

Designation	THERMELAST® 4002	UNS N09902	AISI -	LMSA F102
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Chemical composition

Fe	Ni+ Co	Cr	Ti	Mn	Si
Balance	41.0 - 43.5	4.90 - 5.75	2.20 - 2.75	0.80 max.	1.00 max.
Al	C	S	P	-	-
0.30 - 0.80	0.06 max.	0.04 max.	0.04 max.	-	-

Values (Weight %). In order to achieve maximum homogeneity and consistent quality, the actual manufacturing tolerances are tighter and more precise than the composition indicated.

Main technical properties and features

Thermelast® 4002 is a nickel-iron alloy specifically engineered to provide a controlled coefficient of thermal expansion (CTE). This property defines the extent to which a material expands or contracts in response to temperature changes. The key advantage of this alloy is its ability to closely match the thermal expansion characteristics of two different materials, such as glass, ceramics, and semiconductors. By minimizing thermal expansion mismatch, Thermelast® 4002 significantly reduces thermally induced stresses, thereby enhancing reliability, dimensional stability, and service life of assembled components.

Thermelast® 4002 can be strengthened by cold working, allowing the production of specific metallurgical tempers tailored to application requirements. The mechanical strength of Thermelast® 4002 can be further enhanced through an age-hardening heat treatment performed at 650 °C. The alloy is suitable for both welding and brazing processes, providing flexibility for a wide range of joining applications.

Thermelast® 4002 complies with AMS 5221, AMS 5223, and AMS 5225 specifications.

Typical uses

Springs for the watchmaking industry. Also used in many precision devices in which the elastic elements are subject to temperature variations (Bourdon tubes, aneroid capsules, diaphragms, and springs for weighing instruments).

Typical manufacturing range

	Thickness (mm)	Width (mm)	Length (mm)
Rolled products Strip in coils ^[1]	0.010 - 0.700	1.5 - 200.0	-
Strip as sheets ^[1]	0.015 - 0.400	10.0 - 200.0	300 - 3000

^[1] Not all our production possibilities are presented here. Other dimensions or product forms available upon request. Some combinations of thicknesses and widths are not possible.

Mechanical properties of strips

Temper	R _m (N/mm ²)	R _{p0.2} (N/mm ²)	A _{50mm} (%)	Hardness HV
soft annealed	550 - 750	200 - 400	25 - 50	100 - 220
½ hard	750 - 950	500 - 850	3 - 20	220 - 300
hard	900 - 1100	800 - 1070	min. 2	270 - 350
spring	min. 1050	min. 900	-	min. 320

1. Physical properties

Modulus of elasticity	kN/mm ²	165 - 200 (depending on temper)
Density	g/cm ³	8.05
Melting point	°C	1450 - 1480
Linear dilatation coefficient 20 to 100 °C	10 ⁻⁶ /°C	7.6
Thermal conductivity at 20°C	W/m °K	12.1
Electrical resistivity at 20°C	μΩcm	101
Specific heat	J/(kg. K)	500
Curie temperature	°C	190

Heat treatment of finished parts

The optimum properties of Thermelast® 4002 alloy are achieved by different heat treatments, depending on the properties required. To maintain a bright surface, it is advisable to carry out the treatment in a furnace under hydrogen atmosphere.

Treatment type	Alloy metallurgical conditions after treatment	Temperature (°C)	Time (h)	Cooling
Aging	Good overall properties (high Rm). Maximum stability	650	2	Air
Stress relieving	Minimum hysteresis Low thermoelastic coefficient (TEC)	400	2	Air

Tolerances (strip and foil)

Thickness	Thickness (mm)		Lamineries MATTHEY				
	≥	<	LMSA Standard	LMSA Precision	LMSA Extreme		
The table shown is an outline of our typical thickness tolerances available. They are tighter than industry standards. Our "LMSA Precision" and "LMSA Extreme" tolerances are available upon request.	-	0.025	-	-	± 0.001		
	0.025	0.050	± 0.003	± 0.002	± 0.0015		
	0.050	0.065	± 0.004	± 0.003	± 0.002		
	0.065	0.100	± 0.006	± 0.004	± 0.003		
	0.100	0.125	± 0.008	± 0.006	± 0.003		
	0.125	0.150	± 0.008	± 0.006	± 0.004		
	0.150	0.250	± 0.010	± 0.008	± 0.004		
	0.250	0.300	± 0.012	± 0.008	± 0.005		
	0.300	0.400	± 0.012	± 0.009	± 0.005		
	0.400	0.500	± 0.015	± 0.010	± 0.006		
	0.500	0.600	± 0.020	± 0.012	± 0.007		
	0.600	0.800	± 0.020	± 0.014	± 0.007		
	0.800	1.000	± 0.025	± 0.015	± 0.009		
	1.000	1.200	± 0.025	± 0.018	± 0.012		
	1.200	1.250	± 0.030	± 0.020	± 0.012		
	1.250	1.500	± 0.035	± 0.025	± 0.014		
Width	Our width tolerances "Standard" is +0.2, -0.0 (or ± 0.1 mm upon request). They are available for slit widths < 125 mm and thickness < 1.00 mm. Special tolerances upon request.						
Camber	Width (mm)		Camber max. (mm/m)				
	>	≤	LMSA standard		LMSA extreme		
			≤ 0.5 mm	> 0.5 mm	≤ 0.5 mm	> 0.5 mm	
		3	6	12	-	6	-
		6	10	8	10	4	5
Our tolerance "LMSA Standard" respects the EN Standard 1654 (Length of measurement 1000 mm). Other tolerances upon request.	10	20	4	6	2	3	
	20	250	2	3	1	1.5	
	Surface	Special surface qualities upon request					
Flatness	Special requirement on the longitudinal or transversal flatness upon request						

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