

Quality	X12Cr13	Martensitic
Number	1.4006	Stainless Steel

Chemical composition

C%	Si%	Mn%	P%	S% ^{a)}	Cr%	Ni%	
	max	max	max	max		max	
0,08-0,15	1,00	1,50	0,040	0,015	11,5-13,5	0,75	EN 10088-1: 2014
± 0.01	+ 0.05	± 0.04	+ 0.005	+ 0.003	± 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	MMA welding – AWS electrodes		
1530-1480	1190-900	790-730 air	825-745 air	870-840 cooling 15 °C/h to 590, then air	pre-heating	annealing after w.	
					200	750-700	
Isothermal annealing +I	Quenching +Q	Tempering +T	Stress-relieving +SR		joint with steel		
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		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 (20 - 50% HNO₃) hot or 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%	Kv +20 °C	HB ^{a)}	^{a)} for information only
from	to	N/mm ²	N/mm ² 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	HB ^{a)}		R	Rp 0.2	A%
from	to	N/mm ² max	max		N/mm ²	N/mm ² min	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 EN 10250-4: 2001

size		Testing at room temperature					
mm		R	Rp 0.2	A%	Kv +20 °C	HB	
from	to	N/mm ²	N/mm ² 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/mm ²	1490	1450	1420	1410	1430	1450	1420	1150	860	740	690
Rp 0.2	N/mm ²	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 oil

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/mm ²

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

R	N/mm ²	580	650	700	750	790	800	850	920	1050
Rp 0.2	N/mm ²	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/mm ²	420	410	400	385	365	355	305		+QT 650
Test at	°C	100	150	200	250	300	350	400		

Thermal expansion	10 ⁻⁶ • K ⁻¹	►	10.5	11.0	11.5	12.0				
Modulus of elasticity	longitudinal GPa		215	212	205	200	190			
Poisson number	ν		0.235	0.210						
Electrical resistivity	$\Omega \cdot \text{mm}^2/\text{m}$		0.60							
Electrical conductivity	Siemens•m/mm ²		1.67							
Specific heat	J/(Kg•K)		460							
Density	Kg/dm ³		7.70							
Thermal conductivity	W/(m•K)		30							
Relative magnetic permeability	μ_r		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

