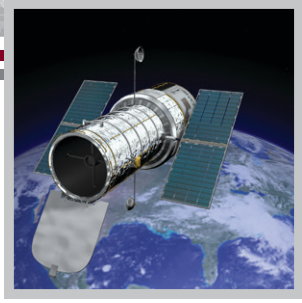
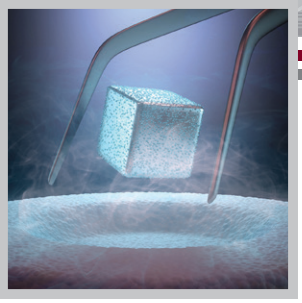
SUPER INVAR





CHEMICAL COMPOSITION %	
Chemical Element	**Super Invar**
Nickel	31.26
Chromium	.03
Manganese	.39
Silicon	.09
Carbon	.05
Aluminum	.07
Sulfur	.01
Cobalt	5.36
Copper	.08

MECHANICAL PROPERTIES	
Property	**Super Invar**
Density	0.294 lb/cubic in
Hardness	77 RB
Tensile Strength	69800 psi
Yield Strength	43900 psi
Elongation 2"	38%
Modulus of Elasticity	21.5 x 10 psi
Poisson's Ratio	.234

Average linear coefficient of thermal expansion µm/m°C	
Temp. range – °C	**Super Invar**
30 to 100	0.84
30 to 150	1.17
30 to 200	1.72
30 to 250	2.53
30 to 300	4.16
30 to 350	5.74
30 to 400	7.03
30 to 500	8.99
30 to 600	10.56
30 to 700	11.56
30 to 800	12.21
30 to 900	12.96

Invar (36% NI-Balance Iron) Alloy has been the metal of choice for low expansion applications for years. "Super-Invar" (31% NI, 5% Co, Balance Iron) has found some favor because it has a near zero coefficient of thermal expansion over a limited temperature range. The useful range of "Super Invar" originally was limited to between –32° to + 275°C because the material begins to transform from Austenite to Martinsite at temperatures below –32°F. Because of the slight variations in chemistry in today's version of this alloy, these ranges may fluctuate. In addition, the cold or hot working of material can affect these variables.

Super Invar is tough and gummy, not hard or abrasive. Tools tend to plow instead of cut, resulting in long stringy "chips." Tools must be sharp, feed and speed low to avoid heat and distortion. The use of a coolant is recommended for all machining operations. Machinability similar to Kovar, Stainless 300 series, and Monel Alloys has been reported. Ni-Fe Alloys generally have a tendency to develop a surface scale during hot working that penetrates the surface. For this reason machining allowances must be increased to eliminate the deep surface oxide. The initial cut is frequently the most difficult.

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