LeKe Piping

WATER CONVEYANCE TUBE STANDARD

NON-ALLOY STEEL TUBES & FITTINGS WATER CONVEYANCE TECHNICAL DELIVERY

EN 10224:2002 + A1:2005

Non-alloy steel tubes and fittings for water and other aqueous liquids

- TUBE GRADES
- DIMENSIONS
- BENDS & TEES
- INSPECTION
- JOINTING
- COATINGS

Technical reference prepared for product and project requirement review.

Confirm final material, dimensions, testing and documentation before ordering.

LEKE PIPING

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EN 10224:2002 + A1:2005

Technical data navigation

Use the index below to open the corresponding technical section.

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REFERENCE NOTE

Source dimensional values and footnotes are retained. Confirm the applicable material, grade, schedule and project specification before ordering.

[A1] EN 10266, [A1] *Steel tubes, fittings and structural hollow sections — Definitions and symbols for use in product standards.*

CR 10261, *Iron and steel — Review of available methods for chemical analysis.*

EN ISO 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing (ISO 377:1997).*

EN ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels (ISO 2566-1:1984).*

EN ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition (ISO 14284:1996).*

3 Terms, definitions and symbols

3.1 General

For the purposes of this European Standard the terms and definitions given in EN 10020, EN 10021, EN 10052 and [A1] EN 10266 [A1] and the following apply.

The symbols used in this European Standard are defined in EN 10020, EN 10021, EN 10052 and [A1] EN 10266. [A1]
Other symbols for sampling and testing are given in the appropriate sampling and testing standards referenced in clauses 9 and 10

3.2
effective length
actual length that a tube contributes when correctly assembled in a run of piping

3.3
allowable operating pressure (PFA)
maximum hydrostatic pressure that a component is capable of withstanding continuously in service

3.4
employer
organization for which a person works on a regular basis. The employer may be either the tube or fitting manufacturer or a third party organization providing non-destructive testing (NDT) services

4 Classification and designation

4.1 Classification

All steels covered by this European Standard are classified as non-alloy steels in accordance with EN 10020.

4.2 Designation

4.2.1 For products covered by this European Standard the steel designation consists of the number of this European Standard (EN 10224) and either the steel name in accordance with EN 10027-1 and CR 10260 or the steel number in accordance with EN 10027-2 (see Table 1).

4.2.2 The steel name consists of the following:

— the capital letter L for line pipe;

— the specified minimum yield strength of the steel for wall thicknesses less than or equal to 16 mm, expressed in MPa[1] (see Table 3).

A1 5 Information to be obtained by the manufacturer A1

5.1 Mandatory information

A1 The following information shall be obtained by the manufacturer at the time of enquiry and order. A1

5.1.1 Tubes

a) the quantity (mass or total length or number);

b) the term ‘tube’;

c) the designation (see 4.2);

d) the dimensions (see 7.6);

e) the options required (see 5.2).

5.1.2 Fittings

a) the number;

b) the type of fitting (see 7.8);

c) the designation (see 4.2);

d) the dimensions (see 7.8);

e) the maximum and, where vacuum conditions exist, the minimum, allowable operating pressure (see 7.1);

f) the options required (see 5.2)

5.2 Options

A number of options are specified in this European Standard and these are listed below. In the event that the purchaser does not indicate his wish to implement any of these options, at the time of enquiry and order the products shall be supplied in accordance with the basic specification.

Option: 1)	The type of tube, seamless or welded shall be as specified (see 6.3.2.1).
Option: 2)	The weld area of electric welded tubes shall be heat treated (see 6.3.2.2).
Option: 3)	The maximum copper content shall be specified (see 7.2.1).
Option: 4)	A product analysis shall be supplied (see 7.2.2).
Option: 5)	Rectification of the body of submerged arc welded tubes and fittings by welding shall not be permitted (see 7.4).
Option: 6)	The tubes shall be supplied in approximate lengths (see 7.6.2).

[1] 1 N/mm^2 = 1 MPa

Option: 7) The tubes shall be supplied in exact lengths (see 7.6.2).

Option: 8) The ends of tubes and/or fittings shall be prepared for butt welding (see 7.10.1).

Option: 9) An alternative bevel end preparation for butt welding shall be provided (see 7.10.4.2).

Option: 10) Products shall be supplied with specific inspection and testing (see 8.1).

Option: 11) An inspection certificate 3.1.A or 3.1.C or an inspection report 3.2 shall be supplied (see 8.2).

Option: 12) The type of leak tightness test shall be as specified (see 10.3.1).

Option: 13) The hydrostatic test shall be carried out at a pressure of 1,5 x P.F.A. (see 10.3.2).

Option: 14) The method of non-destructive testing for the welds of fittings shall be as specified (see 10.5).

Option: 15) The tubes and fittings shall be supplied with a temporary mill protection (see clause 13).

Option: 16) The tubes shall be supplied with a coating and/or lining (see clause 13).

5.3 Examples of an order

Example 1

5 km of submerged arc welded tubes in accordance with EN 10224 with an external diameter of 914 mm and a thickness of 10,0 mm made from steel L275 with preparation of tube ends for butt welding and subjected to specific inspection and testing.

5000 m - tube - EN 10224 - L275 - 914 × 10,0 - Options 1: SAW, 8 and 10.

Example 2

5 gusseted bends in accordance with EN 10224 with external diameter of 914 mm and thickness of 10,0 mm made from steel L275, with a 30° angle for operation at 10 bar gauge pressure, supplied with an inspection certificate 3.1.C, and temporary mill protection.

5 - gusseted bends - EN 10224 - L275 - 914 x 10,0 - 30° - 10 bar - Options 11, 3.1.C and 15.

6 Manufacturing process

6.1 Steel manufacturing process

The steel manufacturing process is at the discretion of the tube or fittings manufacturer.

6.2 Deoxidation process

The steel shall be fully killed.

6.3 Product manufacture and delivery conditions

6.3.1 General

All NDT activities shall be carried out by qualified and competent level 1, level 2 and/or level 3 NDT personnel authorized to operate by the employer.

Qualification shall be in accordance with EN 10256 or, at least an equivalent to it.

NOTE 1 It is recommended that level 3 personnel are certified in accordance with EN 473, or, at least, an equivalent to it.

The operating authorization issued by the employer shall be in accordance with a written procedure.

NDT operations shall be authorized by a level 3 individual approved by the employer.

NOTE 2 The definitions of level 1, 2 and 3 can be found in appropriate standards e.g. EN 473 or EN 10256.

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6.3.2 Tube

6.3.2.1 Tube shall be manufactured from one of the steels specified in Table 1 and by one of the following processes.

a) Seamless (S);

b) Butt welded (BW);

c) Electric welded (EW);

d) Submerged arc weld (SAW).

The welds of butt welded tubes shall be longitudinal; the welds of electric welded and submerged arc welded tubes shall be either longitudinal or helical.

The tube manufacturing process is at the discretion of the manufacturer unless the type of tube, seamless or welded, is specified by the purchaser.

Option 1 The type of tube, seamless or welded, is specified by the purchaser. The tubes shall then be marked with an S or W as appropriate (see also 12.1e).

NOTE The manufacturing process is related to the tube diameter and thickness. Information on the typical range of sizes and thicknesses available for each process is given in annex A.

6.3.2.2 The tubes shall be supplied as welded, hot finished, cold formed or cold finished at the discretion of the manufacturer. However, to achieve the required properties a heat treatment may be performed.

The purchaser may specify that the weld area of as welded EW tubes shall be heat treated to produce properties similar to those in the body of the tube.

Option 2 The weld area of EW tubes shall be heat treated.

6.3.2.3 The delivered tubes shall not include welds used for joining together lengths of the hot or cold rolled strip prior to forming except as specified in 6.3.2.4.

