

KPC METAL CO., LTD. (KPCM) IS

Korea's leading company in production and supply of nickel and titanium alloys and super alloys for critical engineering. Founded in 1977, we have almost 40 years of experience supplying the alloys for industries working in challenging environments. We produce these materials in our in-house facilities including VIM, ESR, VAR, extrusion press, rolling mill, forging press and radial forging machines, enabling us to meet the requirements of our customers. Especially, for our Invar 36 products, we closely work with two very different sectors - aerospace industry (Invar casting) and display device industry (Invar plates), which shows our ability to adapt to different requirements and needs of customers. To satisfy our valued customers in always changing global business environment, we make constant efforts for quality assurance and development of new products.

LOCATIONS



Wachon Factory

Vacuum melting
Casting
Open die forging



Deokchon Factory

Machining
Overlay welding



Sowol Factory

Radial forging
Rolling
Extrusion



Sangam Factory

Ring Rolling



CERTIFICATION & APPROVAL

Certification

ISO9001
AS9100
PED

Approval

Korean Airline
Samsung Display

LOW EXPANSION NICKEL-IRON ALLOY (INVAR 36 & SUPER INVAR 32-5)

Invar 36, is an iron-nickel austenitic alloy of 36% nickel, which exhibits lowest thermal expansivity. It is strong, tough, ductile and retains a useful degree of corrosion resistance. It is magnetic at temperatures below its Curie point and non-magnetic at temperatures above. Invar 36 is the standard alloy for low expansivity up to 200°C, presenting approximately one-tenth of carbon steel thermal expansion up to 200°C. We recommend the higher nickel alloys for applications at higher temperatures.

Because of its uniquely low coefficient of thermal expansion, Invar 36 is used where high dimensional stability is required. The typical applications for Invar 36 include tooling for aerospace composites, standards of length, measuring tapes and gauges, precision components as well as the low expansion component in bi-metal strip, in cryogenic engineering and for laser components. We produce Invar 36 for industries where dimensional changes due to temperature variation must be minimized such as aircraft controls and electronic devices.

We also offer 32% Ni-5% Co, Iron alloy, also known as Super Invar 32-5, which is a magnetic, austenitic, solid solution alloy containing iron, nickel and cobalt and designed to provide minimal thermal expansion. At room temperature, this alloy retains approximately half of the thermal expansion of Invar 36. This material is typically used for structural components or bases and supports in optical and laser systems requiring precision measurements. For the rate of thermal expansion of our products, please see the Linear Expansion Test section on this page.

DESIGNATIONS AND STANDARDS

National/Non-National Standards	Material Designation	SPECIFICATION		
		Chemical composition	Sheet & Plate	Casting
ASTM	UNS K93600 for thermostat alloy	B388 B753(T-36)	B388 B753(T-36)	
	UNS K93603 for low expansion alloy	F 1684	F 1684	
AMS		I-23011		
BOEING		D33028-2		D33028-2

NOMINAL CHEMICAL PROPERTIES

	Fe	Ni	Co	Mn	Si	C	Al	Mg	Zr	Ti	Cr	P	S
Invar 36	Bal.	36	Max. 0.50	Max. 0.60	Max. 0.40	Max. 0.05	Max. 0.10	Max. 0.10	Max. 0.10	Max. 0.10	Max. 0.25	Max. 0.015	Max. 0.015
Super Invar 32-5	Bal.	32	5.0	Max. 0.60	Max. 0.25	Max. 0.05	Max. 0.10	Max. 0.10	Max. 0.10	Max. 0.10	Max. 0.25	Max. 0.015	Max. 0.015

