Maraging steel Durinox

		DIN	ASTM	AISI	LMSA
Designation	**X2NiCrMoTi10-10-5**	1.6908	-	-	E200

Chemical composition (Weight %)

Fe	C	Cr	Ni	Mo	Ti	Mn	Si	P	S
Balance	≤ 0.03	8.5-10.5	8.5-11.0	4.5-5.5	0.5-1.0	≤ 0.30	≤ 0.30	≤ 0.025	≤ 0.015

In order to achieve maximum homogeneity and consistent quality, the actual tolerances on both alloy components and impurities are significantly tighter and more precisely defined than the standard composition indicated.

Main technological properties

This low carbon martensitic steel is hardenable (maraging steel) and presents a very high tensile strength. In the delivered tempers, Durinox can be hardened in order to reach a tensile strength of approximately 2000 N/mm^2. This high performance steel allows an easy cold working of parts; Durinox has a very 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 a heat treatment at high temperature (typically 800-1000°C) and a rapid cooling carried out during the production process, the face centered cubic austenitic phase is transformed into 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. Hardening is due to the appearance of very stable Ni_3Ti or Ni_3Mo intermetallics, this practically without deformation (distortion) of the treated parts. As a result of the Ni-rich particle precipitation hardening mechanism, austenite-forming nickel is removed from the matrix. This shifts the austenite retransformation to even higher temperatures, allowing Durinox to be used at relatively high temperatures.

Lamineries MATTHEY SA produces two different Maraging steels: Durnico, X2NiCoMo18-9-5, 1.6358 (Durimphy, NiMark 300) and Durinox, X2CrNiMo10-10-5, 1.6908 (Ultrafort). A slightly higher mechanical strength can be achieved with Durnico. Corrosion resistance of Durinox exceeds that of Durnico, though is slightly lower than that of stainless steel 1.4435, 316L.

Typical manufacturing range

		Thickness (mm)	Width (mm)	Length (mm)
Rolled products	Strip in coil [1)]	0.030 - 1.000	1.5 - 200.0	-
	Foil cut to length [1)]	0.030 - 1.000	10.0 - 200.0	100 - 3000

1) Not all our production possibilities are presented here. Other dimensions or other product forms available upon request. Certain combinations of thicknesses and widths are not possible.

Mechanical properties of strips

Temper			Heat Treatment	Rm (N/mm^2)	Hv (N/mm^2)
R1000	H300	Soft annealed	-/-	1000-1200	310-360
R1050	H320	Skin passed	-/-	1050-1250	320-380
R1200	H360	Hard	-/-	≥1200	≥360
After hardening (at the customer)					
R1600	H450	Soft + hardened	3h / 480°C	1600-1900	450-550
R1700	H480	Skin passed + hardened	3h / 480°C	1700-1900	480-550
R1800	H530	Hard + hardened	3h / 480°C	≥1800	≥ 530

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Physical properties

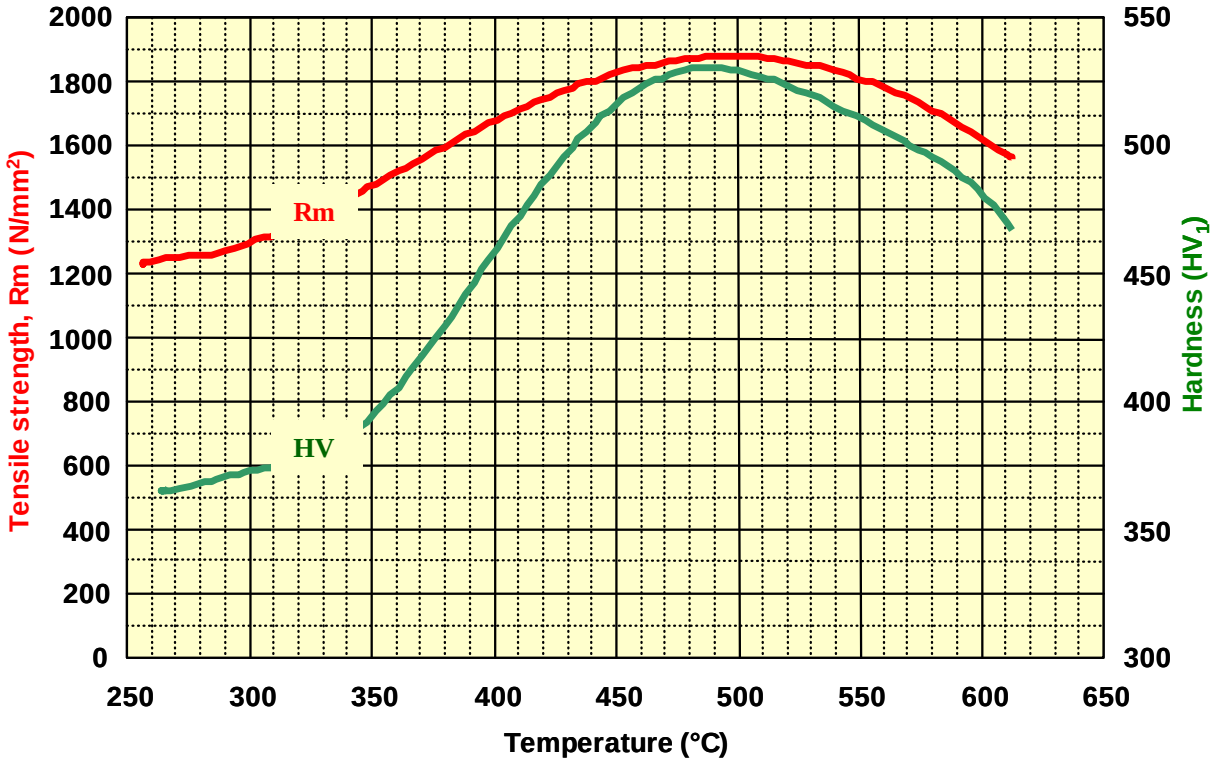
Modulus of elasticity	kN/mm^2	203 at 20°C, 195 at 200°C and 181 at 400°C
Poisson ratio		0.3
Density	kg/dm^3	8.1
Melting point / Melting range	°C	approx.1450
Linear dilatation coefficient (x10^{-6})	/ °C	Soft annealed: 9.9 (20–100°C), 10.7 (20–200°C). 11.1 (20–300°C) et 11.2 (20– 400°C) hardened [1]: 10.3 (20–100°C), 11.0 (20–200°C). 11.2 (20–300°C) et 11.5 (20– 400°C)
Thermal conductivity at 20°C	W/m °K	hardened [1]: 23.6
Specific heat at 20°C	J/kg K	hardened [1]: 440
Electrical resistivity	µΩcm	hardened [1]: 47
Electrical conductivity	MS/m	hardened [1]: 2.13
Curie temperature	°C	approx. 400

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

Typical uses

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

Typical aged hardening curve at different temperatures of Durinox
Initial temper : soft – 3h heat treatment.



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Tolerances

Thickness

The table shown is an outline of our typical thickness tolerances available, which are tighter than industry standards.

Upon request: our "Precision" and "Extreme" tolerances are also available.

Thickness (mm)		Lamineries MATTHEY SA		
≥	<	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	± 0.0012
1.200	1.250	± 0.030	± 0.020	± 0.0012
1.250	1.500	± 0.035	± 0.025	± 0.0014

Width

Our width tolerance is + 0.2 -0.0 mm (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 "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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