6.3.2.4 For helically welded submerged arc welded tubes the weld joining lengths of strip may be part of the delivered tube provided that the weld is made by the same method of welding as the helical seam weld.

6.3.3 Fittings

6.3.3.1 Fittings shall be manufactured from tubes manufactured in accordance with this standard or from plate or strip made from one of the steel grades in Table 1.

6.3.3.2 All welds of fittings made from plate or strip and all fabrication welds shall be arc welds and the preparation for welding and the welding shall be carried out to qualified procedures using competent welders. Procedures in accordance with EN 288-1, 2 and 3 carried out by welders qualified in accordance with EN 287-1 meet this requirement.

7 Requirements

7.1 General

Tubes and fittings, when inspected and tested in accordance with clauses 9 and 10, shall comply with the requirements of 7.2 to 7.10 as appropriate. In addition to the requirements of this European Standard the general technical delivery conditions specified in EN 10021 apply.

Fittings shall be designed to withstand a pressure of not less than 1,5 times the allowable operating pressure.

7.2 Chemical composition

7.2.1 Cast analysis

The cast analysis of the steel shall comply with the requirements of Table 1.

Table 1 — Chemical composition limits of the cast analysis

Steel grade		C %	Si %	Mn %	P %	S %
Steel name	Steel number	max	max	max	max	max
L235	0252	0,16	0,35	1,20	0,030	0,025
L275	0260	0,20	0,40	1,40	0,030	0,025
L355[a]	0419	0,22	0,55	1,60	0,030	0,025

[a] For steel L355 additions of niobium, titanium and vanadium are permitted at the discretion of the manufacturer. In this case the inspection documents shall state the level of these elements.

Elements not included in Table 1 may be present but shall not be intentionally added to the steel without the agreement of the purchaser, except for elements which may be added for finishing the cast. All appropriate measures shall be taken by the steelmaker to prevent the addition of undesirable elements from scrap or other materials used in the steelmaking process.

A maximum copper content lower than that permitted by EN 10020 may be specified by the purchaser to facilitate subsequent forming operations.

Option 3 The maximum copper content is specified lower than that permitted by EN 10020 for non alloy steel.

7.2.2 Product analysis

For products supplied with specific inspection and testing, and when specified by the purchaser, a product analysis shall be provided for each grade of steel supplied.

Option 4 A product analysis shall be provided for each grade of steel supplied.

Table 2 specifies the permissible deviations of the product analysis from the specified limits for cast analysis given in Table 1.

Table 2 — Permissible deviation of the product analysis from the specified cast analysis limits given in Table 1

Element	Limiting values %	Permissible deviation %
C	≤ 0,20	+ 0,02
	> 0,20	+ 0,03
Si	≤ 0,55	+ 0,05
Mn	≤ 1,60	+ 0,10
P	≤ 0,030	+ 0,005
S	≤ 0,025	+ 0,005
Cu	≤ 0,35	+ 0,05
	> 0,35	+ 0,07

NOTE When welding tubes or fittings produced according to this European Standard account should be taken of the fact that the behaviour of the steel during and after welding is dependent not only on the steel, but also on the conditions of preparing for and carrying out the welding.

7.3 Mechanical properties

7.3.1 Tensile test for tubes and fittings

The minimum yield strength, tensile strength range and minimum elongation for the tubes and fittings covered by this European Standard shall be in accordance with Table 3.

For even curvature bends and fittings made from plate or strip the tensile test properties shall be determined after forming.

NOTE The tensile test properties may be affected by subsequent heating or reheat treatments. Purchasers who intend to heat or reheat treat any of the products are advised to discuss the application and proposed heating or reheat treatment with the manufacturer.

Table 3 — Mechanical properties at room temperatures

Steel name	Tensile strength R_m MPa	Minimum yield strength R_e [a] MPa for thicknesses in mm		Minimum elongation A % ($Lo = 5{,}65\sqrt{S_o}$)		Diameter of mandrel for the weld bend test	For the drift expanding test[c] % increase in d/D [d] ratio	
		$T \leq 16$	$T > 16$	l [b]	t [b]		≤ 0,8	> 0,8
L235	360 to 500	235	225	25	23	3T	10	12
L275	430 to 570	275	265	21	19	4T	8	10
L355	500 to 650	355	345	21	19	4T	6	8

[a] R_e shall be R_{eH}, or if a yield phenomenon is not present, $R_{p0,2}$ or $R_{t\,0,5}$. See 10.2.1.

[b] l – longitudinal

t – transverse

[c] Applicable only to tubes of diameter less than or equal to 150 mm and thicknesses less than or equal to 10 mm.

[d] d = D-2T

7.3.2 Flattening test for tubes

Except as permitted by 7.3.3 BW and EW tubes shall pass a flattening test in accordance with 10.2.2. No cracks or imperfections shall be permitted in the metal or in the weld except that cracks originating at the edges of the test piece which are less than 6 mm long and which do not penetrate through the wall shall not be cause for rejection.

7.3.3 Drift expanding test for tubes

The drift expanding test may replace the flattening test for tubes up to and including 150 mm diameter and 10 mm thickness at the discretion of the manufacturer.

BW and EW tubes shall pass a drift expanding test in accordance with 10.2.3. No cracks or imperfections shall be permitted in the metal or in the weld, except that slight incipient cracking at the edges of the test piece shall not be cause for rejection.

7.3.4 Weld bend test for tubes and fittings

7.3.4.1 The weld of submerged arc welded tubes and the seam weld of fittings and fittings components made from plate or strip shall pass a weld bend test in accordance with 10.2.4. on the root and face of the weld using a mandrel of diameter specified in Table 3. No cracks or imperfections shall be permitted in the weld metal, fusion line, heat affected zone or parent metal, except as permitted in 7.3.4.2.

7.3.4.2 The opening out of an imperfection due to incomplete root penetration or lack of fusion shall not be cause for rejection, provided that the imperfection has sound metal at the back and on each side of it. Cracks originating at the edges of the test piece which are less than 6 mm long and which do not penetrate through the wall shall not be cause for rejection.

7.4 Appearance

Tubes and fittings shall be free from external and internal surface defects which can be established by visual inspection in accordance with this European Standard.

The outside surface condition, and where practicable, the inside surface condition shall be such that surface defects, and/or surface imperfections requiring rectification, can be identified.

It shall be permissible to rectify surface imperfections by grinding or machining provided that after so doing the wall thickness in the rectified area is not less than the specified minimum thickness. All ground or machined areas shall blend smoothly into the contour of the tube.

Surface imperfections which encroach on the minimum permissible wall thickness shall be considered defects and shall not be permitted. Rectification of such defects in SAW tubes by grinding or machining followed by welding shall be permitted on the body of SAW tubes and on fittings unless option (5) is specified by the purchaser.

Option 5 Rectification of the body of SAW tubes and fittings by welding shall not be permitted.

Rectification of the weld seam of BW and EW tubes is not permitted. Rectification of the seam weld of SAW tubes and fittings made from SAW tubes in accordance with an established procedure shall be permitted. The rectified tube or fitting shall be tested in accordance with 10.3 and 10.4 or 10.5 as appropriate.

7.5 Soundness

7.5.1 General

Tubes and fittings shall meet the requirements for soundness and freedom from internal imperfections specified in 7.5.2 and 7.5.3.

7.5.2 Leak tightness

All tubes and fittings shall be leak tight. Leak tightness shall be demonstrated either by a hydrostatic test in accordance with 10.3.2 or by an electromagnetic test in accordance with 10.3.3.

NOTE SAW tubes are tested in accordance with 10.3.2.

7.5.3 Soundness of welds

The welds of all tubes and fittings shall be shown to be sound when tested in accordance with the requirements of 10.4 for tubes and 10.5 for fittings.