NOMINAL MECHANICAL PROPERTIES

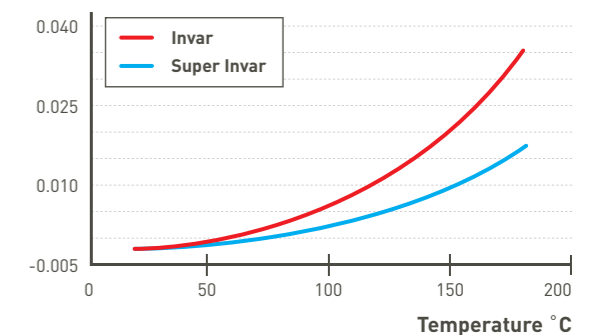
Classification	Room Temperature Tensile strength[Plate]		Hardness		Coefficients of Thermal Expansion ($\mu\text{m}/\text{m}^\circ\text{C}$)
	Tensile Strength	0.2% Yield Strength	Strip, Sheet (For deep drawing)	Plate	
Invar 36	400 ~ 500 (MPa)	230 ~ 350 (MPa)	Thickness \leq 2.54mm : Max. 157(HV)	60 ~ 85 (HRb)	1.2 ~ 2.7 (30 ~ 150°C)
Super Invar 32-5			Thickness \leq 2.54mm : Max. 85(HRb)		Max. 0.9 (-18 ~ 93°C)

LINEAR EXPANSION TEST

Classification	Coefficients of Thermal Expansion ($\mu\text{m}/\text{m}^\circ\text{C}$)	
Invar 36	2.5 (30 ~ 150°C)	3.51 (120 ~ 180°C)

Classification	Coefficients of Thermal Expansion ($\mu\text{m}/\text{m}^\circ\text{C}$)	
Super Invar 32-5	0.53 (-18 ~ 93°C)	1.72 (120 ~ 180°C)

$\Delta\text{L}/\text{L}$ -Expansion %



KPC Metal

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Tel. » 82-53-850-9200
Fax. » 82-53-853-6386
E-mail » kpcm@kpccorp.co.kr
URL » www.kpctitanium.com / www.kpcmmetal.co.kr

VELOX

Forged Round Bar

Address. » 22 Geumsong-ro 87-gil, Gyeongsan-si, Gyeongsangbuk-do, 38412, South Korea
Tel. » 82-53-853-8877
Fax. » 82-53-964-3398
URL » www.velox.co.kr

KPC

Automated ball valve

Main office & factory

Address. » 8 Ansim-ro 59 gil, Dong-gu, Daegu, 41081, South Korea
Tel. » 82-53-960-1500
Fax. » 82-53-963-6386
URL » www.kpccorp.co.kr

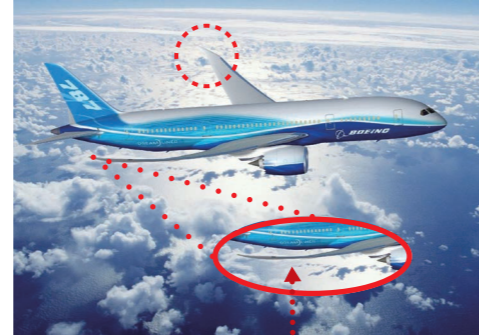
Seoul office

Address. » 13F, Dongwha Bldg, 106 Seosomun-ro, Jung-gu Seoul, 04513, South Korea
Tel. » 82-2-2637-9188
Fax. » 82-2-2637-9118

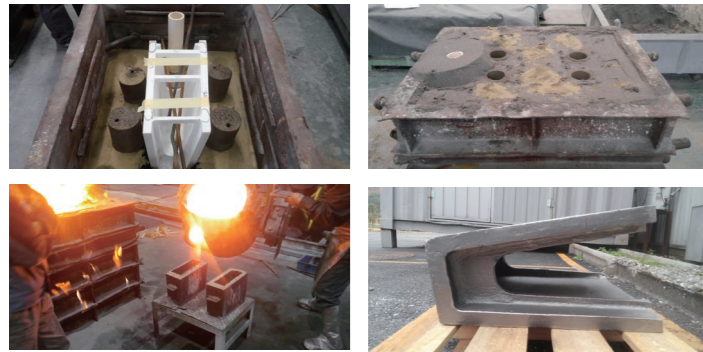
OUR PRODUCTS

INVAR 36 CASTING

Material	BOEING D33028-2
Customer	Commercial Aircraft Manufacturer
Application	Composite Tooling for Aircraft Component
Manufacturing Process	Pattern Making & Casting Design – Molding – Melting & Pouring – Shake-out – Cutting & Grinding
Product Size Range	Up to 20 ton



