DIN 17457-85 WELDED CIRCULAR AUSTENITIC STAINLESS STEEL TUBES SUBJECT TO SPECIAL REQUIREMENTS

1. Field of application

1.1 This standard applies to welded circular tubes and pipes (hereinafter briefly referred to as tubes) subject to special requirements and made from the austenitic stainless steels listed in table 1. These tubes are predominantly used in the construction of pressure vessels, chemical plant and pipework.

The limits of application and other specifications given in this standard shall apply except in cases where other specifications.

1.2 This standard does not apply to general purpose welded circular stainless steel tubes (see DIN17455).

Grade	Mfg. Process	Chemical Composition (%)								
		C	Si	Mn	P	S	Ni	Cr	Mo	Others
X5CrNi1820	W	0.07Max	-	-	-	-	8.5~10.5	17.0~19.0	-	-
X2CrNi1911	W	0.030Max	-	-	-	-	10.0~12.5	18.0~20.0	-	-
X2CrNiN1810	W	0.030Max	-	-	-	-	8.5~11.5	17.0~19.0	-	N: 0.12~0.22
X6CrNiTi1810	W	0.08Max	-	-	-	-	9.0~12.0	17.0~19.0	-	Ti: 5×%C, 0.80Max
X6CrNiNb1810	W	0.08Max	-	-	-	-	9.0~12.0	17.0~19.0	-	Nb: 10×%C, 1.00Max
X5CrNiMo17122	W	0.07Max	-	-	-	-	10.5~13.5	16.5~18.5	2.0~2.5	-
X2CrNiMo17132	W	0.030Max	-	-	-	-	11.0~14.0	16.5~18.5	2.0~2.5	-
X6CrNiMoTi17122	W	0.08Max	-	-	-	-	10.5~13.5	16.5~18.5	2.0~2.5	TI: 5×%C, 0.80Max
X2CrNiMoN17133	W	0.030Max	-	-	-	0.025Max	11.5~14.5	16.5~18.5	2.5~3.0	N: 0.14~0.22
X2CrNiMo18143	W	0.030Max	-	-	-	0.025Max	12.5~15.0	17.0~18.5	2.5~3.0	-
X5CrNiMo17133	W	0.07Max	-	-	-	0.025Max	11.0~14.0	16.5~18.5	2.5~3.0	N: 0.12~0.22
X2CrNiMoN17135	W	0.030Max	-	-	-	0.025Max	12.5~14.5	16.5~18.5	4.0~5.0	N: 0.12~0.22

Grade	Material Number	Tensile Test MPa or N/mm^2		Remarks (Similar to JIS)
		Min Yield point	Tensile Strength	
X5CrNi1820	1.4301	195	500~720	-
X2CrNi1911	1.4306	180	460~680	-
X2CrNiN1810	1.4311	270	550~760	-
X6CrNiTi1810	1.4541	200	500~730	SUS321TB

X6CrNiNb1810	1.4550	205	510~740	SUS347TB
X5CrNiMo17122	1.4401	205	510~710	SUS316TB
X2CrNiMo17132	1.4404	190	490~690	-
X6CrNiMoTi17122	1.4571	210	500~730	-
X2CrNiMoN17133	1.4429	295	580~800	-
X2CrNiMo18143	1.4435	190	490~690	-
X5CrNiMo17133	1.4436	285	510~710	-
X2CrNiMoN17135	1.4439	315	580~800	-

Table 1 Steel grades and chemical composition determined in the cast analysis[1])

Steel grade		% by mass				
Symbol [2])	Material Number	C max	Cr	Mo	Ni	Others[3])
X5CrNi1810	1.4301	0.07	17.0 to 19.0	-	8.5 to 10.5	-
X2CrNi1911	1.4306	0.030	18.0 to 20.0	-	10.0 to 12.5	-
X2CrNiN1810	1.4311	0.030	17.0 to 19.0	-	8.5 to 11.5	N: 0.12 to 0.22
X6CrNiTl1810	1.4541	0.08	17.0 to 19.0	-	9.0 to 12.0	Ti: 5 X %C, up to 0.80
X6CrNiNb1810	1.4550	0.08	17.0 to 19.0	-	9.0 to 12.0	Nb: 10 X %C, up to 1.00[4])
X5CrNiMo17122	1.4401	0.07	16.5 to 18.5	2.0 to 2.5	10.5 to 13.5	_
X2CrNiMo12132	1.4404	0.030	16.5 to 18.5	2.0 to 2.5	11.0 to 14.0	_
X6CrNiMoTi17122	1.4571	0.08	16.5 to 18.5	2.0 to 2.5	10.5 to 13.5	Ti: 5 X %C, up to 0.80
X2CrNiMoN17133	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
X2CrNiMo18143	1.4435	0.030	17.0 to 18.5	2.5 to 3.0	12.5 to 15.0	S≤0.025
X5CrNiMo17133	1.4436	0.07	16.5 to 18.5	2.5 to 3.0	11.0 to 14.0	S≤0.025
X2CrNiMoN17135	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

[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 processablity of the steel. e.g. its weldability not shall they affect the properties specified in this standard.

