BAKER INDUSTRIES

Nickel Alloy IN625

MATERIAL DATA SHEET

Nickel Alloy IN625 is characterized by having high tensile, creep and rupture strength. Conventionally cast or wrought components in this type of nickel alloy have typically excellent fatigue and thermal fatigue properties combined with good oxidation resistance.

Nickel Alloy IN625 is expected to have good corrosion resistance in various corrosive environments. Especially sea-water applications require high pitting and crevice corrosion resistance, stress-corrosion resistance against chloride-ions, high tensile and corrosion-fatigue strength. However, corrosion resistance has not been verified yet and therefore it is recommended to conduct relevant corrosion tests and studies prior to use in specific corrosive environment.

Parts built from Nickel-Alloy IN625 can be heat treated and material properties can be varied within specified range. Parts can be machined, spark-eroded, welded, micro shot-peened, polished and coated in both as-built and in heat treated conditions. Due to the layer-wise building method, the parts have a certain anisotropy.

General process data

Typical achievable part accuracy [1] - *small parts*	approx. ± 40 – 60 µm approx. ± 1.6 – 2.4 x 10^{-3} inch
- *large parts*	± 0.2%
Minimum wall thickness [2]	approx. 0.3 - 0.4 mm approx. 0.012 - 0.0016 inch
Surface roughness [3] - *after shot-peening*	Ra 4 – 6.5 µm, Rz 20 - 50 µm Ra 0.16 – 0.26 x 10^{-3} inch Rz 0.78 – 1.97 x 10^{-3} inch
- *after polishing*	Rz up to < 0.5 µm Rz up to < 0.02 x 10^{-3} inch *(can be very finely polished)*
Volume rate [4]	2 mm^3/s (7.2 cm^3/h) 0.44 in^3/h

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Physical & chemical properties of parts

Material composition	Ni (balance ≥ 58.00 wt-%)		
	Cr (20.00 - 23.00 wt-%)	Ti (≤ 0.40 wt-%)	Ta (≤ 0.05 wt-%)
	Mo (8.00 - 10.00 wt-%)	Al (≤ 0.40 wt-%)	Si (≤ 0.50 wt-%)
	Nb (3.15 - 4.15 wt-%)	Co (≤ 1.0 wt-%)	Mn (≤ 0.50 wt-%)
	Fe (≤ 5.00 wt-%)	C (≤ 0.10 wt-%)	P, S (≤ 0.015 wt-%)
Relative density	approx. 100 %		
Density	min. 8.4 g/cm³ min. 0.30 lb/in³		

Mechanical properties of parts at 20 °C (68 °F) - as built

	Horizontal Axis (XY)	*Vertical Axis (Z)*
Tensile strength [5]	typ. 990 ± 50 MPa typ. 144 ± 7 ksi	typ. 900 ± 50 MPa typ. 131 ± 7 ksi
Yield strength (Rp 0.2 %) [5]	typ. 725 ± 50 MPa typ. 105 ± 7 ksi	typ. 615 ± 50 MPa typ. 89 ± 7 ksi
Elongation at break [5]	typ. (35 ± 5) %	(42 ± 5) %
Modulus of elasticity [5]	typ. 170 ± 20 GPa typ. 25 ± 3 Msi	typ. 140 ± 20 GPa typ. 20 ± 3 Msi

Mechanical properties of parts at 20 °C (68 °F) - stress relieved [6]

	Horizontal Axis (XY)	*Vertical Axis (Z)*
Tensile strength [5]	min. 827 MPa (120 ksi) typ. 1040 ± 100 MPa (151 ± 15 ksi)	min. 827 MPa (120 ksi) typ. 930 ± 100 MPa (135 ± 15 ksi)
Yield strength (Rp 0.2 %) [5]	min. 414 MPa (60 ksi) typ. 720 ± 100 MPa (104 ± 15 ksi)	min. 414 MPa (60 ksi) typ. 650 ± 100 MPa (94 ± 15 ksi)
Elongation at break [5]	min. 30 %, typ. (35 ± 5) %	min. 30 %, typ. (44 ± 5) %
Modulus of elasticity [5]	typ. 170 ± 20 GPa typ. 25 ± 3 Msi	typ. 160 ± 20 GPa typ. 23 ± 3 Msi
Hardness [7]	approx. 30 HRC (287 HB)	

Thermal properties of parts

Maximum operating temperature for parts under load	*approx.* 650 °C *approx.* 1200 °F
Oxidation resistance to [8]	980 °C 1800 °F

[1] Based on users' experience of dimensional accuracy for typical geometries, e.g. ± 40 µm (0.0016 inch) when parameters can be optimized for a certain class of parts or ± 60 µm (0.0024 inch) when building a new kind of geometry for the first time. Part accuracy is subject to appropriate data preparation and post-processing.

[2] Mechanical stability is dependent on geometry (wall height etc.) and application.

[3] Due to the layer-wise building, the surface structure depends strongly on the orientation of the surface, for example sloping and curved surfaces exhibit a stair-step effect. The values also depend on the measurement method used. The values quoted here given an indication of what can be expected for horizontal (up-facing) or vertical surfaces.

[4] Volume rate is a measure of build speed during laser exposure. The total build speed depends on the average volume rate, the re-coating time (related to the number of layers) and other factors such as DMLS-Start settings.

[5] Tensile testing according to ISO 6892-1:2009 (B) Annex D, proportional test pieces, diameter of the neck area 5mm (0.2 inch), original gauge length 25mm (1 inch).

[6] Stress relieve: anneal at 870 °C (1600 °F) for 1 hour, rapid cooling.

[7] Rockwell C (HRC) hardness measurement according to EN ISO 6508-1 on polished surface. Note that measured hardness can vary significantly depending on how the specimen has been prepared.

[8] Based on literature of conventional Ni-alloy with identical chemistry