

Alloy F15 (Kovar)

ASTM F15 Alloy is a nominal 29%Ni-17%Co-54%Fe alloy, in the wide temperature range (-80~450 °C), the expansion coefficient of Kovar is similar to that of borosilicate glass. In the electric vacuum industry, it is used to seal with borosilicate glass to manufacture high airtight components, and it can also be sealed with ceramics.

Common Trade Names

29HK, Nilo K, KV-1

Chemical Composition

Grade	C%	P%	S%	Mn%	Si%	Cu%	Cr%	Mo%
Kovar	Max 0.03	Max 0.02	Max 0.02	Max 0.5	Max 0.30	Max 0.20	Max 0.20	Max 0.20
	Al%	Mg%	Zr%	Ti%	Fe%	Ni%	Co%	
	Max 0.10 ^B	Max 0.10 ^B	Max 0.10 ^B	Max 0.10 ^B	53 ^A	29 ^A	17 ^A	

^AWe will adjust the the percentage to achieve the requirements for coefficient of thermal expansion

^BThe total of Al, Mg, Zr, Ti will not exceed 0.20%

Heat Treatment

900 °C ± 20 °C in hydrogen atmosphere for 1 hour, then heated to 1100 °C ± 20 °C, for 15 min, cooled to 200 °C at the rate of Max 5 °C / min

Thermal Conductivity

Temperature °C	100	200	300	400	500
$\lambda/(W/(m \cdot ^\circ C))$	20.6	21.5	22.7	23.7	25.4

Average Coefficient Of Linear Expansion

Temperature °C	10-6°C -1	Temperature °C	10-6°C -1
20-60	7.8	20-500	6.2
20-100	6.4	20-550	7.1
20-200	5.9	20-600	7.8
20-300	5.3	20-700	9.2
20-400	5.1	20-800	10.2
20-450	5.3	20-900	11.4

Temperature Coefficient of Resistance

Temperature °C	20-50	20-85	20-100	20-200	20-300	20-400
$\alpha R/10^{-3}^\circ C^{-1}$	3.7	3.7	3.9	3.9	3.7	3.3

Hardness of Hard Drawn Strip

Condition	Thickness	Hardness HV
Hard Drawn	>2.5	<=170
	<=2.5	<=165

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Tensile Strength of Wire & Strip

Condition	Wire MPa	Strip MPa
Soft Annealed	<585	<570
1/4 Hard	585-725	520-630
1/2 Hard	655-795	590-700
3/4 Hard	725-860	600-770
Hard	>850	>700

Heat Treatment of Finished Parts

- 1, Stress-relief annealing: In order to eliminate the residual stress of parts after machining, 470-540°C, for 1-2h, air cool
- 2, Intermediate annealing: In order to eliminate the hardening caused by cold rolling, cold drawing and cold stamping, 750-900°C in dry hydrogen, decomposed ammonia or vacuum, for 14min-1h, air or water cool
- 3, Wet hydrogen treatment, 950-1050°C, keep 10-30min, cooled in furnace
- 4, Oxidation treatment before sealing, A uniform and dense oxide film is formed on the surface of the alloy. The oxide film is firmly bound to the matrix and can infiltrate well into the molten glass. 800°C in air, weight gain of finished parts: 0.2-0.4 mg/cm²

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