

# Alloy 46

**Alloy 46** is an iron nickel alloy with 46% nickel and balance iron, it has a constant coefficient of thermal expansion from 20°C to 500°C. It is used for sapphires, soft glass, ceramic seals.

## Common Trade Names

46H, NILO 46, Glass Seal 46, Pernifer 46

## Chemical Composition

Grade	C%	P%	S%	Mn%	Si%	Al%	Ni%	Fe%
Alloy 46	Max 0.05	Max 0.02	Max 0.02	Max 0.80	Max 0.30	Max 0.10	46	Bal.

## Heat Treatment

900 °C ± 20 °C in hydrogen for 1h, cooling in furnace at the rate less than 5°C/min to 200°C

## Physical Properties

Properties	Alloy 46
Resistivity at 20°C (micro ohm · meter)	0.49
Density (gram/cm <sup>3</sup> )	8.18
Specific heat (J/kg · °C)	502
Thermal conductivity (W/m · °C)	14.7
Melting temperature (°C)	1430

## Average Coefficient Of Linear Expansion

Temperature °C	10 <sup>-6</sup> °C <sup>-1</sup>	Temperature °C	10 <sup>-6</sup> °C <sup>-1</sup>
20-100	7.5	20-400	7.2
20-200	7.5	20-450	7.1
20-300	7.1	20-500	8.3
20-350	7.1	20-600	9.5

## Typical Mechanical Property

	σ <sub>b</sub> /MPa	σ <sub>P0.2</sub> /MPa	δ/%	HV
Annealed	510	-	35	170

## Tensile Strength of Strip

Condition	σ <sub>b</sub> /MPa
Soft	<590
Hard	>820

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## Heat Treatment of Finished Parts

- 1, Stress-relief annealing: In order to eliminate the residual stress of parts after machining, 430-540°C in protective atmosphere, for 1-2h, cool in furnace or cool in air
- 2, Intermediate annealing: In order to eliminate the hardening caused by cold rolling, cold drawing and cold stamping, 700-800°C in dry hydrogen or vacuum, for 30min-60min, air or water cool
- 3, Pre-oxidation treatment: In order to form a uniform thickness and dense oxide film on the surface of the alloy, the oxide film is firmly bonded to the substrate and can be well infiltrated with the molten glass. The parts are heated to 1150 ~ 1250 °C in saturated wet hydrogen, kept for 30min, air cooled. The weight gain of the parts is preferably in the range of 0.1 to 0.3 mg/cm<sup>2</sup>.

## Descaling Treatment

When there is thick oxide layer, it may be sandblasted or first immersed in molten alkali, and then pickled. The thin oxide layer can be pickled with a 25% hydrochloric acid solution at 70 °C.

## Machining

High-speed steel or carbide tools are used for machining, low-speed machining, and coolant can be used for cutting. Good grinding performance

## Available Forms

1, Sheet/Plate

Condition: Hot rolled, cold rolled, annealed, pickled

2, Disc/Ring

Condition: Hot rolled, forged, pickled, machined

3, Wire

Condition: Bright annealed, 1/4Hard-Hard Drawn, dia. 0.01-15mm, in coil or cut lengths

4, Bar

Condition: Hot rolled, forged, annealed, pickled, ground

5, Strip/Ribbon

Condition: Cold rolled, thickness 0.01-5mm

6, Tube/Capillary Tube

Condition: OD 0.2-15mm, Wall 0.015-3mm