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July 1985

Welded circular austenitic stainless steel tubes subject to special requirements

Technical delivery conditions

DIN 17457

Geschweißte kreisförmige Rohre aus austenitischen nichtrostenden Stählen für besondere Anforderungen; technische Lieferbedingungen

This standard, together with DIN 17440, DIN 17441, DIN 17455, DIN 17456 and DIN 17458 (July 1985 editions), supersedes DIN 17440, December 1972 edition

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

See Explanatory notes for connection with International Standard ISO 2604/5 – 1978, published by the International Organization for Standardization (ISO).

The subclause marked with a single dot ● give specifications which are to be agreed upon at the time of ordering.

The subclauses marked with two dots ●● give specifications which are optional and may be agreed upon at the time of ordering.

Contents

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 are given in codes of practice for specific fields of application, e.g. the *Technische Regeln Druckbehälter (TRB)* (Technical rules on pressure vessels), *Merkblätter der Arbeitsgemeinschaft Druckbehälter* (Instruction sheets of the Study group on pressure vessels).

1.2 This standard does not apply to general purpose welded circular stainless steel tubes (see DIN 17455).

2 General

2.1 Concept

Steels which are particularly resistant to chemically agressive agents are considered to be stainless steels; they generally have a chromium content of not less than 12 % by mass and a carbon content not exceeding 1,2 % by mass.

2.2 Test classes

Tubes complying with the requirements of this standard may be supplied as test class 1 or test class 2 tubes. Test class 2 tubes are distinguished from test class 1 tubes by their having been subjected to a more extensive test programme.

● The selection of the test class is at the purchaser's discretion.

2.3 Utilization of design stress

Tubes complying with the requirements of this standard are intended to be used on the basis of a 100 % utilization of the permissible design stress in the weld.

3 Classification into grades

This standard covers tubes made from the steel grades listed in table 1.

● The selection of the steel grade is at the purchaser's discretion.

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4 Designation and ordering

4.1 The standard designation for tubes complying with this standard shall give in the following order:

- the term "tube";
- DIN number of the dimensional standard (e.g. DIN 2463 Part 1);
- characteristic dimensions of tube (outside diameter × wall thickness);
- number of the present standard (DIN 17457);
- symbol or material number for the steel grade (see table 1);
- symbol for the type of condition of the tube (see table 6).

Example:

A welded tube conforming to this standard, with an outside diameter of 60,3 mm and a wall thickness of 2 mm as specified in DIN 2463 Part 1, made from X 5 CrNi 18 10 steel (material number 1.4301), in the heat treated and pickled condition (k2), shall be designated as follows:

Tube DIN 2463 – 60,3 × 2
DIN 17457 – X 5 CrNi 18 10 – k2

or Tube DIN 2463 – 60,3 × 2
DIN 17457 – 1.4301 – k2

4.2 ● In addition to the standard designation as given in subclause 4.1, the purchaser shall always state in his order the required quantity (e.g. the total length to be supplied), the test class, the type of length (see DIN 2463 Part 1), the length of the individual tube in the case of specified lengths and exact lengths, the tolerance class for diameter and wall thickness as specified in DIN 2463 Part 1, the type of document on materials testing as specified in DIN 50 049 and, if required, also the relevant technical specification.

Example of an order:

1000 m tube DIN 2463 – 60,3 × 2
DIN 17457 – 1.4301 – k2
test class 1, in specified lengths of 6 m,
tolerance class D2, T3,
accompanied by document DIN 50 049 – 3.1 B

4.3 ●● In addition to this, further details may be agreed at the time of ordering, as described in the subclauses marked with two dots.

5 Requirements

5.1 Manufacturing process

5.1.1 The process employed for making the steels used to manufacture the tubes conforming to this standard is at the manufacturer's discretion, unless a special steelmaking process has been specified at the time of ordering.

5.1.1.1 ●● If so agreed, the purchaser shall be informed on the steelmaking process used.

5.1.2 Tubes conforming to the requirements of this standard shall be manufactured from appropriately bent plate, sheet or strip by fusion welding, with or without filler metal, at the manufacturer's discretion, in automated fabrication or in single-piece fabrication. The welds of automatically welded tubes may be smoothed by appropriate methods, e.g. by hammering or rolling as part of the manufacturing process. Tubes with outside diameters not exceeding 168,3 mm may additionally be brought to the required tube dimensions by cold working (see types of condition I1 and I2 given in table 6).

5.1.3 The tubes shall be welded so as to ensure complete root penetration and so that the tubes conform to the requirements specified in this standard. The welding process shall be inspected to ensure that welds are properly carried out (see subclause 6.5.12 for the non-destructive testing of the weld). Local repair of welds is permitted. The purchaser may, on one occasion only, request a document certifying the suitability of the process employed for repairing welds, as specified in subclause 5.1.4. Areas that are repaired shall then be subjected to non-destructive testing; in addition, the tube shall be tested for leak tightness.

5.1.4 ●● The purchaser may, on one occasion only, request a document certifying compliance with the requirements specified in subclause 5.1.3. The details of this document, in particular with regard to the test house, shall be agreed between manufacturer and purchaser. This document shall be considered valid only for the steel grades, dimensional ranges, welding processes and filler metals to which it refers.

5.2 As delivered condition

The tubes may be supplied in one of the conditions specified in table 6 (see subclause 5.8). The guideline data given in table 5 shall be taken into consideration where the conditions specified in table 6 provide for heat treatment.

5.3 Chemical composition

5.3.1 Cast analysis

The chemical composition of the steels determined in the cast analysis [1]) shall be as specified in table 1. Slight deviations from these values are permitted subject to agreement with the purchaser or his representative if the mechanical properties, weldability and corrosion resistance of the steel conform to the requirements specified in this standard.

5.3.2 Product analysis

When testing the chemical composition of the finished product, the deviations shown in table 2 from the values specified in table 1 are permitted.

5.4 Mechanical and technological properties

5.4.1 The 0,2 % and 1 % proof stresses, the tensile strength, the elongation after fracture and the impact energy determined for the tube material shall conform to the values specified in table 3, which apply for tubes in the as delivered condition specified in subclause 5.2 and for the test conditions specified in subclauses 6.4 and 6.5 of this standard.

The upper limit value of tensile strength may be exceeded if a tensile test transverse to the weld (see subclause 6.3.1.2) is carried out.

