UDC 669.14.018.298-462.2 : 693.814 : 620.1

May 1986

Welded circular fine grain steel tubes for structural steelwork

Technical delivery conditions

DIN 17123

Geschweißte kreisförmige Rohre aus Feinkornbaustählen für den Stahlbau; technische Lieferbedingungen

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.

The subclauses 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 made from the fine grain structural steels listed in table 1. These tubes are used in structural steelwork (as in building and civil engineering, tubular steel construction, bridge and crane construction, etc.). They are not intended to withstand internal or external pressures.

1.2 This standard does not apply to welded circular fine grain structural steel tubes subject to special requirements as specified in DIN 17178.

2 Concept

For the purposes of this standard, fine grain structural steels are steels with a minimum yield strength between 255 and 460 N/mm^2, whose chemical composition is selected so as to ensure weldability, this being a function of the minimum yield strength. The steels are fully killed and contain elements forming precipitations, e.g. nitrides and/or carbonitrides. These prevent the growth of crystal grains in the austenite region and lead to fine grain in the as delivered condition (ferrite grain size 6 and finer when tested as described in DIN 50601). Thus, the steels of this type are highly resistant to brittle fracture.

3 Classification into grades

This standard comprises three series of steel grades, as listed in table 1:

a) the basic (StE...) series;

b) the low temperature (TStE...) series including grades which are to have a minimum impact energy down to temperatures of −50 °C (see table 4);

c) the special low temperature (EStE...) series including grades which are to have a minimum impact energy down to temperatures of −60 °C (see table 4).

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

4 Designation and ordering

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

- the name of product (tube);
- the DIN number of the dimensional standard (e.g. DIN 2458);
- characteristic dimensions of the tube (outside diameter × wall thickness);
- the DIN number of the present standard (DIN 17123);
- the symbol or material number identifying the steel grade (see table 1).

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Example: A welded tube conforming to this standard, with an outside diameter of 168,3 mm and a wall thickness of 4 mm as specified in DIN 2458, made from steel StE 460 (material number 1.8905) shall be designated:

Tube DIN 2458 – 168,3 × 4 –
DIN 17123 – StE 460

or

Tube DIN 2458 – 168,3 × 4 –
DIN 17123 – 1.8905

4.2 ● In addition to the standard designation as specified in subclause 4.1, the order shall always give the quantity required (e.g. total length to be supplied), the type of length (see table 5), the length of the individual tube in the case of specified lengths and exact lengths, the type of materials testing certificate as specified in DIN 50049 or any additional relevant technical rule or code of practice (e.g. *DASt-Richtlinie* (DASt Code of practice) 011).

Example of an order:

**1000 m tube DIN 2458 – 168,3 × 4 –
DIN 17123 – StE 460,**
in specified lengths of 8 m, certificate
DIN 50049 – 3.1 B

4.3 ●● In addition, further details such as are specified in the subclauses marked with two dots may be agreed at the time of ordering.

5 Requirements

5.1 Manufacturing process

5.1.1 The steels shall be produced either by the basic oxygen process, the open hearth process or in the electric furnace.

5.1.1.1 ●● Subject to agreement with the purchaser, an alternative equivalent process may also be used.

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

5.1.2 The steels shall be fully killed, shall have sufficient elements for nitrogen control and shall be fine grained (see clause 2).

5.1.3 The process used to manufacture the tubes is left to the manufacturer's discretion.

5.1.3.1 The tubes shall be fabricated by joining appropriately bent sheet or strip in a fully mechanized welding process, generally by means of double-sided submerged-arc fusion welding, carried out in such a way that a longitudinal weld or a spiral weld is produced, or by means of electric pressure welding in such a way that a longitudinal weld is produced. If necessary, the tubes shall additionally be hot reduced, cold drawn or brought to their ultimate size by drifting or rolling to size.

There shall be no strip joining welds in the pressure welded tubes supplied.

5.1.3.2 Welding shall be carried out in such a way that a penetration weld is produced.

In the case of fusion welded tubes, the welds shall be made from both sides.

5.1.3.3 ●● Internal deburring may be agreed at the time of ordering.

5.1.3.4 Local repair of welds is permitted.

5.1.3.5 The manufacturer's works shall have at its disposal the specialists and suitable equipment or processes to enable welding work to be properly carried out and inspected.

