REDA INSTRUMENTE GMBH

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

STRUMENTI Instruments	MATERIALE Material	DIN EN 10088-1	DUREZZA Hardness Rockwell
Pinza emostatica Forceps	X15Crl3 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 X20CrI3 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	XI5Cr13 X2OCr13 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 Retractos	X5CrNMO 1810 X15Cr13 X15Cr 13	1.4401 1.4024 1.4021	>=185 HV10 40-48 HRC 42-50 HRC
Pinze per dissezione Ligature Condactors	X 12CrNS 18 8 X15Cr 13 X2OCr 13	1.4305 1.4024 1.4021	>=185 HV10 40-48 NRC 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

Digitally signed by Iarovoi Petru
Date: 2024.09.16 15:53:06 EEST
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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
b	1.4006	X12Cr13	35	360	martensitisch
e	1.4016	X6Cr17	N.A.	N.A.	ferritisch
a	1.4021	X20Cr13	42 - 50	420 - 530	martensitisch
b	1.4024	X15Cr13	40 - 48	400 - 500	martensitisch
g	1.4028	X30Cr13	49 - 55	510 - 620	martensitisch
c	1.4034	X46Cr13	50 - 58	530 - 675	martensitisch
m	1.4037	X65Cr13	57 - 61	650 - 750	martensitisch
d	1.4057	X20CrNi16-2	40 - 48	400 - 500	martensitisch
e	1.4104	X14CrMoS17	30	310	martensitisch
e	1.4105	X6CrMoS17	N.A.	N.A.	ferritisch
q	(1.4108)[b]	X30CrMoN15-1	54 - 59	590 - 700	martensitisch
p	1.4109	X70CrMo15	55 - 60	610 - 720	martensitisch
f	1.4112	X90CrMoV18	52 - 60	545 - 720	martensitisch
g	1.4116	X50CrMoV15	50 - 58	530 - 675	martensitisch
h	1.4117[b]	X38CrMoV15	50 - 58	530 - 675	martensitisch
f	(1.4121)[b]	X22CrMoNiS13-1	48 - 54	500 - 600	martensitisch
c	1.4122	X39CrMo17-1	50 - 58	530 - 675	martensitisch
f	1.4123	X40CrMoVN16-2	52 - 57	560 - 660	martensitisch
—	1.4125	X105CrMo17	54 - 60	590 - 720	martensitisch
f	1.4197[c]	X22CrMoNiS13-1	48 - 54	500 - 600	martensitisch
i	1.4301	X5CrNi18-10	N.A.	N.A.	austenitisch
j	1.4305	X8CrNiS18-9	N.A.	N.A.	austenitisch
k	1.4310	X10CrNi18-8	N.A.	N.A.	austenitisch
l	1.4401	X5CrNiMo17-12-2	N.A.	N.A.	austenitisch
m	1.4441	X2CrNiMo18-15-3	N.A.	N.A.	austenitisch
o	1.4542	X5CrNiCuNb 16-4	wählbar	wählbar	ausscheidungshärtend
p	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.

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Quality	**X50CrMoV15**	**Martensitic Stainless Steel**	*Technical card*
Number	**1.4116**		*Lucefin Group*

Chemical composition

C%	Si% max	Mn% max	P% max	S% a) max	Cr%	Mo%	V%	
0,45-0,55	1,00	1,00	0,040	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 improing 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
1480-1460	1100-900	930-870 furnace	850-750 slow cooling

Isothermal annealing	Quenching	Tempering	Stress-relieving
910-890 controlled cooling to 750, then air	1030-980 oil / polymer (HRC 55)	500-400 air	250-150 air

MMA **welding –** AWS electrodes

pre-heating	*annealing after w.*
260	760-740

joint with steel

carbon	CrMo alloyed	stainless
E70 xx	E8018-B 2	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 mm from	to	Testing at room temperature R N/mm²	Rp 0.2 N/mm² min	A% min	Kv +20 °C J min	HB a) max	a) for information only
		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	$10^{-6} \cdot K^{-1}$	►	10.5	11.0	11.0	11.5		
Modulus of elasticity	longitudinal GPa	215	212	205	200	190		
Poisson number	*v*	0,27-0,30 ~						
Electrical resistivity	$\Omega \cdot mm^2/m$	0.65						
Electrical conductivity	$Siemens \cdot m/mm^2$	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			**x** steam, petroleum, gasoline, alcohol, ammonia, organic material
Fresh water	*industrial*	*marine*	*medium*	*oxidizing*	*reducing*	
x			**x**			

