



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

STRUMENTI Instruments	MATERIALE Material	DIN EN 10088-1	DUREZZA Hardness Rockwell
Pinza emostatica Forceps	X15Cr13 X20Cr13 X5CrN 189 XSCrNMO 1810	1.4024 1.4021 1.4301 1.4401	40-48 HRC 42-50 HRC >=185 HV10 >= 185 HV10
Forbici Scissors	X38CrMO V 15 X45CMo V 15 X20Cr13 X5CrNMO 1810	1.4117 1.4116 1.4021 1.4401	50-58 HRC 50-58 HRC 42-50 HRC >=250 HV 10
Portaghi Needle holders	X15Cr13 X20Cr13 X5CrNMO 1810	1.4024 1.4021 1.4401	40-48 HRC 42-50 HRC >=250 HV10
Pinze/forbici per ossa Bone forceps and bone scissors	X40 Cr 13 X35 CrMoV 15 X45 CrMoV 15	1.4034 1.4117 1.4116	50-58 HRC 50-58 HRC 50-58 HRC
Bisturi Scalpel handles	Inox steel	S	50-58 HRC
Divaricatori Retractors	X5CrNMO 1810 X15Cr13 X15Cr 13	1.4401 1.4024 1.4021	>=185 HV10 40-48 HRC 42-50 HRC
Pinze per dissezione Ligature Conductors	X 12CrNS 18 8 X15Cr 13 X20Cr 13	1.4305 1.4024 1.4021	>=185 HV10 40-48 HRC 42-50 HRC
Curette/Curette per ossa tagliente Curettes / bone curettes cutting	G-X35 CrMo 17 X40 Cr13 X38 CrMoV 15 X45 CrMoV 15	1.4122 1.4034 1.4117 1.4116	50-58 HRC 50-58 HRC 50-58 HRC 50-58 HRC
Pinze per estrazione Extraction forceps	X20 Cr13	1.4021	42-50 HRC
Leva per ossa Bone levers	X40 Cr13 X38 CrMoV 15 X45 CrMoV 15	1.4034 1.4117 1.4116	50-58 HRC 50-58 HRC 50-58 HRC



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
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Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

Grades

The standard gives each steel grade a 'Reference Letter', with only cross references to ISO 4957 and ISO 683-13 standard grades. There are 11 martensitic steels, 1 ferritic steel and 4 austenitic steels in Table 2 of the standard. Most instrument manufacturers regard these stainless steel grades as generic and tend to also refer to European or national standards.

The compositions are summarized below.

Long service lives should be expected from martensitic stainless steel dental and surgical instruments, properly manufactured and subjected to appropriate cleaning procedures. For example, dental extraction forceps usually have an average service life of 15 years. There are some examples where such instruments have given 30 years service life. Other more delicate instruments and those with cutting edges may be expected to have a much shorter service lives, but they should not be expected to suffer corrosion damage.

Corrosion resistance

Corrosion problems associated with martensitic stainless steels tend to be related to either process deficiencies or substances encountered in clinical practice. Process deficiencies include incorrect heat treatment (usually apparent from the distribution of carbides in the microstructure), iron contamination from grinding/finishing operations, over-heating during grinding operations or selection of an inappropriate grade.

Corrosion testing

Most of the ISO product standards for dental and surgical instruments refer to ISO 13402, which specifies corrosion tests based on the methods of sterilisation commonly encountered by these products. Martensitic stainless steels should meet the requirement of ISO product standards with ease (ie resistance to autoclaving, corrosion and thermal exposure).

Sterilization practice

Corrosion problems associated with clinical practice tend to be associated with contact with aggressive substances (eg chloride-containing disinfectants) and/or inappropriate exposure times to such substances. For example, steam sterilisers (autoclaves) should use distilled, de-ionised or sterile water and not tap water for sterilisation or there is a risk of corrosion.

Prior to sterilisation, contaminated instruments may be soaked in a disinfectant. On one occasion, neat Milton solution (approx. 16% sodium chloride) was used and the instruments were soaked over a weekend. Extensive corrosion occurred in this case.