[2]) The symbols given in the December 1972 edition of DIN 17440 may continue to be used during the period of validity of this standard (see comparison table in the Explanatory notes).

[3]) Unless otherwise specified. P≤0.045%S≤0.030%,Si≤1.0%≤2.0%.
[4]) Tenteium determined together with niobium and expressed in the form of niobium content.

Table 2 Amounts by which the chemical composition in the product analysis may deviate from the 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 >0.030≤0.08	+0.005 +0.01
Silicon (Si)	≤1.0	+0.05
Manganese(Mn)	≤2.0	+0.04
Phosphorus(P)	≤0.045	+0.005
Sulfur(S)	≤0.030	+0.005
Nitrogen(N)	≤0.22	±0.01
Chromium(Cr)	≥16.5 ≤20.0	±0.20
Molybdenum(Mo)	≥2.0 ≤5.0	±0.10
Nickel(Ni)	≥8.5 <100 ≥10.0 ≤15.0	±0.10 ±0.15
Niobium(Nb)	≤1.00	±0.05
Titanium(Ti)	≤0.80	±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 (with the exception of condition (0) and their resistance to intercrystalline corrosion (applicable to wall thicknesses up to 50mm) 1)

Steel grade	Heat treatment condition 2)	Minimum 0.2% proof stress N/㎡	Minimum 1% proof stress N/㎡	Tensile strength 2) N/㎡	Minimum elongation after fracture 2) (Lo=5do %	Minimum impact energy 3) (ISO V-notch test pieces) J	Resistance to intercrystalline corrosion 4)

Symbol	Material					Longitudinal	Transverse	Longitudinal	Transverse	in the as delivered condition	after further processing by welding without heat treatment
X5 CrNi 1810 X2 CrNi 1911 X2 CrNiN 1810 X6 CrNiTi 1810 X6 CrNiNb 1810	1.4301 1.4306 1.4311 1.4541 6) 1.4541 7) 1.4550	Solution annealed and zuenched	195 180 270 200 180 205	230 215 305 235 215 240	500 to 700 460 to 680 550 to 760 500 to 730 460 to 680 510 to 740	40 40 35 35 35 35	35 35 30 30 30 30	85	55	g. 5) g. g. g. g. g.	g. 5) g. g. g. g. g.
X5 CrNiMo 17 122 X2 CrNiMo 17 132 X6 CrNiMoTi 17 122 6) X6CrNiMoTi 17 122 7) X6CrNiMoNb 17 122	1.4401 1.4404 1.4571 6) 1.4571 7) 1.4580	Solution annealed and zuenched	205 190 210 190 215	240 225 245 225 250	510 to 710 490 to 690 500 to 730 490 to 690 510 to 740	40 40 35 35 35	30 30 30 30 30	85	55	g. 5) g. g. g. g.	g. 5) g. g. g. g.
X2CrNiMoN 17 133 X2CrNiMo 18 143 X5CrNiMo 17 133	1.4429 1.4435 1.4436	Solution annealed and zuenched	295 190 205	330 225 240	580 to 800 490 to 690 510 to 710	35 40 40	30 30 30	85	55	g. g. g. 5)	g. g. g. 5)
X2CrNiMoN 17 135	1.4439	Solution annealed and zuenched	285	315	580 to 800	35	30	85	55	g.	g.

1) For greater wall thicknesses, the values shall be specified by agreement.

2) The upper value of tensile strength may be exceeded by 70N/mm² and the minimum values of elongation after fracture may be 5 units less in the case of products which are supplied in conditions dO, kO, d1 and k1 described in table 6 and which are not in the solution annealed and quenched condition.

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.

5) Only for wall thicknesses not exceeding 6 mm.

