

Designation	EN	UNS (ASTM)	AISI	LMSA
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 precisely 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 °C, hardening occurs thanks to an intensive precipitation of nanometer intermetallic Fe₂Mo compound. Aging will lead to 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 an excellent fatigue resistance (free of TiN inclusions), and a superior surface quality can be obtained after polishing. Furthermore, this alloy has an excellent weldability, a post-weld heat treatment decreases the difference in properties between welded and non-welded areas. This alloy has a moderate corrosion resistance, and can withstand some humid atmospheres.

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

Temper	R _m (N/mm ²)	R _{p0.2} (N/mm ²)	A _{50mm} (%)	Hardness HV
soft	970 - 1200	900 min.	-	280 - 340
soft skin pass	1050 - 1250	950 min.	-	300 - 350
hard	1200 min.	1000 min.	-	360 min.

Physical properties

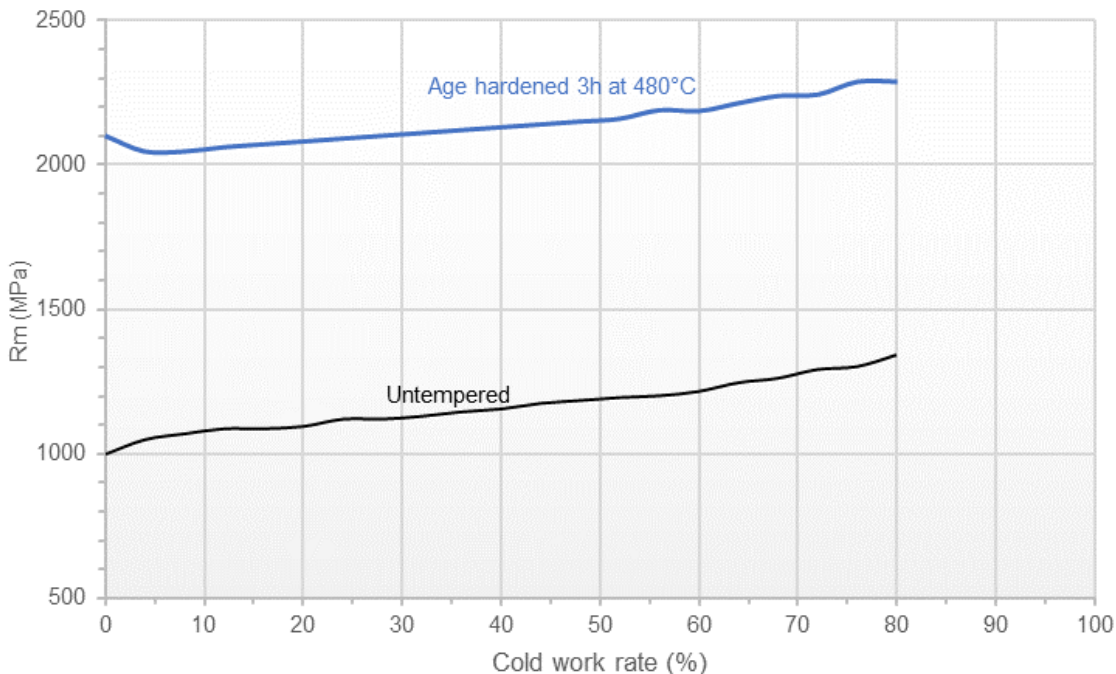
Poisson ratio		0.3
Density	g/cm ³	8.14 ^[1]
Melting point	°C	1430 - 1460
Linear dilatation coefficient (0 - 100°C)	10 ⁻⁶ /°C	9.50
Magnetic saturation induction	Tesla	1.9 ^[1]

^[1] This value is for a standard 480°C tempering. It can change considerably with tempering temperature.

Heat treatment

Phytime® alloy can be age hardened. Age hardening treatment lead to a 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. Worth to note that hardening by aging can induces a slight change in material's dimensions.

Annealing (°C)	Standard aging hardening treatment
830 °C	420 - 480 °C for 3 hours



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

Tolerances (strip and foil)

Thickness	Thickness (mm)		Lamineries MATTHEY			
	≥	<	LMSA Standard	LMSA Precision	LMSA Extreme	
<p>The table shown is an outline of our typical thickness tolerances available. They are tighter than industry standards.</p> <p>Our "LMSA Precision" and "LMSA Extreme" tolerances are available upon request.</p>	-	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	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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