

CarTech® Kovar® Alloy

Identification

UNS Number

• K94610

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.02 %	Manganese	0.30 %
Silicon	0.20 %	Nickel	29.00 %
Cobalt	17.00 %	Iron	Balance

General Information

Description

CarTech Kovar alloy is a vacuum melted, iron-nickel-cobalt, low expansion alloy whose chemical composition is controlled within narrow limits to assure precise uniform thermal expansion properties. Extensive quality controls are employed in the manufacture of this alloy to ensure uniform physical and mechanical properties for ease in deep drawing, stamping and machining.

NOTE: CarTech Kovar Alloy is a Glass and Ceramic Sealing Alloy.

Applications

CarTech Kovar alloy has been used for making hermetic seals with the harder Pyrex glasses and ceramic materials.

This alloy has found wide application in power tubes, microwave tubes, transistors and diodes. In integrated circuits, it has been used for the flat pack and the dual-in-line package.

Preparation for Sealing

All degreased, fabricated Kovar alloy parts should be degassed and annealed in a wet hydrogen atmosphere.

Atmosphere is to be made moist by bubbling the hydrogen through water at room temperature. Care must be taken to prevent surface carbon pickup. Furnace should have a cooling chamber provided with the same atmosphere.

Heating should be conducted within the 1540/2010°F (838/1099°C) temperature range. Time at temperature should be approximately two hours for lowest temperature to 20 minutes for the highest temperature. Parts should then be transferred to the cooling zone and held until below 570°F (299°C), then removed.

An oxide film on the metallic part is preferred for metal-to-hard glass sealing. The best oxide film is thin and tightly adhering. The film can be produced by heating the parts to 1200/1290°F (650/700°C) in regular ambient atmosphere for a time sufficient to form a dark gray to slight brown oxide.

Corrosion Resistance

Important Note: The following 4-level rating scale is intended for comparative purposes only. Corrosion testing is recommended; factors which affect corrosion resistance include temperature, concentration, pH, impurities, aeration, velocity, crevices, deposits, metallurgical condition, stress, surface finish and dissimilar metal contact.

Humidity	Moderate	
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Properties

Physical Properties

The hyperlink entitled "Mean Coefficient of Thermal Expansion: as annealed" contains the average coefficient of expansion properties after annealing in hydrogen for one hour at 1650°F (900°C) at 15 minutes at 2010°F (1099°C) and cooled to room temperature within

CarTech® Kovar® Alloy

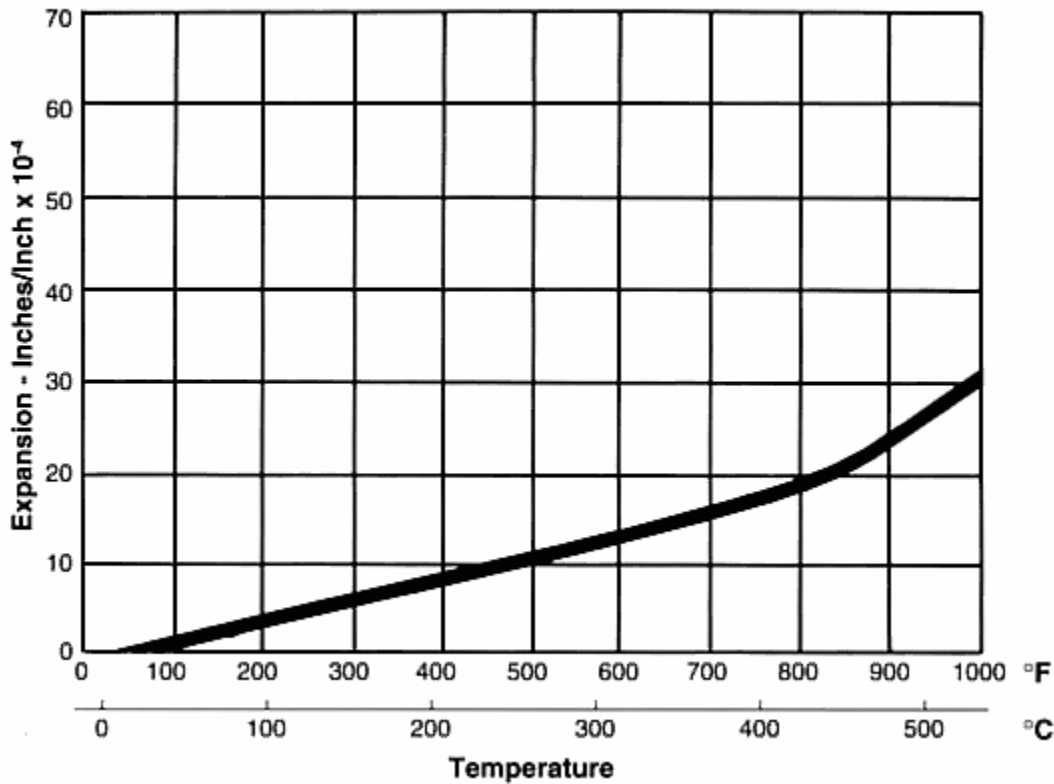
one hour. Material heat treated using this procedure should not exhibit any transformation when cooled to -112°F (-80°C) for four hours. This was determined by means of metallographic examination.