5.4.1.1 ●● The mechanical properties do not apply for condition I0 described in table 6. If required, these shall be agreed at the time of ordering.

5.4.2 The values listed in table 4 shall apply for the elevated temperature 0,2 % and 1 % proof stresses.

5.4.3 The tubes shall comply with the requirements to be verified in the technological tests specified in subclauses 6.5.4 to 6.5.7.

5.4.4 Tubes made from steel grades specified in this standard are suitable for hot working.

5.4.5 Tubes made from the steel grades specified in this standard are particularly suited for cold working (e.g. bending) in the "solution annealed and quenched" condition. It should be noted that the corrosion resistance and the mechanical and physical properties are changed by cold working.

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[1]) When sequential castings are supplied, as is possible in the case of continuously cast tubes, the term "cast" should be read as "casting unit".

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]
X 5 CrNi 18 10	**1.4301**	0,07	17,0 to 19,0	–	8,5 to 10,5	–
X 2 CrNi 19 11	**1.4306**	0,030	18,0 to 20,0	–	10,0 to 12,5	–
X 2 CrNiN 18 10	**1.4311**	0,030	17,0 to 19,0	–	8,5 to 11,5	N: 0,12 to 0,22
X 6 CrNiTi 18 10	**1.4541**	0,08	17,0 to 19,0	–	9,0 to 12,0	Ti: 5 × %C, up to 0,80
X 6 CrNiNb 18 10	**1.4550**	0,08	17,0 to 19,0	–	9,0 to 12,0	Nb: 10 × %C, up to 1,00 [4]
X 5 CrNiMo 17 12 2	**1.4401**	0,07	16,5 to 18,5	2,0 to 2,5	10,5 to 13,5	–
X 2 CrNiMo 17 13 2	**1.4404**	0,030	16,5 to 18,5	2,0 to 2,5	11,0 to 14,0	–
X 6 CrNiMoTi 17 12 2	**1.4571**	0,08	16,5 to 18,5	2,0 to 2,5	10,5 to 13,5	Ti: 5 × %C, up to 0,80
X 2 CrNiMoN 17 13 3	**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
X 2 CrNiMo 18 14 3	**1.4435**	0,030	17,0 to 18,5	2,5 to 3,0	12,5 to 15,0	S ≤ 0,025
X 5 CrNiMo 17 13 3	**1.4436**	0,07	16,5 to 18,5	2,5 to 3,0	11,0 to 14,0	S ≤ 0,025
X 2 CrNiMoN 17 13 5	**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 processability 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 %, Mn ≤ 2,0 %.

[4] Tantalum 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 < 10,0 ≥ 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 contens 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 t0) **and their resistance to intercrystalline corrosion** (applicable to wall thicknesses up to 50 mm) [1]

Steel grade		Heat treatment condition [2]	Minimum 0,2 % proof stress N/mm²	Minimum 1 % proof stress N/mm²	Tensile strength [2] N/mm²	Minimum elongation after fracture [2] ($L_0 = 5\ d_0$) %		Minimum impact energy [3] (ISO V-notch test pieces J		Resistance to intercrystalline corrosion [4]	
Symbol	Material number					Longitudinal	Transverse	Longitudinal	Transverse	in the as delivered condition	after further processing by welding without heat treatment
X 5 CrNi 18 10	1.4301	Solution annealed and quenched	195	230	500 to 720	40	35	85	55	g. [5]	g. [5]
X 2 CrNi 19 11	1.4306		180	215	460 to 680	40	35			g.	g.
X 2 CrNiN 18 10	1.4311		270	305	550 to 760	35	30			g.	g.
X 6 CrNiTi 18 10	1.4541		200	235	500 to 730	35	30			g.	g.
X 6 CrNiNb 18 10	1.4550		205	240	510 to 740	35	30			g.	g.
X 5 CrNiMo 17 12 2	1.4401	Solution annealed and quenched	205	240	510 to 710	40	35	85	55	g. [5]	g. [5]
X 2 CrNiMo 17 13 2	1.4404		190	225	490 to 690	40	35			g.	g.
X 6 CrNiMoTi 17 12 2	1.4571		210	245	500 to 730	35	30			g.	g.
X 2 CrNiMoN 17 13 3	1.4429	Solution annealed and quenched	295	330	580 to 800	35	30	85	55	g.	g.
X 2 CrNiMo 18 14 3	1.4435		190	225	490 to 690	40	35			g.	g.
X 5 CrNiMo 17 13 3	1.4436		205	240	510 to 710	40	35			g. [5]	g. [5]
X 2 CrNiMoN 17 13 5	1.4439	Solution annealed and quenched	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 70 N/mm² and the minimum values of elongation after fracture may be 5 units less in the case of products which are supplied in conditions d0, k0, 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 treatment condition	0,2 % proof stress at a temperature, in °C, of											1 % proof stress at a temperature, in °C, of											Limit temperature [1]
Symbol	Material number		50	100	150	200	250	300	350	400	450	500	550	50	100	150	200	250	300	350	400	450	500	550	
			N/mm²											N/mm²											°C
X 5 CrNi 18 10	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]
X 2 CrNi 19 11	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
X 2 CrNiN 18 10	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
X 6 CrNiTi 18 10	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
X 6 CrNiNb 18 10	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
X 5 CrNiMo 17 12 2	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]
X 2 CrNiMo 17 13 2	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
X 6 CrNiMoTi 17 12 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
X 2 CrNiMoN 17 13 3	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
X 2 CrNiMo 18 14 3	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
X 5 CrNiMo 17 13 3	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]
X 2 CrNiMoN 17 13 5	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 100 000 hours, not have changed so as to show susceptibility to intercrystalline corrosion.

[2] Only for wall thicknesses not exceeding 6 mm.

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 of tubes		Hot working during further processing	
Symbol	Material number	Solution annealing temperature [1] °C	Quenching in	Temperature °C	Type of cooling
X5CrNi 18 10 X2CrNi 19 11 X2CrNiN 18 10	1.4301 1.4306 1.4311	1000 to 1080	Water, Air [2]	1150 to 750	Air
X6CrNiTi 18 10 X6CrNiNb 18 10 X5CrNiMo 17 12 2 X2CrNiMo 17 13 2 X6CrNiMoTi 17 12 2	1.4541 1.4550 1.4401 1.4404 1.4571	1020 to 1100			
X2CrNiMoN 17 13 3	1.4429	1040 to 1120			
X2CrNiMo 18 14 3 X5CrNiMo 17 13 3	1.4435 1.4436	1020 to 1100			
X2CrNiMoN 17 13 5	1.4439	1040 to 1120			

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

[2] If the cooling is sufficiently rapid.