Table 1. **Chemical composition as determined by the cast analysis**

Steel grade		% by mass														
Symbol	Material number	C ≤	Si	Mn	P ≤	S ≤	N ≤	Al_{tot}[1] ≥	Cr ≤	Cu ≤	Mo ≤	Ni ≤	Nb ≤	Ti ≤	V ≤	Nb+Ti+V ≤
StE 255	**1.0461**	0,18	≤ 0,40	0,50 to 1,30	0,035	0,030	0,020	0,020	0,30[2]	0,20[2]	0,08[2]	0,30	0,03	–	–	0,05
TStE 255	**1.0463**	0,16			0,030	0,025										
EStE 255	**1.1103**	0,16			0,025	0,015										
StE 285	**1.0486**	0,18		0,60 to 1,40	0,035	0,030										
TStE 285	**1.0488**	0,16			0,030	0,025										
EStE 285	**1.1104**	0,16			0,025	0,015										
StE 355	**1.0562**	0,20	0,10 to 0,50	0,90 to 1,65	0,035	0,030						0,30[4]			0,10	0,12
TStE 355	**1.0566**	0,18			0,030	0,025										
EStE 355	**1.1106**	0,18			0,025	0,015										
StE 420	**1.8902**	0,20	0,10 to 0,60	1,00 to 1,70	0,035	0,030			0,30	0,20[3]	0,10	1,00	0,05	–[5]	0,20	0,22
TStE 420	**1.8912**				0,030	0,025										
EStE 420	**1.8913**				0,025	0,015										
StE 460	**1.8905**				0,035	0,030										
TStE 460	**1.8915**				0,030	0,025										
EStE 460	**1.8918**				0,025	0,015										

[1] If nitrogen is additionally controlled by niobium, titanium or vanadium, the requirement for a minimum aluminium content need not be complied with.

[2] The sum of the contents by mass of chromium, copper and molybdenum shall not exceed 0,45 %.

[3] If copper is added as an alloying element, the maximum content by mass may be 0,70 %.

[4] If nickel is added as an alloying element, the maximum content by mass may be 0,85 %.

[5] If titanium is added as an alloying element, the maximum content by mass may be 0,20 %.

5.1.3.6 ●● The purchaser may, on one occasion only, request a document certifying compliance with the requirements specified in subclause 5.1.3.5. The details of this document[1], 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

5.2.1 Tubes shall be supplied in the normalized condition.

Normalizing of the tubes may be dispensed with

a) if, in the case of tubes intended to be cold formed, the starting products (plate, sheet or strip) are used in the normalized condition, if necessary with subsequent annealing of the weld zone,

or

b) if, in the case of steel grades having a minimum yield strength not exceeding 355 N/mm^2, the final forming operation in tube production is normalizing forming, ensuring a condition equivalent to normalizing (see *Stahl-Eisen-Werkstoffblatt* (Iron and steel materials sheet) 082).

Normalizing of the starting products for tube production may be substituted by normalizing forming, in the case of steel grades having a minimum yield strength not exceeding 355 N/mm^2.

5.2.2 In the case of tubes with small wall thickness and made from steel grades having a minimum yield strength not less than 420 N/mm^2, a delayed cooling or additional tempering may be needed.

5.2.3 ●● If the surface of tubes is to be provided with an anti-corrosive agent with a limited life, this shall be agreed at the time of ordering.

5.2.4 ●● If special requirements are made on tubes with regard to further processing (e.g. galvanizing), this shall be agreed at the time of ordering.

5.3 Chemical composition

5.3.1 Chemical composition as determined by the cast analysis

The chemical composition of the steels as determined by the cast analysis[2] is given in table 1.

The table specifies the permissible contents of the individual alloying elements. The manufacturer shall inform the purchaser on the types of alloying element used and on the associated percentages, for the steel grade supplied.

5.3.2 ●● Chemical composition as determined by the product analysis

If checking of the chemical composition on the product has been agreed at the time of ordering, the results of the product analysis shall be allowed to deviate, by the amounts stated in table 2, from the limit values for the cast analysis to be notified by the manufacturer.

