LOW EXPANSION ALLOYS

SUPER INVAR 32-5

Super Invar 32-5, a magnetic, austenitic, solid solution alloy containing iron, nickel, and cobalt, is designed to provide minimum thermal expansion at room temperatures. This alloy also exhibits austenite stability to service temperature at least -67°F and thermal expansion properties less than those of Invar 36 alloy (36% nickel-iron) when used in the -67/203& deg;F (-55/95°C) temperature range.

TYPICAL NOMINAL CHEMISTRY

NICKEL (NI)	31.75
CHROMIUM (CR)	0.03
MANGANESE (MN)	0.39
SILICON (SI)	0.09
CARBON (C)	0.05
ALUMINUM (AL)	0.07
COBALT (CO)	5.36
COPPER (CU)	0.08
SULFUR (S)	0.01
IRON (FE)	BALANCE

TYPICAL HARDNESS, ROCKWELL B

ANNEALED	75
COLD WORKED	90

TYPICAL MECHANICAL PROPERTIES

0.2% YIELD STRENGTH

KSI	40
Mpa	276

ULTIMATE TENSILE STRENGTH

KSI	70
Mpa	483

% ELONGATION IN 2”	40

PHYSICAL PROPERTIES

SPECIFIC GRAVITY	8.15
DENSITY lb/cu in	0.294
DENSITY kg/cu m	8150
ELECTRICAL RESISTIVITY (RT) MICROHM-CM	80
MODULUS OF ELASTICITY x 10(6) psi	21
MODULUS OF ELASTICITY x 10(6) MPa	144
MS TEMPERATURE ºF	-112
MS TEMPERATURE ºC	-80
POISSON’S RATIO	0.2

TYPICAL LINEAR COEFFICIENT OF THERMAL EXPANSION

(CM. PER CM. C x 10 – 6)

10(-6)/ºF(-67 TO 203ºF)	0.35
10(-6)/ºC(-55 to 95ºC)	0.63

SUPER INVAR WORKABILITY

Forging

Suggested forging temperature is 2000/2150°F. Heat rapidly and avoid soaking in the forging furnace. Long soaking time may result in a checked surface due to oxygen and sulfur contamination.

Grinding

A soft silicon carbide wheel which will wear without loading is recommended. For finishing grinding, a satisfactory wheel roughness to start with is No. 80 grit.

Machinability

Super Invar 32-5 machines similar to, but not as well as , Type 316 austenitic stainless steel. Its machinability rating is approximately 25% that of AISI B1112. This alloy is somewhat difficult to machine because the machined chips are gummy and stringy. Work hardened bars can result in some improvement in machinability.

Tool geometries normally used for austenitic stainless steels are suitable for this alloy. All tools should be kept sharp with a fine finish, be as large as possible, and rigidly supported.

Recommended cutting fluids are 1 to 1 blend of sulfachlorinated petrolum oil containing 8 to 10% fatty oil and a paraffin blending oil, or a water emulsifiable cutting fluid with polar and extreme pressure additives.

Parts should be degreased and cleaned as soon after machining as possible to remove any residual sulfur which can cause grain boundary embrittlement.

When using carbide tools, surface speed feet/minute can be increased between 2 to 3 times over the high speed suggestions. Feeds can be increased between 50 to 100%.

On certain work, the nature of the part may require adjustment of speeds and feeds. Each job has to be developed for best production results with opitmum tool life. Speeds and feeds should be increased or decreased in small steps.