



SEATTLE, WASHINGTON
1.800.426.9794
PHONE 253.627.2910 · FAX 253.926.4660

LOS ANGELES, CALIFORNIA
1.800.624.8073
PHONE 323.588.2688 · FAX 323.588.1767

WWW.SSA-CORP.COM

MASSILLON, OHIO
1.800.822.6358
PHONE 330.833.5800 · FAX 330.833.5815

HARTFORD, CONNECTICUT
1.800.641.4140
PHONE 860.688.8393 · FAX 860.683.2337

EMAIL: SALES@SSA-CORP.COM

INVAR DATA SHEET FOR COMPOSITE TOOLING

CHEMISTRY

Carbon.....	0.02%
Manganese.....	0.35%
Silicon.....	0.20%
Nickel.....	36.00%
Iron.....	Balance
Sulfur.....	0.002%
Phosphorus.....	0.002%

Age Hardening Chemistry available upon request.

APPLICATION

Service Steel's product has been specifically manufactured for fabricating composite tooling. Our Invar is produced in accordance with the Boeing and Lockheed tooling specifications D33028 and TPS-82, respectively. This chemistry limits the sulfur and phosphorus contents for better weldability.

INVENTORY LIST

PLATE PRODUCTS

- 250 x 96 x 240
-375 x 96 x 240
-500 x 96 x 240
- 1 x 96 x 240
- 1-1/2 x 96 x 240
- 2 x 96 x 240
- 3 x 96 x 240
- 4 x 96 x 240

FLAT BAR PRODUCTS

SSA is stocking Invar 36 Billets to be converted into various flat bar sizes as needed by the customer. Lead time is 3-4 weeks on these products.

WELD WIRE..... .097 x 36 TIG

**Service
Steel
Aerospace
Corp.**



SEATTLE, WASHINGTON
1.800.426.9794
PHONE 253.627.2910 · FAX 253.926.4660

LOS ANGELES, CALIFORNIA
1.800.624.8073
PHONE 323.588.2688 · FAX 323.588.1767

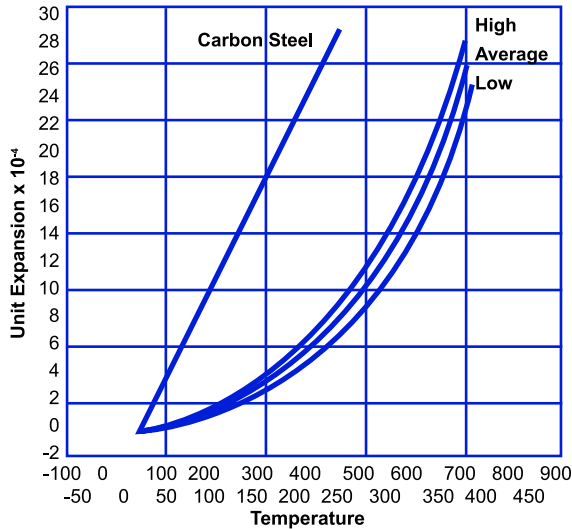
WWW.SSA-CORP.COM

MASSILLON, OHIO
1.800.822.6358
PHONE 330.833.5800 · FAX 330.833.5815

HARTFORD, CONNECTICUT
1.800.641.4140
PHONE 860.688.8393 · FAX 860.683.2337

EMAIL: SALES@SSA-CORP.COM

THERMAL EXPANSION PROPERTIES



COMPARATIVE EXPANSION CURVES - INVAR VS CARBON STEEL

HEAT TREATMENT

Heat to 1450°F (790°C) and hold at heat 30 minutes per inch of thickness, then air cool. Heating to temperatures above 1000°F (536°C) relieves the presence of cold work stresses. The higher the temperature, the lower the annealed hardness, as show in the following table.

Specimen held for 5 minutes at heat:

Temperature Air Treat		Hardness Rockwell B
°F	°C	
1200	850	87/88
1500	815	77/78
1800	980	70/71
1800	1040	66/68

Heat Treatment for Optimal Dimensional Stability:

The presence of cold work stresses causes very slight changes in dimensional stability with respect to time and temperature. This change can be detected only with exceedingly sensitive devices. To assure optimal dimensional stability, heat to 1500°F (815°C), hold at heat for 30 minutes per inch of thickness, water quench, reheat to 600°F (315°C) holding one hour at heat, then air cool. To promote temporal stability (when necessary), Invar has been aged for 24 to 48 hours at 200°F (63°C).

MACHINING

Tool	Turning S3 or S4 Carbide	Milling Sup. High Speed Steel	Drilling High Speed Steel
Lubricant	Water soluble oil	Water soluble oil	Water soluble oil
True rake angle	12-17°	15°	
Tool clearance	5-8°	3-7°	9-13°
Cutting speed (m/mm)	50-75	10-15	10
Feed mm/	02-0.5/rev	0.05-0.10/rev	0.10/rev