Table 2. **Amounts by which the chemical composition as determined by the product analysis may deviate from the limit values to be stated by the manufacturer for the cast analysis (see subclause 5.3.2)**

Element	Limit values specified for the cast analysis as in table 1 % by mass	Permissible deviations of results of product analysis from the limit values as determined by the cast analysis[1] % by mass
C	≤ 0,20	0,02
Si	≤ 0,60	0,05
Mn	≤ 1,00	0,06
	> 1,00 ≤ 1,70	0,10
P	≤ 0,035	0,005
S	≤ 0,030	0,005
Cr	≤ 0,30	0,04
Cu	≤ 0,70	0,07
Mo	≤ 0,10	0,03
Ni	≤ 1,00	0,05
Nb	≤ 0,05	0,01
Ti	≤ 0,20	0,02
V	≤ 0,20	0,02
N	≤ 0,020	0,002

[1] If several product analyses are carried out for a single cast and if these elements show contents 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.

5.4 Mechanical properties

5.4.1 The values of yield stress, tensile strength, elongation after fracture and impact energy given in tables 3 and 4 for tubes with a wall thickness not exceeding 40 mm are based on the test conditions given in clause 6 and shall apply for the as delivered condition as specified in subclauses 5.2.1 and 5.2.2.

The minimum values of yield stress and tensile strength shall also apply for the weld.

5.4.2 ●● If tubes are subjected to stresses vertical to their axis, which will normally occur in the case of wall thicknesses equal to or exceeding 20 mm, minimum values of reduction in area after fracture as laid down in *Stahl-Eisen-Lieferbedingungen* (iron and steel delivery conditions) 096 may be agreed at the time of ordering.

5.4.3 For characterizing the susceptibility to brittle fracture, table 3 gives minimum values of impact energy determined on ISO V-notch test pieces taken in the longitudinal direction, at a test temperature of −20 °C.

5.4.3.1 ●● If the tube dimensions permit sampling without straightening of the tubes, minimum values of impact energy determined on ISO standard test pieces taken transversely to the tube axis or minimum values at test temperatures other than given in table 4 may also be agreed at the time of ordering.

5.5 Weldability

Tubes made from the steel grades complying with this standard are weldable, if the generally recognized rules of the art (see *Stahl-Eisen-Werkstoffblatt* 088) are observed.

[1] Steel structures as specified in DIN 18800 Part 7, subject to approval by the building inspectorate.

[2] When sequential castings are supplied, as is possible with continuously cast tubes, the term "cast" should be read as "casting unit".

Table 3. **Mechanical properties of tubes with a wall thickness not exceeding 40 mm**[1]

Steel grade		Minimum upper yield stress[2], R_{eH}, for wall thicknesses, in mm, of			Tensile strength, R_m	Minimum elongation after fracture, A_5, when testing test pieces taken		Minimum impact energy, A_v[4] (ISO standard test pieces taken in the longitudinal direction; test temperature: −20 °C)
		≤ 12	> 12 ≤ 20	> 20 ≤ 40		parallel	transverse	
Symbol	Material number	N/mm²			N/mm²	to the tube axis %		J
StE 255 TStE 255 EStE 255	1.0461 1.0463 1.1103	255		245	360 to 480[3]	25	23	39 47 65
StE 285 TStE 285 EStE 285	1.0486 1.0488 1.1104	285		275	390 to 510[3]	24	22	39 47 65
StE 355 TStE 355 EStE 355	1.0562 1.0566 1.1106	355		345	490 to 630[3]	22	20	39 47 65
StE 420 TStE 420 EStE 420	1.8902 1.8912 1.8913	420	410	400	530 to 680	21	19	39 47 65
StE 460 TStE 460 EStE 460	1.8905 1.8915 1.8918	460	450	440	560 to 730	19	17	39 47 65

[1] ● For wall thicknesses exceeding 40 mm, the values shall be agreed at the time of ordering.

[2] If the yield stress cannot be easily recognized, the values shall apply for the 0,2 % proof stress.

[3] No objections shall be made if the upper limit is exceeded by up to 20 N/mm².

[4] ●● At the time of ordering, minimum values of impact energy determined on ISO V-notch test pieces taken transverse to the tube axis or minimum values at test temperatures other than given in table 4 may be agreed (see subclause 5.4.3.1).

