# Metal Powder

## Optimized for Selective Laser Melting

# SLM Solutions' Material Competence

## Selective Laser Melting Pioneers

As an inventor of the selective laser melting process, SLM Solutions focuses on the development and distribution of the most innovative, production-oriented metal additive manufacturing systems.


SLM Solutions pioneered multi-laser technology and focuses exclusively on the advancement of selective laser melting. Our focus is to be a leader in product performance and innovation and for you, as our customer, to benefit from that approach. The SLM Solutions Group AG is a publicly traded company headquartered in Lübeck, Germany with global subsidaries and distribution partners.

The properties of the metal powder utilized by SLM® machines, including its purity, fluidity, and bulk density, significantly affect the achievable results. For this reason, SLM Solutions has been active in sourcing metal powder since 2016 to supply customers with materials that ideally fit selective laser melting machines for qualified serial production.

## Memberships for Industry Development

ISO

ASTM INTERNATIONAL

DIN

EPMA
european powder metallurgy association

mga
WE BOOST AM

AMUG
ADDITIVE MANUFACTURING USERS GROUP

America Makes

# Material Expertise From Dental Prostheses to Turbine Blades

Customers from various sectors utilize selective laser melting machines and metal powder material from SLM Solutions to produce complex parts for a wide range of applications, each with its own strict mechanical requirements.

### Aerospace

ASCO's Ti6Al4V combined-assembly gooseneck bracket flap actuation component achieved 31% weight savings and reduced production time.

### Automotive

This AlSi10Mg steering knuckle from Hirschvogel Tech Solutions integrated load-adapted supports to lightweight and realized 40% material savings.

### Dental Prostheses

Multiple patient-specific designs are printed during one SLM® build, enabling efficient mass customization with minimal CoCr material waste.

### Medical Technology

Acteabular cups printed in Grade 23 (ASTM F136) Ti6Al4V with integrated lattice structures to improve bone ingrowth and implant stability.

### Energy

IN718, with its high tensile strength and corrosion resistance is utilized by Präwest for this swirler, a modified nozzle to optimize fuel distribution.

### Tooling

MonaLab GmbH manufactured a single-piece aluminum extrusion tool using the freedom of design to integrate internal features to improve quality.

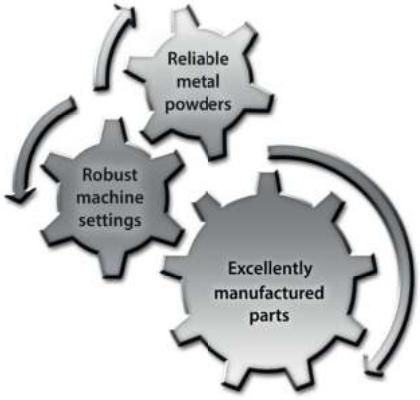
### Research

Open architecture, choice of material and partnership from SLM Solutions offer research users the flexibility to optimize process and material development.

### Material Parameters

Contact us about basic parameter sets, advanced parameters targeting a specific value or our custom parameter development options.

# Core Competencies




- Special metal powder selection for our selective laser melting process
- Extended certified quality assurance
- Qualified parameters for various applications
- Guarantee for processability on SLM Solutions' machines

# Aluminum Alloys

## AlSi10Mg

AlSi10Mg is a hardenable aluminum-alloy widely used in additive manufacturing suitable for thin-walled components with high corrosion resistance, as well as thermal and electrical conductivity properties. Featuring a nearly non-porous texture, it is ideal for highly stressed parts maintaining dynamic load capacity.