7.6 Dimensions of tubes

7.6.1 Outside diameter and thickness

The outside diameters and thicknesses of tubes appropriate to this European Standard are given in Table 4. With the exception of tubes of 2 642 mm and 2 743 mm diameter, they are in accordance with ENV 10220.

NOTE Other diameters and/or thicknesses may be available by agreement with the manufacturer.

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Table 4 — Tube outside diameter and thickness

Outside diameter Series 1)			Thickness																								
1	2	3	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,4	5,6	6,3	7,1	8	8,8	10	11	12,5	14,2	16	17,5	20	22,2	25
26,9			■	■	■	■	■	■	■	■	■	■	■	■	■	■										
		30	■	■	■	■	■	■	■	■	■	■	■	■	■	■										
	31,8		■	■	■	■	■	■	■	■	■	■	■	■	■	■										
	32		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■									
33,7			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■									
		35	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
	38		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
	40		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
42,4			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
		44,5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
48,3			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
	51		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
		54	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	57		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
60,3			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	63,5		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
	70		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
		73	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
76,1			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
		82,5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
88,9			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
	101,6		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
		108	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
114,3			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	127		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	133		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
139,7			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		141,3	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		152,4	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		159	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
168,3			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		177,8	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		193,7	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
219,1			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		244,5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
273			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
323,9					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
355,6					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
406,4					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
457							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
508		559					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	610						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	660									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	711									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	762									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	813									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	864									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	914									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	1016									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	1067										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	1118										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	1168										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	1219										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	1321												■	■	■	■	■	■	■	■	■	■	■	■	■	■
	1422												■	■	■	■	■	■	■	■	■	■	■	■	■	■
	1524													■	■	■	■	■	■	■	■	■	■	■	■	■
	1626													■	■	■	■	■	■	■	■	■	■	■	■	■
	1727														■	■	■	■	■	■	■	■	■	■	■	■
	1829														■	■	■	■	■	■	■	■	■	■	■	■
	1930															■	■	■	■	■	■	■	■	■	■	■
	2032															■	■	■	■	■	■	■	■	■	■	■
	2134																■	■	■	■	■	■	■	■	■	■
	2235																■	■	■	■	■	■	■	■	■	■
	2337																	■	■	■	■	■	■	■	■	■
	2438																	■	■	■	■	■	■	■	■	■
	2540																		■	■	■	■	■	■	■	■
	2642																		■	■	■	■	■	■	■	■
	2743																		■	■	■	■	■	■	■	■

1) Note 1: Series 1 = Tubes for which all the accessories needed for the construction of piping system are standardized
Note 2: Series 2 = Tubes for which not all the accessories are standardized
Note 3: Series 3 = Tube for special application for which very few standardized accessories exist

7.6.2 Length

Tubes shall be supplied in random lengths in accordance with Table 5 unless otherwise specified by the purchaser.

NOTE 1 The range of lengths depends upon the tube manufacturing process.

The purchaser may specify the delivery length either as an approximate length within the range 6 m to 16 m (see option 6) or as an exact length (see option 7).

NOTE 2 Approximate lengths and exact lengths differ in the tolerance on the length (see 7.7.6).

Option 6 The tubes shall be supplied in approximate lengths. The length within the range 6 m to 16 m shall be specified by the purchaser.

Option 7 The tubes shall be supplied in exact lengths. The length shall be specified by the purchaser.

Table 5 — Random lengths - specified length ranges and minimum average lengths

Specified length ranges m	Minimum average length in 100 % of order item m
3-8	6
4-12	8
5,5-14	11
6,5-16,5	13
7,5-18	14,5

7.7 Tolerances for tubes

7.7.1 General

Except as specified in 7.10, the tolerances on the diameter and out of roundness of tubes shall not exceed the values specified in 7.7.2 and 7.7.3 for the appropriate method of manufacture.

7.7.2 Outside diameter

Except as specified in 7.10.1 the tolerances on outside diameter shall be as given in 7.7.2.1, 7.7.2.2 and 7.7.2.3.

7.7.2.1 Seamless tube

The tolerance on outside diameter shall not exceed ± 1 % of the diameter with a minimum of ± 0,5 mm.

7.7.2.2 Electric welded and butt welded tube

The tolerance on outside diameter shall not exceed the values given in Table 6.

Table 6 — Tolerance on the outside diameter for EW and BW tubes

Outside diameter mm	Tolerance
≤ 219,1	± 1 % of diameter with a minimum of ± 0,5 mm
> 219,1	± 0,75 % of diameter

7.7.2.3 Submerged arc welded tubes

The tolerance on the outside diameter shall not exceed ± 0,75 % of diameter with a maximum of ± 6 mm for diameters up to and including 2 032 mm. For tube of diameter greater than 2 032 mm the tolerance shall be agreed between the purchaser and the manufacturer.

7.7.3 Out of roundness

For tubes with a ratio of outside diameter to thickness (D/T) less than or equal to 100, the out of roundness, calculated in accordance with the following equation, shall not exceed 2 %.

$$\text{Out of roundness (O)} = 100\ \frac{(D_{\max} - D_{\min})}{D}$$

where

$D_{\max}$ is the maximum outside diameter (mm) and $D_{\min}$ is the minimum outside diameter (mm) measured in the same plane.

For tubes with D/T greater than 100 a maximum for the out of roundness shall be agreed between the purchaser and the manufacturer.

7.7.4 Wall thickness

The tolerance on thickness shall not exceed the values given in 7.7.4.1, 7.7.4.2, or 7.7.4.3 for the corresponding method of manufacture.

7.7.4.1 Seamless tubes

The tolerance on thickness shall not exceed the values given in Table 7.

Table 7 — Tolerance on thickness for seamless tubes

Outside diameter mm	Tolerance on thickness for T/D ratio (%)			
	≤ 2,5	> 2,5 ≤ 5,0	> 5,0 ≤ 10,0	> 10,0
≤ 219,1	± 12,5 % or ± 0,4 mm whichever is the greater			
> 219,1	± 20 %	± 15 %	± 12,5 %	± 10 %

7.7.4.2 Electric welded and butt welded tubes

The tolerances on thickness excluding the weld area shall not exceed ± 10 % or ± 0,3 mm, whichever is the greater.

The minimum thickness in the area of the weld shall be not less than that permitted for the body of the tube.

The external weld bead of electric welded tube shall be removed by trimming and that of butt welded tube shall be rolled flush.

The height of the internal weld bead shall not exceed (0,5 + 0,05T) mm.

7.7.4.3 Submerged arc welded tubes

The tolerance on thickness excluding the weld bead shall not exceed ± 7,5 % of thickness.

The height of the internal and external weld bead shall be not greater than the values given in Table 8.

Table 8 — Maximum height of weld bead for submerged arc welded tubes

Thickness mm	Maximum bead height mm
≤ 12,5	3,5
> 12,5	4,5

7.7.5 Tube ends

Tubes shall be supplied with plain ends cut nominally square to the axis of the tube unless the purchaser specifies end preparation for butt welding in accordance with 7.10. The ends shall be free of excessive burrs.

NOTE Information on the end preparation for jointing other than butt welding is given in annex C and may be agreed between the purchaser and the manufacturer.

7.7.6 Length

7.7.6.1 Approximate length

The lengths supplied shall not deviate from the specified length by more than ± 500 mm.

7.7.6.2 Exact length

The lengths supplied shall not deviate from the specified length by more than the value given in Table 9.

Table 9 — Tolerance for exact length

Length L mm	Tolerance on length	
	Tube outside diameter	
	< 406,4 mm	≥ 406,4 mm
2 000 < L ≤ 6 000	$^{+10}_{0}$ mm	$^{+25}_{0}$ mm
6 000 < L ≤ 12 000	$^{+15}_{0}$ mm	$^{+50}_{0}$ mm
L > 12 000	+by agreement 0	

7.7.7 Straightness

The tubes shall not deviate from straightness by more than 0,2 % of the total length measured at the centre of the tube length.