Tabelle 4 — Nichtrostender Stahl

Referenzbuchstabe nach Tabelle 1	Werkstoffnummer nach EN 10088-1:2014	Werkstoffkurzbezeichnung nach EN 10088-1:2014	Härte in Rockwell (HRC) ISO 6508-1	Härte in Vickers HV5/HV10 ^a ISO 6507-1	Stahlsorte
<i>b</i>	1.4006	X12Cr13	35	360	martensitisch
<i>e</i>	1.4016	X6Cr17	N.A.	N.A.	ferritisch
<i>a</i>	1.4021	X20Cr13	42 - 50	420 - 530	martensitisch
<i>b</i>	1.4024	X15Cr13	40 - 48	400 - 500	martensitisch
<i>g</i>	1.4028	X30Cr13	49 - 55	510 - 620	martensitisch
<i>c</i>	1.4034	X46Cr13	50 - 58	530 - 675	martensitisch
<i>m</i>	1.4037	X65Cr13	57 - 61	650 - 750	martensitisch
<i>d</i>	1.4057	X20CrNi16-2	40 - 48	400 - 500	martensitisch
<i>e</i>	1.4104	X14CrMoS17	30	310	martensitisch
<i>e</i>	1.4105	X6CrMoS17	N.A.	N.A.	ferritisch
<i>q</i>	(1.4108) ^b	X30CrMoN15-1	54 - 59	590 - 700	martensitisch
<i>p</i>	1.4109	X70CrMo15	55 - 60	610 - 720	martensitisch
<i>f</i>	1.4112	X90CrMoV18	52 - 60	545 - 720	martensitisch
<i>g</i>	1.4116	X50CrMoV15	50 - 58	530 - 675	martensitisch
<i>h</i>	1.4117 ^b	X38CrMoV15	50 - 58	530 - 675	martensitisch
<i>f</i>	(1.4121) ^b	X22CrMoNiS13-1	48 - 54	500 - 600	martensitisch
<i>c</i>	1.4122	X39CrMo17-1	50 - 58	530 - 675	martensitisch
<i>f</i>	1.4123	X40CrMoVN16-2	52 - 57	560 - 660	martensitisch
—	1.4125	X105CrMo17	54 - 60	590 - 720	martensitisch
<i>f</i>	1.4197 ^c	X22CrMoNiS13-1	48 - 54	500 - 600	martensitisch
<i>i</i>	1.4301	X5CrNi18-10	N.A.	N.A.	austenitisch
<i>j</i>	1.4305	X8CrNiS18-9	N.A.	N.A.	austenitisch
<i>k</i>	1.4310	X10CrNi18-8	N.A.	N.A.	austenitisch
<i>l</i>	1.4401	X5CrNiMo17-12-2	N.A.	N.A.	austenitisch
<i>m</i>	1.4441	X2CrNiMo18-15-3	N.A.	N.A.	austenitisch
<i>o</i>	1.4542	X5CrNiCuNb 16-4	wählbar	wählbar	ausscheidungshärtend
<i>p</i>	1.4543	X3CrNiTiNb 12-9	wählbar	wählbar	ausscheidungshärtend

^a Die Umwandlung von Rockwellhärte in Vickershärte erfolgt wie in ISO 18265:2003, Tabelle A.1, angegeben. Zum berechneten HV5/HV10-Wert wird 1 HRC (Wert beruht auf Erfahrungen mit nichtrostendem Stahl) addiert.

^b Nicht in EN 10088-1 enthalten. Wenn die Materialnummer in Klammern angegeben ist, war das Material nur in der Stahl-Eisen-Liste enthalten.

^c Historische Materialnummern, die in verschiedenen Anwendungsbereichen als 1.4121 verwendet werden, sich aber auf das gleiche Material beziehen (als 1.4121). 1.4197 wird für rotierende Instrumente verwendet.



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
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Quality	X50CrMoV15	Martensitic	<i>Technical card</i>
Number	1.4116	Stainless Steel	<i>Lucefin Group</i>

Chemical composition

C%	Si%	Mn%	P%	S% ^{a)}	Cr%	Mo%	V%	
0,45-0,55	max 1,00	max 1,00	max 0,040	max 0,015	14,0-15,0	0,50-0,80	0,10-0,20	EN 10088-1: 2005
± 0.02	+ 0.05	+ 0.03	+ 0.005	+ 0.003	± 0.15	± 0.05	± 0.03	

Product deviations are allowed

^{a)} 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	Full annealing	Soft annealing	MMA welding – AWS electrodes
1480-1460	1100-900	930-870 furnace	850-750 slow cooling	pre-heating 260 annealing after w. 760-740
Isothermal annealing	Quenching	Tempering	Stress-relieving	joint with steel
910-890 controlled cooling to 750, then air	1030-980 oil / polymer (HRC 55)	500-400 air	250-150 air	carbon E70 xx CrMo alloyed E8018-B 2 stainless E309 – E308 cosmetic welding E309

