1.2709 is a maraging tool steel with a high content of alloyed nickel and some molybdenum. 1.2709 is suitable for many tooling and high performance applications that require high strength and toughness.

Chemical Composition (nominal), %

Element / Material	Fe	Ni	Mo	Ti	Co	Al	Mn	C	P	S
1.2709 10-45 µm	Bal.	18.00 - 19.00	4.70 - 5.20	0.50 - 0.80	8.50 - 9.50	0.05 - 0.15	0.10	0.03	0.01	0.01

Mechanical Data[5]	Formula Symbol and Unit	1.2709[2,3]	1.2709[2,4]
Tensile strength	R_m [MPa]	1135 ± 29	1784 ± 313
Offset yield stress	$R_{P0,2}$ [MPa]	987 ± 15	1920 ± 12
Break strain	A [%]	11 ± 1	3 ± 1
Reduction of area	Z [%]	44 ± 2	10 ± 0
E-Modul	E [GPa]	113 ± 8	125 ± 5
Hardness by Vickers	[HV10]	373 ± 2	-
Surface roughness	R_a [µm]	9 ± 1	-
Surface roughness	R_z [µm]	67 ± 5	-

Material Characteristics

- Martensite hardenable
- High toughness
- High tensile strength
- Good properties up to ca. 400°C

Typical Application Areas

- Injection moulding
- Engineering parts
- Automotive
- Aerospace

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

H13

SLM Solutions' Tool Steel 1.2344 is a chromium containing martensitic tool steel. Also known as H13, this material is used in tooling applications that require exceptional strength and toughness.

Chemical Composition (nominal), %

Element / Material	Fe	C	Cr	Mn	Mo	Ni+Cu	P	S	Si	V
H13 10-45 µm [2]	Bal.	0.32 - 0.45	4.75 - 5.50	0.20 - 0.60	1.10 -1.75	0.75	0.03	0.03	0.80 - 1.25	0.80 - 1.20

Mechanical Data[5]	Formula Symbol and Unit	H13[2,3]	H13[2,4]
Tensile strength	R_m [MPa]	1525 ± 146	1888 ± 6
Offset yield stress	$R_{p0,2}$ [MPa]	1507	1655 ± 23
Break strain	A [%]	3	8 ± 1
Reduction of area	Z [%]	3	15 ± 3
E-Modul	E [GPa]	217 ± 19	256 ± 38
Hardness by Vickers	[HV10]	-	-
Surface roughness	R_a [µm]	-	-
Surface roughness	R_z [µm]	-	-

Material Characteristics

- High tensile strength
- Moderate corrosion resistance
- Resistant to thermal fatigue cracking

Typical Application Areas

- Injection moulding
- Tooling

Invar 36®

SLM Solutions' Fe-Alloy Invar36® is a high nickel containing steel that has a uniquely low coefficient of thermal expansion below its Curie temperature of 280°C. Invar36® is used in parts that require a high dimensional stability over a wide range of temperatures.

Chemical Composition (nominal), %

Element / Material	Fe	Ni	Cr	Mn	Si	C	Others	Total Others
Fe-Alloy Invar36 10-45 µm [1]	Bal.	35.00 - 37.00	0.50	0.50	0.50	0.10	0.20	0.50

Mechanical Data[5]	Formula Symbol and Unit	Invar[1,3]	Invar[1,4]
Tensile strength	R_m [MPa]	487 ± 3	487 ± 3
Offset yield stress	$R_{p0,2}$ [MPa]	394 ± 2	386 ± 2
Break strain	A [%]	33 ± 1	32 ± 1
Reduction of area	Z [%]	72 ± 3	71 ± 5
E-Modul	E [GPa]	125 ± 17	151 ± 13
Hardness by Vickers	[HV10]	149 ± 2	-
Surface roughness	R_a [µm]	13 ± 3	-
Surface roughness	R_z [µm]	82 ± 21	-

Material Characteristics

- Low coefficient of thermal expansion below its Curie temperature of 280°C
- Excellent mechnical properties at cryogenic temperatures
- Low tendency to fatigue at low temperatures

Typical Application Areas

- Aerospace
- Valves in motors
- Precision instruments

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

Cu-Alloys

CuSn10

SLM Solutions' Bronze CuSn10 is a copper, tin alloy with high elongation and medium hardness. Bronze is characterized by good wear properties, resistance to atmospheric corrosion, and resistance to cavitation in sea water. Typical applications include components and housings for devices in sea water environments.