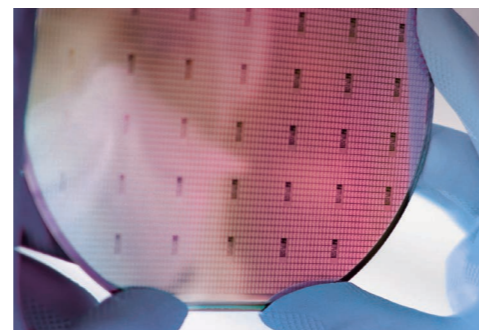
Invar Casting Manufacturing Process



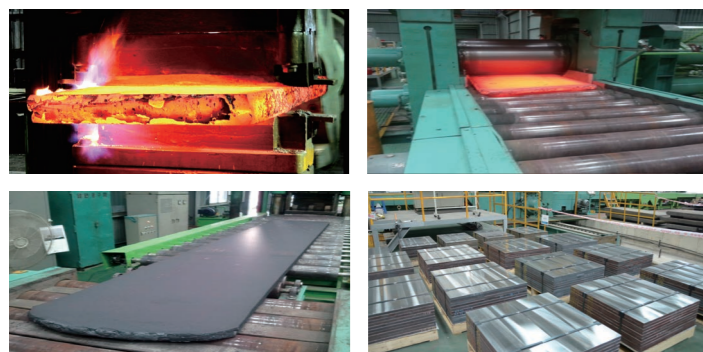
Lay-Up Mandrel for Raked Wing Composite Part

INVAR 36 PLATE

Material	ASTM F1684 K93603 (UNS K93603)
Customer	Display Industry
Application	OLED Deposition Masking Frame
Applicable emperature	200°C
Manufacturing Process	Melting-Forging-Rolling-Machining
Product Size Range (mm)	Thickness: 10 ~ 110 Width: Max. 1,200 Length: Max. 8,000



Invar Plate Manufacturing Process



APPLICATIONS

Invar 36 was developed for applications requiring the lowest possible thermal expansion.

Typical applications are :

- Production, storage and transportation of liquefied gases
- Equipment to indicate and control temperatures below 200°C, i.e., thermostats
- Bushings for screw or bolt connections between different metals
- Bimetallic components and thermostat metals, where Invar 36 constitutes the passive component
- Diaphragm frames
- TV shadow masks
- Molds for the production of carbon fiber reinforced plastic (CFRP) components
- Frames for electronic control units for satellites and space crafts at temperatures down to -200°C
- Mountings for electromagnetic lens systems in laser control devices
- Clock pendulums
- Components in automotive applications

HEAT TREATMENT

Anneal : The alloy softens progressively when heated in the range of 538 to 1260°C. Pronounced grain growth does no occur until 1038°C has been passed. It can be air cooled or water quenched from the annealing temperature.

Stress Relieve : Heat to 316 ~ 371°C for about one hour, air cool, reheat to a temperature somewhat above the top operating temperature, cool slowly to somewhat below the lower operating temperature, again heat slowly to above the operating temperature, cool slowly to room temperature (cooling very slowly through the Curie temperature is also considered to improve stability).

Harden : Cannot be hardened by any thermal treatment.

Stabilize : Water quench from 816°C, then age for one hour at 316°C, air cool.

MACHINABILITY

Being tough and ductile, it is difficult to machine Invar 36. High speed steel or sintered carbide should be used and the cutting edges kept sharp. The machinability characteristics of Invar 36 are quite similar to austenitic stainless steels. Because of its high ductility, the chips formed during machining tend to be stringy and tough, thus imposing rapid wear on cutting tool edges. In general, slow speeds and light feeds should be used to avoid excessive heat and minimize the possibility of the generated heat affecting the expansion characteristics. The use of soluble oil cutting compound is recommended for all machining operations.

WORKABILITY

Invar36 can be strengthened and hardened somewhat by cold work, although it does not work harden as rapidly as the stainless steels. It has almost unlimited capacity for plastic deformation, either hot or cold. Therefore, it can be heated or cooled at any rate without danger of rupture. Hot working can be done at any temperature below 1260°C. Exposure at high temperature to sulfur bearing gases causes poor hot working qualities. Cold working hardens the alloy to a maximum of about Rockwell C32.

FORGING

The principal precaution to observe in forging is to heat quickly and avoid soaking in the furnace. Long soaking may result in a checked surface due to absorption of sulfur from the furnace atmosphere and/or oxide penetration. A forging temperature of 1100 ~ 1180°C is preferred. Invar may also be swaged and cold upset.

OUR MANUFACTURING PROCESS

