

Low Thermal Expansion Alloy

EXEO-S10

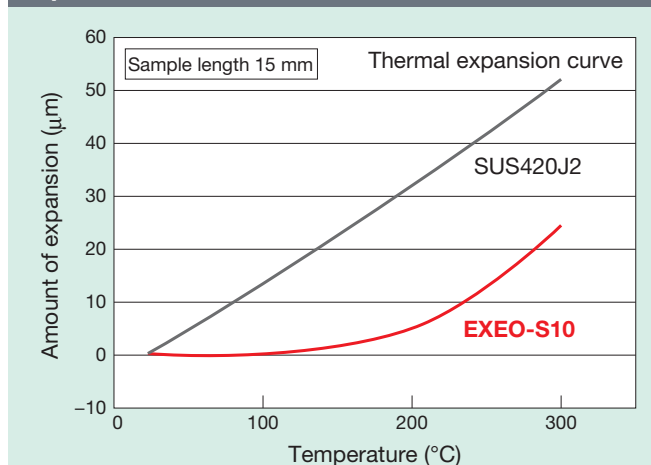
NACHI developed the EXEO series alloys in company-wide combined and connected engineering system by first analyzing and determining necessary characteristics and then applying Nachi original alloy design and special melting technologies.

EXEO-S10 has superior low thermal expansion characteristics, it is clean with few impurities, and the best suitable for precision parts.

- Alloy composition is accurately controlled by using special melting technology.
- Nachi original technologies make it with very low level impurities and non-metallic inclusions.
- It is used as parts of ultra-precision machinery, optical equipment, semiconductor manufacturing machine and electronic devices.

Properties

Expansion characteristics



Physical properties

Item	Hardness (HRB)	Proof stress (MPa)	Tensile strength (MPa)	Elongation (%)	Reduction of area (%)	Density (g/cm ³)	Coefficient of thermal expansion ((30-100°C)/°C)
Annealed material	71	310	440	45	87	8.15	≤1×10 ⁻⁶

Applications

- Spindles for ultra-precision machinery
- Parts for laser beam machine
- Parts for precision measuring equipment
- Parts for optical communications equipment
- Parts for electromagnetic relays
- Parts for satellites
- Parts for magnetic chuck
- Material for glass sealing
- Parts for electromagnetic filters
- Various supports and parts

Production range

Shape	Range of dimensions (mm)
Forged round bar	φ40 – 200 × L1000 - 3000
Rolled round bar	φ13 – 100 × L2000 - 5000
Forged flat bar	Contact us for details (30 - 200)
Rolled flat bar	Contact us for details (t 3 - 40)
Hot drawn steel plate	t 4 - 18, w 400 - 600, L 1000 - 2000
Cold drawn steel plate	t 0.5 - 12, w 500 - 600, L 1000 - 2000

- Available either finished or semi-finished.
- Contact us for production specifications, delivery times, and minimum orders.

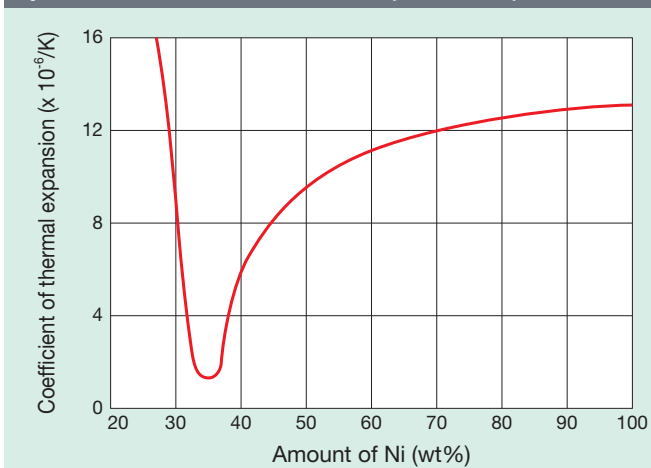


Air-spindle for ultra-precision machinery

About low thermal expansion material

- When the percentage of nickel in iron-nickel alloys reaches 36%, the alloy undergoes magnetic transformation and the expansion coefficient becomes extremely small, about 1/10 of normal metals. This phenomenon is called the Invar property.

Figure 1. Relation between amount of Ni in Fe-Ni alloy and thermal expansion coefficient



(Source: ASM METAL HANDBOOK)

- Cobalt has been added to these alloys for an Fe-Ni-Co ternary alloy. It is called Super Invar alloy because it has a thermal expansion coefficient that is smaller than Invar.

Table 1. Coefficient of thermal expansion for various materials

Name of material	Coefficient of thermal expansion (x 10 ⁻⁶ /K)
Magnesium Mg	26.0
Aluminum Al	23.5
Copper Cu	17.0
Gold	14.1
Nickel Ni	13.3
Iron Fe	12.1
Platinum Pt	9.0
Molybdenum Mo	5.1
Tungsten W	4.5
Brass	17.5
Stainless steel 304	17.3
Stainless steel 420	10.9
High-speed steel M2	8.6
Invar	≤2.0
Super Invar	≤1.0
Diamond	1.1
Pyrex glass	3.2
Magnesium oxide MgO	9.7
Concrete	7 ~ 14
Celluloid	90 ~ 160
Bakelite	21 ~ 33

(Source: Alloy Data Book, Chronological Scientific Tables, and the journals JSPE, etc.)

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