LAMINERIES MATTHEY
NOTZ group advanced metal solutions

Thermelast® 4002

		UNS	AISI	LMSA
Designation	**THERMELAST® 4002**	N09902	-	F102

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 which the main characteristic is its controllable thermoelastic coefficient (TEC). Thermelast® 4002 can be hardened by cold working, which allows specific metallurgical conditions to be obtained. In addition, the mechanical strength of the Thermelast® 4002 alloy can be increased by aging treatment. This alloy can be assembled by welding and or by brazing.

Thermelast® 4002 alloy complies with the AMS 5221, AMS 5223 and AMS 5225 standards.

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/mm²)	$Rp_{0.2}$ (N/mm²)	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

Physical properties

Modulus of elasticity	kN/mm²	165 - 200 (depending on temper)
Density	g/cm³	8.05
Melting point	°C	1450 - 1480
Linear dilatation coefficient 20 to 100 ºC	10^{-6}/ ºC	7.6
Thermal conductivity at 20°C	W/m °K	12.1
Electrical resistivity at 20ºC	µΩcm	101
Specific heat	J/(kg. K)	500
Curie temperature	ºC	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 (ºC)	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

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.

Thickness (mm)		Lamineries MATTHEY		
≥	<	LMSA Standard	LMSA Precision	LMSA Extreme
-	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

Our tolerance "LMSA Standard" respects the EN Standard 1654 (Length of measurement 1000 mm).
Other tolerances upon request.

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
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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