

Designation	NiCr22Fe18Mo9Co2W	EN ~2.4665 / ~2.4613	UNS N06002	AISI -	LMSA B625
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## Chemical composition (Weight %)

Ni	C	Cr	Fe	Co	Mo	W	Mn	Si	P	S
Balance	0.05-0.15	20.5-23.0	17.0-20.0	0.5-2.5	8.0-10.0	0.2-1.0	≤ 1.0	≤ 1.0	≤ 0.04	≤ 0.03

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 technical properties and features

**Common Trade Names:** Hastelloy X®, Nickelvac® HX, Microfer® 4722, Altemp® HX, Inconel® HX, Nicrofer 4722 Co, Pyromet Alloy 680

Lamineries MATTHEY SA produces Alloy X in precision cold-rolled product forms (strip and sheet). Alloy X is an austenitic nickel base alloy containing approximately 22 percent chromium for outstanding resistance to oxidation at high temperatures. Alloy X is designated as UNS N06002 / W. Nr ~2.4665 / ~2.4613 and is listed in NACE MR-01-75. Specifications for Alloy X in forms of sheet or strip include the following: ASTM B435, AMS 5536, ISO 6208 and AECMA PrEn2185.

Alloy X, which is solid solution strengthened, possesses exceptional strength at elevated temperatures. Alloy X has good high temperature and stress rupture properties above 790°C (1450°F) and can be used for applications up to 1200°C (2200°F). With the high levels of chromium, nickel and molybdenum in the material, Alloy X exhibits levels of corrosion resistance similar to high nickel alloys more customarily used in corrosion applications. Although this nickel alloy is primarily noted for heat and oxidation resistance, it also has good resistance to chloride stress-corrosion cracking, carburization, and excellent resistance to reducing or carburizing atmospheres. These last two common conditions often lead to early failure in other high temperature alloys. This nickel alloy has also been found to be exceptionally resistant to stress-corrosion cracking in petrochemical applications.

Alloy X alloy has excellent forming and welding characteristics. It can be forged and, because of its good ductility, can be easily cold worked. The work hardening rate of the alloy is comparable to that of the austenitic stainless steels. Machinability is good in the annealed condition. The alloy can be welded by most of the fusion and resistance welding processes. Alloy X can be welded by both manual and automatic methods including shielded metal arc (SMAW), gas tungsten arc (TIG) and gas metal arc (MIG). The alloy can also be resistance welded.

Alloy X strips or sheets are normally delivered in the solution heat-treated condition unless otherwise specified. In production, the alloy is solution heat-treated at high temperature (>1150°C) and rapid cooled. If the heat treatment and the cooling are done under protective atmosphere (hydrogen), bright-annealed products can be delivered.

## Typical manufacturing range

		Thickness (mm)	Width (mm)	Length (mm)
<b>Rolled products</b>	Strip in coils <sup>1)</sup>	0.010 - 2.000	1.5 - 200.0	-
	Strip as sheets <sup>1)</sup>	0.015 - 1.500	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.

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## Mechanical properties of strips

Temper	Tensile strength, Rm (N/mm <sup>2</sup> )	Yield strength, Rp <sub>0.2</sub> (N/mm <sup>2</sup> )	Elongation, A (%)	Hardness HV
Annealed	650-850	300-600	> 25	170-270
½ hard	900-1200	800-1100	> 5	270-390
Hard	> 1200	> 1100	-	> 380

## Physical properties

Modulus of elasticity	kN/mm <sup>2</sup>	205 (197 at 200°C, 185 at 400°C, 158 at 800°C and 137 at 1000°C )
Poisson ratio		0.32
Density	kg/dm <sup>3</sup>	8.20
Melting point / Melting range	°C	1260-1355
Linear dilatation coefficient (20-90°C)	10 <sup>-6</sup> / °C	13.9 (15.6 from 20 to 700°C and 16.8 from 20 to 1000°C)
Thermal conductivity at 20°C	W/m °K	9.1 (14.1 at 200°C, 22.9 at 700°C and 26.9 at 900°C)
Electrical resistivity	μΩcm	116
Electrical conductivity	MS/m	0.86
Electrical conductivity	%IACS	1.49
Specific heat J/kg K	J/kg K	486 (496 at 200°C, 510 at 400°C, 562 at 600°C )
Magnetic properties		Non magnetic (slightly diamagnetic)
Permeability		μ = 1.002

## Typical uses

Alloy X is used for components in combustion chambers of gas turbine engines (such as transition ducts and combustor cans), as well as in afterburners and tailpipes in aircraft and land-based gas turbine engines. Additionally it is used for fans, roller hearths and support members in industrial furnaces, catalyst support grids, and in nuclear engineering. In thin gauge strip and sheet, Alloy X is used as many types of membranes or formed sheet metal components for applications where its unusual resistance to oxidizing and reducing atmospheres, as well as its high temperature strength are necessary.

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## Tolerances

Thickness	Thickness (mm)		Lamineries MATTHEY SA		
	≥	<	LMSA Standard	LMSA Precision	LMSA Extreme
		0.025	-	-	± 0.001
<p>The table shown is an outline of our typical thickness tolerances available. They are tighter than industry standards.</p> <p>Our "Precision" and "Extreme" tolerances are available upon request.</p>	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

	Width (mm)		Camber max. (mm/m)			
	>	≤	LMSA standard		LMSA extreme	
			≤ 0.5 mm	> 0.5 mm	≤ 0.5 mm	> 0.5 mm
<p>Our tolerance "standard" respects the EN Standard 1654 (Length of measurement 1000 mm). Other tolerances upon request.</p>	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