Table 4 Minimum values of elevated temperature 0.2% and 1% proof stresses and guideline values for the limit temperature in the case of intercrystalline corrosive stress

Steel grade		Heat	0.2% proof stress at a temperature, in℃, of											1% proof stress at a temperature, in℃, of											Limit temperature 1)
Symbol	Material number	treatment condition	50	100	150	200	250	300	350	400	450	500	550	50	100	150	200	250	300	350	400	450	500	550	℃
			N/㎟											N/㎟											
X5 CrNi 1810	1.4301	Solution annealed and quenched	177	157	142	127	118	110	104	98	95	92	90	211	191	172	157	145	135	129	125	122	120	120	300 2)
X2 CrNi 1911	1.4306		162	147	132	118	108	100	94	89	85	81	80	201	181	162	147	137	127	121	116	112	109	108	350
X2 CrNiN 1810	1.4311		245	205	175	157	145	136	130	125	121	119	118	280	240	210	187	175	167	161	156	152	149	147	400
X6 CrNiNb 1810	1.4541		190	176	167	157	147	136	130	125	121	119	118	222	208	195	185	175	167	161	156	152	149	147	400
	1.4550		191	177	167	157	147	136	130	125	121	119	118	226	211	196	186	177	167	161	156	152	149	147	400
X5 CrNiMo 17 122	1.4401	Solution annealed and quenched	196	177	162	147	137	127	120	115	112	110	108	230	211	191	177	167	156	150	144	141	139	137	300 2)
X2 CrNiMo 17 132	1.4404		182	166	152	137	127	118	113	108	103	100	98	217	199	181	167	157	145	139	135	130	128	127	400
X6 CrNiMoTi 17 122 2	1.4571		202	185	177	167	157	145	140	135	131	129	127	234	218	206	196	186	175	169	164	160	158	157	400
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 2)
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

1) Up to these temperatures, the material will, within 100000 hours, not have changed so as to show susceptibility to intercrystalline corrosion.

2) Only for wall thicknesses not exceeding 6mm.

5.5. Weldability

5.5.1 Tubes made from the steel grades specified in this standard are suitable for arc welding.

5.5.2. According to DIN 8528 Part 1 however, weldability is dependent not only on the grade of steel but also on the conditions during welding, on the design and the operating conditions of the structural component.

5.5.3. Any filler metal required shall be selected on the basis of DIN 8556 Part 1 taking the intended application, the stress, the welding process and other recommendations into consideration.

5.6. Further processing and heat treatment

See table 5 for guideline data on heat treatment in the fabrication of the tubes and on further processing, and also for guideline data on hot working as part of further processing.

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		Solution annealing temperature 1)	
Symbol	Material Number	Solution annealing temperature 1) ℃	Quenching in	Temperature	Type of cooling
X5CrNi 1810 X2CrNi 1911 X2CrNi 1810	1.4301 1.4306 1.4311	1000 to 1080	Water, air 2)	1150 to 750	Air
X6CrNiTi 1810 X6CrNiNb 1810 X5CrNiMo 17 122 X2CrNiMo 17 132 X6CrNiMoTi 17 122 X6CrNiMoTi 17 122	1.4541 1.4550 1.4401 1.4404 1.4571 1.4580	1020 to 1100			
X2CrNiMoN 17 133	1.4429	1040 to 1120			
X2CrNiMo 18 143 X5CrNiMo 17 133	1.4435 1.4436	1020 to 1100			
X2CrNiMoN 17 135	1.4439	1040 to 1120			

1) When heat treatment forms part of further processing of the 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℃ or if the product has been cold worked, the temperature of renewed solution annealing may be 20K less than the lower limit for solution annealing.

2) If the cooling is sufficiently rapid.

Table 6. Types of condition of tubes

Symbol	Type of condition	Surface finish 1)
d0 2)	Tubes welded from surface finish c1 *) or c2 *) plate, sheet or strip, not pickled	Metalicall clean.

d1 2)	Tubes welded from surfacec1*) or c2 *) plate, sheet or strip, pickled	Metallically bright.
d2 2)	Tubes welded from surface finish c1 *) or c1 *) or c2 *) plate, sheet or strip, heat treated. pickled	
d3 2)	Tubes welded from surface finish c1) or c2 *) plate, sheet or strip, bright heat treated.	
k0 2)	Tubes welded from surface finish h *). m *)or n*) plate, sheet or strip not pickled	Metallically clean, except that the weld is substantially smoother than for type d0.
k1 2)	Tubes welded from surface finish h*), m*) or n*)plate, sheet or strip, pickled	Metallically bright, except that the weld is substantially smoother than for types d1 to d3
k2 2)	Tubes welded from surface finish h*),m*) or n*) plate, sheet or strip, heat treated, pickled.	
k3 2)	Tubes welded from surface finish h*), m*), or n*) plate, if appropr	
lo 3)	Tubes welded from surface finish h*), m*) or n*) plate, sheet or strip, heat treated, pickled or bright heat treated, if appropriate, cold worked	
l1	Tubes welded from surface finish c1*), c2*), h*), m*) or n*) plate, sheet or strip, heat treated if appropnate, at least 20% cold worked, heat treated, with re-crystallized weld metal, pickled	Metallically bright, weld almost indistinguishable.
l2	Tubes welded from surface finish c1*), c2*), h*), m*) or n*) plate. sheet or strip, heat treated if appropriate. at least 20% cold worked. bright heat treated. with re-crystallized weld metal	
o	Ground 4)	Ground metallically bright, type and degree of grinding shall be agreed at the time of ordering 5)
p	Polished 4)	Polished metallically bright, type and quality of pollsing shall be agreed at the time of ordering 5)

*) See DIN 17440 or DIN 17441.