Table 4. ●● **Requirements regarding impact energy to be particularly agreed for impact tests on ISO V-notch test pieces (see subclause 5.4.3.1)**

Steel grades as in tables 1 and 3	Direction of sampling	Minimum values of impact energy, A_v, for wall thicknesses, s, from 10 to 40 mm at a test temperature, in °C, of								
		−60	−50	−40	−30	−20	−10	0	+10	+20
		J								
Basic series (StE...)	Longitudinal	–	–	–	–	39	43	47	51	55
	Transverse	–	–	–	–	21	24	31	31	31
Low temperature series (TStE...)	Longitudinal	–	27	31	39	47	51	55	59	63
	Transverse	–	16	20	24	27	31	31	35	39
Special low temperature series (EStE...)	Longitudinal	25	30	40	50	65	80	90	95	100
	Transverse	20	27	30	35	45	60	70	75	80

5.6 Heat treatment and further processing

5.6.1 The temperatures for normalizing the steel grades are a function of their chemical composition.

Although the normalizing temperature may not differ from one works to the next for one and the same steel grade (see subclause 5.3.1), it shall generally be between 880 and 960 °C.

5.6.2 Stress relieving shall be performed at temperatures between 530 and 580 °C, with cooling in still air. The holding period (as specified in DIN 17014 Part 1) shall not exceed 150 minutes. Where the holding period exceeds 90 minutes, the lower limit of the temperature range shall be aimed at.

5.6.3 In the event of further processing of the steels complying with this standard, the data specified in *Stahl-Eisen-Werkstoffblatt* 088 and in the certificate (see subclause 5.1.3.6) shall be observed.

5.7 Appearance of surface

5.7.1 Tubes shall have a smooth internal and external surface consistent with the manufacturing process.

5.7.2 Slight irregularities in the surface such as raised or depressed areas or shallow grooves resulting from the manufacturing process are permitted provided that the remaining wall thickness continues to meet the requirements specified in subclause 5.8.2.3, and the function of the tube is not impaired (see subclause 8.1).

5.7.3 Proper removal of shallow surface defects using appropriate means is permitted provided that the remaining wall thickness continues to meet the requirements specified in subclause 5.8.2.3. Stopping of surface defects is not permitted.

5.8 Dimensions, masses per unit length, permissible deviations

5.8.1 Dimensions

DIN 2458 shall apply for the outside diameter and wall thickness of tubes. Table 5 shall apply for the types of length.

Table 5. **Types of tube length and permissible deviations in length**

Type of length		Permissible deviations in length, in mm
Manufacturing length [1]		[1]
Specified length		± 500
Exact length	up to 6 m	$^{+10}_{0}$
	over 6 up to 12 m	$^{+15}_{0}$
	over 12 m	By agreement.

[1] The tubes are supplied in the manufacturing lengths occurring in production.

● These lengths are a function of the tube outside diameter, wall thickness and manufacturer's works and shall be agreed at the time of ordering.

5.8.1.1 ●● Subject to agreement at the time of ordering, tubes with dimensions other than given in table 5 may also be supplied.

5.8.2 Permissible dimensional deviations

5.8.2.1 The permissible deviations in the tube outside diameter, d_a, shall be

for $d_a < 200$ mm: ± 1 % (values of $\pm 0{,}5$ mm are permitted in all cases);

for d_a from 200 to less than 1000 mm: $\pm (0{,}005 \times d_a + 1)$ mm;

for $d_a \geq 1000$ mm: ± 6 mm.

At points where the surface of the tube has been repaired by mechanical means, e.g. by grinding, the permissible minus deviation may be slightly exceeded provided that the requirements specified in subclause 5.8.2.3 are complied with.

5.8.2.2 ●● By agreement at the time of ordering, the permissible deviation specified for tube outside diameters exceeding 500 mm may also be related to the internal diameter, taking the permissible deviation in wall thickness into consideration.

5.8.2.3 The permissible deviations in wall thickness, s, shall be

for $s \leq 3$ mm: $^{+0{,}30}_{-0{,}25}$ mm;

for s over 3 mm up to and including 10 mm: $^{+0{,}45}_{-0{,}35}$ [3] mm;

for $s > 10$ mm: $-0{,}50$ mm, the upper limit being given by the permissible deviation in mass.

At isolated points, the wall thickness may be up to 5 % smaller than the minimum wall thickness resulting from the permissible lower deviation, for lengths not greater than twice the outside diameter of the tube, and for not more than a maximum of 300 mm. This is intended to take account of local points where the defects have been removed by grinding (see subclause 5.8.4) for the permitted weld reinforcement).

Misaligned weld edges in pressure welded tubes, where the reduction in cross section exceeds the permissible lower deviation in wall thickness are not permitted.

5.8.2.4 Table 5 gives the permissible deviations in length.

5.8.3 Permissible deviations of form

5.8.3.1 Circularity

Tubes shall be as circular as possible. The out-of-roundness, R, shall not exceed 2 %. This value cannot be ensured for tubes with a d_a/s ratio exceeding 100.

