

## DIN 17177-79 ELECTRICALLY RESISTANCE OR INDUCTION WELDED STEEL TUBES FOR ELEVATED TEMPERATURE

The Sections marked with a solid circle(○) contain particulars on agreements which shall, or may be, reached at the time of ordering.

## 1. Scope

This Standard applies to electric resistance or induction welded tubes 1) manufactured from the heat-resisting selection of steels 2) used in part for temperatures up to 530°C and at simultaneous high pressures, where the total stress and the relevant scaling conditions can raise or lower the temperature limit.

Grade	Mfg. Process	Chemical composition (%)								
		C	Si	Mn	P	S	Ni	Cr	Mo	Others
St37.8	E	0.17Max	0.10~0.35	0.40~0.80	0.040Max	0.040Max	-	-	-	-
St42.8	E	0.21Max	0.10~0.35	0.40~1.20	0.040Max	0.040Max	-	-	-	-
15Mo3	E	0.12~0.20	0.10~0.35	0.40~0.80	0.035Max	0.035Max	-	-	0.25~0.35	-

Grade	Material number	Tensile Test MPa or N/mm <sup>2</sup>		Remarks (Similar to JIS)
		Min Yield point	Tensile Strength	
St37.8	1.0315	235	360~480	(STPT370)
St42.8	1.0498	255	410~530	(STPT410, STB410)
15Mo3	1.5415	275	450~600	-

Table 1. Heat-resistant steels for electric resistance and induction welded tubes, their chemical composition (according to the ladle analysis) and colour designation of tubes

Steel grade 1)		Chemical composition in % by wt.						Colour designation 2)
Code number	Material number	C	Si	Mn	P	S	Mo	
St 37.8 3)	1.0315	≤ 0.17	0.10 to 0.35 4)	0.40 to 0.80	0.040	0.040		Two white rings
St 42.8 3)	1.0498	≤ 0.21	0.10 to 0.35 4)	0.40 to 1.20	0.040	0.040		Two yellow rings
15 Mo 3	1.5415	0.12 to 0.20	0.10 to 0.35	0.40 to 0.80	0.035	0.035	0.25 to 0.35	one yellow ring and two carmine rings

1) Electric pressure-welded tubes of alloy steels other than steel 15 Mo 3 may be supplied to this a Standard provided the necessary proof of the suitability of the industrial tube making process has been obtained in an authorized approval test.

2) In normal proactive both ends are painted with rings in the colour required. If requested, it can be agreed at the time of ordering then the paint marking in the relevant colours should extend over the entire length of the tube.

- 3) The steels St 37.8 and St 42.8 satisfy the "Technical Regulations for Steam Boilers" published by the Deutscher Dampfkesselausschuss (German Steam Boiler Committee) in the same way as St 35.8 and St 45.8 according to DIN 17 175
- 4) The minimum silicon content is allowed to fall below 0.10% when the steel is aluminum-killed or vacuum deoxidized.

Table2. Permissible deviations in the chemical composition of the sample analysis from limiting values quoted in the cast analysis (see Table 1)

Element	Limiting values quoted in ladle analysis according to Table 1 % by wt.	Permissible deviation 7) of sample analysis from the limiting values quoted in the ladle analysis according to Table 1 % by wt.
C	≤ 0.21	± 0.02
Si	≤ 0.35	± 0.03
Mn	≤ 1.00 > 1.00 ≤ 1.20	± 0.04 ± 0.05
P and S	≤ 0.040	± 0.010
Mo	≤ 0.35	± 0.04
1) In a cast the deviation of an element		

Table3. Extent of testing for electric pressure welded tubes in both quality grades

No	Extent of testing	According to Section	Quality grade I	Quality grade II	Authority for the execution of the test 1)
1	Tensile test 2)	8.4.3	on two tubes per batch from the first two batches, on one tube from each subsequent batch	on two tubes per batch from the first two batches, on one tube from each subsequent batch	S.A.
2	Ring test 3)	8.4.5	on one end of the tubes acc to No.1	depending on the diameter (see Section 8.4.5) on 20% of the cut or part-lengths at one end or on 100% of the cut or part-lengths at both ends if necessary though also at one end, see Section 8.4.5.2.2.	S.A.
3	Non-destructive test	8.4.6	weld examination on all tubes	as for quality grade I, additionally over the complete tube circumference	M.W.
4	Visual inspection	8.4.7	all tubes	all tubes	S.A.

5	Gauging	8.4.8	all tubes	all tubes	S.A.
6	Leakage test	8.4.9	all tubes	all tubes	M.W.
7	Identification test	8.4.10	-	on all alloy tubes	M.W.
8	Special tests 4) No. 8, No. 9	8.4.2	subject to agreement	subject to agreement.	M.W.
9	Hot tensile test	8.4.4	unless otherwise agreed 1 sample per cast and size or 1 sample per cast and annealed batch (heat treated batch)	unless otherwise agreed 1 sample per cast and size or 1 sample per cast and annealed batch (heat treated batch)	S.A.

- 1) S.A = subject to agreement; M.W. = Manufacturing works.  
 2) One sample or set of samples suffices for batches containing up to 10 tubes.  
 3) Note the particulars on the dimension range governing the application of these test in Table 11.  
 4) Special tests shall be carried out only after agreement between manufacturer and customer.