7.8 Types and dimensions of fittings

7.8.1 General

The fittings covered by the requirements of this European Standard are even curvature bends, gusseted bends, and tees, the dimensions for which shall be in accordance with 7.8.2, 7.8.3 and 7.8.4 respectively.

7.8.2 Even curvature bends

7.8.2.1 For general applications, the dimensions of even curvature bends, formed by manipulation of tubes, for tubes with outside diameters from 26,9 mm to 323,9 mm shall be as given in Table 10 (see Figures 1 and 2). The purchaser shall specify the outside diameter, wall thickness and angle of the bend at the time of enquiry and order (see 5.1.2.d).

NOTE 1 Tighter radius bends may be agreed between the purchaser and manufacturer.

NOTE 2 Bends are commonly specified with angles of 11° 15', 22° 30', 45° and 90° but they may be of any angle as required by the purchaser.

7.8.2.2 The bending radius R (see Figures 1 and 2) for tube with outside diameters greater than 323,9 mm up to and including 1 016 mm shall be specified by the purchaser at the time of enquiry and order (see 5.1.2.d).

NOTE Even curvature manipulated bends in diameters greater than 1 016 mm may be available by agreement with the supplier.

7.8.2.3 The length of straight S, specified in Table 10 shall be the minima applicable to bends prepared for butt welding. The lengths of straight S may be modified to suit other types of joint but shall be not less than the values specified in Table 10 or 1,5 D for tubes of diameter greater than 323,9 mm.

7.8.2.4 When bitumen lining is required on even curvature manipulated bends of diameter greater than 168,3 mm, the tube length in the bend shall be limited to 1 800 mm or a gusseted bend used.

Table 10 — Dimensions of even curvature bends: tube outside diameters from sizes 26,9 mm to 323, 9 mm inclusive

Dimensions in millimetres

Tube		Bend	
Diameter D	**Minimum thickness** T	**R**	**S min**[a]
26,9	2,6	100	100
33,7	2,6	125	100
42,4	2,9	160	125
48,3	2,9	200	125
60,3	3,6	250	150
76,1	3,6	325	150
88,9	4,0	400	150
114,3	4,5	500	150
139,7	4,5	625	190
168,3	4,5	750	225
219,1	5,0	1000	300
273	6,3	1250	375
323,9	7,1	1500	450

[a] See Figures 1 and 2.

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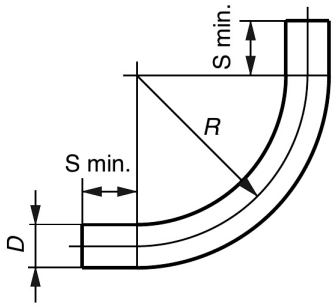


Figure 1 — Even curvature bend of 90°

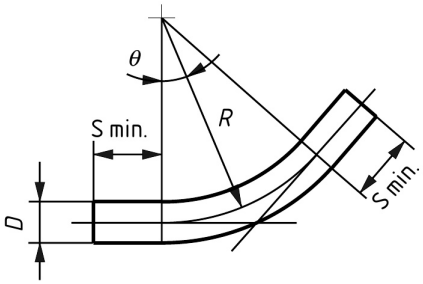


Figure 2 — Even curvature bend less than 90°

7.8.3 Gusseted bends

Gusseted bends shall be of the general form shown in Figures 3 or 4 or 5 dependent on the angle of the bend. For bends with angle θ greater than 45° in tubes of 457 mm diameter and above, the bend radius R shall be not less than 1,0 D. For other conditions the bend radius R shall be not less than 1,5 D. The diameter, thickness, the type (1, 2 or 3) and the angle θ shall be specified by the purchaser and the dimensions L and R agreed between purchaser and manufacturer at the time of enquiry and order.

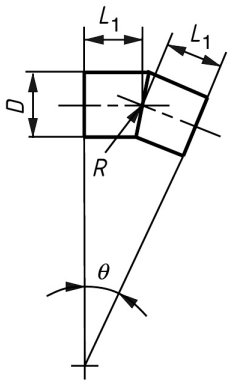


Figure 3 — Gusseted bend type 1, θ ≤ 30°

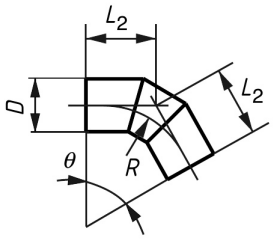


Figure 4 — Gusseted bend type 2, 31° < θ ≤ 60°

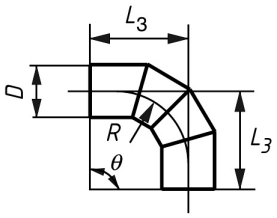


Figure 5 — Gusseted bend type 3, 61° < θ ≤ 90°

7.8.4 Tees

Tees shall be supplied with plain ends (see Figure 6) or with ends suitable for sleeve joints (see Figure 7) or with flanges attached to the branch and/or the barrel (see Figure 8). Dimensions of standard tees shall be as given in Table 11. The purchaser shall specify the diameter and wall thickness of the barrel and branch.

When sleeve joint tees or tees with flanges on the branch and/or on the barrel are required the dimensions F, E and H shall be as shown in Figures 7 and 8 as appropriate.

NOTE For information on the dimensions of sleeves see C.2.

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Table 11 — Dimensions of tees: tube outside diameters from sizes 26,9 mm to 2 743 mm inclusive

Dimensions in millimetres

	Barrel	Branch		
Diameter D or D1 (See Figure 6)	**F (Min)**	**G**	**E**	**H**
		0,5 D plus		
26,9	150	150	75	75
33,7	150	150	75	75
42,4	200	200	150	100
48,3	200	200	150	100
60,3	240	200	100	100
76,1	240	200	100	100
88,9	250	200	100	110
114,3	270	200	100	130
139,7	280	200	110	140
168,3	290	200	110	140
219,1	370	250	110	150
273	410	250	130	160
323,9	450	250	130	180
355,6	530	300	150	200
406,4	600	300	150	230
457 to 711	1,5 D 1 but with minimum of 0,5 D	300	230	300
762 to 914		380	300	300
1 016 to 2 540		380	380	380
2 642		400	400	400
2 743		420	420	420

NOTE 1 Dimensions F, G, E and H should be rounded to the nearest 10 mm.

NOTE 2 The effective length of the barrel of tees with sleeve joint for welding equals 2 F.

NOTE 3 Any barrel may have a branch of equal or smaller diameter attached to it.

NOTE 4 Reinforcement may be required to prevent overstressing.

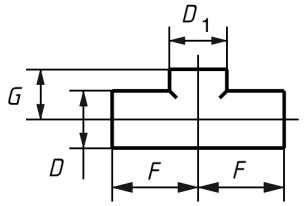


Figure 6 — Plain end tee for butt-welded joint

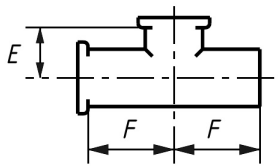


Figure 7 — Sleeve joint tee for welding

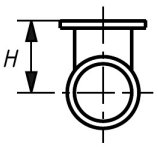


Figure 8 — Tee with flanged branch

7.9 Tolerances for fittings

7.9.1 General

The ends of fittings (except for socketed or flanged tees) shall be prepared to match those of the tubes to which they are to be joined.

7.9.2 Bends

Bends shall be supplied with plain ends cut nominally square to the axis of the bend unless the purchaser specifies end preparation for butt welding in accordance with 7.10. The ends shall be free from excessive burrs.

NOTE Information on end preparation for jointing other than butt welding is given in annex C and may be agreed between the purchaser and the manufacturer.