5.7 Corrosion resistance

5.7.1 The corrosion resistance of tubes complying with this standard under the effect of the various corrosive stresses found in use is not the subject of this standard as it cannot be covered by a requirement of general validity.

5.7.1.1 ●● If necessary, specific corrosion tests may be agreed at the time of ordering. The conditions and the evaluation of the results of testing shall also be specified on this occasion.

5.7.2 The data given in table 3 shall apply for the resistance of the steels to intercrystalline corrosion when tested as specified in subclause 6.5.9.

5.8 Type of condition, appearance of surface and weld

5.8.1 The tubes shall be supplied in one of the conditions listed in table 6.

● The selection of the type of condition is left to the manufacturer's discretion.

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	Metallically clean.
d1 [2]	Tubes welded from surface finish c1 *) or c2 *) plate, sheet or strip, pickled	Metallically bright.
d2 [2]	Tubes welded from surface finish 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, sheet or strip, bright heat treated	
l0 [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 appropriate, 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 polishing shall be agreed at the time of ordering [5].

*) See DIN 17440 or DIN 17441.

[1] See also subclauses 5.8.2 and 5.8.3

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

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

[4] Conditions 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.

5.8.2 The tubes shall have an inside and outside surface consistent with the manufacturing process used.

5.8.3 Slight irregularities in the surface resulting from the manufacturing process, such as raised or depressed areas or shallow grooves are permitted, except for condition p (polished), as long as the remaining wall thickness fulfils the requirements specified in subclause 5.11 and the function of the tubes is not impaired.

5.8.4 Proper removal of surface defects using appropriate means (e.g. grinding) is permitted as long as the remaining wall thickness fulfils the requirements specified in subclause 5.11.

5.8.5 At no point shall the thickness of the welded joint be below the wall thickness of the tube, taking permissible dimensional deviations into account.

5.8.6 The root reinforcement of automatically welded tubes with nominal size not greater than 100 mm shall not exceed 0,25 mm + 0,03 · s. This may require the weld to be smoothed.

5.9 Leak tightness

The tubes shall remain leaktight when tested as specified in subclause 6.5.10.

5.10 Non-destructive testing

5.10.1 The requirements given in *Stahl-Eisen-Prüfblatt* (Iron and steel test sheet) 1914 are to be met in the non-destructive test of the weld as specified in subclause 6.5.12.

5.10.2 ●● By agreement at the time of ordering, the entire wall of test class 2 tubes may be subjected to a test, e.g. as described in *Stahl-Eisen-Prüfblatt* 1914.

5.11 Dimensions, masses per unit length and permissible deviations

DIN 2463 Part 1 shall apply for the dimensions and masses per unit length of tubes and for permissible deviations.

● DIN 28181 shall apply for tubular heat exchangers. The order shall follow the pattern of the sample order given in that standard.

5.12 Physical properties

Reference is made to volume 10 of the *Stahleisen-Sonderberichte* (Iron and steel special reports) (see the "Standards and other documents referred to" clause) for guideline data on the physical properties of the steels conforming to the requirements of this standard.

6 Tests to be carried out and documents on materials testing

6.1 General

The tubes supplied shall be accompanied by one of the following documents on materials testing as specified in DIN 50049:

- document DIN 50049 – 3.1 A (inspection certificate A);
- document DIN 50049 – 3.1 B (inspection certificate B);
- document DIN 50049 – 3.1 C (inspection certificate A);
- document DIN 50049 – 3.2 A (inspection report A);
- document DIN 50049 – 3.2 C (inspection report C).

● The type of document required and the test house where acceptance inspection is to be carried out by a third party shall be specified in the order.

6.2 Test site

The tubes shall be tested at the manufacturer's works. Production shall not be unduly disturbed when acceptance inspection is carried out by experts who are not employees of the manufacturer.

6.3 Scope of test programme

6.3.1 The tubes shall be inspected by batches. Table 7 gives a synopsis of the scope of test programme in each case.

6.3.1.1 For the purposes of testing, the tubes shall be divided up by steel grade, cast, test class, dimensions and, if possible, by the type of heat control into batches comprising 100 tubes. The tubes may be divided up by factory lenghts.

Remainders of up to 50 tubes may be distributed uniformly across the batches. Quantities and remainders of more than 50 tubes and consignments of less than 50 tubes count as one complete batch.

6.3.1.2 One tube (sample tube) shall be taken from each batch for verifying the mechanical properties of test class 1 or 2 tubes. The following tests shall be carried out on this sample tube:

- 1 tensile test at ambient temperature on the parent metal. In the case of tubes with outside diameter not less than 200 mm or a wall thickness not less than 12 mm, which are to be used for pressure vessel casings, testing shall cover 10% of the test batch;
- 1 additional tensile test at ambient temperature transverse to the weld on tubes with outside diameter not less than 200 mm (see also subclause 5.4.1). In the case of tubes with outside diameter not less than 200 mm or a wall thickness not less than 12 mm, which are to be used for pressure vessel casings, testing shall cover 10% of the test batch;
- 1 set of test pieces for impact tests on the parent metal in the case of tubes with a wall thickness not less than 20 mm. In the case of tubes to be used for pressure vessel casings, testing shall cover 10% of the test batch;
- 1 set of test pieces for impact tests in the centre of the weld in the case of tubes with a wall thickness not less than 12 mm. In the case of tubes to be used for pressure vessel casings, testing shall cover 10% of the test batch.

● Tubes to be used for pressure vessel casings shall be particularly specified in the order.

6.3.1.3 ●● If a check of the elevated temperature 0,2% and 1% proof stresses has been agreed at the time of ordering, the test temperature and scope of test programme shall also be agreed.

6.3.1.4 Test class 1 tubes

In the case of tubes with a wall thickness not exceeding 40 mm, a flattening test, ring expanding test or ring tensile test shall be carried out on two test pieces, one taken from each end of the sample tube. At the manufacturer's discretion, a drift expanding test may be carried out in place of the ring expanding test.