### Chemical Composition (nominal) %

| Element / Material[1] | Al | Si | Mg | Cu | Fe | Mn | Zn | Ti | Ni | Pb | Sn | Other | 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[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 435 | 260 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 260 | 145 |
| Elongation at break | A [%] | 7 | 10 |
| Reduction of area | Z [%] | 5 | 30 |
| Young's modulus | E [GPa] | 75 | 55 |
| Vickers hardness | HV10 | 125 | 80 |
| Roughness average | Ra [µm] | 15 | 10 |
| Mean roughness depth | Rz [µm] | 65 | 65 |

### Material Characteristics

- Good corrosion resistance
- High electrical conductivity
- High strength while maintaining dynamic load capacity

### Typical Application Areas

- Aerospace
- Automotive
- Lightweight engineering

## AlSi7Mg0.6

AlSi7Mg0.6 is suitable in applications requiring high corrosion resistance and good tolerance against strain. SLM® processed components exhibit a homogeneous, nearly non-porous texture with mechanical characteristics in the material specification range.

### Chemical Composition (nominal) %

| Element / Material[1] | 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[2] | Formula Symbol and Unit | As-Built[3] |
|---|---|---|
| Tensile strength | $R_m$ [MPa] | 375 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 210 |
| Elongation at break | A [%] | 8 |
| Reduction of area | Z [%] | 10 |
| Young's modulus | E [GPa] | 60 |
| Vickers hardness | HV10 | 110 |
| Roughness average | Ra [µm] | 5 |
| Mean roughness depth | Rz [µm] | 45 |

### Material Characteristics

- Good electrical conductivity
- Good corrosion resistance
- Good tolerance against strain
- Excellent thermal conductivity

### Typical Application Areas

- Aerospace
- Automotive
- Research & Prototyping

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)

Further information and data can be found in our material data sheets.

# AlSi9Cu3

AlSi9Cu3 is an Al-based light metal used in applications requiring good high-temperature strength, low density and good corrosion resistance. The alloy is typically used to produce components with high strength and high dynamic loadability.

## Chemical Composition (nominal) %

| Material / Element[1] | Al | Si | Fe | Cu | Mn | Mg | Cr | Ni | Zn | Pb | Sn | Ti |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AlSi9Cu3 20-63 µm | Bal. | 8.00 - 11.00 | 1.30 | 2.00 - 4.00 | 0.55 | 0.05 - 0.55 | 0.15 | 0.55 | 1.20 | 0.35 | 0.25 | 0.25 |

| Mechanical Data[2] | Formula Symbol and Unit | As-built[3] |
|---|---|---|
| Tensile strength | $R_m$ [MPa] | 415 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 235 |
| Elongation at break | A [%] | 5 |
| Reduction in area | Z [%] | 10 |
| Young's modulus | E [GPa] | 55 |
| Vickers hardness | HV10 | 130 |
| Roughness average | Ra [µm] | 5 |
| Mean roughness depth | Rz [µm] | 45 |

### Material Characteristics

- Good electrical conductivity
- Good high temperature strength
- High thermal conductivity

### Typical Application Areas

- Aerospace
- Automotive
- Research & Prototyping

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)

Further information and data can be found in our material data sheets.

# Titanium Alloys

## Ti6Al4V ELI (Grade 23)

Ti6Al4V ELI (Grade 23) is the high purity version of Ti6Al4V (Grade 5), the most widely used titanium-based alloy in the world. Ti6Al4V ELI (Grade 23) stands out because of its thermal expansion coefficient, biocompatibility, high strength at low density and excellent corrosion resistance.

### Chemical Composition (nominal) %

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

Chemistry according to ASTM F136, B348

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated | + HIP |
|---|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 1280 | 970 | 1000 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 1135 | 880 | 895 |
| Elongation at break | A [%] | 8 | 14 | 15 |
| Reduction of area | Z [%] | 20 | 50 | 40 |
| Young's modulus | E [GPa] | 115 | 120 | 125 |
| Vickers hardness | HV10 | 370 | 305 | 315 |
| Impact energy | [J] | 15 | 30 | 20 |
| Roughness average | Ra [µm] | 10 | - | - |
| Mean roughness depth | Rz [µm] | 70 | - | - |

### Material Characteristics

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

### Typical Application Areas

- Orthopedic implants
- Aerospace
- Automotive
- Energy applications

## TA15

TA15 is a near-α titanium alloy containing aluminum and zirconium, offering good weldability in combination with very high strength and a thermally stable microstructure, even at operating temperatures ranging from 500 °C up to 800 °C for short period of times. Applications often include heavily loaded components such as frames and other structural parts.

