

DIN 17456-85 GENERAL PUROSE SEAMLESS CIRCULAR STAINLESS STEEL TUBES

The subclauses marked with a single dot give specifications which are to be agreed upon at the time of ordering.

The subclauses marked with a two dots give specifications which optional and may be agreed upon at the time of ordering.

1. Field of application

1.1 This standard applies to general purpose seamless circular tubes and pipes (hereinafter briefly referred to as tubes) made from the stainless steels listed in table 1. They are used, for example as construction tubing, a pipes for the food, pharmaceutical and automobile industries. and as pipes for domestic installation and for decorative purposes. Tubes conforming to requirements o this standard are intended to be used on the basic of an 80% utilization of the permissible design stress in weld.

1.2 This standard does not apply to general purpose welded circular austenitic stainless steel tubes subject to special requirements (see DIN 17458).

Grade	Mfg. Process	Chemical Composition (%)								
		C	Si	Mn	P	S	Ni	Cr	Mo	Others
X6CrTi12	S	0.08Max	-	-	-	-	-	10.5~12.5	-	Ti: 6×%C 1.00Max
X6CrAl13	S	0.08Max	-	-	-	-	-	12.0~14.0	-	Al: 0.010~0.30
X5CrNi1911	S	0.030Max	-	-	-	-	8.5~10.5	18.0~14.0	-	-
X6Cr17	S	0.08Max	-	-	-	-	-	15.5~17.5	-	-
X6CrTi17	S	0.08Max	-	-	-	-	-	16.0~18.0	-	Ti: 7×%C 1.20Max
X5CrNi1810	S	0.07Max	-	-	-	-	8.5~10.5	17.0~19.0	-	-
X2CrNi1911	S	0.03Max	-	-	-	-	10.5~12.5	18.0~20.0	-	-
X2CrNiTi1810	S	0.03Max	-	-	-	-	8.5~10.5	17.0~19.0	-	N: 0.12~0.22
X6CrNiTi1810	S	0.08Max	-	-	-	-	9.0~12.0	17.0~19.0	-	Ti: 5×%C 0.80Max
X5CrNiNB1810	S	0.08Max	-	-	-	-	9.0~12.0	17.0~19.0	-	Nb: 10Ti: 7×%C
X5CrNiMo17122	S	0.07Max	-	-	-	-	10.5~13.5	16.5~18.5	2.0~2.5	1.20Max%C 1.00Max
X2CrNiMo17132	S	0.030Max	-	-	-	-	11.0~14.0	16.5~18.5	2.0~2.5	-
X6CrNiMoTi17122	S	0.08Max	-	-	-	-	10.5~13.5	16.5~18.5	2.0~2.5	SUS321TB
X2CrNiMoN17133	S	0.030Max	-	-	-	0.25Max	11.5~14.5	16.5~18.5	2.5~3.0	-
X2CrNiMo18143	S	0.030Max	-	-	-	0.25Max	12.5~15.5	17.0~18.5	2.5~3.0	-
X5CrNiMo17133	S	0.07Max	-	-	-	0.25Max	11.0~14.0	17.0~18.5	2.5~3.0	-

X2CrNiMoN17135	S	0.030Max	-	-	-	0.25Max	12.5~14.5	16.5~18.5	4.0~5.0	-
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Grade	Material Number	Tensile Test MPa or N/mm ²		Remarks (Similar to JIS)
		Min Yield point	Tensile Strength	
X6CrTi12	1.4512	190	390~560	-
X6CrAl13	1.4002	250	400~600	SUS405TP
X5CrNi1911	1.4006	250	450~650	-
X6Cr17	1.4016	270	450~650	-
X6CrTi17	1.4510	270	430~600	-
X5CrNi1810	1.4301	195	500~720	-
X2CrNi1911	1.4306	180	460~680	-
X2CrNiTi1810	1.4311	270	550~760	-
X6CrNiTi1810	1.4541	200	500~730	-
X5CrNiNB1810	1.4550	205	510~740	-
X5CrNiMo17122	1.4401	205	510~710	SUS316TB
X2CrNiMo17132	1.4404	190	490~690	SUS316HTB
X6CrNiMoTi17122	1.4571	210	500~730	SUS321TB
X2CrNiMoN17133	1.4429	295	580~800	-
X2CrNiMo18143	1.4435	190	490~690	-
X5CrNiMo17133	1.4438	205	510~710	-
X2CrNiMoN17135	1.4439	285	580~800	-