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

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

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

Quality	**X46Cr13**	**Martensitic Stainless Steel**
Number	**1.4034**	

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Chemical composition

C%	Si% max	Mn% max	P% max	S% a) max	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**
1480-1470	1180-930	not suitable	850-750 slow cooling to 600, then air

Quenching +Q	**Tempering +T**	**Stress-relieving +SR**	**Stress-relieving +SR** after +C
1050-950 oil / air (HRC 50 ~)	700-650 air	200 fast cooling in air	650-600 furnace cooling

MMA **welding –** AWS electrodes

pre-heating	*annealing after w.*
250-200	750

joint with steel

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% HNO_3) hot or cold

Mechanical properties

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

size mm from	to	Testing at room temperature **R** N/mm²	**Rp** 0.2 N/mm² min	**A%** min	**Kv** +20 °C J min	**HB** a) max	a) for information only
		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 mm from	to	Testing at room temperature **R** N/mm² max	**HB** a) max	**R** N/mm²	**Rp** 0.2 N/mm² min	**A%** min	**Kv** +20 °C 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 annealed material		+QT850 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

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 EN	**USA** UNS	**USA** ASTM	**China** GB	**Russia** GOST	**Japan** JIS	**India** IS	**Republic of Korea** KS
X46Cr13	(S42000)	(**420**)		(4Ch13)			

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Quality	**X20Cr13**	**Martensitic Stainless Steel**	
Number	**1.4021**		

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Chemical composition

C%	Si% max	Mn% max	P% max	S% a) max	Cr%	
0,16-0,25	1,00	1,50	0,040	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
1510-1460	1200-930	790-730 air	825-745 air	900-870 cooling 15 °C/h to 590, then air

Isothermal annealing +I	Quenching +Q	Tempering +T	Stress-relieving +SR
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

MMA **welding –** AWS electrodes

pre-heating	*annealing after w.*
250-200	750

joint with steel

carbon	CrMo alloyed	stainless
E60 xx	E8018-B 2	E309

cosmetic welding
E420 – E410

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

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 mm from	to	Testing at room temperature R N/mm²	Rp 0.2 N/mm² min	A% min	Kv +20 °C J min	HB a) max	a) for information only
		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 mm from	to	Testing at room temperature R N/mm² max	HB a) max	R N/mm²	Rp 0.2 N/mm² min	A% min	Kv +20 °C 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
Fresh water	*industrial*	*marine*	*medium*	*oxidizing*	*reducing*	
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 EN	USA UNS	USA ASTM	China GB	Russia GOST	Japan JIS	India IS	Republic of Korea KS
X20Cr13	(S42000)	(**420**)	2Cr13	20Ch13	SUS 420J1		STS 420J1

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

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Quality	**X46CrS13**	**Martensitic Stainless Steel**
Number	**1.4035**	

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Chemical composition

C%	Si% max	Mn% max	P% max	S%	Cr%	
0,43-0,50	1,00	2,00	0,040	0,15-0,35	12,5-14,0	EN 10088-1: 2014
± 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
1480-1460	1100-930	not suitable	850-750 slow cooling to 600, then air

Quenching +Q	Tempering +T	Stress-relieving +SR
1050-950 oil / air	675-625 fast cooling in air	200 air

MMA **welding –** AWS electrodes
pre-heating *annealing after w.*
not recommended

joint with steel
carbon CrMo alloyed stainless

cosmetic welding

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 mm from	to	Testing at room temperature R N/mm²	Rp 0.2 N/mm² min	A% min	Kv +20 °C J min	HB a) max	a) for information only
	63	800 max				245	+A annealed material

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

size mm from	to	Testing at room temperature R N/mm² max	HB a) max	R N/mm²	Rp 0.2 N/mm² min	A% min	Kv +20 °C J min
	10 b)	880	280				
10	16	880	280				
16	40	800	250				
40	63	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 EN	USA UNS	USA ASTM	China GB	Russia GOST	Japan JIS	India IS	Republic of Korea KS
X46CrS13							

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Quality	**X14CrMoS17**	**Martensitic Stainless Steel**
Number	**1.4104**	

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Chemical composition

C%	Si% max	Mn% max	P% max	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	EN 10088-1: 2014
± 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 +RA	Soft annealing +A
1510-1430	1100-930	790-710 cooling to 300, then air	850-750 air