A synopsis of the tests to be considered for the relevant tube dimensions is given in table 8.

6.3.1.5 Test class 2 tubes

6.3.1.5.1 In the case of tubes automatically welded from strip, with a wall thickness not exceeding 40 mm, a flattening test, ring expanding test or ring tensile test shall be carried out on test pieces taken from one end of each tube or each factory length (18 m max.). In the case of tubes from single-piece fabrication, the above test shall be carried out on test pieces taken from both ends of each factory length (see table 8). At the manufacturer's discretion, a drift expanding test may be carried out in place of the ring expanding test.

6.3.1.5.2 In the case of tubes with wall thicknesses exceeding 40 mm, a non-destructive test as described in subclause 6.5.13 shall be carried out on both ends of each tube, over a length of 25 mm.

Table 7. **Summary of scope test programme and documents on materials testing**
(see figure 1 for sampling points and location of test pieces; see subclause 6.3.1 for batch size)

Testing			Scope of test programme		Responsibility for carrying out the tests	Type of document on materials testing
No.	Type of test	As in subclause	Test class 1	Test class 2		
1	Cast analysis	5.3.1	Per cast or casting unit		Manufacturer	DIN 50049 – 2.2 [1]
2	Tensile test at ambient temperature	6.3.1.2 6.4.1 6.5.1	One sample tube per batch. One test piece from the parent metal, plus one test piece transverse to the weld for tubes with outside diameters d_a not less than 200 mm [2].		By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C or DIN 50049 – 3.2 A or DIN 50049 – 3.2 C
3	Impact test	6.3.1.2 6.4.2 6.5.3	For wall thicknesses ≥ 20 mm, 1 set of 3 individual test pieces taken from the parent metal of each sample tube, plus 1 set transverse to the weld for wall thicknesses ≥ 12 mm [3].		By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C or DIN 50049 – 3.2 A or DIN 50049 – 3.2 C
4	Flattening test, drift expanding test, ring expanding test or ring tensile test (see table 8)	6.3.1.4 6.3.1.5.1 6.4.3 6.5.4 6.5.5 6.5.6 6.5.7	For wall thicknesses ≤ 40 mm		By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C or DIN 50049 – 3.2 A or DIN 50049 – 3.2 C
			1 test piece from both ends of sample tubes	For tubes automatically welded from strip, 1 test piece from one end of each tube or factory length (18 m max.); for tubes from single-piece fabrication, 1 test piece from both ends of each factory length.		
5	Non-destructive testing of tube ends	6.3.1.5.2 6.5.13	For wall thicknesses > 40 mm		Manufacturer	DIN 50049 – 3.1 B
			–	All tubes		
6	Leak tightness test	6.3.1.6 6.5.10	All tubes		Manufacturer	DIN 50049 – 2.1 [1]
7	Visual examination	6.3.1.6 6.5.11	All tubes		By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C or DIN 50049 – 3.2 A or DIN 50049 – 3.2 C
8	Materials identity test	6.3.1.6 6.5.18	All tubes		Manufacturer	DIN 50049 – 2.1 [1]
9	Non-destructive testing of weld	5.10.1 6.3.1.6 6.5.12	All tubes		Manufacturer	DIN 50049 – 3.1 B
10	Check on dimensions	6.3.1.6 6.5.16 6.5.17	All tubes		By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C or DIN 50049 – 3.2 A or DIN 50049 – 3.2 C
11	Non-destructive testing of tube wall [4]	5.10.2 6.3.1.7 6.5.14	–	All tubes	Manufacturer	DIN 50049 – 3.1 B
12	Hot tensile test [4]	6.3.1.3 6.5.2	By agreement.		By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C or DIN 50049 – 3.2 A or DIN 50049 – 3.2 C
13	Product analysis [4]	5.3.2 6.3.1.9 6.4.4 6.5.8	1 product analysis per cast		Manufacturer	DIN 50049 – 3.1 B
14	Testing for intercrystalline corrosion [4]	5.7.2 6.3.1.8 6.5.9	By agreement.		Manufacturer	DIN 50049 – 3.1 B

[1] This certificate may also be included in the next higher stage of document.
[2] In the case of tubes with d_a not less than 200 mm or wall thickness not less than 12 mm, which are to be used for pressure vessel casings, testing shall cover 10 % of the test batch.
[3] In the case of tubes to be used for pressure vessel casings, testing shall cover 10 % of the test batch.
[4] Only by agreement between manufacturer und purchaser.

Table 8. **Tube dimensions to be considered for the technological tests carried out on test classes 1 and 2 tubes**

Tube diameter, in mm		Wall thickness			
Outside	Inside	< 2 mm	≥ 2 mm ≤ 16 mm	> 16 mm ≤ 40 mm	> 40 mm
≤ 21,3	> 15	Flattening test [1], [2]	Flattening test [1], [2]	–	–
≤ 21,3	≤ 15	Flattening test [1], [2]	Flattening test [1], [2]	–	–
> 21,3 ≤ 146	> 15	Flattening test [1], [2]	Ring expanding test [3] Impact test [4]	Flattening test [1] Impact test [4]	Impact test
> 21,3 ≤ 146	≤ 15	–	Flattening test [1], [2] Impact test [4]	Flattening test [1] Impact test [4]	Impact test
> 146	> 100	–	Ring tensile test [5], [6] Impact test [4]	Ring tensile test [5], [6] Impact test [4]	Impact test
> 146	≤ 100	–	–	Flattening test [2], [6] Impact test [4]	Impact test

[1] Weld alternately in the horizontal position (3 o'clock position) or vertical position (12 o'clock position).

[2] This test may be replaced by the drift expanding test.

[3] At the manufacturer's discretion, the drift expanding test may be carried out in place of the ring expanding test.

[4] The impact test on the parent metal shall only be carried out on tubes with a wall thickness not less than 20 mm. The impact test in the centre of the weld shall only be carried out on tubes with a wall thickness not less than 12 mm.

[5] The weld shall be in the tension zone.

[6] In place of this test, non-destructive testing of the tube ends as described in subclause 6.5.13 may be carried out by the manufacturer, on tubes with outside diameter exceeding 508 mm.

6.3.1.6 Irrespective of the test class, the following tests shall be carried out on all tubes in the batch:

- testing for leak tightness;
- materials identity testing;
- non-destructive testing of the weld over the entire tube length;
- visual examination of the type of condition and surface finish;
- check on dimensions.

