

Désignation	X2NiCoMo18-9-5	DIN	UNS (ASTM)	AISI	LMSA
		~1.6358	-	-	E100

### Chemical composition

Fe	C	Co	Ni	Mo	Ti <sup>[1]</sup>	Al	Mn	Si	P	S
Balance	≤0.03	8.0 - 10.0	17.0 - 19.0	4.5 - 5.5	0.35 - 0.8	0.05 - 0.15	≤0.10	≤ 0.10	≤ 0.01	≤ 0.01

Values (Weight %). In order to achieve maximum homogeneity and consistent quality, the actual manufacturing tolerances are tighter and more precisely than the composition indicated.  
<sup>[1]</sup> DIN 1.6358, Ti. 0.50 -0.80.

### Main technical properties and features

This low carbon hardenable martensitic steel (maraging steel) allows an easy cold working of high spring property parts. The produced strips are delivered in soft, skin passed and cold rolled tempers. Durnico® has a high fatigue strength limit and the cutting edges, often critical in mechanical clock industry, for example, remain smooth. The hardening of parts (typically at 480 °C 3h under vacuum or under inert atmosphere) results in a high degree of hardening without perceptible dimensional change.

After an annealing at high temperature (typically 800 - 1000 °C) and a rapid cooling carried out during the production process, a soft annealed condition is achieved which corresponds to a soft martensite. In contrast to carbon steels, there is no distortion of the lattice by interstitial carbon atoms and the martensitic structure can be easily cold deformed. Moderate temperature tempering results in a high degree of hardening due to of very stable Ni<sub>3</sub>Ti or Fe<sub>2</sub>Mo intermetallic precipitates. This hardening is obtained without any perceptible dimensional change. In the majority of cases this allows the finishing of parts in soft annealed metal without retouching after heat treatment. The work hardening only becomes significant for rates (> 60 %), but the effect of tempering on Durnico® is practically additive. Therefore, the higher tensile strengths are obtained by adding both contributions.

Lamineries MATTHEY proposes two different Maraging steels: Durnico®, X2NiCoMo18-9-5, (Durimphy, NiMark 300) and Durinox®, X2CrNiMo10-10-5, (Ultrafort). A slightly higher mechanical strength can be achieved with Durnico®. Corrosion resistance of Durinox® exceeds that of Durnico®, although it is slightly lower than that of stainless steel 1.4435, 316L.

### Typical uses

Springs, pallet forks, wheels, bridges, connectors, various parts subjected to high stresses, etc.

### Typical manufacturing range

	Thickness (mm)	Width (mm)	Length (mm)
<b>Rolled products</b> Strip in coils <sup>[1]</sup>	0.030 - 1.600	1.5 - 200.0	-
Strip as sheets <sup>[1]</sup>	0.030 - 1.600	10.0 - 200.0	100 - 3000

<sup>[1]</sup> 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.

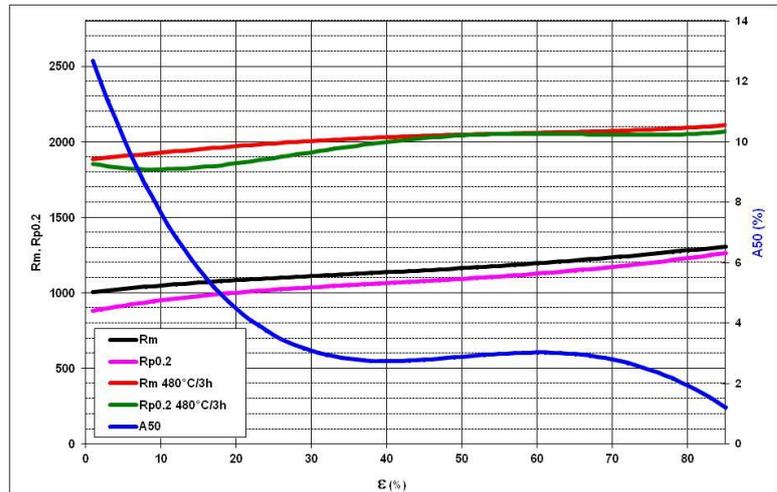
**Mechanical properties of strips**

Temper		Heat Treatment	R <sub>p0.2</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	Hardness HV
R1000	- soft	-	900 min.	1000 - 1200	310 - 345
R1050	- skin pass	-	950 min.	1050 - 1250	310 - 350
R1300	- hard	-	1000 min.	1200 min.	360 min.

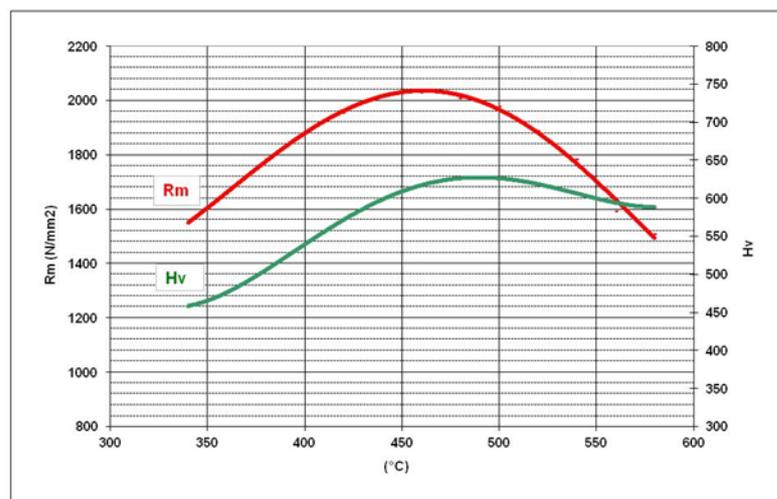
After hardening (by the customer)

R1800	H540	soft + hardened	3h à 480 °C	-	1800 - 2100	540 - 630
R1900	H550	skin pass + hardened	3h à 480 °C	-	1900 - 2100	550 - 640
R2200	H600	hard + hardened	3h à 480 °C	-	2100 min.	600 min.

Strain-hardening curve.  
R<sub>m</sub>, R<sub>p0.2</sub> (N/mm<sup>2</sup>) before and after heat treatment



Evolution of HV and R<sub>m</sub> of skin passed Durnico® as function of temperature (3 hours).



### Physical properties

Modulus of elasticity	kN/mm <sup>2</sup>	195
Poisson ratio		0.3
Density	g/cm <sup>3</sup>	8.1
Melting point	°C	1430 - 1460
Linear dilatation coefficient	10 <sup>-6</sup> /°C	Hardened <sup>[1]</sup> : 9.5 (0 - 100 °C)
Thermal conductivity at 20°C	W/m °K	Hardened <sup>[1]</sup> : 19.7
Electrical resistivity	μΩcm	Hardened <sup>[1]</sup> : 44
Electrical conductivity	MS/m	Hardened <sup>[1]</sup> : 2.28
Specific heat at 20°C	J/(kg. K)	Hardened <sup>[1]</sup> : 440
Curie temperature	°C	Approx. 400

[1] These values are given for standard tempering at 480 °C on soft annealed metal. They can vary slightly with the tempering temperature.

### Tolerances (strip and foil)

Thickness	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

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.

Width	Camber max. (mm/m)				
	Width (mm)		LMSA standard		LMSA extreme
	>	≤	≤ 0.5 mm	> 0.5 mm	≤ 0.5 mm
	3	6	12	-	6
	6	10	8	10	4
	10	20	4	6	2
	20	250	2	3	1

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

<b>Surface</b>	Special surface qualities upon request
<b>Flatness</b>	Special requirement on the longitudinal or transversal flatness upon request

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