Transformation temperature during heating **Ac₁** ~ 880, **Ac₃** ~ 920 and during cooling **Ms** ~ 280, **Mf** ~ 120

Mechanical properties

Hot-formed EN 10088-3: 2005 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		
	900 max				280		+A annealed material

Table of tempering values at room temperature after quenching at 990 °C in oil

HB	543	518	512	518	512	525	496	381	301
HRC	54	52,5	52	52,5	52	53	51	41	32
Tempering °C	200	250	300	350	400	450	500	550	600

Thermal expansion	10 ⁻⁶ · K ⁻¹	▶	10.5	11.0	11.0	11.5			
Modulus of elasticity	longitudinal	GPa	215	212	205	200	190		
Poisson number		ν	0,27-0,30 ~						
Electrical resistivity		Ω · mm ² /m	0.65						
Electrical conductivity		Siemens · m/mm ²	1.54						
Specific heat		J/(Kg · K)	460						
Density		Kg/dm ³	7.70						
Thermal conductivity		W/(m · K)	30						
Relative magnetic permeability		μ _r	700 ~						
Temperature		°C	20	100	200	300	400	600	800

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

Corrosion resistance	Atmospheric	Chemical	
Fresh water	<i>industrial</i> <i>marine</i>	<i>medium</i> <i>oxidizing</i> <i>reducing</i>	x steam, petroleum, gasoline, alcohol, ammonia, organic material
x		x	

Magnetic	yes
Machinability	mean
Hardening	by quenching
Service temperature in air	up to 760 °C

Europe	USA	USA	China	Russia	Japan	India	Republic of Korea
EN	UNS	ASTM	GB	GOST	JIS	IS	KS
X50CrMoV15			(7Cr17)	50Ch14MF	(SUS 440A)		



INSTRUMENTE GMBH

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Quality	X46Cr13					Martensitic
Number	1.4034					Stainless Steel

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 Luvini Steel

Chemical composition

C%	Si%	Mn%	P%	S% ^{a)}	Cr%	
0,43-0,50	1,00	1,00	0,040	0,015	12,5-14,5	EN 10088-1: 2014
± 0.02	+ 0.05	+ 0.03	+ 0.005	+ 0.003	± 0.15	

Product deviations are allowed
^{a)} 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	MMA welding – AWS electrodes
1480-1470	1180-930	not suitable	850-750 slow cooling to 600, then air	pre-heating 250-200 annealing after w. 750
Quenching +Q	Tempering +T	Stress-relieving +SR	Stress-relieving +SR after +C	joint with steel
1050-950 oil / air (HRC 50 ~)	700-650 air	200 fast cooling in air	650-600 furnace cooling	carbon CrMo alloyed stainless E70 xx E8016-B 2 E309-E308 cosmetic welding E420

Transformation temperature during heating **Ac1** ~ 805, **Ac3** ~ 870 and during cooling **Ms** ~ 280, **Mf** ~ 130

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	
	800 max				245	+A annealed material
160	850-1000	650	10	12		+QT850 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%	Kv +20 °C
from to	N/mm ² max	max		N/mm ²	N/mm ² min	min	J min
	10 ^{b)}	950	305	900-1150	700	7	
10	16	950	305	900-1150	700	7	
16	40	900	280	850-1100	650	8	12
40	63	840	260	850-1000	650	8	12
63	160	800	245	850-1000	650	10	12

^{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

Table of tempering values at room temperature after quenching at 990 °C in oil

HB	543	518	512	518	512	525	496	381	301
HRC	54	52,5	52	52,5	52	53	51	41	32
Tempering °C	200	250	300	350	400	450	500	550	600

Magnetic yes
Machinability good after annealing
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
X46Cr13	(S42000)	(420)		(4Ch13)			




INSTRUMENTE GMBH

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Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

Quality	X20Cr13	Martensitic
Number	1.4021	Stainless Steel

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Chemical composition

C%	Si%	Mn%	P%	S% ^{a)}	Cr%	
0,16-0,25	max 1,00	max 1,50	max 0,040	max 0,015	12,0-14,0	EN 10088-1: 2014
± 0.01	+ 0.05	+ 0.04	+ 0.005	+ 0.003	± 0.15	