Tolerance on the angle between the end faces shall be within $\pm$ 1° of the specified bend angle θ (see Figures 1 to 5).

The radius R of the bend shall be within $\pm$ 1 % of the specified radius.

The minimum wall thickness of even curvature bends shall be not less than that permitted in the tube of equivalent material to which it is intended to be connected.

The tolerance on leg length L_1, L_2 and L_3 for gusseted bends (see Figures 3 to 5) shall be $\pm$ 35 mm for outside diameters less than or equal to 219,1 mm and $\pm$ 70 mm for outside diameters greater than 219,1 mm. When a fixed leg length is specified the tolerance on the leg length shall be $\pm$ 6 mm.

7.9.3 Tees

Plain end tees shall be supplied with the ends cut nominally square to the axis of the barrel and the branch as appropriate unless the purchaser specifies end preparation for butt welding with 7.10. The ends shall be free from excessive burrs.

NOTE Information on end preparation for jointing other than butt welding is given in annex C and may be agreed between the purchaser and the manufacturer.

The tolerance on the angle of branch relative to the axis of the barrel shall be ± 1°.

The tolerance on the dimensions E, F, G and H (see Figures 6 to 8) shall be ± 6 mm.

7.10 End preparation of tubes and fittings for butt welding

7.10.1 General

The purchaser may specify that the ends of tubes and fittings shall be prepared for butt welding in accordance with 7.10.2 to 7.10.4.

Option 8 The ends of tubes and/or fittings shall be prepared for butt welding.

7.10.2 Diameter tolerance at tube and fitting ends

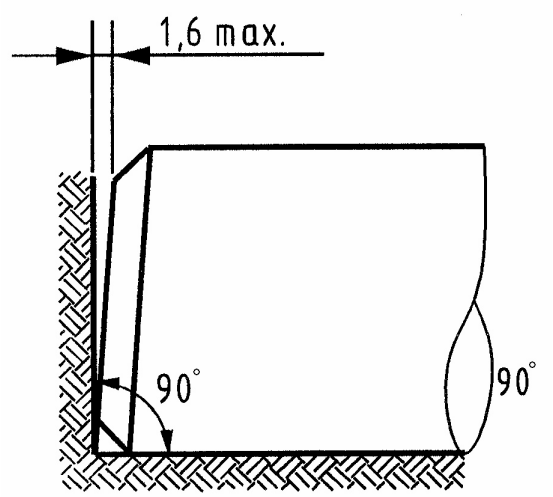
The tolerance on the outside diameter of the tubes for a distance of 100 mm from each end and for a distance to be agreed at each end of fittings, shall be in accordance with Table 12. Out of roundness shall be within the limits for the diameter tolerance for tubes and fittings with D/T less than or equal to 100. For D/T values above 100 the out of roundness shall be agreed between the purchaser and the manufacturer.

Table 12 — End tolerance on diameter (D)

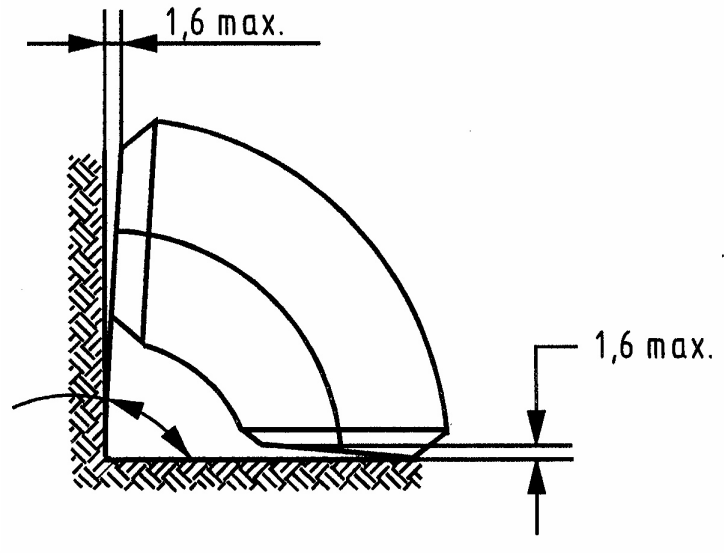
Outside diameter mm	End tolerance
≤ 219,1	± 0,5 mm or ± 0,5 % D whichever is the greater
219,1 < D ≤ 2 032	± 1,6 mm
> 2 032	± 3 mm

7.10.3 Squareness of ends

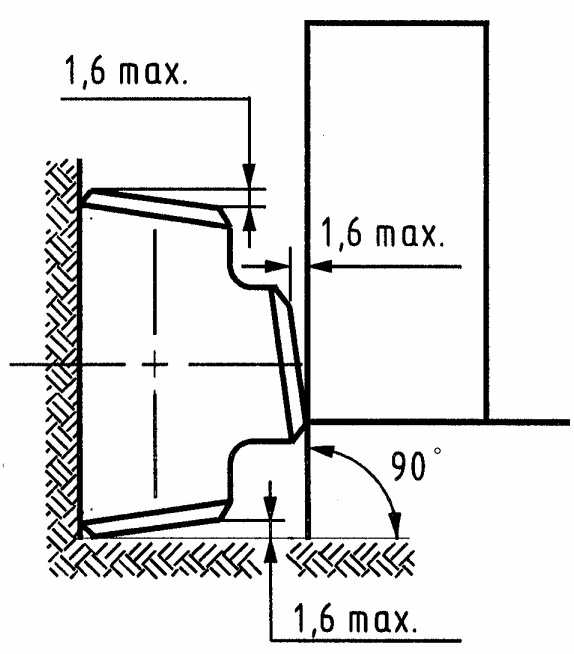
The ends of tubes and fittings shall be at right angles to the axis of the tube or fitting within 1,6 mm measured across the diameter as shown in Figure 9.



a) Tube



b) Bends



c) Tees

Figure 9 — Squareness of ends

7.10.4 Bevelled ends

7.10.4.1 The ends of tubes and fittings of thickness less than 3,2 mm shall be supplied without bevelled ends.

7.10.4.2 Tubes and fittings of thickness equal to or greater than 3,2 mm shall be supplied with ends bevelled as shown in Figure 10 unless option (9) is specified by the purchaser.

Linear dimension in millimetres

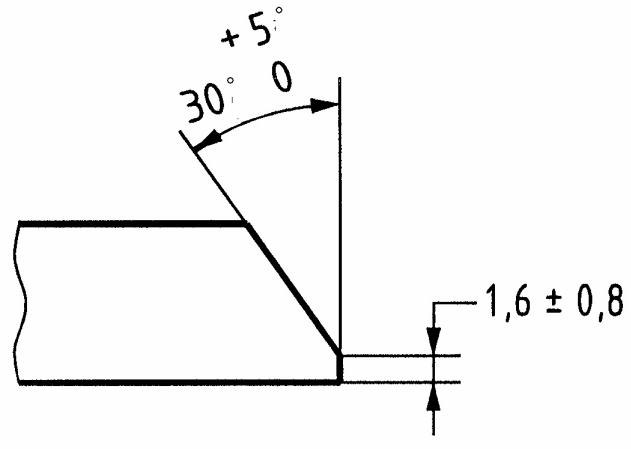


Figure 10 — Butt-weld end preparation

Option 9 An alternative bevel end preparation for butt welding shall be provided; the purchaser shall specify the type of preparation required.

7.11 Reaction to fire

The tube and fitting material is class A1[2)] , but see clause 13.

〈A1〉 7.12 Dangerous substances

Tubes and fittings, produced in accordance with this document, shall not release any dangerous substances in excess of the maximum permitted levels specified in the relevant European Standard for the material or permitted in the national regulations of the member state of destination. 〈A1〉

8 Inspection

8.1 General

Compliance with the requirements of this European Standard shall be checked by non-specific inspection and testing (see EN 10021) unless option (10) is specified by the purchaser.

