DIN 2391-81 Part II SEAMLESS PRECISION STEEL TUBES

1. Field of application

This Standard defines the technical delivery conditions for seamless precision steel tubes according to DIN 2391 Part 1 which are made from the steel grades listed in section 5. Tubes according to this Standard are mainly used where accuracy to dimension and, possibly, small wall thicknesses and good surface condition are required.

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		Chemical co	omposition (%)							
Grade	Mfg. Process	С	Si	Mn	p	S	Ni	Cr	Мо	Others	(1) (2) (3) (4)
St30Si	S	0.10Max	0.30Max	0.55Max	0.040Max	0.040Max	-	-	-	-	1 2 3 4
St30A1	s	0.10Max	0.05Max	0.55Max	0.040Max	0.040Max	-	-	-	Al deoxydized	1) 2) 3) 4)
St35	s	0.17Max	0.35Max	0.40Max	0.050Max	0.050Max	-	-	-	-	1 2 3 4
St45	s	0.21Max	0.35Max	0.40Max	0.050Max	0.050Max	-	-	-	-	 (1) (2) (3) (4)
St52	s	0.22Max	0.55Max	1.60Max	0.050Max	0.050Max	-	-	-	-	1)

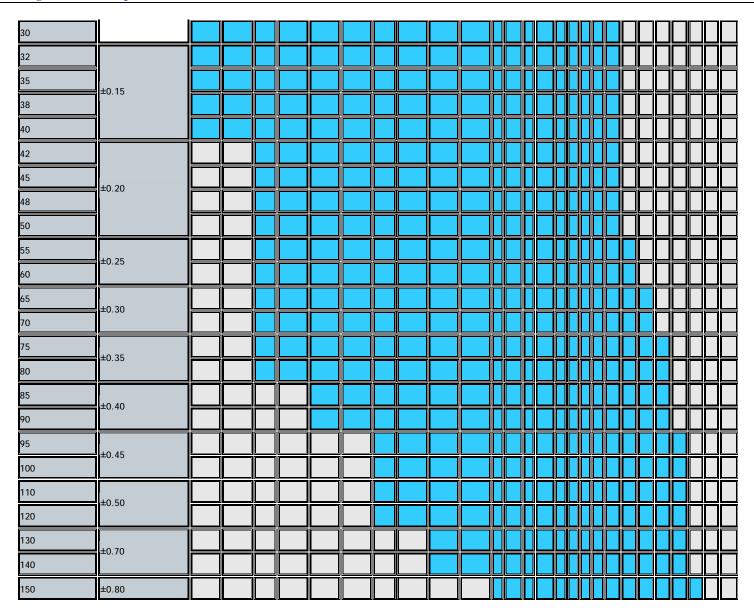
					2
					3
					4

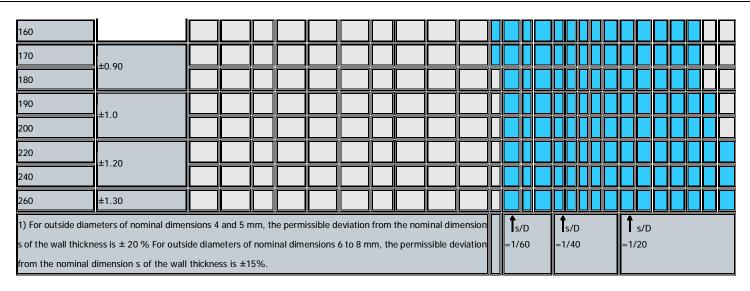
 $\textcircled{1} \textbf{Cold-finished/hard} \ \textcircled{2} \textbf{Cold-finished/soft} \ \textcircled{3} \textbf{Annealed} \ \textcircled{4} \textbf{Normalized}$

Grade	Material number	Tensile Test MPa o	r N/mm²	Remarks (Similar to JIS)
Grade	iwateriai riurribei	Min Yield point	Tensile Strength	Terriarks (Similar to 313)
		-	400Min	
St30Si	1.0211	_	355Min	(STKM11)
3(303)	1.0211	-	285Min	(STRIVITI)
		215	295~420	
		-	400Min	
St30Al	1.0212	_	355Min	(STKM11)
SISUAI	1.0212	_	285Min	(STRIVITI)
		215	295~420	
		-	440Min	
St35	1.0308	-	370Min	(STC38)
5155	1.0306	_	315Min	(31036)
		235	340~470	
		-	540Min	
St45	1.0408	-	470Min	(CT//M12)
5145	1.0406	_	390Min	(STKM13)
		255	440~570	
		_	590Min	
St52	1.0580	-	540Min	(STKM19)
3 (3∠	1.0380	-	490Min	(21VIVI1A)
		350	490~630	