### Chemical Composition (nominal) %

| Element / Material[1] | Ti | Al | Zr | Mo | V | Si | C | Fe | O | N | H | Others | Total Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TA15 20-63 µm | Bal. | 5.50 - 7.10 | 1.50 - 2.50 | 0.50 - 2.00 | 0.8 - 2.50 | 0.15 | 0.08 | 0.25 | 0.15 | 0.05 | 0.015 | 0.10 | 0.30 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] |
|---|---|---|
| Tensile strength | $R_m$ [MPa] | 1375 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 1210 |
| Elongation at break | A [%] | 5 |
| Reduction of area | Z [%] | 10 |
| Young's modulus | E [GPa] | 110 |
| Vickers hardness | HV10 | 385 |
| Roughness average | Ra [µm] | 15 |
| Mean roughness depth | Rz [µm] | 100 |

### Material Characteristics

- High specific strength
- Good weldability
- Thermal stability at high temperatures

### Typical Application Areas

- Aerospace
- Automotive

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)

Further information and data can be found in our material data sheets.

# Ti (Grade 2)

Ti Grade 2 titanium-alloy is a commercially pure titanium grade with excellent biocompatibility 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[1] | Ti | Fe | C | N | O | H | Others | Total Others |
|---|---|---|---|---|---|---|---|---|
| Ti Gd. 2 20-63 µm | Bal. | 0.30 | 0.08 | 0.03 | 0.25 | 0.015 | 0.10 | 0.40 |

Chemistry according to ASTM F67, B348

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] |
|---|---|---|
| Tensile strength | $R_m$ [MPa] | 700 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 585 |
| Elongation at break | A [%] | 25 |
| Reduction of area | Z [%] | 65 |
| Young's modulus | E [GPa] | 115 |
| Vickers hardness | HV10 | 220 |
| Roughness average | Ra [µm] | 15 |
| Mean roughness depth | Rz [µm] | 80 |

### Material Characteristics

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

### Typical Application Areas

- Medical
- Aerospace
- Chemical / Petrochemical

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)

Further information and data can be found in our material data sheets.

# Nickel Alloys

## HX

HX nickel is a nickel-chromium-iron-alloy important for high-temperature applications in corrosive environments for a number of industries. In a corrosive environment, this alloy can be used up to 1177 °C for static components, while creep strength is given up to 850 °C.

### Chemical Composition (nominal) %

| Element / Material[1] | 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[2] | Formula Symbol and Unit | As-Built[3] |
|---|---|---|
| Tensile strength | $R_m$ [MPa] | 720 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 545 |
| Elogation at break | A [%] | 17 |
| Reduction of area | Z [%] | 20 |
| Young's modulus | E [GPa] | 155 |
| Vickers hardness | HV10 | 240 |
| Roughness average | Ra [µm] | 10 |
| Mean roughness depth | Rz [µm] | 55 |

### Material Characteristics

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

### Typical Application Areas

- Turbine engine components
- Furnace assemblies
- Energy applications

## IN625

IN625 is a precipitation-hardenable nickel-chromium alloy containing significant amounts of iron, niobium, and molybdenum. It combines high corrosion resistance and strength with outstanding weldability and resistance to postweld cracking. This alloy has excellent creep-rupture strength at temperatures to 700 °C.