Isothermal annealing +I	Quenching +Q	Tempering +T
not suitable	1060-980 air/oil/ /polymer	650-550 fast cooling in air

MMA **welding –** AWS electrodes
pre-heating *annealing after w.*
difficult; address qualified electrodes producers
joint with steel

carbon	CrMo alloyed	stainless
E309	E309	E309 – E308

cosmetic welding
E309

Chemical treatment ▪ *Pickling* (20 - 50% HNO_3) + (2 - 6% $Na_2Cr_2O_7.2H_2O$) hot or cold

Mechanical properties

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

size mm from	to	Testing at room temperature R N/mm²	Rp 0.2 N/mm² min	A% min	Kv +20 °C J min	HB a) max	a) for information only
		730 max				220	+A annealed material
	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 mm from	to	Testing at room temperature R N/mm² max	HB a) max	R N/mm²	Rp 0.2 N/mm² min	A% min	Kv +20 °C 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 EN	USA UNS	USA ASTM	China GB	Russia GOST	Japan JIS	India IS	Republic of Korea KS
X14CrMoS17			Y10Cr17		SUS 430F		STS 430F

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Quality	**X5CrNi18-10**	**Austenitic Stainless Steel**
Number	**1.4301**	

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Chemical composition

C% max	Si% max	Mn% max	P% max	S% a) max	Cr%	Ni%	N% max	
0,07	1,00	2,00	0,045	0,015	17,5-19,5	8,0-10,5	0,11	EN 10088-1: 2014
± 0.01	+ 0.05	± 0.04	+ 0.005	+ 0.003	± 0.2	± 0.1	± 0.01	

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**
1460-1400	1800-950	1120-1000 water	not necessary	not suitable

Sensitization	**Quenching +Q**	**Tempering +T**	**Stress-relieving +SR**
not recommended	not suitable	not suitable	430-350 air

MMA **Welding** - electrodes AWS

pre-heating	*post welding*
not necessary	slow cooling

joint with steel

carbon	CrMo alloyed	stainless
E309-E308	E309-E308	E308

cosmetic welding
E308 – E308L

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 mm from	to	Testing at room temperature **R** N/mm²	**Rp** 0.2 N/mm² min	**A%** min (L)	**A%** min (T)	**Kv** +20 °C J min (L)	**Kv** +20 °C J min (T)	**HB** a) max	
	160	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 mm from	to	Testing at room temperature **R** N/mm²	**Rp** 0.2 N/mm² min	**A%** min (L)	**A%** min (T)	**Kv** +20 °C J min (L)	**Kv** +20 °C J min (T)	
	10 b)	600-950	400	25				
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 EN	**USA** UNS	**USA** ASTM	**China** GB	**Russia** GOST	**Japan** JIS	**India** IS	**Republic of Korea** KS
X5CrNi18-10	S30400	(304)	0Cr18Ni9	07Ch18N10		X04Cr19Ni9	

Carbon - Chromium correlation

REDA INSTRUMENTE GMBH

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

Quality	**X5CrNiMo17-12-2**	**Austenitic Stainless Steel**
Number	**1.4401**	

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Chemical composition

C% max	Si% max	Mn% max	P% max	S% a) max	Cr%	Ni%	N% max	Mo%	
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**
1400-1380	1200-900	1100-1050 water	unnecessary	not suitable

Sensitization	**Quenching +Q**	**Tempering +T**	**Stress relieving +SR**
sensitization test at 800-450	not suitable	not suitable	450-200 furnace

MMA **welding –** AWS electrodes

pre-heating	*post welding*
not necessary	slow cooling

joint with steel

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 mm from	to	Testing at room temperature **R** N/mm²	**Rp** 0.2 N/mm² min	**A%** min (L)	**A%** min (T)	**Kv** +20 °C J min (L)	**Kv** +20 °C J min (T)	**HB** a) max	
	160	500-700	200	40		100		215	+AT
160	250	500-700	200		30		60	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 mm from	to	Testing at room temperature **R** N/mm²	**Rp** 0.2 N/mm² min	**A%** min (L)	**A%** min (T)	**Kv** +20 °C J min (L)	**Kv** +20 °C J min (T)	
	10 b)	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	*industrial*	*marine*	*medium*	*oxidizing*	*reducing*	
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 EN	**USA** UNS	**USA** ASTM	**China** GB	**Russia** GOST	**Japan** JIS	**India** IS	**Rep. of Korea** KS
X5CrNiMo17-12-2	S31600	**316**	0Cr17Ni12Mo2	08Ch17N13M2	SUS 316	X04Cr17Ni12Mo2	STS 316