Chemical Composition (nominal), %

Element / Material	Cu	Sn	Al	Fe	Mn	Ni	P	Pb	S	Sb	Si	Zn
Bronze CuSn10 10-45 µm[1]	Bal.	9.0 - 11.00	0.01	0.2	0.1	2.0	0.2	1.0	0.05	0.2	0.02	0.5

Mechanical Data[5]	Formula Symbol and Unit	CuSn10[2,3]
Tensile strength	R_m [MPa]	495 ± 17
Offset yield stress	R_e [MPa]	373 ± 7
Break strain	A [%]	16 ± 4
Reduction of area	Z [%]	16 ± 3
E-Modul	E [GPa]	116 ± 16
Hardness byVickers	[HV10]	159 ± 1
Surface roughness	R_a [µm]	10 ± 2
Surface roughness	R_z [µm]	71 ± 13

Material Characteristics

- Good mechanical properties
- Resistance to cavitation in sea water
- Good corrosion resistance
- Good thermal conductivity

Typical Application Areas

- Maritime
- Heat exchangers

1 Layer thickness 30 µm
2 Layer thickness 50 µm
3 As built
4 Heat treated
5 Process conditions and parameters according to SLM Solutions standards

SLM® Machines

SLM®125

The Selective Laser Melting Machine SLM®125 offers a build envelope of **125 x 125 x 125 mm³**. The **flexibly applicable machine with high productivity** is equipped with a single fiber laser (1x 400 W) and produces high-quality metal parts.

The **precise and economical** SLM®125 has been designed for quick results in the research and development sector, as well as for the **production of smaller metal parts.**

SLM®280 2.0

The Selective Laser Melting Machine SLM®280 2.0 provides a **280 x 280 x 365 mm³** build envelope and a **patented multi-beam technology**. During the build process up to two fiber lasers expose the build field via a 3D scan optic.

The **high-performance machine** is available in several configurations, providing single optics (1x 400 W or 1x 700 W), dual optics (1x 700 W and 1x 1000 W) and twin optics (2x 400 W or 2x 700 W). Depending on how the manucatured parts are arranged, a 80 % higher build rate can be achieved. In addition, the **patented bidirectional powder coating** helps to reduce the manufacturing time of individually manufactured metal parts.

SLM®500

The Selective Laser Melting Machine SLM®500 provides a large build envelope of **500 x 280 x 365 mm³** and the **patented multi-beam technology.** In the high-performance machine, four fiber lasers (4x 400 W or 4x 700 W) are in action simultaneously, increasing the build-up rate by up to 90 % compared with the twin configuration (2x 400 W or 2x 700 W). The universally usable machine with **high productivity** is perfectly suited for **series production of complex metal parts** and it is specifically designed for use in the production environment. An extremely comprehensive basic configuration and the large choice of options enable application-oriented machine configuration.

With three times higher gas flow, the robust SLM® machine produces parts with the highest density and surface quality. Soot is removed from the process chamber efficiently and reliably, even for the longest duration builds.

About SLM Solutions

The Lübeck-based SLM Solutions Group AG is a leading provider of metal-based additive manufacturing technology. SLM Solutions focuses on the development, assembly and sale of machines and integrated system solutions in the field of selective laser melting.

SLM® technology offers diverse options in the metal-based additive manufacturing of parts, such as a new design and geometric freedom, lightweight construction through the reduction of metal part weight, significant advantages in terms of production speed and the manufacturing of internal undercut parts in low quantities.

Our products are utilized globally by customers from the most varied sectors, particularly in the aerospace, automotive, tooling, energy and healthcare industries, as well as in research and education.

They particularly value the following advantages of our technology partnership:

- Highest **productivity** using patented multi-laser technology
- Highest material density and **part quality** through our innovative gas stream management
- Completely closed **powder management** in an inert gas atmosphere
- Cutting-edge process monitoring using various **quality control modules**
- Multilingual open **software architecture** with customer adaptability
- Ultracompact **modular design**
- Long-term and **confidential customer relationships**
- **A technological leader and pioneer** in metal-based additive manufacturing with decades of market experience

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