### Chemical Composition (nominal) %

| Element / Material[1] | Ni | Cr | Mo | Nb | Fe | Co | Si | Mn | Ti | Al | C | S | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IN625 10-45 µm | Bal. | 20.00 - 23.00 | 8.00 - 10.00 | 3.15 - 4.15 | 5.00 | 1.00 | 0.50 | 0.50 | 0.40 | 0.40 | 0.10[3] | 0.015 | 0.015 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated[3] |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 25 | 1020 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 665 | 665 |
| Elongation at break | A [%] | 31 | 38 |
| Reduction of area | Z [%] | 45 | 41 |
| Young's modulus | E [GPa] | 175 | 185 |
| Vickers hardness | HV10 | 280 | 290 |
| Roughness average | Ra [µm] | 10 | - |
| Mean roughness depth | Rz [µm] | 40 | - |

### Material Characteristics

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

### Typical Application Areas

- Aircraft engine components
- Energy applications
- Turbine parts

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)
Further information and data can be found in our material data sheets.

# IN718

IN718 is a precipitation-hardenable nickel-chromium alloy combining good corrosion resistance at low and high temperatures up to 100+0 °C. The alloy shows outstanding weldability including resistance to postweld cracking. Furthermore, the material has excellent tensile, fatigue, creep and rupture strength at temperatures up to 700 °C.

## Chemical Composition (nominal) %

| Element / Material[1] | Ni | Cr | Fe | Ta + Nb | Mo | Ti | Al | Cu | C | Si , Mn | B | Co | P, S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IN718 10-45 µm | 50.00 - 55.00 | 17.00 - 21.00 | Bal | 4.75 - 5.50 | 2.80 - 3.30 | 0.65 - 1.15 | 0.20 - 0.80 | 0.30 | 0.08 | 0.35 each | 0.006 | 1.00 | 0.015 each |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 1025 | 1440 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 680 | 1240 |
| Elongation at break | A [%] | 31 | 12 |
| Reduction of area | Z [%] | 35 | 20 |
| Young's modulus | E [GPa] | 170 | 200 |
| Vickers hardness | HV10 | 300 | 465 |
| Impact energy | [J] | 75 | 25 |
| Roughness average | Ra [µm] | 5 | - |
| Mean roughness depth | Rz [µm] | 50 | - |

### Material Characteristics

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

### Typical Application Areas

- Aircraft engine components
- Rocket parts
- High-temperature environments
- Energy applications

# IN939

IN939 is a highly heat- and corrosion resistant nickel based alloy. It can be used at temperatures up to 700 °C, making it ideally suited for aerospace technologies and turbine production. Nickel-based alloys exhibit good mechanical characteristic values such as high tensile- and good endurance strength.

## Chemical Composition (nominal) %

| Element / Material[1] | Ni | Cr | Co | Ti | W | Al | Ta | Nb | Mn | Si | C | Zr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IN939 10-45 µm | Bal. | 22.00 - 23.00 | 18.00 - 20.00 | 3.00 - 4.50 | 1.00 - 3.00 | 1.00 - 3.00 | 1.00 - 1.80 | 0.50 - 1.50 | 0.50 | 0.50 | 0.15 | 0.10 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated | + HIP |
|---|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 970 | 1245 | 1350 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 685 | 750 | 955 |
| Elongation at break | A [%] | 26 | 13 | 11 |
| Reduction of area | Z [%] | 35 | 10 | 10 |
| Young's modulus | E [GPa] | 165 | 200 | 195 |
| Vickers hardness | HV10 | 305 | - | - |
| Roughness average | Ra [µm] | 5 | - | - |
| Mean roughness depth | Rz [µm] | 45 | - | - |

### Material Characteristics

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

### Typical Application Areas

- Aerospace
- Turbine components
- Toolmaking

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)

Further information and data can be found in our material data sheets.

# Tool and Stainless Steel

## 316L (1.4404)

316L is a stainless steel known for good hardness with a high ductility. 316L has versatile applications where corrosion-resistance is important, such as in medical technologies, the automotive industry as well as in aerospace engineering.