The data given in table 3 shall apply for the resistance of the steels to intercrystalline corrosion when tested as specified in subclause 6.5.4.

Steel grade		% by mass				
Symbol 2)	Material number	C	Cr	Mo	Ni	Others 3
Ferritic steels						
x6CrTi 12	1.4512	≤0.08	10.5 to 12.5	-	-	Ti: 6x%C, up to 1.00

X6CrTi 13	1.4002	≤0.08	12.0 to 14.0	-	-	Al: 0.10 to 0.30
x10Cr 13	1.4006	0.08 to 0.12	12.0 to 14.0	-	-	-
x6Cr 17	1.4016	≤0.08	15.5 to 17.5	-	-	-
x6CrTi 17	1.4510	≤0.08	16.0 to 18.0	-	-	Ti: 7 x %C, up to 1.20
Austenitic steels						
x5CrNi 1810	1.4301	≤0.07	17.0 to 19.0	-	8.5 to 10.5	-
x2CrNi 1911	1.4306	≤0.030	18.0 to 20.0	-	10.0 to 12.5	-
x2CrNi 1810	1.4311	≤0.030	17.0 to 19.0	-	8.5 to 11.5	N: 0.12 to 0.22
x6CrNiTi 1810	1.4541	≤0.08	17.0 to 19.0	-	9.0 to 12.0	Ti: 5x %C, up to 0.80
x6CrNiNb 1810	1.4550	≤0.08	17.0 to 19.0	-	9.0 to 12.0	Nb: 10 x %C, up to 1.00 4)
x5CrNiMo 17 122	1.4401	≤0.07	16.5 to 18.5	2.5 to 2.5	10.5 to 13.5	-
x2CrNiMo 17 132	1.4404	≤0.030	16.5 to 18.5	2.5 to 2.5	11.0 to 14.0	-
x6CrNiMoTi 17 122	1.4571	≤0.08	16.5 to 18.5	2.5 to 2.5	10.5 to 13.5	Ti: 5 x %C, up to 0.80
x2CrNiMoN 17 33	1.4429	≤0.030	16.5 to 18.5	2.5 to 3.0	11.5 to 14.5	N: 0.14 to 0.22; S ≤ 0.025
x2CrNiMo 18 143	1.4435	≤0.030	17.0 to 18.5	2.5 to 3.0	12.5 to 15.0	S ≤ 0.025
x5CrNiMo 17 133	1.4438	≤0.07	16.5 to 18.5	2.5 to 3.0	11.0 to 14.0	S ≤ 0.025
x2CrNiMoN 17 135	1.4439	≤0.030	16.5 to 18.5	4.0 to 5.0	12.5 to 14.5	N: 0.12 to 0.22; S ≤ 0.025
<p>1) Elements not quoted in this table in respect of the individual steel grades shall not be added deliberately to the steel without the purchaser's consent, except for the purpose of finishing the melt. Such elements shall in no way impair the usability or processability of the steel, e.g. its weldability, nor shall they affect the properties specified in this standard.</p> <p>2) The symbols given in the December 1972 edition of DIN 17 440 may continue to be used during the period of validity of this standard (see table in the Explanatory notes).</p> <p>3) Unless otherwise specified, P ≤ 0.045%, S ≤ 0.030%, Si ≤ 1.0%, for austenitic steels, Mn ≤ 2.0%, and for ferritic steels, Mn ≤ 1.0%.</p> <p>4) Tantalum determined together with niobium and expressed in the form of niobium content.</p>						