REDA INSTRUMENTE GMBH

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

Quality	**X90CrMoV18**	**Martensitic Stainless Steel**
Number	**1.4112**	

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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	EN 10088-1: 2014
± 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**
1440-1420	1175-930	910-890 cooling 15 °C/h to 590, then air	840-780 slow cooling
Isothermal annealing +I	**Quenching +Q**	**Tempering +T**	**Stress-relieving +SR**
900-840 controlled cooling to 690, then air	1050-1000 oil / polymer (HRC 58)	550-450 air	350-100 air

MMA **welding –** AWS electrodes

pre-heating	*annealing after w.*
200-150	750-700

joint with steel

carbon	CrMo alloyed	stainless
E70 xx	E8018-B 2	E309 – E308

cosmetic welding
E309 special

Transformation temperature during heating **Ac1** ~ 790, **Ac3** ~ 870 and during cooling **Ms** ~ 280, **Mf** ~ 130

Chemical treatment ▪ *Pickling* (20 - 50% HNO_3) hot. *Passivation* (20 - 25% HNO_3) + (2.5% $Na_2Cr_2O_7.2H_2O$) hot

Mechanical properties

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

size mm from	to	Testing at room temperature R N/mm²	Rp 0.2 N/mm² min	A% min	Kv +20 °C J min	HB a) max	a) for information only
	100					265	+A **annealed** material

Bars, typical values according to UNS S44003 steel 440B

size mm from	to	Testing at room temperature R N/mm² min	Rp 0.2 N/mm² min	A% min	Z% min	HB max	R N/mm² min	Rp 0.2 N/mm² min	A% min	Z% min	HB 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 mm from	to	Testing at room temperature R N/mm²	Rp 0.2 N/mm² min	A% min	Kv +20 °C J min	HB a) max	
						269	+A **annealed** material

a) Only for guidance

Corrosion resistance	Atmospheric		Chemical			**x** steam, petroleum, gasoline, alcohol, food, fruit juices
Fresh water	*industrial*	*marine*	*medium*	*oxidizing*	*reducing*	
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 EN	**USA** UNS	**USA** ASTM	**China** GB	**Russia** GOST	**Japan** JIS	**India** IS	**Republic of Korea** KS
X90CrMoV18	S44003	**440B**	90Cr18MoV		SUS 440B		STS 440B

INSTRUMENTE GMBH

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

Tabelle 1 — Anwendungsbereich — Nichtrostender Stahl

Referenzbuchstabe für Tabelle 4	Referenzbuchstabe nach ISO 7153-1:1991 (zurückgezogen)	Chirurgische Instrumente																			Teile			
		Elevatoren/Raspatorien	Zangen/Pinzetten	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/ Küretten/Knochenlöffel	Hämmer	Nadelhalter	Nadelhalter mit Verschleißschutz (Einlagen oder Beschichtung)	Wundspreizer, -sperrer/ Brustbeinspreizer	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[a]	X	X			X
b	A		X	X[a]			X	X[a]				X			X	X			X	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			X								
h	H	X			X	X[a]			X	X	X		X	X			X								
i	M		X												X	X								X	X
j	N														X[b]	X[b]	X[b]	X					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	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/Küretten/ Knochenlöffel	Hämmer	Nadelhalter	Nadelhalter mit Verschleißschutz (Einlagen oder Beschichtung)	Wundspreizer, -sperrer/ Brustbeinspreizer	Federn	Massive Griffe	Hohlhefte	Schrauben/Nieten/Führungsstifte
aa					X																			
ab			X				X												X					
ac			X		X		X												X					

REDA INSTRUMENTE GMBH

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

Tabelle 3 — Anwendungsbereich — Titan

Referenzbuchstabe für Tabelle 7	Chirurgische Instrumente																				Teile			
	Elevatoren/Raspatorien	Zangen/Pinzetten	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/Küretten/ Knochenküretten	Hämmer	Nadelhalter	Nadelhalter mit Verschleißschutz (Einlagen oder Beschichtung)	Wundspreizer, -sperrer/ Brustbeinspreizer	Federn	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 96298-1und -2 / EN ISO 7153-1
Material Composition according to DIN 96298-1und -2 / EN ISO 7153-1
Materiale Specifica di DIN 96298-1und -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