1) See also subclauses 5 .8.3

2) A "g" is be appended to the symbol for the type of condition of tubes habving smoothed welds (see subclause 5.1.2)

3) The mechanical properties specified in table 3 do not apply for this of condition. If required, they shall be agreed at the time of ordering.

4) Condition k1, k2, k3 l1 or l2 are usually used as the starting condition.

5) The order shall specify whether grinding or polishing is to be internal or external, or internal and external.

JIS Number and Corresponding Foreign Standards

JIS			ASTM			BS			DIN			NF			ISO		
Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade	Type

G3463			A213	TP304	SUS	3605	304s18	SUS	2462	X5CrNi189	SUS	A49-230	TUZ6CN 18.09	SUS	2604/2	TS48	SUS
	SUS		A249	TP304	SUS	"	304S25	SUS	2463	X5CrNi189	SUS						
	304TB	SUS	A269	TP304	SUS	3606	LWHT304S22	SUS									
			A623	TP304	SUS	3606	LWCF304S22	SUS									
			A688	TP304	SUS	"	LWBC304S25	SUS									
	SUS		A213	TP304H	SUS	3059	CFS304S59	SUS							2604/2	TS48	SUS
	304HTB	SUS	A249	TP304H	SUS	3606	304S59	SUS									
	SUS		A213	TP304L	SUS	3605	304S14	SUS	2462	X2CrNi189	SUS	A49-207	TSZ2CN 18.10	SUS	2604/2	TS46	SUS
	304LTB	SUS	A249	TP304L	SUS	"	304S22	SUS	2463	X2CrNi189	SUS	"	TSZ2CN 18.10	SUS			
			A269	TP304L	SUS	3606	LWHT304S22	SUS				A49-230	TSZ2CN 18.10	SUS			
			A632	TP304L	SUS	"	LWCF304S22	SUS									
			A688	TP304L	SUS	"	LWBC304S22	SUS									
						"	CFS304S22	SUS									
	SUS																
	309TB	SUS															
	SUS																
	309STB	SUS	A213	TP309S	SUS												
	SUS														2604/2	TS68	SUS
	310TB	SUS	A632	TP310	SUS												
	SUS																
	310STB	SUS	A213	TP310S	SUS												
	SUS		A213	TP316	SUS				2462	X5CrNiMo 1810	SUS	A49-230	TUZ6CN 18.09	SUS	2604/2	TS60	SUS

	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	SUS
	316HTB	SUS	A249	TP316H	SUS				17456						"	TS61	SUS
	SUS		A213	TP316L	SUS	3605	316S14	SUS	2462	X2CrNiMo 1810	SUS				2604/2	TS57	SUS
	316LTB	SUS	A249	TP316L	SUS	"	316S22	SUS		X2CrNiMo 1812	SUS				"	TS58	SUS
			A269	TP316L	SUS	3606	LWHT316S24	SUS	2463	X2CrNiMo 1810	SUS						
			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	SUS
	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	
	347TB	SUS	A249	TP347	SUS	"	347S17	SUS	17457			"	TUZ6CNNb 18.10	SUS			
			A269	TP347	SUS	3606	LWHT347S17	SUS	17458	X6CrNiNb 1810							

			A632	TP347	SUS	"	LWCF347S17	SUS									
						3606	LWBC347S17	SUS									
						3606	CFS317S17	SUS									
	SUS		A213	TP347H	SUS	3059	CFS347S17	SUS							2604/2	TS56	SUS
	347HTB	SUS	A249	TP347H	SUS	3605	347S59	SUS									
	SUS																
	XM15JITB	SUS															
	SUS																
	329J2LTB	SUS															
	SUS		A268	TP405	SUS												
	405TB	SUS															
	SUS		A268	TP409													
	409TB	SUS															
	SUS		A268	TP410	SUS				2462	X10Cr13	SUS						
	410TB	SUS															
	SUS																
	410TiTB	SUS															
	SUS		A268	TP430	SUS				2462	X8Cr7	SUS						
	430TB	SUS															
	SUS		A213	18Cr2Mo	SUS												
	444TB	SUS															
	SUS																
	XM8TB	SUS															
	SUS		A731	18Cr2Mo	SUS												
	XM27TB	SUS	"	TP439	SUS												