The out-of-roundness (see also subclause 6.5.7) shall be determined using the following formula:

$$R = 200 \cdot \frac{d_{a\,max} - d_{a\,min}}{d_{a\,max} + d_{a\,min}}, \text{ in \%} \qquad (1)$$

where $d_{a\,max}$ is the greatest outside diameter measured, $d_{a\,min}$ the smallest outside diameter measured.

5.8.3.2 Straightness

5.8.3.2.1 Tubes shall be straight to the eye. In cases of dispute, the deviation from straightness shall be not more than $0{,}002 \times l$ (where l is the tube length).

5.8.3.2.2 ●● Particular requirements on straightness may be agreed.

5.8.4 Permissible weld reinforcement

The weld reinforcement, Δa, as a function of the wall thickness, s, shall not exceed the following values:

a) for fusion welded tubes:

for $s \leq 8$ mm, $\Delta a \leq 2{,}5$ mm;

for s over 8 mm up to and including 14 mm, $\Delta a \leq 3{,}0$ mm;

for s over 14 mm up to and including 40 mm, $\Delta a \leq 4{,}0$ mm;

b) for pressure welded tubes:

after the upset has been removed, the inside weld reinforcement shall not exceed 0,3 mm + 0,05 × s (s given in mm) (see also subclause 5.1.3.2).

5.8.5 Finish of tube ends

5.8.5.1 Tube ends shall be cut perpendicular to the tube axis; the edges are not required to be deburred.

5.8.5.2 ●● Deburring may, however, be agreed at the time of ordering.

5.8.6 Masses per unit length

The masses per unit length shall comply with the values specified in DIN 2458. For tubes in non-standard sizes, the mass per unit length shall be calculated taking the density as 7,85 kg/dm^3 for all steel grades.

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[3] The upper limit for tubes made from heavy plate is given by the permissible deviation in mass.

6 Testing and materials testing certificates

6.1 General

Tubes complying with this standard may be supplied with one of the following materials testing certificates as specified in DIN 50049

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

● The type of certificate required and the test house where acceptance inspection is to be carried out by a third party shall be stated at the time of ordering.

6.2 Test site

The tubes shall be tested at the manufacturer's works. Production at the manufacturer's works 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

Table 6 shows a summary of the scope of test programme in each case.

6.3.1 The tubes shall be inspected by batches.

For the purposes of testing, the tubes shall be divided by steel grade and, where possible, by casts, dimensions and heat treatment units, into batches each comprising 100 units.

Remainders up to 50 units may be distributed uniformly across the other batches. Remainders over 50 units and consignments less than 50 units of a batch are to be considered a whole batch.

One tube (sample tube) shall be taken at the inspector's discretion from each batch. The following tests shall be carried out on this sample tube:

– tensile test;
– impact test for wall thicknesses equal to or exceeding 5 mm;
– ●● product analysis, if this was agreed at the time of ordering.

6.3.2 All tubes shall be inspected for surface appearance.

6.3.3 All tubes shall be inspected for their accuracy to size (see subclause 5.8).

6.4 Sampling and sample preparation

See figure 1 for the sampling points and the location of test pieces.

