

KOVAR "A"

Published by
Engineering Alloys Digest, Inc.
Upper Montclair, New Jersey

KOVAR "A"

(A Metal-to-Glass Sealing Alloy)

KOVAR "A" is a cobalt, nickel, iron alloy recommended for sealing into hard glass. Has similar expansion curve as glass, makes firm bond between metal and glass, is easy to machine and form, and has high resistance to thermal shock.

Composition:	Nominal	Range
Nickel	29	28.70-29.20
Cobalt	17	17.30-17.80
Manganese	0.3	0.50 max.
Silicon	—	0.20 max.
Carbon	—	0.06 max.
Iron	balance	52.90-53.40

Physical Constants:

Density, lb./cu.in.	0.302
Melting point, Deg. C (approx.)	1450
Electrical resistance, microhm cm.	49
ohms/cir mil ft.	294
Thermal conductivity, cal/cm/sec/deg. C	0.0395
Modulus of elasticity, psi	20,000,000
Curie point deg. C (approx.)	435
Coef. thermal expansion (annealed) in/in/deg. C	
30-200 deg. C	4.33-5.30 x 10 ⁻⁶
30-500 deg. C	5.71-6.21 x 10 ⁻⁶

PROPERTIES

	Mechanical Properties (0.030" sheet)	
	Typical	Annealed
Tensile strength, psi	89700	75000
Yield strength, psi	50500	—
Proportional limit, psi	32200	—
Elongation, % in 2"	—	25
Brinell hardness	200-250	140-160

(Tested parallel to the direction of rolling)

MAGNETIC PROPERTIES—LOSSES IN WATTS PER POUND

Thickness, in.	10 Kilogausses 60 cycles/sec.	10 Kilogausses 840 cycles/sec.	2 Kilogausses 5000 cycles/sec.	2 Kilogausses 10,000 cycles/sec.
0.010	1.05	23.4	16.6	41.0
0.030	1.51	—	—	—
0.050	2.77	—	—	—

MAGNETIC PROPERTIES

Magnetic Permeability	Flux Density (gausses)
1000	500
2000	2000
3700	7000 (max. value)
2280	12000
213	17000

Heat Treatment:

Annealing may be done in temperatures from 700 to 1100 deg. C. It is nearly softened when annealed at 800 deg. C for 30 minutes after considerable cold reduction. The time interval required varies with the size and shape of the charge, and annealing under 900 deg. C may be done in air if surface scale is removed by sand-blasting or pickling after annealing. Hydrogen annealing is preferable, however, to avoid oxidation.

Machinability:

Machines readily at slow speeds with standard high speed cutting tools. For fine finish work, the cut should be lubricated with lard oil. Single point turning tools of high speed steel should be ground to 6-8 deg. side rake, 8-12 deg. back rake, 5-8 deg. side clearance, 7-10 deg. front clearance, 10-15 deg. cutting-edge angle, and 10-15 deg. lead angle. Circular and straight cutoff blades have about 7-10 deg. back rake and 5-8 deg. side rake. Cutting tools should have a sharp, smooth and keen cutting edge. Stone the cutting edge after normal grinding.

Workability:

Readily hot or cold worked. Work-hardens very rapidly on cold working. Kovar deep draws readily and in this respect is slightly better than mild steel. The recommended rule for deep drawing Kovar is 40% maximum reduction on the first draw, 25% maximum reduction on the first redraw (30% after reanneal), and 20% maximum reduction on the second and subsequent redraws (25% after reanneal). Spinning of Kovar is not recommended since there is danger of fracturing the metal.

Weldability:

Readily soft-soldered, brazed or welded. Soft soldered with 60:40 lead-tin solder. Copper brazed to soft steel at 1100 deg. C in a suitable atmosphere of hydrogen,

and also to other non-ferrous metals. Excellent joints are made by atomic hydrogen welding Kovar "A" to soft steel. Electric arc and resistance welding are equally satisfactory. Arc welding should be done with a flux-coated electrode of either 18-8 or 25-12 chrome-nickel content.

Pickling:

To remove the oxide on Kovar "A" from the sealing operation before soldering or brazing, pickle electrolytically in a 5-10% sulphuric acid containing 1% quinoline or 1% Rodine No. 110 as an inhibitor. The piece to be cleaned is used as one electrode with carbon or another part serving as the other electrode. The current should be 10-12 volts a-c, with approximately 10 amperes per square inch of surface to be cleaned. Normal acid pickling with a hydrochloric-nitric solution (10% by weight of each acid) for 2-5 minutes immersion at 160 deg. F is sufficient to loosen the oxide and scale, which can then be wiped off with a cloth.

General Characteristics:

Kovar "A" has high resistance to amalgamation with mercury and withstands high thermal shock. The remarkable physical properties of this alloy make it ideal for any application demanding a vacuum-tight, metal-to-glass joint to conduct power into a glass vessel or to insulate electrodes from metal-walled vessels. The thermal expansion of Kovar "A" is similar to that of hard clear glass from room temperature up to annealing temperature of glass.

Forms Available:

Sheet, wire, rod, tubing, and cup and eyelet formed parts.

Applications:

Small rectifiers, grid-glow tubes, ignitrons, metal-glass seals, vacuum tight metal-to-glass seals.

Manufacturers:

Westinghouse Electric Corporation

Pittsburgh, Pennsylvania

Carborundum Co., Refractories Div.

Larrobe, Pennsylvania