Product deviations are allowed

^{a)} 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	Subcritical annealing	Soft annealing +A	Full annealing	MMA welding – AWS electrodes
1510-1460	1200-930	790-730 air	825-745 air	900-870 cooling 15 °C/h to 590, then air	pre-heating annealing after w. 250-200 750
Isothermal annealing +I	Quenching +Q	Tempering +T	Stress-relieving +SR		joint with steel carbon CrMo alloyed stainless E60 xx E8018-B 2 E309
885-830 cooling 30 °C/h to 705, then air	1050-950 oil/polymer/air (HRC 46 ~)	700-650 fast cooling in air	250-150 air		cosmetic welding E420 – E410

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

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	
	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

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%	Kv +20 °C
from to	N/mm ²	max	N/mm ²	N/mm ² min	min	J min
10 ^{b)}	910	290	750-1000	600	8	
10 16	910	290	750-1000	550	8	
16 40	850	260	700-950	500	10	25
40 63	800	230	700-900	500	12	25
63 160	760	220	700-850	500	13	25
	+A annealed material		+QT700 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

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

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



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

Quality	X46CrS13		Martensitic		 GRUPPO TECHNICAL CARD GRUPPO LUCEFIN REVISION 2015 ALL RIGHTS RESERVED LUCEFIN Lovin Steel		
Number	1.4035		Stainless Steel				
Chemical composition							
C%	Si%	Mn%	P%	S%	Cr%	EN 10088-1: 2014	
0,43-0,50	max 1,00	max 2,00	max 0,040	0,15-0,35	12,5-14,0		
± 0.02	+ 0.05	+ 0.04	+ 0.005	± 0.02	± 0.15		
Product deviations are allowed							
Temperature °C							
Melting range	Hot-forming	Recrystallization +RA	Soft annealing +A	MMA welding – AWS electrodes			
1480-1460	1100-930	not suitable	850-750 slow cooling to 600, then air	pre-heating annealing after w. not recommended			
Quenching +Q	Tempering +T	Stress-relieving +SR	joint with steel				
1050-950 oil / air	675-625 fast cooling in air	200 air	carbon CrMo alloyed stainless				
Transformation temperature during heating Ac₁ ~ 805 , Ac₃ ~ 870 and during cooling Ms ~ 280 , Mf ~ 130							
Chemical treatment • Pickling (20 - 50% HNO ₃) 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		
63	800 max				245	+A annealed material	
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%	Kv +20 °C			
from to	N/mm ² max	N/mm ² min	min	J min			
10 ^{b)}	880	280					
10	880	280					
16	800	250					
40	760	230					
+A annealed material							
^{a)} for information only							
^{b)} in the range 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							
Corrosion resistance		Atmospheric		Chemical		x weak acid, steam, ammonia, petroleum, organic material	
Fresh water		industrial	marine	medium	oxidizing reducing		
x							
Magnetic		yes					
Machinability		high					
Hardening		by quenching					
Service temperature in air		continuous service up to 600 °C; intermittent service up to 700 °C					
Europe	USA	USA	China	Russia	Japan	India	Republic of Korea
EN	UNS	ASTM	GB	GOST	JIS	IS	KS
X46CrS13							



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

Quality	X14CrMoS17						Martensitic
Number	1.4104						Stainless Steel

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Chemical composition						
C%	Si%	Mn%	P%	S%	Cr%	Mo%
0,10-0,17	1,00	1,50	0,040	0,15-0,35	15,5-17,5	0,20-0,60
± 0.01	+ 0.05	+ 0.04	+ 0.005	± 0.02	± 0.2	+ 0.03
Product deviations are allowed						
Temperature °C						
Melting range	Hot-forming	Recrystallization	Soft annealing	MMA welding – AWS electrodes <i>pre-heating annealing after w.</i> difficult; address qualified electrodes producers <i>joint with steel</i>		
1510-1430	1100-930	+RA 790-710 cooling to 300, then air	+A 850-750 air			
Isothermal annealing +I	Quenching	Tempering	carbon CrMo alloyed stainless E309 E309 E309 – E308 cosmetic welding E309			
not suitable	+Q 1060-980 air/oil/ /polymer	+T 650-550 fast cooling in air				