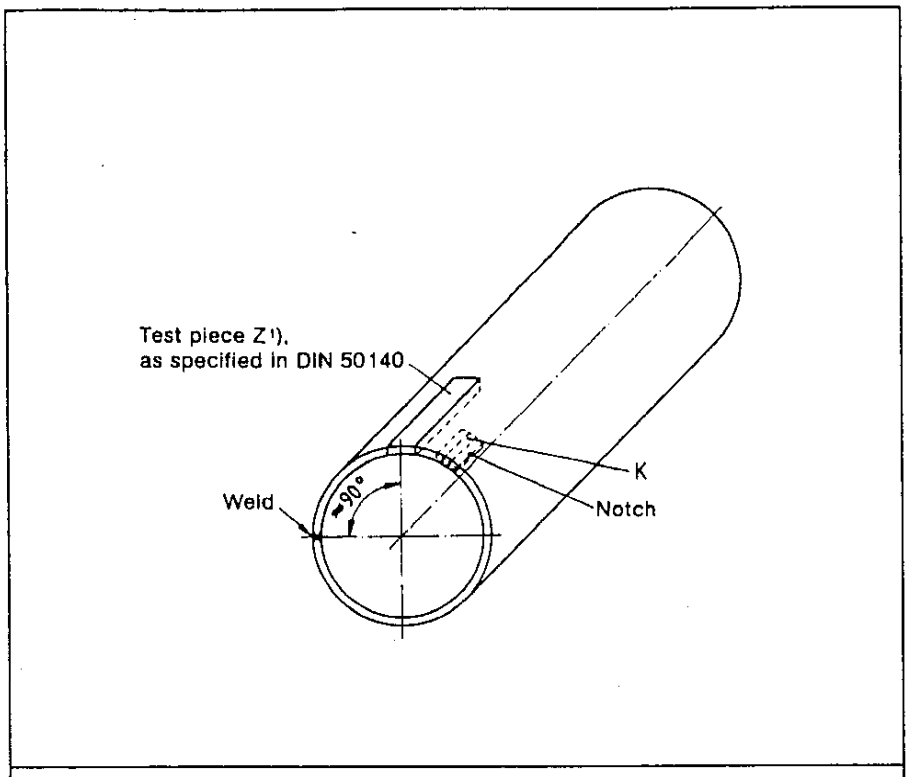
6.4.1 Tensile test

6.4.1.1 In the case of tubes with outside diameters not greater than 500 mm, one strip test piece (see DIN 50140) shall be taken from the parent metal of the sample tube, longitudinal to the tube axis and offset from the weld by about 90°. The test piece shall not be heat treated and shall not be straightened within the gauge length. At the manufacturer's discretion, tubes may also be subjected to the tensile test in full (see DIN 50140).

Table 6. **Summary of the scope of test programme and materials testing certificates**
(see figure 1 for sampling points and location of test pieces; see subclause 6.3.1 for batch size)

No.	Testing: Type of test	As in subclause	Scope of test programme	Responsibility for carrying out the tests	Type of materials testing certificate
1	Cast analysis	5.3.1	All characterizing elements per cast or casting unit.	Manufacturer	DIN 50049 – 2.2[1]
2	Tensile test	6.4.1 6.5.1	1 sample tube per batch, **1 test piece.**	By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C
3	Impact test	6.4.2 6.5.2	At one end of sample tube (No. 2) (for a wall thickness not less than 5 mm): **1 set of 3 test pieces.**	By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C
4	Surface inspection	6.5.4	All tubes.	By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C
5	Check on dimensions	6.5.5 to 6.5.7	All tubes.	By agreement.	DIN 50049 – 3.1 A or DIN 50049 – 3.1 B or DIN 50049 – 3.1 C
6	Product analysis[2]	6.4.3 6.5.3	By agreement.	Manufacturer	DIN 50049 – 3.1 B
7	Reduction in area after fracture[3]	6.4.1.4	By agreement.	Manufacturer	DIN 50049 – 3.1 B

[1] This certificate may also be included in the next higher stage of document.
[2] The product analysis is only to be carried out subject to agreement between the manufacturer and purchaser.
[3] This property is to be tested only subject to agreement between the manufacturer and purchaser on test pieces taken transverse to the tube axis.



[1]) Taken transverse to the tube axis as specified in DIN 50125 for tubes with an outside diameter exceeding 500 mm (see subclause 6.4.1.2).

Figure 1. Sampling points and location of test pieces
In the illustration,
K = set of 3 ISO V-notch test pieces as specified in DIN 50115;
Z = tensile test piece (see subclause 6.4.1).

6.4.1.2 In the case of tubes with outside diameters greater than 500 mm, one flat test piece (see DIN 50125) shall be taken from the parent metal transverse to the tube axis and offset from the weld by about 90°. The test piece shall be cold straightened and may be annealed at a temperature below 500 °C.

6.4.1.3 Short proportional test pieces shall normally be taken for the tensile test. The removal of local irregularities from test pieces which have not been worked on all sides is permitted, the rolling skin shall however be retained at the thinnest spots.

6.4.1.4 ●● If minimum values of reduction in area after fracture have been agreed at the time of ordering, testing shall be carried out on the basis of *Stahl-Eisen-Lieferbedingungen* 096, the scope of test programme being the subject of a particular agreement.

6.4.2 Impact test

For the impact test, a set of three ISO V-notch standard test pieces shall be taken from the sample tube parallel to the tube axis, unless testing of test pieces taken transverse to the tube axis has been agreed at the time of ordering (see subclause 5.4.3.1). In the case of tubes with wall thicknesses exceeding 30 mm, the centre line of the test pieces shall have a distance from the tube external surface equal to one quarter of the wall thickness or shall be positioned as close as possible to this location.