Option 10 The products shall be supplied with specific inspection and testing (see EN 10021).

8.2 Inspection documents

When products according to this European Standard are checked by non-specific inspection and testing, a test report type 2.2 in accordance with EN 10204 shall be supplied.

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2) In accordance with Commission Decision 96/303/EEC of 4th October 1996 amended by Commission Decision 2000/603/EC of 4th October 2000 the material is class A1 and therefore does not require to be tested for reaction to fire.

When products according to this European Standard are checked by specific inspection and testing (see option 10), an inspection certificate type 3.1.B in accordance with EN 10204 shall be supplied unless option (11) is specified by the purchaser.

Option 11 For products checked by specific inspection and testing an inspection certificate type 3.1.A or 3.1.C or an inspection report type 3.2 in accordance with EN 10204 shall be supplied. The type of document to be supplied shall be specified by the purchaser.

When an inspection document 3.1.A, 3.1.C or 3.2 is specified the purchaser shall notify the manufacturer of the name and address of the organization or person who is to carry out the inspection and produce the inspection document. In the case of an inspection report 3.2 it shall also be agreed which party is to issue the document.

8.3 Content of inspection document

8.3.1 General

The content of the inspection document shall be in accordance with [A1] EN 10168 [A1] as given in 8.3.2 for non-specific inspection and testing and in 8.3.3 for specific inspection and testing.

8.3.2 Non-specific inspection and testing

For tubes with non-specific inspection and testing the test report shall contain the following codes and information:

A	Commercial transactions and parties involved
B	Description of products to which the test report applies
C02	Directions of the test pieces
C10-C13	Tensile tests
C50-C69	Bend test (Weld), flattening or Drift Expanding Test
C71-C92	Chemical composition
D01	Marking and identification, the surface appearance, the shape and the dimensional properties
D02-D99	Leak Tightness Test, NDT of the weld
Z	Validation

8.3.3 Specific inspection and testing

For tubes supplied with specific inspection and testing the inspection document shall contain the following codes and information:

A	Commercial transactions and parties involved
B	Description of products to which the inspection document applies
C02	Direction of test pieces
C10-C13	Tensile tests
C50-C69	Bend Test (weld), flattening or Drift Expanding Test
C71-C92	Chemical composition

D01	Marking and identification, surface appearance, shape and dimensional properties
D02-D99	Leak Tightness Test, NDT of the weld
Z	Validation

8.4 Summary of inspection and testing

8.4.1 Tubes

Inspection and testing shall be carried out as summarized in Table 13 for non-specific inspection and testing and in Table 14 for specific inspection and testing.

8.4.2 Fittings

Fittings or components of fittings which are manufactured from tubes or formed into tubes prior to the completion of the fitting shall be tested at the tubular stage in accordance with 8.4.1 and Table 15, where applicable. Fittings or components not tested as a tube, or when forming has been undertaken, shall be tested in accordance with 8.4.1 and Table 15, where applicable.

Even curvature bends previously tested as a tube shall only be subject to a tensile test in accordance with 10.2.1 after forming.

All welds which have not been tested as part of a tube shall be tested in accordance with 10.5 before the application of any coating or lining material.

Fittings shall be subject to visual examination (see 10.6) and dimensional inspection (see 10.7).

Table 13 — Requirements for non-specific inspection and testing of tubes

Type of test	Seamless tube	Electric welded tube	Submerged arc welded tube	Butt welded tube
Cast analysis	1 representative	1 representative	1 representative	1 representative
Tensile test	Manufacturers procedure	Manufacturers procedure	Manufacturers procedure	Manufacturers procedure
Flattening test[a]	Manufacturers procedure	Manufacturers procedure	-	Manufacturers procedure
Drift expanding Test[a]	-	Manufacturers procedure	-	Manufacturers procedure
Weld bend test	-	-	Manufacturers procedure	-
Leak tightness test	All hydrostatic or electro-magnetic	All hydrostatic or electro-magnetic	All hydrostatic	All hydrostatic or electro-magnetic
Visual examination	See 10.6	See 10.6	See 10.6	See 10.6
Dimensional inspection	See 10.7	See 10.7	See 10.7	See 10.7
Non-destructive test of the weld	-	All	All including skelp end welds of helically welded tube	All

[a] The drift expanding test is an alternative for electric welded and butt welded tubes of outside diameter equal to or less than 150 mm and thicknesses less than 10 mm.

Table 14 — Requirements for specific inspection and testing of tubes

Type of test	Seamless tube	Electric welded tube	Submerged arc welded tube	Butt welded tube
Cast analysis	1 per cast	1 per cast	1 per cast	1 per cast
Tensile test	1 per test unit	1 per test unit	1 per test unit	1 per test unit
Flattening test[a]	1 per test unit	1 per test unit	-	1 per test unit
Drift expanding Test[a]	-	1 per test unit	-	1 per test unit
Weld bend test	-	-	2 per test unit	-
Leak tightness test	All hydrostatic or electro-magnetic	All hydrostatic or electro-magnetic	All hydrostatic	All hydrostatic or electro-magnetic
Visual examination	See 10.6	See 10.6	See 10.6	See 10.6
Dimensional inspection	See 10.7	See 10.7	See 10.7	See 10.7
Non-destructive test of the weld	-	All	All including skelp end welds of helically welded tube	All
Product analysis (Optional)	one per grade of steel			
[a] The drift expanding test is an alternative for electric welded and butt welded tubes of outside diameter equal to or less than 150 mm and thicknesses less than 10 mm.				

9 Sampling of tubes and fittings

9.1 Frequency of testing

For non-specific inspection and testing the tests shall be carried out by the manufacturer in accordance with his own procedures (see EN 10021).

For specific inspection and testing, the tests shall be carried out on the products to be supplied or on test units of which the product to be supplied is a part (see EN 10021).

9.1.1 Test unit

When specific inspection and testing is carried out the test unit shall consist of the number of tubes or fittings specified in Table 15 of the same type, specified diameter, specified thickness, steel grade and manufactured using the same processing conditions e.g. welding process, heat treatment.

In addition, for fusion welded products, the test unit shall consist of products which have been welded using the same type of flux and filler wire.

Table 15 — Number of tubes or fittings in a test unit

Outside diameter mm	Number of tubes	Number of fittings
≤ 48,3	1000	100
> 48,3 ≤ 114,3	400	100
> 114,3 ≤ 323,9	200	100
> 323,9	100	100
NOTE Any residual fraction of a test unit should be considered as a test unit.		

9.1.2 Number of sample products

One sample tube or fitting shall be selected for the mechanical tests (one per test unit), and where appropriate, the product analysis (one per steel grade).

9.1.3 Type of test and number of tests

See 8.4.

9.2 Location, orientation and preparation of samples and test pieces

9.2.1 General

Samples and test pieces shall be taken from the end of a tube or fitting in the final delivery condition in accordance with Figure 11 and EN ISO 377.

