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

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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)

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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

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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.