The test pieces shall be taken and prepared in such a way that the notch axis is perpendicular to the tube surface.

If the wall thickness is inadequate for the manufacture of ISO standard test pieces, test pieces shall be taken whose width measured in the direction of the notch axis is equal to the wall thickness, but whose other dimensions correspond to those of ISO standard test pieces, in the case of wall thicknesses from 5 mm to less than 10 mm (see subclause 6.5.2). In this case, the values otherwise required decrease in direct proportion to the test piece cross section.

6.4.3 Chemical composition

The sample chips required for checking the chemical composition shall be taken uniformly over the entire thickness of the product, the test being carried out as a product analysis on the finished tube or, at the manufacturer's descretion, on the starting product (sheet or strip); the procedure for spectral analysis shall be analogous. *Stahl-Eisen-Prüfblatt* (Iron and steel test sheet) 1805 shall normally apply for sampling.

6.5 Test procedure

6.5.1 The tensile test shall be carried out in accordance with DIN 50140 or DIN 50145.

6.5.2 Unless otherwise agreed at the time of ordering (see subclause 5.4.3.1), the impact test shall be carried out as specified in DIN 50115 at the test temperatures given in table 3. The specified minimum values shall apply for the mean obtained from three test pieces; only one individual value may be lower than this specified minimum value, yet by not more than 30%.

Where the width of test pieces is not equal to 10 mm (see subclause 6.4.2), the impact energy measured, $A_{v,p}$, shall be stated along with the test piece cross-sectional area. It can be converted to the impact energy, A_v, in J, using the formula

$$A_v = \frac{8 \times 10 \times A_{v,p}}{S_p} \qquad (2)$$

where

S_p is the cross sectional area of the test piece under the notch.

6.5.3 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).

6.5.4 The appearance of the tubes shall be examined visually under appropriate lighting conditions by an inspector having normal vision.

Note. Subject to agreement between manufacturer and purchaser, any other suitable method of test may be used instead of the visual examination.

6.5.5 The wall thicknesses shall be measured at the ends of the tube using suitable measuring instruments.

6.5.6 The outside diameter shall be measured using suitable measuring instruments, as a two-point measurement or measurement of circumference. In the case of tubes with outside diameters greater than 500 mm, only the measurement of circumference shall be used.

6.5.7 For determining the circularity, a two-point measurement in one cross-sectional plane shall be made.

6.6 Retests

6.6.1 Tubes not satisfying the requirements when tested as specified in subclauses 6.5.4 to 6.5.7 (visual examination, check on dimensions) shall be rejected.

The manufacturer's works shall have the right to take suitable measures to remedy defects or to correct 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 including tensile test and impact test as specified in subclauses 6.5.1 and 6.5.2, the manufacturer is justified in repeating the test giving unsatisfactory results on the same tube with twice the number of test pieces. 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 and 6.5.2. If one of the requirements is still not fulfilled, the entire batch shall be considered not to comply with the standard. However, testing of tubes individually may be agreed between the parties concerned.

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.

6.6.3 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 Materials testing certificates

Depending on the agreement made at the time of ordering (see subclause 6.1), either certificate
DIN 50049 – 3.1 A (inspection certificate A),
DIN 50049 – 3.1 B (inspection certificate B) or
DIN 50049 – 3.1 C (inspection certificate C)
shall be issued for tubes complying with this standard. The type and scope of the tests, the responsibility for carrying out the tests and the type of certificate covering the tests are shown in table 6.

The certificates shall state how the tubes have been marked (see 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 symbol;
- symbol identifying the steel grade;
- an appended symbol SW indicating that the tube has been welded and is to be used for structural steelwork;
- inspector's mark.

7.2 Marking shall generally be applied by stamping. A different marking method (e.g. labelling the bundle of tubes) is also permitted for tubes with a small outside diameter and/or a small wall thickness.