9.2.2 Product analysis

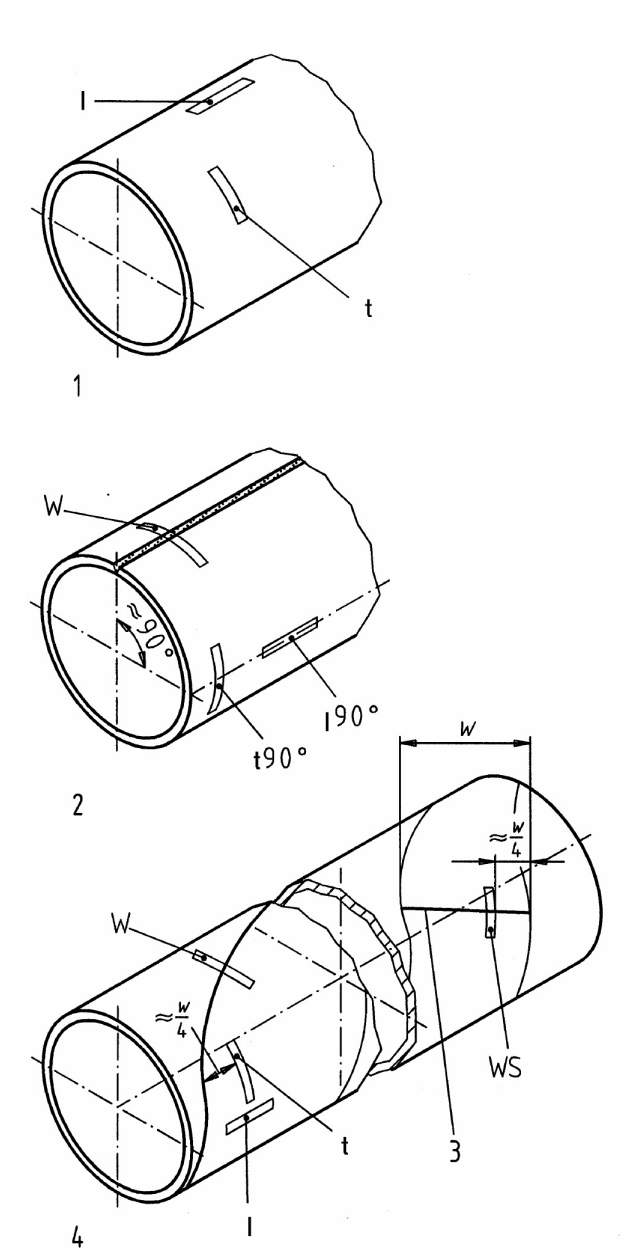
Samples for product analysis shall be taken from the test pieces or samples for mechanical testing or from the whole thickness of the tube at the same location as for the mechanical test samples, in accordance with EN ISO 14284.

9.2.3 Tensile test

The test piece for the tensile test shall be either a full tube section or a test piece taken from the sample tube or fitting in accordance with EN 10002-1.

The test piece may be taken either longitudinally or transversely at the discretion of the manufacturer.

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Key

1 Seamless tube
2 Longitudinally welded tubes
3 Strip end weld
4 Helically welded tubes
W Sample of the weld
WS Sample of the strip end weld
w Width of the strip

Figure 11 — Location and direction of test pieces for the tensile and weld bend test

9.2.4 Flattening test

The test piece for the flattening test shall consist of a full tube section in accordance with EN 10233.

9.2.5 Drift expanding test

The test piece for the drift expanding test shall consist of a full tube section in accordance with EN 10234.

9.2.6 Weld bend test

The test pieces for the weld bend test shall be in accordance with EN 910.

10 Test methods

10.1 Chemical analysis

The elements to be determined shall be those in Table 1. The choice of a suitable physical or chemical analytical method for the analysis shall be at the discretion of the manufacturer. In cases of dispute the method used shall be agreed, taking into account CR 10261.

10.2 Mechanical tests

Mechanical tests shall be carried out at a temperature between 10 °C and 35 °C.

10.2.1 Tensile test

The tensile test shall be carried out in accordance with EN 10002-1 and the following determined:

— tensile strength (R_m);

— upper yield strength (R_{eH});

If a yield phenomenon is not present, the 0,2 % non-proportional extension proof strength ($R_{p0,2}$) or the 0,5 % total extension ($R_{t0,5}$) shall be determined. In cases of dispute, the 0,2 % proof strength ($R_{p0,2}$) shall apply.

— the percentage elongation after fracture with reference to a gauge length L_o of $5,65\sqrt{S_o}$.

If a non-proportional test piece is used, the percentage elongation value shall be converted to the value for a gauge length $L_o = 5,65\sqrt{S_o}$ using the conversion tables given in EN ISO 2566-1.

So is the original cross-sectional area of the gauge length.

10.2.2 Flattening test

The flattening test shall be carried out in accordance with EN 10233.

The weld of welded tubes shall be positioned at 90° to the direction of flattening and the test piece shall be flattened until the distance between the platens is not greater than 67 % of the original outside diameter.

10.2.3 Drift expanding test

The drift expanding test shall be carried out in accordance with EN 10234.

One end of the test piece shall be expanded using a cone with an included angle (β) of 60° until the increase in outside diameter is not less than the appropriate value given in Table 3.

10.2.4 Weld bend test

This weld bend test shall be carried out in accordance with EN 910.

The test pieces shall be bent through an angle of 180° around a bar of the diameter specified in Table 3.

10.3 Leak tightness test

10.3.1 General

The tubes shall pass a leak tightness test. The test shall be either a hydrostatic test in accordance with 10.3.2. or an electromagnetic test in accordance with 10.3.3. The choice of test is at the discretion of the manufacturer unless option (12) is specified.

Option 12 The purchaser shall specify the type of leak tightness test, hydrostatic test (see 10.3.2) or electromagnetic test (see 10.3.3).

10.3.2 Hydrostatic test

The tube shall withstand the test without leakage or visible deformation. The hydrostatic test shall be carried out at a test pressure of 70 bar or P, calculated from the following equation, whichever is the lower, unless option (13) is specified by the purchaser.

$$P = \frac{20ST}{D}$$

where

P is the test pressure in bar

D is the specified outside diameter (mm)

T is the specified wall thickness (mm)

S is the stress in MPa corresponding to 70 % of the specified minimum yield strength (see Table 3) for the type of steel concerned.

NOTE This hydrostatic leak tightness test is not a strength test.

Option 13 The hydrostatic leak tightness test shall be carried out at 1,5 × PFA (allowable operating pressure) provided that this value is not greater than P as calculated from the above equation.

10.3.3 Electromagnetic test

When an electromagnetic test for leak tightness is carried out the tubes shall be tested in accordance with EN 10246-1.

10.4 Non-destructive test of the seam weld of welded tubes

10.4.1 General

The non-destructive test of the seam weld of welded tube shall be carried out in accordance with 10.4.2 for electric welded or butt welded tube and 10.4.3 for submerged arc welded tube.

10.4.2 Electric welded tube and butt welded tube

The test shall be carried out in accordance with EN 10246-3, EN 10246-5, EN 10246-7 or EN 10246-8 to acceptance level 4. The test method is at the discretion of the manufacturer.

10.4.3 Submerged arc welded tubes

10.4.3.1 General

The non-destructive test shall be carried out in accordance with 10.4.3.2 and when applicable in accordance with 10.4.3.3.

10.4.3.2 Ultrasonic test of the weld seam

An ultrasonic test of the weld seam in accordance with EN 10246-9, to acceptance level U4, shall be carried out over the whole length of the tube. When the weld seam cannot be tested automatically the test shall be carried out manually.

In addition, an ultrasonic test in accordance with EN 10246-17, acceptance level U4 or a radiographic test in accordance with EN 10246-10, image quality R2, shall be carried out over a distance of 200 mm along the weld at each end of the tube. The test method is at the discretion of the manufacturer.

10.4.3.3 Ultrasonic test for skelp end welds

Skelp end welds for helically welded tubes shall be tested using a manual ultrasonic test to the requirements of EN 10246-9 acceptance level U4, or by the radiographic test method in accordance with EN 10246-10 image quality R2. The test method is at the discretion of the manufacturer.

10.5 Non destructive testing of the welds of fittings

The seam weld of fittings or fittings components which have not previously been tested (i.e. as a tube) shall be tested in accordance with 10.4.3.