Table 2 Amount by which the chemical composition in the product analysis may deviate from limit values specified for the cast analysis

Element	Limit values specified for the cast analysis as in table 1 % by mass	Permissible deviations 1) % by mass
Carbon (C)	≤0.030	+ 0.005

	> 0.030 ≤ 0.12	±0.01
Silicon (Si)	≤ 1.0	+ .05
Manganese (Mn)	≤ .0	+0.03
	> 1.0 ≤ 2.0	+0.04
Phosphorus (P)	≤ 0.045	+0.005
Sulfur (S)	≤ 0.030	+0.005
Nitrogen (N)	≤ 0.22	±0.01
Aluminium (Al)	≤ 0.30	±0.05
Chromium (Cr)	≥ 10.5 < 15.0	±0.15
	≥ 15.0 ≤ 20.0	±0.20
Molybdenum (Mo)	≥ 2.0 ≤ 5.0	±0.10
Nickel (Ni)	≥ 8.5 < 10.0	±0.10
	≥ 10.0 ≤ 15.0	±0.15
Niobium (Nb)	≤ 1.00	±0.05
Titanium (Ti)	≤ 1.20	±0.05
1) If several product analyses are carried out for a single cast and if these elements show contents for a single element outside the range specified for the cast analysis, this content shall either exceed the permissible maximum content or be below the permissible minimum content, but not both at the same time for one cast.		

Table 3 Mechanical properties of the steels at ambient temperature in the as delivered condition specified in table 6 and their resistance to Intercrystalline corrosion (applicable to wall thicknesses up to 50 mm in the case of austenitic steel tubes and up to 5 mm in the case of ferritic steel tubes 1) 2)

Steel grade		Heat treatment condition 2)	Maximum HB or HV hardness 3)	Minimum yield stress or 0.2% proof stress N/m ²	Minimum 1% proof stress N/m ²	Tensile strength 2) N/m ²	Minimum elongation after fracture 2) (Lo=5do %)		Resistance to intercrystalline corrosion 4)	
Symbol	Material						Longitudinal	Transverse	in the as delivered condition	after further processing by welding without heat treatment
Ferritic steels										

X6 CrTi 12	1.4512		175	190	-	390 to 560	30	25	n.g.	n.g.
X2 CrNi 1911	1.4002		180	250	-	400 to 600	20	15	n.g.	n.g.
X2 CrNiN 1810	1.4006	Annealed	200	250	-	450 to 650	20	15	n.g.	n.g.
X6 CrNiTi 1810	1.4016		185	270	-	450 to 600	20	15	n.g.	n.g.
X6 CrNiNb 1810	1.4510		185	270	-	450 to 600	20	15	g.	g.

Austenitic steels

X5 CrNi 1810	1.4301			195	230	500 to 700	40	35	g. 6)	g. 8)
X2 CrNi 1911	1.4306	Solution		180	215	460 to 680	40	35	g.	g.
X6 CrNiNi 1810	1.4311	annealed		270	305	550 to 760	35	30	g.	g.
X6CrNiTi 1810 7)	1.4541 7)	and		200	235	500 to 730	35	30	g.	g.
X6CrNiTiNb 1810 8)	1.4541 8)	quenched		180	215	460 to 680	35	30	g.	g.
X6CrNiNb 1810	1.4550			205	240	510 to 740	35	30	g.	g.