6.3.1.6.1 ●● It may also be agreed to carry out the visual examination and check on dimensions of the tubes in accordance with a sampling plan, e.g., as described in DIN 40080.

6.3.1.7 ●● By agreement, testing of the entire tube wall, e.g. as described in *Stahl-Eisen-Prüfblatt* 1914, August 1983 edition, subclause 3.1, may be carried out on all test class 2 tubes.

6.3.1.8 ●● A test for resistance to intercrystalline corrosion may be carried out by agreement. The scope of test programme shall be agreed.

6.3.1.9 ●● If a check of the chemical composition (product analysis) has been agreed, this check shall be carried out on one tube per cast.

6.4 Sampling and sample preparation

The information given in figure 1 shall apply for the sampling points and the test piece location.

6.4.1 Tensile test

6.4.1.1 In the case of tubes with outside diameter less than 200 mm, one strip test piece (see DIN 50140) shall be taken from the parent metal, longitudinal to the tube axis and offset from the weld by about 180°. It is permitted to remove local irregularities. The test piece shall not be heat treated and not straightened within the gauge length. At the manufacturer's discretion, tubes may also be subjected to a tensile test in full (see DIN 50140).

In the case of tubes with outside diameter equal to or greater than 200 mm, a flat test piece as illustrated in figure 1 of DIN 50120 Part 1 (September 1975 edition) shall be taken transverse to the weld and cold straightened. A strip test piece shall be taken in addition from the parent metal, longitudinal to the tube axis and offset from the weld by about 180°.

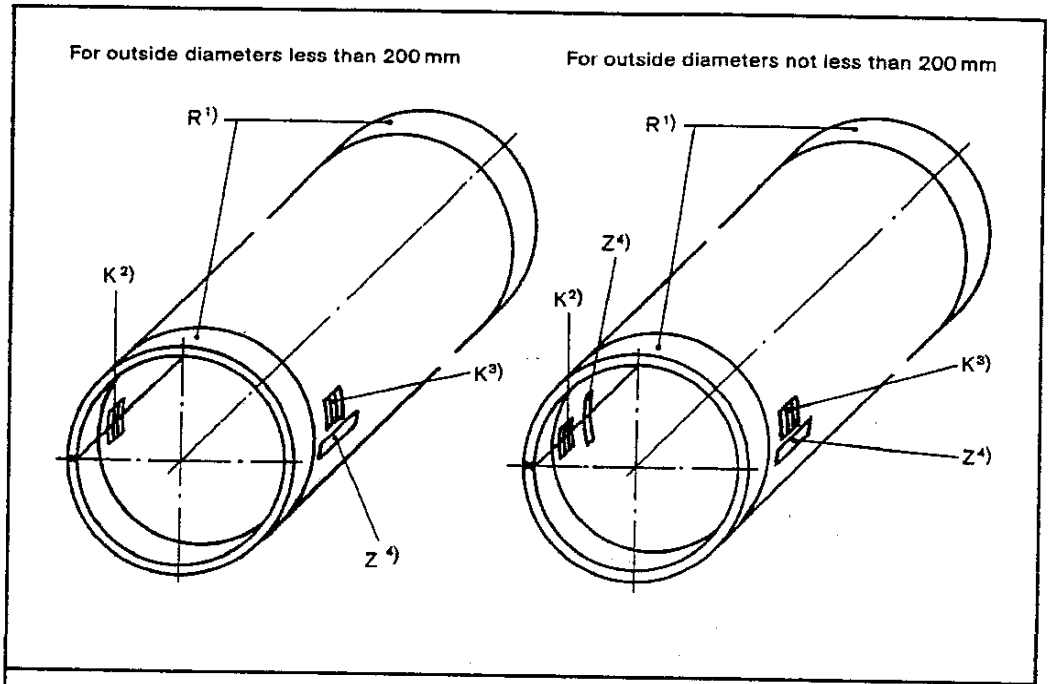
For testing the parent metal, round or flat test pieces worked on all sides may be taken transverse to the tube axis for the tensile test, if the tube dimensions permit this without straightening of the test piece (see DIN 50125).

6.4.1.2 As a rule, short proportional test pieces shall be taken for the tensile test on the parent metal.

6.4.2 Impact test

For the purposes of the impact test carried out on the parent metal, a set of three ISO V-notch test pieces shall be taken from the sample tube transverse to the tube axis where the tube dimensions permit this without straigthening of the test pieces. Otherwise, the test pieces shall be taken longitudinal to the tube axis. In the case of tubes with wall thicknesses exceeding 30 mm, the centre line of the test pieces shall have a distance from the external surface equal to one quarter of the wall thickness or shall be positioned as close as possible to this location. For the purposes of the impact test carried out in the centre of the weld, a set of three ISO V-notch test pieces shall be taken from the sample tube transverse to the weld, where the tube dimensions permit this without straightening of the test pieces. Otherwise, the test pieces shall be taken longitudinal to the tube axis.

The test pieces shall be taken and prepared in such a way that the axis of the notch is perpendicular to the tube surface. In the case of test pieces taken from the weld, the axis of the notch is to lie in the middle of the weld.



1) See also subclause 6.4.3.
2) For tubes with wall thicknesses not less than 12 mm, test pieces to be taken transverse or longitudinal to the tube axis (see also subclause 6.4.2).
3) For tubes with wall thicknesses not less than 20 mm, test pieces to be taken transverse or longitudinal to the tube axis (see also subclause 6.4.2).
4) See also subclause 6.4.1.

In the illustrations above
K = set of 3 ISO V-notch test pieces, as specified in DIN 50115, R = ring test piece, Z = tensile test piece

Figure 1. Sampling points and location of test pieces

6.4.3 Technological tests

In the case of test class 1 tubes, the test pieces for the flattening test described in DIN 50136, the ring expanding test described in DIN 50137, the drift expanding test described in DIN 50135 or the ring tensile test described in DIN 50138 shall be taken from both ends of the sample tube as specified in subclause 6.3.1.2. In the case of test class 2 tubes, the ring test piece shall be taken from one end of each tube or each factory length.

If factory lengths are subsequently cut into subsections, no further test pieces need to be taken from these subsections provided that it is clearly indicated from which already tested factory length the subsections have been taken. If such identification is not given, the factory lengths shall not be tested; the subsections shall be tested instead. In the case of test class 2 tubes, allocation of ring test pieces to the tube ends from which they have been taken must be possible.