Table 4. Limits governing the application of quality grades I and III

Quality	Outside diameter of tube			
	≤ 63.5mm		> 63.5mm	
	Temperature 2) °C	Permissible working pressure 3) bar	Temperature 2) °C	Permissible working pressure 3) bar
I	≤ 450	≤ 80	≤ 450	≤ 32
III	> 450	> 80	> 450	> 32

- 1) If pressure and temperature data do not belong to the same quality group, the higher group applies.  
 2) Temperature of conveyed fluid.  
 3) See DIN 2401 Part 1

Table 5. Mechanical properties of electric resistance or induction welded tubes of heat-resistant steels at room temperature

Steel grade		Tensile strength N/m <sup>2</sup>	Yield point 1) for wall thicknesses up to 16mm N/m <sup>2</sup> minimum	Elongation at fracture (Lo = 5*do)	
Code number	Material number			Long	Transverse
St 37.8	1.0315	360 to 480	235	% minimum	
				25	23

St 42.8	1.0498	410 to 600	255	21	19
15 Mo 3	1.5415	450 to 600	270 2)	22	20
1) For tubes of $\leq 30$ mm outside diameter and $\leq 3$ mm wall thickness the minimum values are by 10N/mm <sup>2</sup> lower.					
2) A 15N/mm <sup>2</sup> higher minimum value applies for $\leq 10$ mm wall thickness.					

Table 6. Minimum 0.2% yield limit of electric resistance and indication welded tubes of heat-resistant steels at elevated temperatures

Steel grade		Wall thickness mm	0.2% yield limit						
Code number	Material number		200°C	250°C	300°C	350°C	400°C	450°C	500°C
N/mm <sup>2</sup> minimum									
St 37.8	1.0315	$\leq 16$	185	165	140	120	110	105	-
St 42.8	1.0498	$\leq 16$	205	185	160	140	130	125	-
15 Mo 3	1.5415	$\leq 16$ 1)	225	205	180	170	160	185	150

1) For thicknesses  $\leq 10$ mm, 15N/mm<sup>2</sup> higher minimum 0.2% yield limits apply at all temperatures.

Table 7. Provisional expansion data 1) (change in diameter) in the ring expanding test

Steel grade		Expansion 2) in ring expanding test (provisional data)					
Code number	Material number	$\geq 0.9$	$\geq 0.8$	$\geq 0.7$	$\geq 0.6$	$\geq 0.5$	$< 0.5$
			$< 0.9$	$< 0.8$	$< 0.7$	$< 0.6$	
% minimum							
St 37.8	1.0315	8	10	12	20	25	30
St 42.8	1.0498						
15 Mo 3	1.5415	6	8	10	15	20	30

1) These values shall regarded as initial recommendations which are based on a series of tests and will have to be reassessed in the light of future experience.

2) The deformability of ring expanding samples will additionally be assessed in terms of the appearance of the fracture and fracture surfaces.

Table 8. Permissible Length deviations

For orders specifying	Permissible length deviation in mm
Production lengths	1)
Approximate lengths	$\pm 500$

Exact lengths	+0
from ≤ 6m (nominal dimension)	0
from > 6m ≤ 12 m (nominal dimension)	+15
from >12 m	0
Subject to agreement	
1) The products are supplied in production lengths which differ according to diameter wall thickness and production plant.	

Table 9. Reference data for the hot working and the normalizing of heat-resistant steels for electric pressure-welded tubes

Steel grade		Hot working °C	Normalizing °C
Code number	Material number		
St 37.8	1.0315	between 1100 and 850 2)	900 to 930
St 42.8	1.0498		870 to 900
15 Mo 3	1.5415		910 to 940
1) The work pieces must attain the specified temperature over the entire cross-section. Provided this has been accomplished, for normalizing a further holding at these temperatures is unnecessary.			
2) The temperature can drop to 750°C during processing.			

Table 10. Welding methods and data for the post-heat-treatments

Steel grade		Welding methods	Annealing temperature 1) and holding time 2), 3) at the specified post-heat treatment °C
Code number	Material number		
St 37.8	1.0315	All fusion welding methods and flash butt welding	520 to 600
St 42.8	1.0498		
15 Mo 3	1.5415		530 to 620
1) If required (see Section 7.3), these temperatures apply also for annealing after cold working.			
2) The holding time for the specified temperatures depends on the wall thickness. A minimum holding time of 15 minutes is recommended.			
3) The annealing treatment shall also comply with the data supplied by the manufacturer of the filler metal.			

Table 11. Dimension ranges for the application of mechanical and technological methods for testing tubes in both qualities.

Outside diameter of tubes mm	Nominal wall thicknesses of tubes	
	< 2mm	2 ≥mm ≤16mm
≤21.3	Tensile test Ring flattening test 1)	Tensile test Ring flattening test 1)
> 21.3 ≤ 146	Tensile test Ring flattening test	Tensile test Ring flattening test
> 146	-	Tensile test Ring flattening test

1) If the weld seam is not discernable, the drift expanding test shall be carried out.

## Appendix A

The following Table gives tentative figures for the longtime high-temperature strength of the heat-resistant steels. The figures listed mean values for the scatter range representing the results so far available. From the data so far at hand from long-time creep tests it can be assumed that the bottom limit of this scatter range at the stated temperature for the steel grades listed is about 20% lower than the mean values quoted.

Note: The values quoted here are based on investigations of the base material. Some limited experience has suggested that the values are also applicable to welded tubes.

Table A.1

Steel grade Code number	Temperature	1% creep limit 1), 2)		Creep strength 2), 3)		
		10 000 h N/mm <sup>2</sup>	10 000 h N/mm <sup>2</sup>	100 000 h N/mm <sup>2</sup>	100 000 h N/mm <sup>2</sup>	200 000 h N/mm <sup>2</sup>
St 37.8	380	164	118	229	165	145
St 42.8	390	150	106	211	148	129
	400	136	95	191	132	115
	410	124	84	174	118	101
	420	113	73	158	103	89
	430	101	65	142	91	78
	440	91	57	127	79	67