Chemical treatment • Pickling (20 - 50% HNO₃) + (2 - 6% Na₂Cr₂O₇·2H₂O) 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	A%	Kv	HB	a) for information only
from	to	N/mm ²	N/mm ² min	min	J min	max	
		730 max				220	+A annealed material
60	60	650-850	500	12			+QT650 quenched and tempered
60	160	650-850	500	10			+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	R	Rp	A%	Kv
from	to	N/mm ² max	max	N/mm ²	N/mm ² min	min	J min
	10 ^{b)}	880	280	700-980	580	7	
10	16	880	280	700-980	530	7	
16	40	800	250	650-930	500	9	
40	63	760	230	650-880	500	10	
63	100	730	220	650-850	500	10	
		+A annealed material		+QT650 quenched and tempered			

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

Magnetic	yes
Machinability	high
Hardening	by quenching, cold-drawn and and other cold plastic deformations
Service temperature in air	continuous service up to 740 °C; intermittent service up to 820 °C

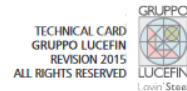
Europe	USA	USA	China	Russia	Japan	India	Republic of Korea
EN	UNS	ASTM	GB	GOST	JIS	IS	KS
X14CrMoS17			Y10Cr17		SUS 430F		STS 430F



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

Quality	X5CrNi18-10	Austenitic
Number	1.4301	Stainless Steel



Chemical composition

C%	Si%	Mn%	P%	S% ^{a)}	Cr%	Ni%	N%
max	max	max	max	max			max
0,07	1,00	2,00	0,045	0,015	17,5-19,5	8,0-10,5	0,11
± 0.01	+ 0.05	± 0.04	+ 0.005	+ 0.003	± 0.2	± 0.1	± 0.01

EN 10088-1: 2014

Product deviations are allowed

^{a)} for 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	Solution annealing (Solubilization) +AT	Stabilizing	Soft annealing +A	MMA Welding - electrodes AWS
1460-1400	1800-950	1120-1000 water	not necessary	not suitable	pre-heating post welding not necessary slow cooling
Sensitization	Quenching +Q	Tempering +T	Stress-relieving +SR		joint with steel
not recommended	not suitable	not suitable	430-350 air		carbon CrMo alloyed stainless E309-E308 E309-E308 E308 E308 - E308L

Chemical treatment • Pickling (6 - 25% HNO₃) + (0.5 - 8% HF) hot • Passivation 20 - 50% HNO₃ hot

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 +20 °C	Kv +20 °C	HB ^{a)}	
from to	N/mm ²	N/mm ² min	min (L)	min (T)	J min (L)	J min (T)	max	
160 250	500-700	190	45		100		215	+AT solubilization
160 250	500-700	190		35		60	215	+AT solubilization

^{a)} for information only (L) = longitudinal (T) = transversal

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 +20 °C	Kv +20 °C		
from to	N/mm ²	N/mm ² min	min (L)	min (T)	J min (L)	J min (T)		
10 16	600-950	400	25					+AT solubilization
16 40	600-850	190	30		100			
40 63	580-850	190	30		100			
63 160	500-700	190	45		100			
160 250	500-700	190		35		60		

^{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 (L) = longitudinal (T) = transversal

Corrosion resistance		Atmospheric		Chemical			x nitric acid, weak organic acids, rural and urban atmospheres
Fresh water		industrial	marine	medium	oxidizing	reducing	
x		x		x	x		
Magnetic	not						
Machinability	high						
Hardening	cold-drawn and other cold plastic deformations						
Service temperature in air	continuous service up to 850 °C; intermittent service up to 800 °C						
Europe	USA	USA	China	Russia	Japan	India	Republic of Korea
EN	UNS	ASTM	GB	GOST	JIS	IS	KS
X5CrNi18-10	S30400	(304)	0Cr18Ni9	07Ch18N10		X04Cr19Ni9	