8 Complaints

8.1 Under current law, a complaint may only be raised against defective tubes if the defects noticeably impair their processing and use. 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 2458	Welded steel tubes; dimensions, masses per unit length
DIN 17014 Part 1	Heat treatment of ferrous materials; terminology
DIN 17178	Welded circular fine grain steel tubes subject to special requirements; technical delivery conditions
DIN 18800 Part 7	Steel structures; construction, verification of suitability for welding
DIN 50049	Materials testing certificates

DIN 50115	Testing of metallic materials; impact test
DIN 50125	Testing of metallic materials; tensile test pieces
DIN 50140	Testing of metallic materials; tensile test on tubes and strips from tubes
DIN 50145	Testing of metallic materials; tensile test
DIN 50601	Metallographic examination; determination of the ferritic or austenitic grain size of steel and ferrous materials
Stahl-Eisen-Werkstoffblatt 082[4])	*Begriffsbestimmung zur thermomechanischen Behandlung von Stahl* (Terminology associated with the thermo-mechanical treatment of steel)
Stahl-Eisen-Werkstoffblatt 088[4])	*Schweißgeeignete Feinkornbaustähle, Richtlinien für die Verarbeitung, besonders für das Schweißen* (Weldable fine grain structural steels; rules for processing, with special reference to welding)
Stahl-Eisen-Lieferbedingungen 096[4])	*Blech, Band und Breitflachstahl mit verbesserten Eigenschaften für Beanspruchungen senkrecht zur Erzeugnisoberfläche* (Plate, strip and wide flats with improved properties for stressing at right angles to the surface of the product)
Stahl-Eisen-Prüfblatt 1805[4])	*Probenahme und Probenvorbereitung für die Stückanalyse bei Stählen* (Sampling and sample preparation for the product analysis of steels)
Handbuch für das Eisenhüttenlaboratorium[4])	(Handbook for the ferrous metallurgy laboratory); volume 2: *Die Untersuchung der metallischen Werkstoffe* (Investigation of metallic materials); Düsseldorf 1966; volume 5 (supplement): A 4.4 – *Aufstellung empfohlener Schiedsverfahren* (List of recommended arbitration procedures); B – *Probenahmeverfahren* (Sampling methods); C – *Analysenverfahren* (Methods of analysis); most recent edition in each case.
DASt Richtlinie 011[5])	*Hochfeste schweißgeeignete Feinkornbaustähle StE 460 und StE 690; Anwendung für Stahlbauten* (High-strength weldable fine grain structural steels StE 460 and StE 690 to be used for structural steelwork)

Other relevant standards

DIN 17100	Steels for general structural purposes; quality standard
DIN 17119	Welded cold formed square and rectangular steel tubes (hollow sections) for structural steelwork; technical delivery conditions
DIN 17120	Welded circular steel tubes for structural steelwork; technical delivery conditions
DIN 17125	Square and rectangular fine grain steel tubes (hollow sections) for structural steelwork; technical delivery conditions
EN 39	Steels tubes for working scaffolds; requirements, testing

Explanatory notes

When *Stahl-Eisen-Werkstoffblatt* 089-70 *Schweißbare Feinkornbaustähle, Gütevorschriften* (Weldable fine grain structural steels, quality specifications) published by the *Verein Deutscher Eisenhüttenleute* (Society of German Ferrous Metallurgy Engineers) was adopted as Standard DIN 17102, it was decided that DIN Standards were also to be prepared for weldable fine grain structural steel tubes and forgings. For the succinct presentation in the relevant specification and to facilitate their application, a total of 5 standards on weldable fine grain steel tubes have been prepared, classified according to manufacturing process (welded or seamless), use (for structural steelwork or subject to special requirements) and cross-sectional shape (circular or square and rectangular). This standard deals with welded circular tubes for structural steelwork, whereas DIN 17125 covers welded (and seamless) square and rectangular tubes (hollow sections) for structural steelwork and DIN 17178 welded circular tubes subject to special requirements.

The specifications for chemical composition, mechanical properties, etc. comply with those given in DIN 17102. In the present standard, however, reflecting market demand, the steel grades are limited to the basic series, the low temperature series and the special low temperature series, and only the grades with a minimum yield strength of 255, 285, 355, 420 and 460 N/mm^2 have been included.

International Patent Classification

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E 04 B 1/42	E 04 G 1/02	E 01 D 9/00
E 04 C 3/04	E 04 H 1/20	G 01 N 3/00

[4]) Published by *Verein Deutscher Eisenhüttenleute;* obtainable from *Verlag Stahleisen mbH,* Postfach 82 29, D-4000 Düsseldorf 1.

[5]) Published by *Deutscher Ausschuß für Stahlbau;* obtainable from *Stahlbau-Verlags-GmbH,* Ebertplatz 1, D-5000 Köln 1.