X5 CrNiMo 17 122	1.4401	Solution		205	240	510 to 710	40	30	g. 6)	g. 6)
X2 CrNiMo 17 132	1.4404	annealed		190	225	490 to 690	40	30	g.	g.
X6 CrNiMoTi 17 1227)	1.4571 7)	and		210	245	500 to 730	35	30	g.	g.
X6CrNiMoTi 17 122 7)	1.4571 8)	quenched		190	225	490 to 690	35	30	g.	g.
X6CrNiMoNb 17 122 8)										

X2CrNiMoN 17 133	1.4429	Solution		295	330	580 to 800	35	30	g.	g.
X2CrNiMo 18 143	1.4435	annealed		190	225	490 to 690	40	30	g.	g.
X5CrNiMo 17 133	1.4436	and		205	240	510 to 710	40	30	g. 5)	g. 5)
		quenched								

X2CrNiMoN 17 135	1.4439	Solution								
		annealed		285	315	580 to 800	35	30	g.	g.
		and								
		quenched								

- 1) For greater wall thicknesses, the values shall be specified by agreement.
- 2) The values specified do not apply for condition f described in table 6. For this condition, they shall be agreed at the time of ordering, if required.
- 3) Average value from three test pieces at ambient temperature. Only one individual value of the test unit may be less than this value by a maximum of 30%.
- 4) When tested in accordance with DIN 50 914, G. means existing up to the limit temperatures listed in the last column of table 4.

X2CrNiMoN 17 133	1.4429	Solution annealed and quenched	265	225	197	178	165	155	150	145	140	138	136	300	260	227	208	195	185	180	175	170	168	166	400	
X2CrNiMo 18 143	1.4435		182	166	152	137	127	118	113	108	103	100	98	217	199	181	167	157	145	139	135	130	128	127	400	
X5CrNiMo 17 133	1.4436		196	177	162	147	137	127	120	115	112	110	108	230	211	191	177	167	156	150	144	141	139	137	300 4)	
X2CrNiMoN 17 135	1.4439	Solution annealed and quenched	260	225	200	185	175	165	155	150	-	-	-	290	255	230	210	200	190	180	175	-	-	-	400	
<p>1) Up to these temperatures, the material will, within 100000 hours, not have changed so as to show susceptibility to intercrystalline corrosion.</p> <p>2) Not to be used for tubes manufactured by hot working or subjected to further processing.</p> <p>3) To be used for tubes manufactured by hot working or subjected to further processing.</p> <p>4) Only for wall thicknesses not exceeding 6 mm.</p>																										

Table 5 Guideline data for the heat treatment during fabrication and further processing of tubes and guideline data for hot working as part of further processing

Steel grade		Heat treatment during fabrication and further processing of tubes			Hot working during further processing	
Symbol	Material Number	Recrystallization or solution annealing temperature °C	Type of cooling		Temperature °C	Type of cooling
Ferritic steels						
x6CrTi 12	1.4512	750 to 850	Air, water		1100 to 800	Air
c6CrAl 13	1.4002	750 to 850	Furnace, air			
x10Cr 13	1.4008	750 to 850	Furnace, air			
x6Cr 17	1.4018	750 to 850	Air, water			
x6CrTi 17	1.4510	750 to 850	Air, water			
Austenitic steels						
X5CrNi 1810	1.4301	1000 to 1080 1)	Quenching in water, air 2)		1150 to 750	Air
X2CrNi 1911	1.4308					
x2CrNi 1810	1.4311					

x6CrNiTi 1810	1.4541	1020 to 1100 1)		
x6CrNiNb 1810	1.4550			
x5CrNiMo 17 122	1.4401			
x2CrNiMo 17132	1.4404			
x6CrNiMoTi 17 122	1.4571			
x2CrNiMoN 17 133	1.4429	1040 to 1120 1)		
x2CrNiMo 16 143	1.4435	1020 to 1100 1)		
x5CrNiMo 17 133	1.4436			
x2CrNiMoN 17 135	1.4439	1040 to 1120 1)		
<p>1) When heat treatment forms part of further processing of the product, an attempt shall be made to achieve the lower values of the range specified for solution annealing. If hot working has been carried out at a temperature of at least 850°C or if the product has been cold worked, the temperature of renewed solution annealing may be 20 K less than the lower limit for solution annealing.</p> <p>2) If the cooling is sufficiently rapid.</p>				

5.8. Type of condition, appearance of surface

5.8.1. The tubes shall be supplied in one of the conditions listed in table 6.

The selection of the type of condition is left to the manufacturer's discretion.