Welded Steel Tubing and Pipe-Corresponding to DIN 2391-1

Valid thickness Nominal dimension 0.5 0.8 1 1.2 1.5 1.8 2 2.2 2.5 2.8 3 4.5 5 5.5 6 7 8 9 10 12 14 16 18		0				leer iu	biriy a	nu rip	e-co	rrespo	nung	ווע סו															
Outside diameter da Image: Control of the	Wall thickness	Nominal dimension	0.5	0.8	1	1.2	1.5	1.8	2	2.2	2.5	2.8	3	4.5	5	5.5	6 7	8	9	10	12	2 14	16	18	20	22	25
Nominal dimension	s	Permissible deviation																									
dimension	Outside diameter o	la																									
8 9 10 10 10 10 10 10 10 10 10 10 10 10 10		Permissible deviation																									
8	5																										
12 ±0.08	6 7	±0.1																						I			
12 ±0.08	8																				Ï			Ë	Ï	Ë	
14 15 16 18 20 22																					Ï			‡			
16 18 20 22		±0.08																			ļ			ļ			
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3. Quality grade

The tubes are supplied in the following quality grades:

Α	١	precision steel tubes intended primarily for mechanical stressing, without any particular quality requirement and without acceptance test certificate
В	3	precision steel tubes intended primarily for mechanical stressing, with special requirement and exclusively with acceptance test certificate
_		precision steel tubes with special requirement according to section 12. Theses requirements and corresponding tests must be agreed, with the customer having to specify his requirements at the
C	,	time of enquiry and on ordering

Table 1. Steel grades

Quality grade	Steel grade	
Quality grade	Code number	Material number
	St 30 Si	1.0211
	St 30 Al	1.0212
A and B	St 35	1.0308
	St 45	1.0408
	St 52	1.0580

	All steel grades according to quality grade A	and B, as well as other steels, e.g. according to
C	DIN 1651	DIN 17 210
	DIN 17 100	DIN 17 211
	DIN 17 200	DIN 17 212

6. Chemical composition

- 6.1. Table 2 contains data on the chemical composition of the steels. Small departures from these data which apply to the ladle analysis, are permissible if they do not impair the properties of the steel when in use.
- 6.2. In carrying out subsequent testing on the finished tube, the maximum permissible contents in terms of carbon, phosphorus and sulfur as defined by the ladle analysis of table 2 may be increased:

in the case of deviations due to sampling and method of analysis by + 5 % in the case of deviations due to segregation: by + 20% for killed steels by + 5 %

of the particular maximum content.

Table 2. Steel grades and chemical composition of the steels (ladle analysis)

Steel grade		Chemical com	position, %			
Symbol	Material number	С	Si	Mn	Р	S
Symbol	wateriai Humbei	max	max		max	max
St 30 Si	1.0211	0.10	0.30	≤ 0.55	0.040	0.040
St 30 Al 9)	1.0212	0.20	0.05	≤ 0.55	0.040	0.040
St 35	1.0308	0.17	0.35	≥ 0.40	0.050	0.050
St 45	1.0408	0.21 2)	0.35	≥ 0.40	0.050	0.050
St 52	1.0580	0.22	0.55	≤ 1.60	0.050	0.050
1) This steel is de	oxidized using aluminum.			-		
2) In subsequent	testing on the individual tube, tl	ne C-content must not	exceed 0.25%.			

7. Condition on delivery

The tubes are supplied in one of the conditions listed in table 3. Other conditions on delivery are specified in table 9 (quality grade C).

Symbol Explanation Term Cold-finished/hard BK No heat treatment after the last cold-forming process. The tubes therefore have only low deformability. (cold-finished as-drawn) Cold-finished/soft After the last heat treatment there is a light finishing pass (cold drawing) With proper subsequent processing, BKW (lightly cold-worked) the tube can be cold-formed (e.g. bent, expanded) within certain limits. Annealed GBK After the final cold-forming process the tubes are annealed in a controlled atmosphere or under vacuum. Normalized NBK The tubes are annealed above the upper transformation point in a controlled atmosphere or under vacuum.

Table 3. Conditions on delivery

- 8. Mechanical and technological properties
- 8.1. The mechanical properties depend on the condition on delivery as defined in table 3.
- 8.2. In technological testing (drift expanding test and flattening test) the samples must comply with the requirements of sections 11.2.3.2. and 11.2.3.3.
- 8.3. In the case of other steel grades and/or other conditions on delivery then those specified in tables 2, 3 and 8, the mechanical and technological properties must be mutually agreed. In these cases, the tubes are supplied according to quality grade C.
- 8.4. The steels listed in table 2 are deemed to be suitable for welding because of their chemical composition and metal lurgical treatment.

In the BK or BKW conditions on delivery, the mechanical properties are modified in the zone which has been subjected to heating. This should be taken into account (see DIN 8528 Part 1) in assessing the weldability of a component.

