Quality	**X12Cr13**	**Martensitic Stainless Steel**	*Technical card 2018*
Number	**1.4006**		*Lucefin Group*

Chemical composition

C%	Si% max	Mn% max	P% max	S% a) max	Cr%	Ni% max	
0,08-0,15	1,00	1,50	0,040	0,030	11,5-13,5	0,75	EN 10088-3: 2014
± 0.01	+ 0.05	± 0.04	+ 0.005	± 0.005	± 0.15	+ 0.03	

Product deviations are allowed

a) for improving machinability, it is allowed a sulphur content of 0,015 % - 0,030; for polishability, it is suggested a controlled sulphur content of max 0,015 %

Temperature °C

Melting range	**Hot-forming**	**Subcritical annealing**	**Soft annealing +A**	**Full annealing**
1530-1480	1190-900	790-730 air	825-745 air	870-840 cooling 15 °C/h to 590, then air

Isothermal annealing +I	**Quenching +Q**	**Tempering +T**	**Stress-relieving +SR**
885-830 controlled cooling 30 °C/h to 705, then air	1000-950 oil / polymer (HRC 36 ~)	780-650 fast cooling in air	200 air

MMA **welding –** AWS electrodes

pre-heating	*annealing after w.*
200	750-700

joint with steel

carbon	CrMo alloyed	stainless
E60 xx	E8018-B 2	E309 – E308

cosmetic welding

E410

Transformation temperature during heating **Ac1** ~ 810, **Ac3** ~ 885 and during cooling **Ms** ~ 340, **Mf** ~ 190

Chemical treatment ▪ *Pickling* (10 - 15% HNO_3) + (0.5 – 1.5 HF) cold

Mechanical properties

Heat-treated material EN 10088-3: 2014 in conditions 1C, 1E, 1D, 1X, 1G, 2D

size		Testing at room temperature					
mm		**R**	**Rp** 0.2	**A%**	**Kv2** +20 °C	**HBW** a)	a) for information only
from	to	N/mm²	N/mm² min	min	J min	max	
		730 max	-	-	-	220	+A annealed material
	160	650-850	450	15	25	-	+QT650 quenched and tempered

Bright bars of heat-treated material EN 10088-3: 2014 in conditions 2H, 2B, 2G, 2P

size		Testing at room temperature						
mm		**R**	**HBW** a)		**R**	**Rp** 0.2	**A%**	**Kv2** +20 °C
from	to	N/mm² max	max		N/mm²	N/mm² min	min	J min
	10 b)	880	280		700-1000	550	9	-
10	16	880	280		700-1000	500	9	-
16	40	800	250		650-930	450	10	25
40	63	760	230		650-880	450	10	25
63	160	730	220		650-850	450	15	25
		+A annealed material			+QT650 quenched and tempered material			

a) for information only

b) in the range of 1 mm ≤ d < 5 mm, values are valid only for rounds – the mechanical properties of non round bars of < 5 mm of thickness have to be agreed at the time of request and order

Forged UNI EN 10250-4: 2001

size		Testing at room temperature					
mm		**R**	**Rp** 0.2	**A%**	**Kv** +20 °C	**HB**	
from	to	N/mm²	N/mm² min	min	J min	max	
		730 max	-	-	-	220	+A annealed
	160	650-850	450	15	25	-	+QT650 quenched and tempered

Table of tempering values at room temperature on rounds of Ø 10 mm after quenching at 980°C in oil

R	N/mm²	1490	1450	1420	1410	1430	1450	1420	1150	860	740	690
Rp 0.2	N/mm²	1210	1170	1150	1150	1160	1180	1140	870	650	550	500
A	%	10.8	10.8	10.9	12.0	12.5	13.0	16.0	16.5	18.0	20.0	21.5
Kv	J	35	40	36	29	28	27	28	30	41	49	100
Tempering	**°C**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**550**	**600**	**650**	**700**

Transition-curve determined with Kv. Material quenched at 970 °C in oli

Average	J	6	16	26	50	80	120	140	150	170	tempering at 790 °C	**690**
Average	J	5	12	18	26	50	84	110	114	140	tempering at 665 °C	**820**
Average	J	4	6	8	14	26	36	76	78	120	tempering at 595 °C	**950**
Tests at	**°C**	-160	-120	-80	-40	0	+40	+80	+100	+200	**tensile strenght**	**N/mm²**