Table 6 Types of condition of tubes

Symbol	Type of condition	Surface finish	Notes
c1	Hot worked, heat treated 1), descaled	Metallically clean	
c2	Hot worked, heat treated 1), pickled		
f	Mechanically or chemically descaled, cold worked, not heat treated	Metallically bright-drawn. much smoother than for conditions c1 and c2	Cold working without subsequent heat treatment modifies the properties depending on the degree of working; this applies in particular to austenitic steel tubes.
g	Cold worked, heat treated, not descaled	Scaled	Suitable only for components which will be descaled or worked.

h	Cold worked, heat treated and pickled	Metallically bright-pickled, smoother than for condition c2	
m	Cold worked and free from scale, heat treated	Metallically bright-annealed, smoother than for condition h.	
n1	Cold redrawn tubes free from scale (polished-drawn), not heat treated	Metallically polished-drawn, smoother than for condition h or m	Tubes complying with this condition are somewhat harder than those of condition h or m and their mechanical properties are modified. These tubes are especially suitable for grinding and polishing.
n2	Cold redrawn (polished-drawn), bright heat treated	Metallically bright-annealed, smoother than for condition h or m	Especially suitable for grinding and polishing.
o	Ground	Metallically bright-ground; the type and degree of grinding shall be agreed at the time of ordering.	Conditions h, m or n2 are generally used as starting condition 2).
p	Polished	Metallically bright-ground; the type and degree of grinding shall be agreed at the time of ordering.	
1) See also subclause 5.2. 2) The order shall specify whether grinding or polishing is to be internal or external. or internal and external.			

5.8.2. The tubes shall have an inside and outside surface consistent with the manufacturing process used.

5.8.3. Slight irregularities in the surface resulting from the manufacturing process, such as raised or depressed areas or shallow grooves are permitted, except for condition P(polished), as long as the remaining wall thickness fulfils the requirements specified in subclause 5.10 and the function of the tubes is not impaired.

5.8.4. Proper removal of surface defects using appropriate means (e.g. grinding) is permitted as long as the remaining wall thickness fulfils the requirements specified in subclause 5.10.

5.9. Leak tightness

The tubes shall remain leaktight when testedes specified in subclause 6.5.5.

5.10. Dimensions, masses per unit length and permissible deviations

DIN 2462 Part1 shall apply for the dimensions and masses per unit length of tubes and for permissible deviations.

DIN 11850 shall apply for tubes intended for use in the food industry. The order shall follow the pattern of the sample order given in that standard.

5.11. Physical properties

Reference is made to volume 10 of the Stahleisen-Sonderberichte (Iron and steel special reports)(see the "Standards and other documents referred to clause) for guideline data on the physical properties of the steels conforming to the requirements of this standard.

As the symbols or the steel grades differ from those specified in DIN 17 440. December 1972 edition, following the specifications for the chemical composition, and in accordance with DIN 17440. July 1985 edition, a compilation of the material numbers, which have not changed, and the previous and new symbols is given below in tabular form. It shall be noted that the symbols used in DIN 17 440. December 1972 edition. may still be used during the period of validity of this standard.