### Chemical Composition (nominal), %

| Element / Material[1] | Fe | Cr | Ni | Mo | Mn | Si | P | S | C | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 316L (1.4404) 10-45 µm | Bal. | 16.00 - 18.00 | 10.00 - 14.00 | 2.00 - 3.00 | 2.00 | 1.00 | 0.045 | 0.030 | 0.030 | 0.10 | 0.04 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 620 | 575 |
| Offset yield strength | $R_{P0,2}$ [MPa] | 505 | 345 |
| Elongation at break | A [%] | 43 | 52 |
| Reduction of area | Z [%] | 65 | 65 |
| Young's modulus | E [GPa] | 180 | 180 |
| Vickers hardness | HV10 | 210 | 170 |
| Roughness average | Ra [µm] | 10 | - |
| Mean roughness depth | Rz [µm] | 70 | - |

### Material Characteristics

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

### Typical Application Areas

- Aerospace / Automotive
- Surgical instruments
- Offshore installations
- Food industry

## 15-5PH (1.4545)

15-5PH is a stainless, martensitic, precipitation-hardening Cr-Ni-Cu 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[1] | Fe | Cr | Ni | Cu | Nb + Ta | Mn | Si | P | S | C | N | 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 | 0.04 | 0.03 | 0.07 | 0.10 | 0.10 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 1225 | 1440 |
| Offset yield strength | $R_{P0,2}$ [MPa] | 860 | 1290 |
| Elongation at break | A [%] | 15 | 10 |
| Reduction of area | Z [%] | 50 | 30 |
| Young's modulus | E [GPa] | 180 | 195 |
| Vickers hardness | HV10 | 370 | 455 |
| Roughness average | Ra [µm] | 25 | - |
| Mean roughness depth | Rz [µm] | 140 | - |

### Material Characteristics

- Precipitation hardenable
- Excellent tensile strength
- Moderate corrosion resistance

### Typical Application Areas

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

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)
Further information and data can be found in our material data sheets.

# 17-4PH (1.4542)

17-4PH is a martensitic precipitation-hardenable Cr-Ni-Cu-steel possessing high strength and toughness. A versatile material, it provides an outstanding combination of good corrosion resistance and mechanical properties at temperatures up to 320 °C and is suitable for heavy-strain applications, thanks to its high wear resistance.

## Chemical Composition (nominal), %

| Element / Material[1] | Fe | Cr | Ni | Cu | Mn | Si | Nb + Ta | C | N | O | P | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-4 PH (1.4542) 10-45 µm | Bal. | 15.00 - 17.50 | 3.00 - 5.00 | 3.00 - 5.00 | 1.00 | 0.07 | 0.15 - 0.45 | 0.07 | 0.10 | 0.04 | 0.04 | 0.03 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 940 | 1270 |
| Offset yield strength | $R_{P0,2}$ [MPa] | 500 | 910 |
| Elongation at break | A [%] | 25 | 18 |
| Reduction of area | Z [%] | 50 | 40 |
| Young's modulus | E [GPa] | 165 | 165 |
| Vickers hardness | HV10 | 230 | 355 |
| Roughness average | Ra [µm] | 10 | - |
| Mean roughness depth | Rz [µm] | 60 | - |

### Material Characteristics

- Precipitation hardenable
- Excellent tensile strength
- Moderate corrosion resistance

### Typical Application Areas

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

# 1.2709

Tool steels such as 1.2709 are primarily used for manufacturing tools and molds. They are characterized by a high hardness combined with a high ductility. Their specific mechanical properties allow usage in high-stressed components due to its high wear resistance.

