

<b>Quality</b>	<b>X2CrNiMoN22-5-3</b>	<b>Austenitic-Ferritic</b>	<i>Technical card 2018</i>
Number	<b>1.4462</b> <sup>a)</sup>	<b>Stainless Steel (Duplex)</b>	<b>Lucefin Group</b>

### Chemical composition

C%	Si%	Mn%	P%	S%	Cr%	Ni%	N%	Mo%	
max	max	max	max	max					
0,03	1,00	2,00	0,035	0,015	21,0-23,0	4,5-6,5	0,10-0,22	2,5-3,5	EN 10088-3: 2014
+ 0.005	+ 0.05	+ 0.04	+ 0.005	+ 0.003	± 0.25	± 0.10	± 0.02	± 0.10	

Product deviations are allowed

<sup>a)</sup> subject to agreement, this steel grade can be delivered with a Pitting Resistance Equivalent n° (PRE = Cr + 3,3Mo + 16N) higher than 34

### Temperature °C

Melting range	Hot-forming	Solution annealing (Solubilization) +AT	Stabilizing	Soft annealing +A	MMA welding – AWS electrodes
1440-1390	1150-950	1100-1020 water	not suitable	not suitable	<i>pre-heating</i> 100 <i>post welding</i> solubilization
Embrittlement	Carbides precipitation	Sigma phase formation	Stress-relieving +SR short stay	Recrystallization +RA	joint with steel
475	800-450	950-700	600-550 air	1100-1020 quick cooling	carbon      CrMo alloyed      stainless E309L-16    E309MoL-15    E317L <i>cosmetic welding</i> E 2209-17

**Chemical treatment** - *Pickling* (52% HNO<sub>3</sub>) + (65% HF) hot - *Passivation* 20 - 45% HNO<sub>3</sub> 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%	A%	Kv <sub>2</sub> +20 °C	Kv <sub>2</sub> -40 °C	HBW <sup>a)</sup>
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min (L)	min (T)	J min (L)	J min (L) <sup>b)</sup>	max
	160	650-880	450	25	-	100	40	270

<sup>a)</sup> for information only (L) = longitudinal (T) = transversal <sup>b)</sup> EN 10272 : 2003

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

size		Testing at room temperature						
mm		R	Rp 0.2	A%	A%	Kv <sub>2</sub> +20 °C	Kv <sub>2</sub> +20 °C	
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min (L)	min (T)	J min (L)	J min (T)	
	10 <sup>b)</sup>	850-1150	650	12	-	-	-	
10	16	850-1100	650	12	-	-	-	+AT
16	40	650-1000	450	15	-	100	-	solubilization
40	63	650-1000	450	15	-	100	-	
63	160	650-880	450	25	-	100	-	

<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  
(L) = longitudinal (T) = transversal

**Forged** +AT solubilization UNI EN 10250-4: 2001

size		Testing at room temperature						
mm		R	Rp 0.2	A%	A%	Kv +20 °C	Kv +20 °C	Kv -196 °C
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min (L)	min ((T)	J min (L)	J min (T)	J min (T)
	350	650-880	450	25	20	100	60	-

**Cold-hardened** EN 10263-5: 2003

size		Testing at room temperature						
mm		R	Z%			R	Z%	
from	to	N/mm <sup>2</sup>	min			N/mm <sup>2</sup>	min	
5	10	1020 max	-	+AT+C		900 max	55	+AT+C+AT
10	25	1000 max	-	+AT+C		880 max	55	+AT+C+AT

Effect of **coldworking** (hot-rolled +AT+C). Approximate values

<b>R</b>	N/mm <sup>2</sup>	750	850	1000	1120	1210	1300	1340	1370	1370
<b>Rp 0.2</b>	N/mm <sup>2</sup>	560	800	960	1080	1160	1270	1280	1330	1350
<b>A</b>	%	34	23	13	8	6	5	4,5	3	2
<b>Riduzione</b>	%	<b>0</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>

After cold deformation with a reduction higher than 10%, it is recommended solution annealing

**Minimum yield stress and tensile strength values at high temperatures on material +AT EN 10028-7: 2007**

<b>R<sub>p</sub> 0.2</b>	N/mm <sup>2</sup>	422 <sup>a)</sup>	360	335	315	300
<b>R</b>	N/mm <sup>2</sup>	621 <sup>a)</sup>	590	570	550	540
Test at	°C	<b>50</b>	<b>100</b>	<b>150</b>	<b>200</b>	<b>250</b>

a) determined by linear interpolation

<b>Thermal expansion</b>	10 <sup>-6</sup> • K <sup>-1</sup>	▶	13.0	13.5	14.0
<b>Modulus of elasticity</b>	longitudinal GPa	200	194	186	180
<b>Poisson number</b>	ν	0.25			
<b>Electrical resistivity</b>	Ω • mm <sup>2</sup> /m	0.80	0.85	0.90	1.00
<b>Electrical conductivity</b>	Siemens • m/mm <sup>2</sup>	1.25			
<b>Specific heat</b>	J/(Kg • K)	500	530	560	590
<b>Density</b>	Kg/dm <sup>3</sup>	7.80			
<b>Thermal conductivity</b>	W/(m • K)	15.0	16.0	17.0	18.0
<b>Relative magnetic permeability</b>	μ <sub>r</sub>	magnetizable			
°C		<b>20</b>	<b>100</b>	<b>200</b>	<b>300</b>

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

<b>Corrosion resistance</b>	Atmospheric		Chemical			x intercrystalline, pitting, crevice, stress corrosion cracking
Brackish water	<i>industrial</i>	<i>marine</i>	<i>medium</i>	<i>oxidizing</i>	<i>reducing</i>	
x	x	x	x	x		

<b>Magnetic</b>	yes
<b>Machinability</b>	difficult
<b>Hardening</b>	cold-drawn and other cold plastic deformations
<b>Service temperature</b>	in pressure vessels, up to -200 °C; do not use over +340 °C. Air oxidation 1000 °C

Europe	USA	USA	China	Russia	Japan	India	R. Corea
EN	UNS	ASTM	GB	GOST	JIS	IS	KS
X2CrNiMoN22-5-3	S31803	Type 2205	022Cr22Ni5Mo3N	02Ch22N5AM2	(SUS 329J3L)		(STS 329J3L)

*Empirical formulas for stainless steels; classification by EN 10088-1 microstructure*

<b>FNA</b> Ferrite number based on complemented Schaeffler/De Long diagram ASME III div. 1 NB-2433	FNA = 3,34F – 2,46A – 28,6 FNA = 4,44F – 3,39A – 38,4 FNA = 4,06F – 3,23A – 32,2  where: F= 1,5Si + Cr + Mo + 2Ti + 0,5Nb A= 30C + 0,5Mn + 30N + Ni + 0,5Cu + 0,5Co	for FNA = max 5,9 for FNA = 6,0 – 11,9 for FNA = min 12	Austenitic when: FNA = (-40) - 20  Austenitic-Ferritic ( <b>Duplex</b> ) when: FNA = 30 – 50 or SM = 8 - 15
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<b>PRE</b> Pitting Resistance Equivalent Herbsleb (30N) -Truman (16N)	PRE = Cr + 3,3Mo + 16N  PRE = Cr + 3,3Mo + 30N	most common formula for super-austenitic/duplex/ferritic steels; also for austenitic steels with Mo>3%	Resistant when: PRE = 40 - 60
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1.4462 steel +AT - structure: 50% austenite, 30% ferrite, 20% sigma-phase (σ). The sigma-phase is an indication of embrittlement