Carbon - Chromium correlation



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

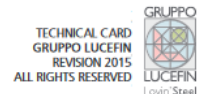
Quality	X5CrNiMo17-12-2		Austenitic								
Number	1.4401		Stainless Steel								
<p>TECHNICAL CARD GRUPPO LUCEFIN REVISION 2015 ALL RIGHTS RESERVED</p> <p>GRUPPO LUCEFIN Lucefin Steel</p>											
Chemical composition											
C%	Si%	Mn%	P%	S% a)	Cr%	Ni%	N%	Mo%			
max	max	max	max	max			max				
0,07	1,00	2,00	0,045	0,015	16,5-18,5	10,0-13,0	0,11	2,0-2,5	EN 10088-1: 2014		
± 0.01	+ 0.05	+ 0.04	+ 0.005	+ 0.003	± 0.2	± 0.15	± 0.01	± 0.1			
Product deviation are allowed											
a) 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	Solution annealing (Solubilization) +AT		Stabilizing	Soft annealing +A		MMA welding – AWS electrodes				
1400-1380	1200-900	1100-1050 water		unnecessary	not suitable		pre-heating post welding not necessary slow cooling				
Sensitization	Quenching +Q	Tempering +T		Stress relieving +SR			joint with steel				
sensitization test at 800-450	not suitable	not suitable		450-200 furnace			carbon CrMo alloyed stainless E309-E308 E309-E308 E308 cosmetic welding E 316 or E 16-8-2				
Chemical treatment • Pickling (6 - 25% HNO ₃) + (0.5 - 8% HF) hot • Passivation 20 - 50% HNO ₃ hot											
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 +20 °C	Kv +20 °C	HB a)				
from to	N/mm ²	N/mm ² min	min (L)	min (T)	J min (L)	J min (T)	max				
160 250	500-700	200	40	30	100	60	215 +AT				
	500-700	200					215 solubilization				
a) for information only (L) = longitudinal (T) = transversal											
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 +20 °C	Kv +20 °C					
from to	N/mm ²	N/mm ² min	min (L)	min (T)	J min (L)	J min (T)					
10 10	600-950	400	25								
10 16	580-950	380	25				+AT				
16 40	500-850	200	30		100		solubilization				
40 63	500-850	200	30		100						
63 160	500-700	200	40		100						
160 250	500-700	200		30		60					
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											
(L) = longitudinal (T) = transversal											
Corrosion resistance											
		Atmospheric		Chemical			x halides, sulfuric acid, phosphoric, organic and formic acids				
Fresh water		<i>industrial</i>	<i>marine</i>	<i>medium</i>	<i>oxidizing</i>	<i>reducing</i>					
x		x	x	x	x	x					
Magnetic no											
Machinability low											
Hardening cold-drawn and other cold plastic deformations											
Service temperature in air continuous service up to 850 °C; intermittent service up to 800 °C											
Europe	USA	USA	China	Russia	Japan	India	Rep. of Korea				
EN	UNS	ASTM	GB	GOST	JIS	IS	KS				
X5CrNiMo17-12-2	S31600	316	0Cr17Ni12Mo2	08Ch17N13M2	SUS 316	X04Cr17Ni12Mo2	STS 316				



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

Quality Number	X90CrMoV18		Martensitic Stainless Steel							
	1.4112									
Chemical composition										
C%	Si% max	Mn% max	P% max	S% ^{a)} max	Cr%	Mo%	V%			
0,85-0,95	1,00	1,00	0,040	0,015	17,0-19,0	0,90-1,30	0,07-0,12			
± 0.03	+ 0.05	+ 0.03	+ 0.005	+ 0.003	± 0.2	+ 0.05	+ 0.03			
Product deviations are allowed										
^{a)} 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	Full annealing		Soft annealing +A	MMA welding – AWS electrodes					
1440-1420	1175-930	910-890 cooling 15 °C/h to 590, then air		840-780 slow cooling	<i>pre-heating</i>	<i>annealing after w.</i>				
					200-150	750-700				
Isothermal annealing +I	Quenching +Q	Tempering +T		Stress-relieving +SR	<i>joint with steel</i>					
900-840 controlled cooling to 690, then air	1050-1000 oil / polymer (HRC 58)	550-450 air		350-100 air	carbon	CrMo alloyed	stainless			
					E70 xx	E8018-B 2	E309 – E308			
					<i>cosmetic welding</i>					
					E309 special					
Transformation temperature during heating Ac1 ~ 790, Ac3 ~ 870 and during cooling Ms ~ 280, Mf ~ 130										
Chemical treatment - <i>Pickling</i> (20 - 50% HNO ₃) hot. <i>Passivation</i> (20 - 25% HNO ₃) + (2.5% Na ₂ Cr ₂ O ₇ ·2H ₂ O) hot										
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					
	100				265	+A annealed material				
Bars, typical values according to UNS S44003 steel 440B										
size	Testing at room temperature									
mm	R	Rp 0.2	A%	Z%	HB	R	Rp 0.2	A%	Z%	HB
from to	N/mm ²	N/mm ²	min	min	max	N/mm ²	N/mm ²	min	min	max
	min	min	min	min	max	min	min	min	min	max
	738	427	18	35	269	827	655	9	20	285
	+A hot-rolled annealed					+A+C cold-drawn				
Forged (ASTM A 473-99 steel ASTM 440B)										
size	Testing at room temperature									
mm	R	Rp 0.2	A%	Kv +20 °C	HB^{a)}					
from to	N/mm ²	N/mm ² min	min	J min	max					
					269	+A annealed material				
^{a)} Only for guidance										
Corrosion resistance		Atmospheric			Chemical			x steam, petroleum, gasoline, alcohol, food, fruit juices		
Fresh water		<i>industrial</i> <i>marine</i>			<i>medium</i> <i>oxidizing</i> <i>reducing</i>					
x										
Magnetic		yes								
Machinability		difficult								
Hardening		by quenching								
Service temperature in air		max 300 °C for cold plastic deformations and 760 °C for hot-formed products								
Europe	USA	USA	China	Russia	Japan	India	Republic of Korea			
EN	UNS	ASTM	GB	GOST	JIS	IS	KS			
X90CrMoV18	S44003	440B	90Cr18MoV		SUS 440B		STS 440B			





INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

Tabelle 1 — Anwendungsbereich — Nichtrostender Stahl

Referenzbuchstabe für Tabelle 4	Referenzbuchstabe nach ISO 7153-1:1991 (zuletzt geändert)	Chirurgische Instrumente																	Teile								
		Elevatoren/Raspatorien	Zangen/Pinzetten (Einlagen oder Beschichtung)	Zangen/Pinzetten mit Verschleißschutz (Einlagen oder Beschichtung)	Scheren	Scheren mit Verschleißschutz (Einlagen oder Beschichtung)	Ringzangen	Ringzangen mit Verschleißschutz (Einlagen oder Beschichtung)	Hohlmeißelzangen	Knochensplitterzangen	Knochenstanzen	Branchenzangen	Konchotome	Skalpelle/Messer	Wundhaken	Sonden	Flach- und Hohlmeißel/ Kureiten/Knochenlöffel	Hämmer	Nadelhalter	Nadelhalter mit Verschleißschutz (Einlagen oder Beschichtung)	Brustspreizer	Wundspreizer, -sperrer/ Brustspreizer	Federn	Massive Griffe	Hohlhefte	Schrauben/Nieten/Führungsstifte	
a	B	X	X	X ^a	X ^a	X	X ^a	X	X	X	X	X	X	X	X	X	X	X	X ^a	X ^a	X	X	X				X
b	A		X	X ^a		X	X ^a				X					X			X ^a	X ^a	X						X
c	D	X			X	X ^a		X	X	X		X	X				X										
d																											
e	L																	X							X		X
f	R																								X		
g	I	X			X	X ^a		X	X	X		X	X														
h	H	X			X	X ^a		X	X	X		X	X														
i	M		X												X	X									X	X	X
j	N														X ^b	X ^b	X ^b								X		X
k	O																										
l	P														X	X											
m																											
o			X	X		X	X																				X
p	G+S		X	X		X	X																				X
q																											X

^a Für Instrumente mit Verschleißschutz gelten die Härtewerte nur für das Trägermaterial.
^b Für biegsame Schäfte.

Tabelle 2 — Anwendungsbereich — Hartmetalle

Referenzbuchstabe für Tabelle 6	Chirurgische Instrumente																	Teile									
	Elevatoren/Raspatorien	Zangen/Pinzetten (Einlagen oder Beschichtung)	Zangen/Pinzetten mit Verschleißschutz (Einlagen oder Beschichtung)	Scheren	Scheren mit Verschleißschutz (Einlagen oder Beschichtung)	Ringzangen	Ringzangen mit Verschleißschutz (Einlagen oder Beschichtung)	Knochenhohlmeißel	Knochensplitterzangen	Knochenstanzen	Branchenzangen	Konchotome	Skalpelle/Messer	Wundhaken	Sonden	Flach- und Hohlmeißel/ Kureiten/ Knochenlöffel	Hämmer	Nadelhalter	Nadelhalter mit Verschleißschutz (Einlagen oder Beschichtung)	Brustspreizer	Wundspreizer, -sperrer/ Brustspreizer	Federn	Massive Griffe	Hohlhefte	Schrauben/Nieten/Führungsstifte		
aa					X																						
ab		X					X													X							
ac		X			X		X													X							