6.4.4 Chemical composition

For checking the chemical composition by means of a product analysis on the finished tube, the sample chips shall be taken at points uniformly distributed over the entire wall thickness of the tube. In the case of tubes welded with filler metals, the chips shall be taken outside the weld. A similar sampling method shall be used for spectral analyses. In general, *Stahl-Eisen-Prüfblatt* 1805 shall apply for sampling.

6.5 Procedure

6.5.1 The tensile test shall be carried out as described in DIN 50140 or DIN 50145.

The tensile test transverse to the weld shall be carried out on test pieces as shown in figure 1 of DIN 50120 Part 1 (September 1975 edition).

6.5.2 If verification of the elevated temperature 0,2 % and 1 % proof stresses has been agreed, this shall be done as specified in DIN 50145.

6.5.3 The impact test shall be carried out as specified in DIN 50115.

6.5.4 The flattening test shall be carried out as specified in DIN 50136, the test pieces being tested alternately with the weld in the 12 o'clock position and in the 3 o'clock position. The test pieces or tube ends shall be flattened until a specified distance between platens H is reached. The following equation shall apply for the distance between platens H, in mm:

$$H = \frac{(1 + c)\, s}{c + s/d_a}$$

where

s is the wall thickness, in mm;

d_a is the outside diameter, in mm;

c is a constant for which 0,10 shall be substituted in the equation. If the ratio s/d_a exceeds a value of 0,25, c shall be substituted by 0,09.

6.5.5 The drift expanding test shall be carried out as described in DIN 50135, using a tapered mandrel, with the expansion reaching the following values, depending on the

diameter ratio d_i/d_a (d_i being the inside diameter, d_a the outside diameter):

20% for d_i/d_a greater than 0,6,
15% for d_i/d_a not exceeding 0,6.

6.5.6 The ring expanding test shall be carried out as described in DIN 50137. The test pieces shall be expanded until fracture occurs and shall then be inspected. If a 40% expansion is reached (referred to the inside diameter) the test may be discontinued.

6.5.7 The ring tensile test shall be carried out as described in DIN 50138 until fracture occurs, with the weld in the middle of the test piece.

6.5.8 The chemical composition shall be determined in accordance with the methods specified by the Chemists' Committee of the *Verein Deutscher Eisenhüttenleute* (Society of German Ferrous Metallurgy Engineers) (see the "Standards and other documents referred to" clause).

6.5.9 The resistance to intercrystalline corrosion shall be tested as specified in DIN 50914.

6.5.10 For the leak tightness test using water as described in DIN 50104, the test pressure shall be 80 bar. The test pressure shall be maintained for at least 5 seconds.

6.5.10.1 ●● A higher test pressure may be agreed.

In no case however shall the safety margin with respect to the 0,2% proof stress drop below 1,1 (see DIN 2413, June 1972 edition, subclause 4.6; $Y' = 0{,}9$). Where appropriate, this shall also apply in the case of thin-walled tubes with large diameters, even at 80 bar.

6.5.10.2 In the test using air under water, the test pressure shall be 6 bar. The test pressure shall be maintained for at least 5 seconds.

6.5.10.3 In the test using air and a foaming agent, the test pressure shall be 0,3 bar.

6.5.10.4 ●● Unless special agreements have been made at the time of ordering, the choice of the above test methods shall be at the manufacturer's discretion.

6.5.10.5 In place of a hydrostatic pressure test, a non-destructive test (e.g., as specified in Stahl-Eisen-Prüfblatt 1925, or a leak detection using helium) may be carried out.

6.5.10.6 ● For tubes with outside diameters less than 6 mm, the type of leak tightness test shall be agreed at the time of ordering.

6.5.11 The type of condition and surface finish (surface appearance of the tubes) shall be examined visually on the outside of the tubes and, if possible, on the inside, under appropriate lighting conditions by an inspector having normal vision.

Note. Instead of the visual examination, a different test method may also be used, subject to agreement between manufacturer and purchaser.

6.5.12 Non-destructive testing of the welds shall be carried out as described in *Stahl-Eisen-Prüfblatt* 1914.

6.5.13 In the case of test class 2 tubes with a wall thickness exceeding 40 mm, the entire circumference of the tube ends shall be tested non-destructively using the radiographic method specified in *Stahl-Eisen-Prüfblatt* 1914 or the ultrasonic method specified in *Stahl-Eisen-Prüfblatt* 1919.

6.5.14 ●● Non-destructive testing of the entire tube wall, e.g., as specified in *Stahl-Eisen-Prüfblatt* 1914, shall be carried out by agreement.

6.5.15 Non-destructive testing shall be carried out by the manufacturer.

●● Subject to prior agreement, the purchaser or a qualified inspector acting on his behalf may be present at the inspection.

6.5.16 The wall thicknesses shall be measured at the ends of the tubes using suitable measuring instruments.

6.5.17 The diameter shall be measured using suitable measuring instruments as a two-point measurement in the case of tubes not exceeding 168,3 mm in outside diameter or as a measurement of circumference in the case of tubes exceeding 168,3 mm in outside diameter.

6.5.18 The materials identity test shall be carried out in a suitable manner.

6.6 Retests

6.6.1 Tubes not satisfying the requirements when tested as specified in subclauses 6.5.10 to 6.5.17 (leak tightness test, visual examination, non-destructive testing, check on dimensions) and test class 2 tubes when tested additionally as specified in subclauses 6.5.4 or 6.5.5 to 6.5.7 (flattening test, drift expanding test, ring expanding test or ring tensile test) shall be rejected. The manufacturer shall have the right to take suitable measures to correct defects or deviations found in these tests and to present these tubes for renewed acceptance inspection.

6.6.2 If one of the sample tubes fails the acceptance inspection specified in subclauses 6.5.1 and 6.5.3 and also in subclauses 6.5.4 or 6.5.5, 6.5.6 or 6.5.7 for test class 1 tubes, the manufacturer is justified in repeating the test giving unsatisfactory results on twice the number of test pieces of the same tube. All test pieces shall satisfy the requirements. If the requirements are still not satisfied in the new tests, the tube shall be rejected.