Material number	Previous symbol from DIN 17 440. December 1972 edition	New symbol
1.4002	X7CrAl 13	X6CrAl 13
1.4006	X10Cr 13	X10Cr 13
1.4016	X8Cr 17	X6Cr 17
1.4301	X5CrNi 189	X5CrNi 1810
1.4306	X2CrNi 189	X2CrNi 1911
1.4311	X2CrNiN 1810	X2CrNiN 1810
1.4401	X5CrNiMo 1810	X5CrNiMo 17 122
1.4404	X2CrNiMo 1810	X2CrNiMo 17 132
1.4429	X2CrNiMoN 1813	X2CrNiMoN 17 133
1.4435	X2CrNiMo 1812	X2CrNiMo 18 143
1.4436	X5CrNiMo 1812	X5CrNiMo 17 133
1.4439 1)	X3CrNiMoN 17 135	X2CrNiMoN 17 135
1.4510	X8CrTi 17	X6CrTi 17
1.4512 1)	X5CrTi 12 1)	X6CrTi 12
1.4541	X10CrNiTi 189	X6CrNiTi 1810
1.4550	X10CrNiNb 189	X6CrNiNb 1810
1.4571	X10CrNiMoTi 1810	X6CrNiMoTi 17 122
1) Not included in DIN 17440. December 1972 edition.		

	SUS																
	310STB	SUS	A213	TP310S	SUS												
	SUS		A213	TP316	SUS			2462	X5CrNiMo 1810	SUS	A49-230	TUZ6CN 18.09	SUS	2604/2	TS60		
	316TB	SUS	A249	TP316	SUS	3605	316S18	SUS	2463	X5CrNiMo 1810	SUS						
			A269	TP316	SUS				"	X5CrNiMo 1812							
			A632	TP316	SUS	3606	LWHT316S25	SUS	17455	X5CrNiMo 17122							
			A688	TP316	SUS	"	LWCF316S25	SUS	17456	X2CrNiMo 17132							
						"	LWBC316S25	SUS	17457	X5CrNiMo 17122							
						"	CFS316S25	SUS	17458	X2CrNiMo 17132							
						"	LWHT316S30	SUS									
						"	LWCF316S30	SUS									
						"	LWBC316S30	SUS									
						"	CFS316S30	SUS									
	SUS		A213	TP316H	SUS	3059	CFS316S59	SUS	17455	X5CrNiMo 17122				2604/2	TS52		
	316HTB	SUS	A249	TP316H	SUS				17456					"	TS61		
	SUS		A213	TP316L	SUS	3605	316S14	SUS	2462	X2CrNiMo 1810	SUS			2604/2	TS57		
	316LTB	SUS	A249	TP316L	SUS	"	316S22	SUS		X2CrNiMo 1812	SUS			"	TS58		
			A269	TP316L	SUS	3606	LWHT316S24	SUS	2463	X2CrNiMo	SUS						

										1810							
			A632	TP316L	SUS	"	LWCF316S24	SUS		X2CrNiMo 1812	SUS						
			A688	TP316L	SUS	"	LWBC316S24	SUS	17457	X5CrNi 17122							
						"	CFS346S24	SUS	17458								
						"	LWHT316S29	SUS									
						"	LWCF31^S29	SUS									
						"	LWBC316S29	SUS									
						"	CFS316S29	SUS									
	SUS		A249	TP317	SUS												
	317TB	SUS	A632	TP317	SUS												
	SUS		A249	TP317	SUS												
	317LTB	SUS															
			A213	TP321	SUS	3605	321S18	SUS	2462	X10CrNi Ti89	SUS	A49-230	TUZ6CNT 18.10	SUS	2604/2	TS53	
	321TB	SUS	A249	TP321	SUS	"	321S22	SUS	2463	X10CrNi Ti189	SUS						
			A269	TP321	SUS	3606	LWHT321S22	SUS	17457								
			A632	TP321	SUS	"	LWCF321S22	SUS	17458	X6CrNiTi 1810							
						"	LWBC321S22	SUS									
						"	CFS321S22										
	SUS		A213	TP321	SUS	3059	CFS321S59	SUS									
	321HTB	SUS	A249	TP321H	SUS	3605	321S59	SUS									
			A213	TP347	SUS	3605	347S18	SUS	2462	X10CrNi Nb189	SUS	A49-207	TSZ6CNNb 18.10	SUS	2604/2	TS50	