## Chemical Composition (nominal), %

| Element / Material[1] | Fe | Ni | Co | Mo | Ti | Al | Mn | Si | P | S | C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.2709 10-45 µm | Bal. | 18.00 - 19.00 | 8.50 - 9.50 | 4.70 - 5.20 | 0.50 - 0.80 | 0.05 - 0.15 | 0.10 | 0.10 | 0.01 | 0.01 | 0.03 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 1150 | 2025 |
| Offset yield strength | $R_{P0,2}$ [MPa] | 940 | 1945 |
| Elongation at break | A [%] | 12 | 5 |
| Reduction of area | Z [%] | 55 | 20 |
| Young's modulus | E [GPa] | 175 | 195 |
| Vickers hardness | HV10 | 350 | 580 |
| Roughness average | Ra [µm] | 10 | - |
| Mean roughness depth | Rz [µm] | 60 | - |

### Material Characteristics

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

### Typical Application Areas

- Injection molding
- Engineering parts
- Automotive
- Aerospace

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)

Further information and data can be found in our material data sheets.

# Tool and Stainless Steel

## H13 (1.2344)

H13 (1.2344) is a chromium containing martensitic tool steel. This material is resistant to thermal fatigue cracking and is used in tooling applications that require exceptional strength and toughness.

### Chemical Composition (nominal), %

| Element / Material[1] | Fe | C | Cr | Mn | Mo | Ni+Cu | P | S | Si | V |
|---|---|---|---|---|---|---|---|---|---|---|
| H13 10-45 µm | 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[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 1070 | 1890 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 945 | 1605 |
| Elongation at break | A [%] | 8 | 3 |
| Reduction of area | Z [%] | 30 | 5 |
| Young's modulus | E [GPa] | 150 | 155 |
| Vickers hardness | HV10 | 355 | - |
| Surface roughness | Ra [µm] | 5 | - |
| Surface roughness | Rz [µm] | 45 | - |

### Material Characteristics

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

### Typical Application Areas

- Injection molding
- Tooling

## Invar 36®

The Fe-alloy Invar36® is a high-nickel content iron-based alloy that has a uniquely low coefficient of thermal expansion below its Curie temperature of 280 °C. Invar36® is used in components that require both high reliability and high dimensional stability over a wide range of temperatures.

### Chemical Composition (nominal), %

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

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 480 | 480 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 385 | 375 |
| Elongation at break | A [%] | 33 | 33 |
| Reduction of area | Z [%] | 75 | 75 |
| Young's modulus | E [GPa] | 135 | 140 |
| Vickers hardness | HV10 | 150 | - |
| Surface roughness | Ra [µm] | 15 | - |
| Surface roughness | Rz [µm] | 80 | - |

### Material Characteristics

- Low coefficient of thermal expansion below its Currie temp
- Excellent mechanical properties at cryogenic temperatures
- Low tendency to fatigue at low temperatures

### Typical Application Areas

- Aerospace
- Engine valves
- Precision instruments

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)
Further information and data can be found in our material data sheets.

# Cobalt Alloys

## CoCr28Mo6

CoCr28Mo6 is a high temperature resistant Co-Alloy with versatile applications. This corrosion resistant and biocompatible material combines high hardness with high ductility, limiting many traditional processing manufacturing options. The SLM® process provides a comparatively economic and quick option to manufacture cobalt-chromium components.

### Chemical Composition (nominal), %

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

Chemistry according to ASTM F75

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] |
|---|---|---|
| Tensile strength | $R_m$ [MPa] | 1215 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 755 |
| Elongation at break | A [%] | 21 |
| Reduction of area | Z [%] | 15 |
| Young's modulus | E [GPa] | 205 |
| Vickers hardness | HV10 | 385 |
| Roughness average | Ra [µm] | 15 |
| Mean roughness depth | Rz [µm] | 90 |

### Material Characteristics

- Exceptional biocompatibility
- Heat resistant
- Resistance to thermal fatigue
- High ductility