Two further tubes shall be taken from the batch concerned in place of the rejected sample tube and shall be submitted to the tests specified in subclauses 6.5.1, 6.5.3, 6.5.4 or 6.5.5, 6.5.6 or 6.5.7. If the requirement is still not fulfilled, the entire batch shall be considered not to comply with the standard. However, individual testing may be agreed between the parties concerned.

6.6.3 If the unsatisfactory result of testing can be improved by means of heat treatment or other suitable measures, the supplier shall be given the opportunity to present a batch which was rejected, for renewed acceptance inspection. If the test pieces continue to fail to satisfy the requirements, the entire batch shall be considered not to comply with the standard.

6.6.4 Test results attributable to improperly carried out sampling, sample preparation or test procedure or to an accidental and local defect in a test piece shall be deemed invalid.

6.7 Documents on materials testing

6.7.1 Depending on the agreement made at the time of ordering (see subclause 6.1), one of the following documents shall be issued

- DIN 50049 – 3.1 A (inspection certificate A);
- DIN 50049 – 3.1 B (inspection certificate B);
- DIN 50049 – 3.1 C (inspection certificate C);
- DIN 50049 – 3.2 A (inspection report A);
- DIN 50049 – 3.2 C (inspection report C).

The type and scope of the tests, the responsibility for carrying out the tests and the type of documentation covering these tests are shown in table 7.

In each case, the technical rule agreed at the time of ordering shall be specified.

6.7.2 The documents shall state the marking of the tubes as specified in clause 7.

7 Marking

7.1 Every tube supplied in accordance with this standard shall be clearly and durably marked at one end, as follows:

- manufacturer's mark;
- steel grade (material number);
- symbol specified in table 6 identifying the type of condition of the tubes;
- an appended symbol W indicating that the tube is welded;
- 1 or 2 for test class 1 or test class 2;
- for test class 1 tubes, the number of the test batch or the cast number;
- for test class 2 tubes, the tube number or the cast number for tubes with an outside diameter not less than 114,3 mm or the symbol identifying the cast;
- inspector's mark;
- symbol identifying non-destructive testing if testing as specified in subclause 6.5.14 has been agreed.

7.2 Marking as specified in subclause 7.1 shall be made by stamping, embossing or printing.

A different type of marking (e.g. labelling of the bundle of tubes) is permitted for tubes with small outside diameter and/or small wall thickness.

7.3 ●● Marking over the entire length of tube may be agreed at the time of ordering.

8 Complaints

8.1 Under current law, a complaint may only be raised against defective tubes if the defects impair their processing and use to a more than negligible extent. This shall apply unless otherwise agreed at the time of ordering.

8.2 It is normal and practical for the purchaser to give the supplier the opportunity to judge whether the complaints are justified, if possible by submitting the tube objected to or samples of the tubes supplied.

Standards and other documents referred to

DIN 2413	Steel pipes; calculation of wall thickness with regard to internal pressure
DIN 2463 Part 1	Welded austenitic stainless steel tubes; dimensions, masses per unit length
DIN 8528 Part 1	Weldability; metallic materials; concepts
DIN 8556 Part 1	Filler metals for welding stainless and heat resisting steels; designation, technical delivery conditions
DIN 17440	Stainless steels; technical delivery conditions for plate and sheet, hot rolled strip, wire rod, drawn wire, steel bars, forgings and semi-finished products
DIN 17441	Stainless steels; technical delivery conditions for cold rolled strip and slit strip and for plate and sheet cut therefrom
DIN 17455	General purpose welded circular austenitic stainless steel tubes; technical delivery conditions
DIN 28181	Welded steel pipes for tubular heat exchangers
DIN 40080	Sampling procedures and tables for inspection by attributes
DIN 50049	Documents on materials testing
DIN 50104	Internal pressure test on hollow products; leak tightness test up to a defined internal pressure; general specifications
DIN 50115	Testing of metallic materials; impact test
DIN 50120 Part 1	Testing of steel; tensile test on welded joints; fusion welded butt joints
DIN 50125	Testing of metallic materials; tensile test pieces, guidelines for their preparation
DIN 50135	Testing of metallic materials; drift expanding test on tubes
DIN 50136	Testing of metallic materials; flattening test on tubes
DIN 50137	Testing of steel; ring expanding test on tubes
DIN 50138	Testing of metallic materials; tensile test on tubes and tube strips
DIN 50140	Testing of metallic materials; tensile test on tubes and strips from tubes
DIN 50145	Testing of metallic materials; tensile test
DIN 50914	Testing stainless steels for resistance to intercrystalline corrosion; copper sulfate-sulfuric acid method; Strauss test
Stahl-Eisen-Prüfblatt 1805 [2]	*Probenahme und Probenvorbereitung für die Stückanalyse bei Stählen* (Sampling and sample preparation for the product analysis of steels)
Stahl-Eisen-Prüfblatt 1914 [2]	*Zerstörungsfreie Prüfung von schmelzgeschweißten Nähten in Rohren aus nichtrostenden Stählen* (Non-destructive testing of welds in fusion welded stainless steel tubes)
Stahl-Eisen-Prüfblatt 1919 [2]	*Ultraschallprüfung auf Dopplungen von Rohren aus warmfesten Stählen* (Ultrasonic examination of creep resisting steel tubes for laminations)
Stahl-Eisen-Prüfblatt 1925 [2]	*Elektromagnetische Prüfung von Rohren zum Nachweis der Dichtheit* (Electromagnetic testing of tubes for leak tightness)

[2] Obtainable from *Verlag Stahleisen mbH*, Postfach 82 29, D-4000 Düsseldorf 1.

Handbuch für das Eisenhüttenlaboratorium [2]) (Handbook for the ferrous metallurgy laboratory);
volume 2: *Die Untersuchung der metallischen Werkstoffe*
(Investigation of metallic materials); Düsseldorf 1966;
volume 5: (supplement):
A 4.1 – *Aufstellung empfohlener Schiedsverfahren*
(List of recommended arbitration procedures);
B – *Probenahmeverfahren* (Sampling methods);
C – *Analysenverfahren* (Methods of analysis);
most recent edition in each case.

