

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 deoxidized	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

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

Grade	Material number	Tensile Test MPa or N/mm ²		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	

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	Elongation at reapture	Tensile strength	Elongation at reapture	Tensile strength	Elongation at reapture	Tensile strength	Upper yield point	Elongation at reapture
				<i>R_m</i> N/mm ²	A5 %	<i>R_m</i> N/mm ²	A5 %	<i>R_m</i> N/mm ²	A5 %	<i>R_m</i> N/mm ²