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

Tabelle 3 — Anwendungsbereich — Titan

Referenzbuchstabe für Tabelle 7	Chirurgische Instrumente														Teile												
	Elevatoren/Kaspatorien	Zangen/Pinzetten	Zangen/Pinzetten mit Verschleißschutz (Einlagen oder Beschichtung)	Scheren	Scheren mit Verschleißschutz (Einlagen oder Beschichtung)	Ringzangen	Ringzangen mit Verschleißschutz (Einlagen oder Beschichtung)	Knochenhohmeißel	Knochen splitterzangen	Knochenstanzen	Branchenzangen	Konchotome	Skalpelle/Messer	Wundhaken	Sonden	Knochentraktoren	Flach- und Hohmeißel/Kürretten/	Hammer	Nadelhalter	Wundspitzer/-sperrer/ Brustspitzer	Nadelhalter mit Verschleißschutz (Einlagen oder Beschichtung)	Massive Griffe	Hohlhefte	Schrauben/Nieten/Führungsstifte			
ba														X	X												
bb														X	X												
bc														X	X												
bd														X	X												
bf		X	X	X		X	X				X			X	X				X	X		X	X			X	

Tabelle 5 — Korrespondenztabelle zwischen EN 10088-1 und anderen Normen

Materialnummer nach EN 10088-1:2014	Referenzbuchstabe nach ISO 7153-1:1991 (zurückgezogen)	Art der Ähnlichkeit ^a mit ISO 7153-1:1991 (zurückgezogen)	AISI-Typ nach ASTM F 899-12b	Art der Ähnlichkeit ^a mit ASTM F 899-12b	UNS-Materialnummer nach ASTM
1.4006	A	I	410	I	S41000
1.4016	—	—	430	W	S43000
1.4021	B	I	420 A	I	S42000
1.4024	A	N	410	I	S41000
1.4028	C	I	420 B	N	S42000
1.4034	D	I	420 C	N	S42000
1.4037	F	I	—	—	—
1.4057	—	—	431	W	S43100
1.4104	L	N	—	—	—
1.4105	L	I	430 F	N	S43020
(1.4108)	—	—	—	—	S42027
1.4109	G+S	W	440 A	W	S44002
1.4112	R	I	440 B	W	S44003
1.4116	I	N	—	—	—
1.4117	H	I	420 Mod	W	S42000
(1.4121)	—	—	420 F Mod	N	—
1.4122	K	N	—	—	—
1.4123	—	—	420 Mod	W	S42000
1.4125	—	—	440C	I	S44004
1.4197	—	—	420 F Mod	N	—
1.4301	M	N	304 / 304H	N	S30400
1.4305	N	N	303	N	S30300
1.4310	O	I	~301 / 302	N	S30100 S30200
1.4401	P	N	316	N	S31600
1.4441	—	—	—	—	S31673
1.4542	—	—	630 (17-4 PH)	N	S17400
1.4543	—	—	XM-16	I	S45500

^a I = identisch; N = sehr ähnlich, aber nicht identisch; W = größere Unterschiede zu EN 10088-1



INSTRUMENTE GMBH

Materialspezifikationen nach DIN 96298-1 und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1 und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1 und -2 / EN ISO 7153-1

Referenzbuchstabe für Tabelle 4	Referenzbuchstabe nach ISO 7153-1:1991 (zurückgezogen)	Dentalinstrumente
a	B	Zahnärztliche Extraktionszangen Laborzangen und KFO-Zangen Zahnärztliche Sonden Wurzelheber Füllinstrumente Zahnärztliche Pinzetten
b	A	Zahnärztliche Pinzetten
c	D	Scaler Zahnärztliche Sonden Wurzelheber Füllinstrumente
f	R	Scaler Zahnärztliche Küretten Laborzangen und KFO-Zangen Zahnärztliche Sonden Füllinstrumente
g	C	Scaler Zahnärztliche Küretten Zahnärztliche Extraktionszangen Dentalmeißel Laborzangen und KFO-Zangen Zahnärztliche Sonden Wurzelheber Füllinstrumente Zahnärztliche Pinzetten
i	M	Abformtrays
k	O	Zahnärztliche Sonden
p	S	Scaler Zahnärztliche Küretten Zahnärztliche Sonden Füllinstrumente

DIN 7153-1 contents the handling and characteristic with information of minimum and maximum proportionale chemical parts in stainless steel for medical surgical instruments.
DIN 96298-1 and -2 Medical instruments – contents the finish and testing for medical surgical instruments.
We declare herwith, that our raw material is inspected under DIN 7153.

REDA Instrumente GmbH

Thomas Benas

Quality Manager

Valid until 2020-05-16