### Typical Application Areas

- Orthopedic implants
- Dental prostheses
- Energy engineering
- Jet engines

## SLM® MediDent

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

### Chemical Composition (nominal), %

| Element / Material[1] | Co | Cr | Mo | W | Si | Fe | Mn | Ni | Pb | C | B | P | S | Be | Cd | Total Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SLM® MediDent 10-45 µm | Bal. | 22.70-26.70 | 4.00 - 6.00 | 4.40 - 6.40 | 2.00 | 0.50 | 0.10 | 0.10 | 0.02 | 0.02 | 0.10 | 0.10 | 0.10 | 0.02 | 0.02 | 0.50 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 1140 | 1415 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 655 | 1185 |
| Elongation at break | A [%] | 14 | 4 |
| Reduction of area | Z [%] | 10 | 5 |
| Young's modulus | E [GPa] | 170 | 245 |
| Vickers hardness | HV10 | 375 | - |
| Roughness average | Ra [µm] | 10 | - |
| Mean roughness depth | Rz [µm] | 75 | - |

### Material Characteristics

- Biocompatible
- Corrosion resistant

### Typical Application Areas

- Dental
- Medical

1 Maximum values, unless stated otherwise as a range
2 Process conditions and parameters according to SLM Solutions' standards
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)

Further information and data can be found in our material data sheets.

# Copper 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. SLM®-processed CuSn10 components exhibit a homogeneous, nearly non-porous texture with targeted mechanical characteristics.

### Chemical Composition (nominal) %

| Element / Material[1] | Cu | Sn | Al | Fe | Mn | Ni | P | Pb | S | Sb | Si | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bronze CuSn10 20-63 µm | Bal. | 9.00 - 11.00 | 0.01 | 0.20 | 0.10 | 2.00 | 0.20 | 1.00 | 0.05 | 0.20 | 0.02 | 0.50 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] |
|---|---|---|
| Tensile strength | $R_m$ [MPa] | 505 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 380 |
| Elongation at break | A [%] | 19 |
| Reduction of area | Z [%] | 20 |
| Young's modulus | E [GPa] | 115 |
| Vickers hardness | HV10 | 160 |
| Roughness average | Ra [µm] | 15 |
| Mean roughness depth | Rz [µm] | 90 |

### Material Characteristics

- Good mechanical properties
- Good corrosion resistance
- Cavitation resistance in sea water
- Good thermal conductivity

### Typical Application Areas

- Pump housings
- Hydraulic turbines
- Instrument panels
- Diffusers and impellers

## CuNi2SiCr

The low-alloyed copper-alloy CuNi2SiCr is a thermally hardenable alloy with high stiffness, even at elevated temperatures. Due to the low additives, the properties of pure copper (strength, softening temperature) can be considerably improved, while other properties (electrical and thermal conductivity, corrosion resistance) are largely retained. Typical areas of application are toolmaking, conductive contacts in electrical engineering or valves.

### Chemical composition (nominal), %

| Material / Element[1] | Cu | Ni | Si | Cr | Fe | Mn | Pb | Total others |
|---|---|---|---|---|---|---|---|---|
| CuNi2SiCr 20-63 µm | Bal. | 2.00 - 3.00 | 0.50 - 0.80 | 0.20 - 0.50 | 0.15 | 0.10 | 0.02 | 0.10 |

| Mechanical Data[2] | Formula Symbol and Unit | As-Built[3] | Heat Treated |
|---|---|---|---|
| Tensile strength | $R_m$ [MPa] | 300 | 645 |
| Offset yield strength | $R_{p0,2}$ [MPa] | 245 | 565 |
| Elongation at break | A [%] | 37 | 20 |
| Reduction of area | Z [%] | 80 | 55 |
| Young's modulus | E [GPa] | 95 | 110 |
| Vickers hardness | HV10 | 105 | 220 |
| Roughness average | Ra [µm] | 20 | - |
| Mean roughness depth | Rz [µm] | 105 | - |

### Material characteristics

- Balanced combination of electrical and thermal conductivity
- High wear resistance
- High corrosion resistance, in particular to stress corrosion cracking

