

## 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.

Grade	Mfg. Process	Chemical composition (%)									① ② ③ ④
		C	Si	Mn	P	S	Ni	Cr	Mo	Others	
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

①Cold-finished/hard ②Cold-finished/soft ③Annealed ④Normalized

Grade	Material number	Tensile Test MPa or N/mm <sup>2</sup>		Remarks (Similar to JIS)
		Min Yield point	Tensile Strength	
St30Si	1.0211	-	400Min	(STKM11)
		-	355Min	
		-	285Min	
		215	295~420	
St30Al	1.0212	-	400Min	(STKM11)
		-	355Min	
		-	285Min	
		215	295~420	
St35	1.0308	-	440Min	(STC38)
		-	370Min	
		-	315Min	
		235	340~470	
St45	1.0408	-	540Min	(STKM13)
		-	470Min	
		-	390Min	
		255	440~570	
St52	1.0580	-	590Min	(STKM19)
		-	540Min	
		-	490Min	
		350	490~630	

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

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### 3. Quality grade

The tubes are supplied in the following quality grades:

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

Table 1. Steel grades

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

C	All steel grades according to quality grade A and B, as well as other steels, e.g. according to	
	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:                    |          |
|   | for rimming steels                                               | 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 composition, %				
Symbol	Material number	C max	Si max	Mn	P max	S 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 deoxidized using aluminum.

2) In subsequent testing on the individual tube, the 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).

Table 3. Conditions on delivery

Term	Symbol	Explanation
Cold-finished/hard (cold-finished as-drawn)	BK	No heat treatment after the last cold-forming process. The tubes therefore have only low deformability.
Cold-finished/soft (lightly cold-worked)	BKW	After the last heat treatment there is a light finishing pass (cold drawing) With proper subsequent processing, 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.

## 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.

Table 4. Mechanical properties of the tubes at room temperature

Steel grade		Condition on delivery								
		Cold-finished/hard (BK) 3)		Cold-finished/soft (BKW) 3)		Annealed (GBK) 3)		Normalized (NBK)		
Code number	Material number	Tensile strength <i>R<sub>m</sub></i> N/mm <sup>2</sup>	Elongation at reapture A <sub>5</sub> %	<i>Tensile strength</i> <i>R<sub>m</sub></i> N/mm <sup>2</sup>	Elongation at reapture A <sub>5</sub> %	<i>Tensile strength</i> <i>R<sub>m</sub></i> N/mm <sup>2</sup>	Elongation at reapture A <sub>5</sub> %	<i>Tensile strength</i> <i>R<sub>m</sub></i> N/mm <sup>2</sup>	Upper yield point ReH N/mm <sup>2</sup>	Elongation at reapture A <sub>5</sub> %

		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  $\geq 80\%$  of the tensile strength, cold-finished/soft condition on delivery  $\geq 70\%$  of the tensile strength.

4) In the case of tubes of outside diameter  $\leq 30$  mm, the wall thickness of which is  $\leq 3$  mm, the minimum value of the yield point is 10 N /mm<sup>2</sup> lower.

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



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