Specific Gravity	8.36
Density	0.3020 lb/in ³
Mean CTE	
77 to 212°F, Annealed	3.25 x 10 ⁻⁶ in/in/°F
77 to 392°F, Annealed	2.89 x 10 ⁻⁶ in/in/°F
77 to 572°F, Annealed	2.85 x 10 ⁻⁶ in/in/°F
77 to 662°F, Annealed	2.72 x 10 ⁻⁶ in/in/°F
77 to 752°F, Annealed	2.81 x 10 ⁻⁶ in/in/°F
77 to 842°F, Annealed	2.92 x 10 ⁻⁶ in/in/°F
77 to 932°F, Annealed	3.41 x 10 ⁻⁶ in/in/°F
77 to 1112°F, Annealed	4.34 x 10 ⁻⁶ in/in/°F
77 to 1292°F, Annealed	5.06 x 10 ⁻⁶ in/in/°F
77 to 1472°F, Annealed	5.73 x 10 ⁻⁶ in/in/°F
77 to 1652°F, Annealed	6.25 x 10 ⁻⁶ in/in/°F

Mean coefficient of thermal expansion As annealed

Temperature		Coefficient	
77°F to	25°C to	10 ⁻⁶ /°F	10 ⁻⁶ /°C
212	100	3.25	5.86
392	200	2.89	5.20
572	300	2.85	5.13
662	350	2.72	4.89
752	400	2.81	5.06
842	450	2.92	5.25
932	500	3.41	6.15
1112	600	4.34	7.80
1292	700	5.06	9.12
1472	800	5.73	10.31
1652	900	6.25	11.26

Thermal Expansion Curve - Kovar Alloy



Thermal Conductivity	120.0	BTU-in/hr/ft ² /°F
Modulus of Elasticity (E)	20.0	x 10 ³ ksi
Electrical Resistivity (70°F)	294.0	ohm-cir-mil/ft
Curie Temperature	815	°F
Melting Range	2640	°F

Magnetic Properties

Kovar alloy is magnetic at all temperatures below the Curie point. Magnetic properties will depend upon heat treatment; the lower the hardness, the higher the permeability values and lower hysteresis loss.

Magnetic Permeability		
1830°F, 500.00 G	1000.0	Mu
2010°F, 500.00 G	1900.0	Mu
1830°F, 1000.0 G	1400.0	Mu
2010°F, 1000.0 G	3500.0	Mu
1830°F, 2000.0 G	2000.0	Mu
2010°F, 2000.0 G	5800.0	Mu
1830°F, 5000.0 G	2300.0	Mu
2010°F, 5000.0 G	10000	Mu
1830°F, 10000 G	3400.0	Mu
2010°F, 10000 G	8200.0	Mu
1830°F, 12000 G	3000.0	Mu
2010°F, 12000 G	5000.0	Mu

Flux Density	Treatment	
	1830°F (999°C) 30 min. - FC Permeability	2010°F (1099°C) 20 min. - FC Permeability
500	1000	1900
1000	1400	3500
2000	2000	5800
5000	2300	10000
10000	3400	8200
12000	3000	5000

Typical Mechanical Properties

Typical Mechanical Properties of Strip - Kovar Alloy

Tested parallel to the direction of rolling. Material annealed 1830°F (999°C) for 30 minutes, then furnace cooled.

Yield Strength		Tensile Strength		% Elongation in 2" (50.8 mm)	Hardness Rockwell B
ksi	MPa	ksi	MPa		
50	345	75	517	30	68

Other Information

Applicable Specifications

Kovar alloy is manufactured to meet the requirements of ASTM Specification F-15.

- ASTM F-15

Forms Manufactured

- Bar-Flats
- Billet
- Wire
- Bar-Rounds
- Strip

Technical Articles

- [A Guide to Etching Specialty Alloys for Microstructural Evaluation](#)
- [After 100 Years, the Uses for Invar Continue to Multiply](#)

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