X12Cr13 **n° 1.4006** martensitic stainless steel *Lucefin Group*

Effect of **cold-working** (hot-rolled +A+C). Approximate values

R	N/mm²	580	650	700	750	790	800	850	920	1050
Rp 0.2	N/mm²	380	500	580	600	690	720	780	810	900
A	%	20	10	8	8	8	8	8	8	7
Reduction **%**		**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**

Minimum values at high temperatures on quenched and tempered material EN 10088-3: 2014

Rp 0.2	N/mm²	420	410	400	385	365	355	305	+QT 650
Test at	**°C**	**100**	**150**	**200**	**250**	**300**	**350**	**400**	

Thermal expansion	$10^{-6} \cdot K^{-1}$	►	10.5	11.0	11.5	12.0	
Modulus of elasticity	longitudinal GPa	215	212	205	200	190	
Poisson number	*v*	0.235	0.210				
Electrical resistivity	Ω • mm²/m	0.60					
Electrical conductivity	Siemens•m/mm²	1.67					
Specific heat	J/(Kg•K)	460					
Density	Kg/dm³	7.70					
Thermal conductivity	W/(m•K)	30					
Relative magnetic permeability	μr	900 [1)]					
°C		**20**	**100**	**200**	**300**	**400**	

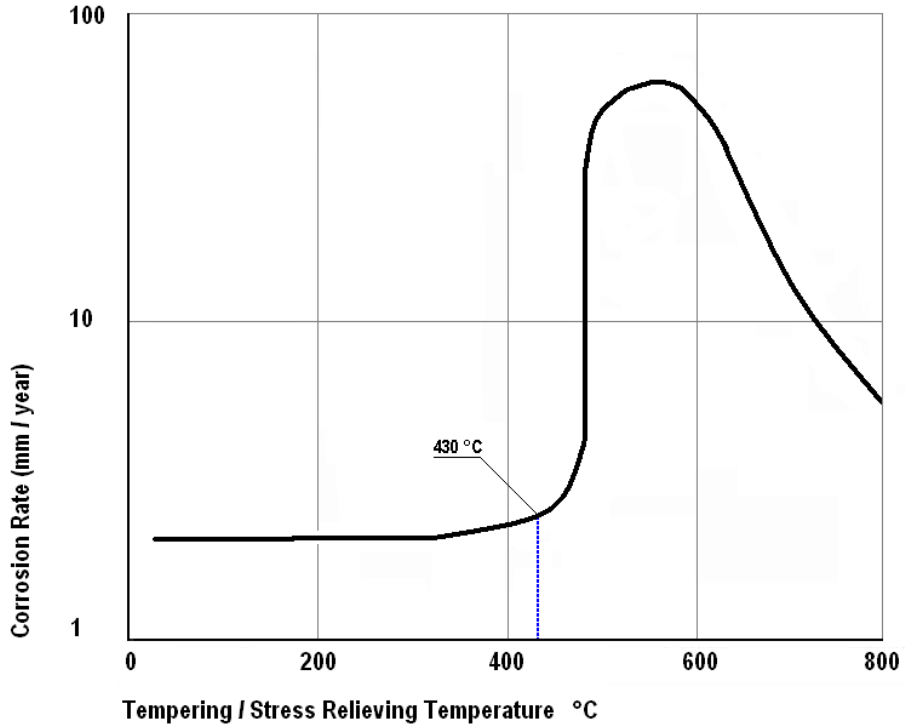
The symbol ► indicates temperature between 20 °C and 100 °C, 20 °C and 200 °C …..
[1)] max 900 for material in its natural state; max 750 for full annealed material

Corrosion resistance	Atmospheric		Chemical			**x** petroleum, gasoline, alcohol, ammonia, mercury, food
Fresh water	*industrial*	*marine*	*medium*	*oxidizing*	*reducing*	
x			**x**			

Magnetic	yes
Machinability	good on annealed and quenched and tempered
Hardening	by quenching
Service temperature in air	continuous service up to 705 °C; intermittent service up to 815 °C

Europe	**USA**	**USA**	**China**	**Russia**	**Japan**	**India**	**Republic of Korea**
EN	UNS	ASTM	GB	GOST	JIS	IS	KS
X12Cr13	S41000	**410**	1Cr12	12Ch13	SUS 410	X12Cr12	STS 410

Schematic diagram - Loss of resistance to corrosion - AISI 410 steel



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