		Condition o	n delivery							
Steel grade		Cold-finishe	d/hard	Cold-finished	/soft	Annealed		Normalized		
		(BK) 3)		(BKW) 3)		(GBK) 3)		(NBK)		
		Tensile	Elongation at	Tensile	Elongation at		Elongation at	Tensile		Elongation at
Code	Material	strength	repture	<i>strength</i> <i>R</i> m	repture	<i>strength</i> <i>R</i> m	repture	strength	yield point	repture
number	number	<i>R</i> m	A5	N/mm²	A 5	N/mm²	A5	<i>R</i> m N/mm²	<i>R</i> eH	A5
		N/mm²	%		%		%		N/mm²	%

Table 4. Mechanical properties of the tubes at room temperature

		min	min	min	min	min	min		min	min
St 30 Si	1.0211	400	8	330	12	280	30	290 to 420	215	30
St 30 Al	1.0212	400	8	330	12	280	30	290 to 420	215	30
St 35	1.0308	440	6	370	10	315	25	340 to 470	235	25
St 45	1.0408	540	5	470	8	390	21	440 to 570	255	21
St 52	1.0580	590	4	540	7	490	22	490 to 630	355	22

3) The yield point for the annealed (GBK)condition on delivery is at least 50% of the (ultimate) tensile strength. Depending upon the degree of deformation in the drawing operation, the yield point of tubes delivered in the cold-finished/hard (BK) and cold-finished/soft (BKW) conditions, may be increased to a level close to the tensile strength. In calculating the yield point, the following values are recommended: cold-finished/hard condition on delivery ≥ 80% of the tensile strength, cold-finished/soft condition on delivery ≥ 70% of the tensile strength.

4) In the case of tubes of outside diameter ≤ 30 mm, the wall thickness of which is ≤ 3mm, the minimum value of the yield point is 10 N /mi lower.

JIS			ASTM			BS			DIN			NF			ISO		Index	
Standard Number	Grade	Туре	Standard Number		Туре	Standard Number		Type	Standard Number	Grade	Type	Standard Number	Grade	Type	Standard Number	Grade		Number
G3445	STKM11A	С	A512	MT1010	С	1717	ERWC1	С	2391	St30Si	С				3304	R28	С	C017
			A513	MT1010	С					St30A1	С				3305	"	С	
									2393	St28	С				3306		С	
										RSt28	С							
									2394	St28	С							
										USt28	С							
										RSt28	С							
	STKM12A	С	A512	MT1015	С	1717	ERWC2	С	2391	St37-2					3304	R33	С	
			A513	MT1015	С	6323	HFS3	С		RSt37-2					3305			
	STKM12B	С	A512	MT1015	С				2394	St37-2					3306	"		
			A513	MT1015	С					Ust38-2								

			A519	MT1015	С					RSt-2								
	STKM12C	С				1717	CEWC2	С				A49-322	TU37b	С				
							CFSC3	С				1	TU37b	С				
						6323	CFS3	С				7(17 027	10075					
						"	CFS3A	С										
						1	1	1										
	STKM13A	С	A312	1		1717	ERWC3	С	2391	St45	С	A49-324			2937		С	
			A513	MT1020	С				2393	St44-2	С	A49-330	TU37b	С	3304	R37	"	
									2394	St44-2	С	A49-343	TU38b	С	3305	"	"	
S	STKM13B	С	A513	MT1020	С										3306			
S	STKM13C	С				1717	CEWC3	С										
							CFSC4	С										
						6323	CFS4	С										
9	STKM14A	С	A513	MT1020	С	6323	HFS4	С							2937	TS9	С	
															3304	R42		
9	STKM14B	С				6323	HFS5	С							3305	R42	С	
S	STMK14C	С													3306			
9	STKM15A	С	A513	1030	С													
			A519	1030	С													
S	STKM15C																	
S	STKM16A	С	A519	1040	С							A49-311	TUXC35	С				
												A49-312	TUXC35	С				
9	STKM16C	С																
9	STKM17A	С	A519	1050	С	6323	HFS8	С										
9	STKM17C	С				6323	CFS8	С										

ST	KM18A	С	A519	1518	С	1717	ERWC5	С				A49-310	TU52b	С				
												A49-311	TU52b	С				
												A49-312	TU52b	С				
ST	KM18B	С										A49-321	TU52b	С				
												A49-323	TU52b	С				
												A49-326	TU52b	С				
ST	KM18C	С										A49-330	TU52b	С				
												A49-341	TS42a	С				
													TS47a	С				
												A49-343	TS18M5	С				
ST	KM19A	С	A519	1524	С				2391	ST52	С				2937	TS18	С	
									2393	ST52-3	С				2938	Gr.1	С	
									2394	ST52-3	С				3304	R50	С	
															3305	R50	С	
															3306	R50	С	
ST	KM20A	С																