LAMINERIES MATTHEY
NOTZ group advanced metal solutions

Phytime®

		EN	UNS (ASTM)	AISI	LMSA
Designation	**X2NiCoMo18-16-5**	-	-	-	**E150**

Chemical composition

Fe	Co	Mo	Ni
Balance	15.50 - 17.50	4.50 - 5.50	17.00 - 19.00

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

Phytime® is an iron-nickel-cobalt-molybdenum maraging alloy with a high yield strength. This alloy has a martensitic metallurgical structure and can be hardened by age hardening treatment. During aging, performed mostly at 480 ºC, hardening occurs thanks to an intensive precipitation of nanometer intermetallic Fe_2Mo compound. Aging will lead to an increase in the mechanical properties, although with a slight dimensional change. Reason why heat treatment can be performed after components forming, to avoid distortion. Higher mechanical strength can be obtained with a combination of work hardening, followed by aging treatment.

Phytime® is titanium-free alloy and it has excellent fatigue resistance (free of TiN inclusions), and a superior surface quality can be obtained after polishing. Furthermore, this alloy has excellent weldability, a post-weld heat treatment decreases the difference in properties between welded and non-welded areas. This alloy has moderate corrosion resistance and can withstand some humid atmospheres. Annealing is commonly carried out at a temperature of 830 ºC.

Typical uses

Springs, watchmaking industry, automotive industry (cable connectors to motors), aerospace industry, belt for automatic gearbox transmission.

Typical manufacturing range

		Thickness (mm)	Width (mm)	Length (mm)
Rolled products	Strip in coils [1]	0.010 - 0.400	1.5 - 200.0	-
	Strip as sheets [1]	0.015 - 0.400	10.0 - 200.0	100 - 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

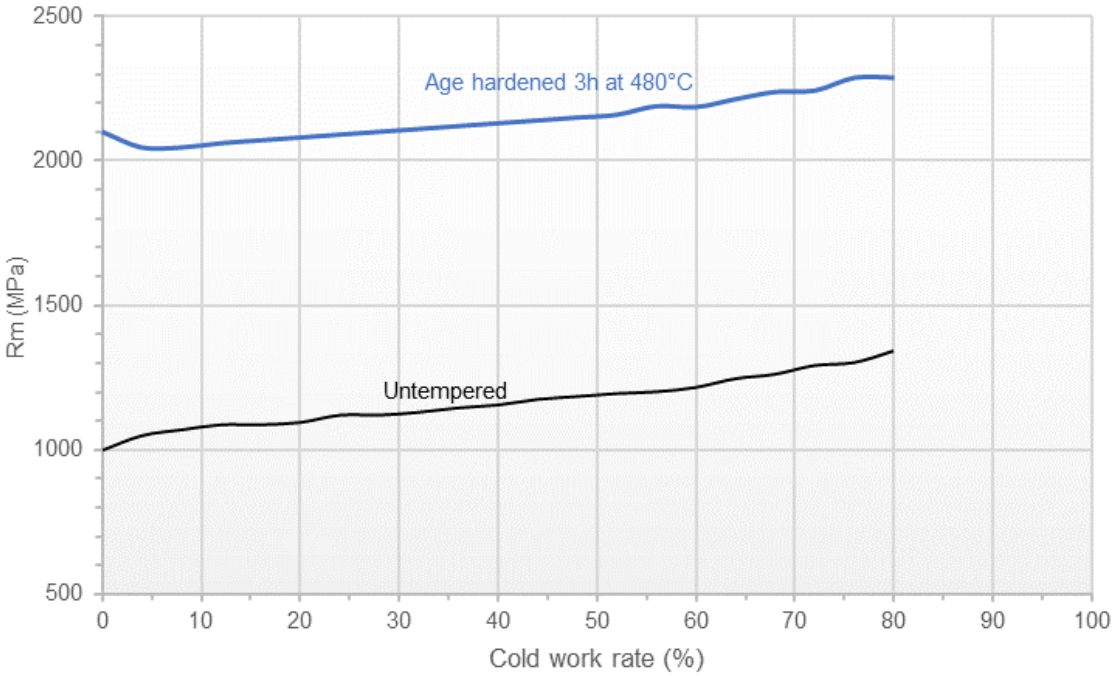
État		Heat treatment	R_m (N/mm^2)	$Rp_{0.2}$ (N/mm^2)	A_{50mm} (%)	Dureté HV
R970	soft	-	970 - 1200	900 min.	-	280 - 340
R1050	soft skin pass	-	1050 - 1250	950 min.	-	300 - 350
R1200	hard	-	1200 min.	1000 min.	-	360 min.
After hardening (at customer)						
R1800	soft + hardened	3h à 480 ºC	1800 - 2100	-	-	540 - 630
R1900	soft skin pass + hardened	3h à 480 ºC	1900 - 2100	-	-	550 - 640
R2200	hard + hardened	3h à 480 ºC	2100 min.	-	-	600 min.

Physical properties

Poisson ratio		0.3
Density	g/cm^3	8.14
Melting point	°C	1430 - 1460
Linear dilatation coefficient (0 - 100ºC)	10^{-6}·/ ºC	9.50
Magnetic saturation induction	Tesla	1.9

Heat treatment

Phytime® alloy can be age hardened. Age hardening treatment lead to precipitation of nanometric intermetallic precipitates. It is highly recommended to perform heat treatment under vacuum in the order of 10^{-5} Torr, or under inert atmosphere such as argon, in order to avoid the metal taking on a blue hue color. Some heat treatment atmospheres, such as hydrogen and cracked ammonia, must not be used. They do not change the surface color of the material but are chemically active thus may cause the material to become extremely brittle. It is worth noting that hardening by aging can induce a slight change in material's dimensions. Age hardening treatment is carried out at a temperature of approximately 420 - 480 ºC for 3 hours.



Effect of work hardening and aging treatment on the mechanical properties of Phytime®. Source: Aperam.

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 thicknesses < 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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