

<b>Quality</b>	<b>X20Cr13</b>	<b>Martensitic</b>
Number	<b>1.4021</b>	<b>Stainless Steel</b>

### Chemical composition

C%	Si%	Mn%	P%	S% <sup>a)</sup>	Cr%	
	max	max	max	max		
0,16-0,25	1,00	1,50	0,040	0,015	12,0-14,0	EN 10088-1: 2005
± 0.01	+ 0.05	+ 0.04	+ 0.005	+ 0.003	± 0.15	

Product deviations are allowed

<sup>a)</sup> for improving machinability, it is allowed a controlled 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	Recrystallization +RA	Soft annealing +A	Full annealing	MMA welding – AWS electrodes <i>pre-heating</i> <i>annealing after w.</i>
1510-1460	1100-800	not suitable	825-745 air	900-870 cooling 15 °C/h to 590, then air	250-200    750
Isothermal annealing +I	Quenching +Q	Tempering +T	Stress-relieving +SR		<i>joint with steel</i> carbon    CrMo alloyed    stainless
885-830 controlled cooling to 705, then air	1050-950 oil/polymer/air (HRC 46 ~)	700-650 air	250-150 air		E60 xx    E8018-B 2    E309 <i>cosmetic welding</i> E420 – E410

Transformation temperature during heating **Ac1** ~ 790, **Ac3** ~ 850 and during cooling **Ms** ~ 240, **Mf** ~ 90

### Mechanical properties

**Hot-formed** EN 10088-3: 2005 in conditions 1C, 1E, 1D, 1X, 1G, 2D

size		Testing at room temperature					
mm		<b>R</b>	<b>Rp</b> 0.2	<b>A%</b>	<b>Kv</b> +20 °C	<b>HB</b> <sup>a)</sup>	<sup>a)</sup> for information only
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	J min	max	
		760 max				230	+A annealed
	160	700-850	500	13	25		+QT700 quenched and tempered
	160	800-950	600	12	20		+QT800 quenched and tempered

**Cold-processed** EN 10088-3: 2005 in conditions 2H, 2B, 2G, 2P

size		Testing at room temperature						
mm		<b>R</b>	<b>HB</b> <sup>a)</sup>		<b>R</b>	<b>Rp</b> 0.2	<b>A%</b>	<b>Kv</b> +20 °C
from	to	N/mm <sup>2</sup> max	max		N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	J min
	10 <sup>b)</sup>	910	290		750-1000	600	8	
	10	910	290		750-1000	550	8	
	16	850	260		700-950	500	10	25
	40	800	230		700-900	500	12	25
	63	760	220		700-850	500	13	25
		+A annealed material			+QT700 quenched and tempered material			

<sup>a)</sup> for information only

<sup>b)</sup> 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		<b>R</b>	<b>Rp</b> 0.2	<b>A%</b>	<b>C%</b>	<b>Kv</b> +20 °C	<b>HB</b>
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	min	J min	max
		760 max					230
	160	700-850	500	13		25	
	160	800-950	600	12		20	

**Table of tempering** values at room temperature on rounds of Ø 10 mm after quenching at 970°C in oil

		1650	1550	1540	1530	1530	1500	1200	900	790	600
<b>R</b>	N/mm <sup>2</sup>										
<b>Rp</b> 0.2	N/mm <sup>2</sup>	1320	1280	1260	1250	1230	1180	980	680	600	560
<b>A</b>	%	12	11	10.5	10.5	11	12	15	17	18	20
<b>Kv</b>	J	25	22	18	12	10	12	18	32	36	60
<b>Tempering °C</b>		<b>200</b>	<b>300</b>	<b>350</b>	<b>400</b>	<b>450</b>	<b>500</b>	<b>550</b>	<b>600</b>	<b>650</b>	<b>700</b>

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

		580	650	670	680	685	690	720	745	760
<b>R</b>	N/mm <sup>2</sup>									
<b>Reduction %</b>		<b>0</b>	<b>8</b>	<b>10</b>	<b>12</b>	<b>14</b>	<b>16</b>	<b>18</b>	<b>20</b>	<b>22</b>

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

R	N/mm <sup>2</sup>	760	810	830	840	855	870	880	895
Rp 0.2	N/mm <sup>2</sup>	570	740	770	780	795	800	820	830
A	%	18	16	15	15	14	13	12	11
Reduction	%	0	8	10	12	14	16	18	20

Minimum values at high temperatures EN 10088-3: 2005

Rp 0.2	N/mm <sup>2</sup>	460	445	430	415	395	365	330	material +QT700
Rp 0.2	N/mm <sup>2</sup>	515	495	475	460	440	405	355	material +QT800
Test at	°C	100	150	200	250	300	350	400	

Thermal expansion	10 <sup>-6</sup> • K <sup>-1</sup>	▶	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 • mm <sup>2</sup> /m	0.60						
Electrical conductivity	Siemens•m/mm <sup>2</sup>	1.67						
Specific heat	J/(Kg•K)	460						
Density	Kg/dm <sup>3</sup>	7.70						
Thermal conductivity	W/(m•K)	30						
Relative magnetic permeability	μr	950 <sup>1)</sup>						
°C		20	100	200	300	400	600	800

The symbol ▶ indicates temperatures between 20 °C and 100 °C, 20 °C and 200 °C .....

<sup>1)</sup> max 950 for full annealed material

Corrosion resistance	Atmospheric		Chemical			x aggressive atmosphere lacking chlorine-derived substances
	Fresh water	<i>industrial</i> <i>marine</i>	<i>medium</i>	<i>oxidizing</i>	<i>reducing</i>	
x						

Magnetic	yes
Machinability	good
Hardening	by quenching
Service temperature in air	continuous service up to 650 °C; intermittent service up to 750 °C

Europe	USA	USA	China	Russia	Japan	India	Republic of Korea
EN	UNS	ASTM	GB	GOST	JIS	IS	KS
X20Cr13	S42000	420	2Cr13	20Ch13	SUS 420J1		STS 420J1

T.T.T. diagram (Transformation – Time – Temperature)- AISI 420 steel