### Typical application areas

- Welding technology
- Electrical engineering
- Tooling

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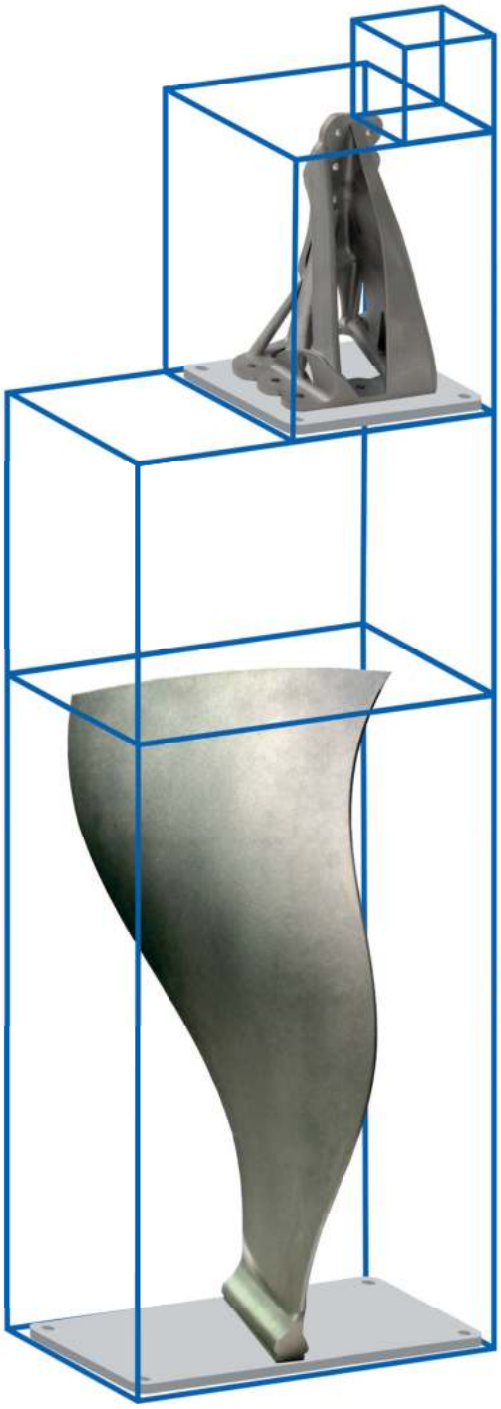
3 Rounded mean values of identified layer thicknesses and different orientations (elongations at break are not rounded)

Further information and data can be found in our material data sheets.

# Selective Laser Melting Machines

SLM Solutions is known as the innovation leader in selective laser melting and offers machines in fours sizes. Features such as bi-directional powder recoating to reduce manufacturing time, open powder architecture allowing use material from any supplier and full process parameter access for custom development come standard on every SLM® machine. The flexibility of selective laser melting systems allow the process to be tailored to customer applications, while the robustness of best-in-class safety and increased build speeds enable qualified serial production in any industry.




## Versatile SLM®125

Small platform, powerful results

## Trusted SLM®280

Industry-leading quality and reliability

## Production-Ready SLM®500

Productivity gains, low cost of ownership

## Large Format SLM®800

Integrated automation, proven results

## Metal Focused

SLM Solutions invented the selective laser melting technology, and still today that's all we focus on, honing our expertise and transferring this knowledge to customers

# SLM Solutions - Technology Pioneers, Innovation Leaders

SLM Solutions helped invent the laser powder bed fusion process, was the first to offer multi-laser systems and all selective laser melting machines offer patented quality, safety and productivity features. Taking a vested interest in customers' long-term success in metal additive manufacturing, SLM Solutions' experts work with customers at each stage of the process to provide support and knowledge-sharing that elevate use of the technology and ensure customers' return on investment is maximized. Optimal paired with SLM Solutions' software, powder and quality assurance products, the SLM® technology opens new geometric freedoms that can enable lightweight construction, integrate internal cooling channels or decrease time to market.

A publicly traded company, SLM Solutions Group AG focuses exclusively on metal additive manufacturing and is headquartered in Germany with offices in China, France, India, Italy, Russia, Singapore and the United States and a network of global sales partners.





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