Stahleisen-Sonderberichte, volume 10 [2]):
Physikalische Eigenschaften von Stählen und ihre Temperaturabhängigkeit; Polynome und graphische Darstellungen
(Physical properties of steels and their dependence on temperature; polynomials and graphic representations)

Previous editions

DIN 17440: 01.67, 12.72

Amendments

The following amendments have been made in comparison with the December 1972 edition of DIN 17440.

a) The specifications for tubes have been excluded from the field of application of DIN 17440. These specifications, according to manufacturing process and level of requirements, are now dealt with in Standards DIN 17455 to DIN 17458.

b) The layout of the present standard has been harmonized with that of recently published standards for tubes made from other steel groups.

c) Where applicable, the symbols (see table in the Explanatory notes) and specifications relating to chemical composition, mechanical properties and heat treatment have been adopted from DIN 17440, July 1985 edition.

Explanatory notes

In response to a request from the tube manufacturers, following the procedure applied for other steel groups, stainless steel tubes are no longer specified in DIN 17440, but are covered by a series of standards which deal separately with processes of tube manufacture (welded or seamless) and fields of application (general purpose tubes and tubes subject to special requirements). The reasons given when making the request were that

- not all the steels covered in DIN 17440 are used for tubes;
- there are a number of specifications particular to tubes (e.g., relating to testing);
- the number of footnotes may be reduced thereby making the standard more suitable for data processing, and
- the revision of the standards, and consequently a more rapid up-dating to the latest state of the art, will also be simplified.

In accordance with this concept, this standard deals only with welded circular austenitic stainless steel tubes subject to special requirements (e.g. construction of pressure vessels, chemical plant and pipework).

It was agreed that, where applicable, all specifications agreed for DIN 17440, July 1985 edition, would also be adopted for DIN 17455 to DIN 17458.

Of the austenitic steel grades listed in DIN 17440, December 1972 edition, X 5 CrNi 18 12 *) (1.4303), X 2 CrNiMoN 17 12 2 *) (1.4406), X 2 CrNiMo 18 16 4 *) (1.4438) and X 6 CrNiMoNb 17 12 2 *) (1.4580) steels are not covered by this standard, whilst X 2 CrNiMoN 17 13 5 *) (1.4439) steel has been added.

As the symbols for the steel grades differ from those specified in DIN 17440, December 1972 edition, following the specifications for the chemical composition, and in accordance with DIN 17440, July 1985 edition, a compilation of the material numbers, which have not changed, and the previous and new symbols is given below in tabular form. It is expressly noted that the symbols used in DIN 17440, December 1972 edition, may still be used during the period of validity of this standard.

Material number	Previous symbol from DIN 17440, December 1972 edition	New symbol
1.4301	X 5 CrNi 18 9	X 5 CrNi 18 10
1.4306	X 2 CrNi 18 9	X 2 CrNi 19 11
1.4311	X 2 CrNiN 18 10	X 2 CrNiN 18 10
1.4401	X 5 CrNiMo 18 10	X 5 CrNiMo 17 12 2
1.4404	X 2 CrNiMo 18 10	X 2 CrNiMo 17 13 2
1.4429	X 2 CrNiMoN 18 13	X 2 CrNiMoN 17 13 3
1.4435	X 2 CrNiMo 18 12	X 2 CrNiMo 18 14 3
1.4436	X 5 CrNiMo 18 12	X 5 CrNiMo 17 13 3
1.4439 [1])	X 3 CrNiMoN 17 13 5 [1])	X 2 CrNiMoN 17 13 5
1.4541	X 10 CrNiTi 18 9	X 6 CrNiTi 18 10
1.4550	X 10 CrNiNb 18 9	X 6 CrNiNb 18 10
1.4571	X 10 CrNiMoTi 18 10	X 6 CrNiMoTi 17 12 2

[1]) Not included in DIN 17440, December 1972 edition.

*) Symbol as specified in DIN 17440, July 1985 edition.

For [2]), see page 14.

Tubes complying with the requirements of this standard may be supplied as test class 1 or test class 2 tubes. They are distinguished by the extent of testing. Test class 1 tubes are suitable for use in pipework construction, test class 2 tubes for purposes specified in *AD-Merkblatt* (AD instruction sheet) W2 *Austenitische Stähle* (Austenitic steels). The specifications for test class 2 tubes given in the present standard do not agree in all points with those laid down in *AD-Merkblatt* W2, September 1981 edition; however, the specifications given in the present standard were generally considered more appropriate, and is is hoped that in the revised edition of *AD-Merkblatt* W2 a reference to DIN 17457 with regard to welded tubes will suffice.

Subclause 7.3 of the present standard permits agreement on marking tubes over their entire length. Longitudinal marking of tubes with an outside diameter of 17,2 to 114,3 mm and a wall thickness of 1,6 to 3,2 mm is normal practice at the time of publication of this standard.

This standard is related to ISO 2604/5 – 1978, Steel tubes for pressure purposes; quality requirements. Part 5: Longitudinally welded austenitic stainless steel tubes, published by the International Organization for Standardization (ISO).

In the following table the steel grades specified in this standard are compared with those specified in ISO 2604/5 – 1978. The comparison is made only with regard to the chemical composition of the steels.

Comparison of steels specified in this standard with those specified in ISO 2604/5 – 1978

DIN 17457		ISO 2604/5 – 1978	
Symbol	Material number	Symbol	[1]
X 5 CrNi 18 10	1.4301	TW 47	○
X 2 CrNi 19 11	1.4306	TW 46	○
X 2 CrNiN 18 10	1.4311	–	
X 6 CrNiTi 18 10	1.4541	TW 53	×
X 6 CrNiNb 18 10	1.4550	TW 50	×
X 5 CrNiMo 17 12 2	1.4401	TW 60	○
X 2 CrNiMo 17 13 2	1.4404	TW 57	●
X 6 CrNiMoTi 17 12 2	1.4571	–	
X 2 CrNiMoN 17 13 3	1.4429	–	
X 2 CrNiMo 18 14 3	1.4435	TW 58	○
X 5 CrNiMo 17 13 3	1.4436	TW 61	○
X 2 CrNiMoN 17 13 5	1.4439	–	
–	–	TW 69	

[1] This column indicates the degree of agreement with regard to the chemical composition of the steels specified in DIN 17457 and those specified in ISO 2604/5 – 1978.

The symbols have the following meaning:

× complete agreement,
● slight differences,
○ significant differences.

International Patent Classification

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B 21C 37/08
E 03F 3/04
C 22C 38/40
G 01M 3/00
G 01M 19/00