All welds other than seam welds shall be tested by one of the following methods:

a) Penetrant testing in accordance with EN 571-1;

b) Magnetic particle testing in accordance with EN 1290;

c) Ultrasonic testing in accordance with EN 1714;

d) Radiographic testing in accordance with EN 1435.

The method of non-destructive testing is at the discretion of the manufacturer unless a specific method from those given above is specified by the purchaser.

The acceptance level shall be agreed between the purchaser and manufacturer.

Option 14 The method of non destructive testing is specified by the purchaser from those listed in 10.5

10.6 Visual examination

Tubes and fittings shall be visually examined for compliance with the requirements of 7.4.

10.7 Dimensional inspection

Tubes and fittings shall be inspected for compliance with the requirements of 7.6, 7.7, 7.8, 7.9 and where specified in 7.10. A gauge is normally used for measurement of outside diameter.

However, for tubes with outside diameter equal to or greater than 406,4 mm a circumference tape may be used.

11 Retests, sorting and reprocessing

For retests, sorting and reprocessing the conditions of EN 10021 shall apply.

12 Marking

12.1 Each tube and fitting shall be legibly marked by stencilling or other indelible marking with the following information in the sequence indicated:

a) the manufacturer's name or identification mark;

b) the number of this European Standard;

c) the steel name (see 4.2.2);

d) in the case of specific inspection and testing;

— an identification number (e.g. order or item number) which permits the correlation of the product or delivery unit with the related inspection document;

— the mark of the inspection representative when specific inspection is required;

e) when the type of tube, welded or seamless is specified (see 6.3.2.1 option 1) the letter, S (seamless) or W (welded), as appropriate.

Marking on the tube shall commence not more than 300 mm from one end.

12.2 For tubes that are bundled and fittings which are bagged, the information given in 12.1, shall be either stamped on one or more metal or other durable tags, or printed on banding clips or straps, which shall be securely attached to each bundle or bag. Not more than one steel grade shall be included in any one bundle or bag.

13 Protective coating or lining

The tubes and fittings shall be supplied bare unless option 15 or option 16 are specified at the time of enquiry and order.

Option 15	The tubes and fittings shall be supplied with a temporary mill protection.
Option 16	The tubes and fittings shall be supplied with a coating and/or lining, the type of coating/lining shall be agreed at the time of enquiry and order.

A1 Products supplied coated, when the coating contains more than 1,0 % by weight or volume (whichever is the lower) of homogenously distributed organic material, shall be tested and classified according to EN 13501-1. A1

For information on the type of coating/lining available see informative annex D.

14 Evaluation of conformity

14.1 General

The compliance of tubes or fittings with the requirements of this document and with the stated values (including classes) shall be demonstrated by:

— initial type testing (ITT);

— factory production control (FPC).

14.2 Initial type testing

14.2.1 General

ITT is the complete set of tests or other procedures described in the technical specification, determining the performance of samples of products representative of the steel tube and fitting designs. Initial type testing shall be performed to show conformity with this document on first use of this document for non-alloy steel tubes or fittings being put onto the market and:

— at the beginning of the production of a new or modified steel tube or fitting design or change to the raw material;

— at the beginning of a new or modified method of production.

In the case of type testing on steel tubes or fittings for which initial type testing in accordance with this document was already performed, type testing may be reduced:

— if it has been established that the performance characteristics compared with the already tested steel tubes and fittings have not been affected or;

— if historical data is available (see 14.2.4).

The results of all type tests shall be recorded and stored for at least 5 years.

14.2.2 Characteristics

All characteristics in Clause 7, for which the manufacturer is stating a value, shall be subject to ITT by tests and/or tablulated values in accordance with the relevant subclasses of Clause 7, with the exception of ‘Release of dangerous substances’. This may be assessed indirectly by controlling the content of the substance concerned, providing the manufacturer is able to demonstrate the content, or lack, of the identified substance(s) and that the manufacturing process does not increase the level of any established subtance(s).

14.2.3 Product families

For the purposes of testing (including FPC testing) steel tubes or fittings may be grouped into families, where it is considered that the results for a characteristic from any one product is common to all tubes or fittings within that family.

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A1 14.2.4 Use of historical data

Tests previously performed on the same steel tube or fitting design in accordance with the provisions of this document (same characteristic(s), test method, sampling procedure, system of attestation of conformity, etc.) may be taken into account.

14.2.5 'Deemed to satisfy' provisions and use of reference tabulated data

In those cases where conformity with this document is based on 'deemed to satisfy' provisions or tabulated values, type testing shall be limited to the verification of whether the steel tube or fitting meets the requirements to use those values, classes or levels, unless better values, classes or levels are being claimed.

14.2.6 Sampling

ITT shall be performed on samples of non-alloy steel tubes and fittings representative of the maufactured types in accordance with Table 16. The frequency of testng or assessment shall be in accordance with Clause 8.4.

Table 16 Characteristics and compliance criteria for initial type testing of tubes and fittings.

Characteristic	Requirement Clause	Assessment Method	Compliance Criteria
Yield Strength	7.3.1 & Table 3	10.2.1	Pass
Dimensional Tolerances	7.6, 7.7, 78, 7.9 or 7.10 as applicable	10.7	Pass
Tightness: Liquid	7.5.2	10.3.2 or 10.3.3	Pass

14.3 Factory production control

14.3.1 General

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market conform with the stated performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control feedstock and any other incoming materials or components, equipment, the production process and the product.

An FPC system conforming with the requirements of EN ISO 9001, and made specific to the requirements of this document, shall be considered to satisfy the above requirements.

The results of inspections, tests or assessments requiring action shall be recorded, as shall any action taken. The action to be taken when control values or criteria are not met shall be recorded and retained for the period specified in the manufacturer's FPC procedures.

14.3.2 Equipment

Testing — All weighing, measuring and testing equipment shall be calibrated and regularly inspected according to documented procedures, frequencies and criteria. A1

A1 Manufacturing — All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process. Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

14.3.3 Feedstock and components

The specifictions of all incoming feedstock and components shall be documented, as shall the inspection scheme for ensuring their conformity.

14.3.4 Design process

The factory production control system shall document the various stages in the design of products, identify the checking procedure and those individuals responsible for all stages of design.

During the design process itself, a record shall be kept of all checks, their results, and any corrective actions taken. This record shall be sufficiently detailed and accurate to demonstrate that all stages of the design phase, and all checks, have been carried out satisfactorily.

14.3.5 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of all declared performance characteristics are being maintained during regular production and record the results of these as part of the production control system. These records shall be retained for the period defined in the manufacturer's FPC procedures and shall include at least the following:

— identification of the product tested;

— dates of sampling;

— test methods used;

— test and inspection results;

— dates of the tests;

— identification of the responsible authority within the factory.

14.3.6 Inspection

Inspection of non-alloy steel tubes and fittings shall be in accordance with Clause 8.

14.3.7 Non-conforming products

The manufacturer shall have written procedures which specify how non-conforming products shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures. A1

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Annex A
(informative)

Size range of tube manufacturing processes

Table A.1 gives an indication of the range of sizes and thicknesses of tube generally available from the manufacturing processes covered by this European Standard. Sizes and thicknesses outside the indicated range may also be available.

Table A.1 — Tube sizes generally available from manufacturing processes covered by this European Standard

Dimensions in millimetres

Manufacturing process	Outside diameter range	Thickness range
Seamless (S)	26,9 – 711	2,0 – 100
Butt Welded (BW)	26,9 – 114,3	2,0 – 6.3
Electric Welded (EW)	26,9 – 610	1,4 – 16
Submerged Arc Welded (SAW)	168,3 – 2743	6,3 – 50

Annex B
(informative)

Relationship between outside diameter and nominal size (DN)

Table B.1 — Relationship between outside diameter and nominal size

Outside diameter mm	DN	Outside diameter mm	DN	Outside diameter mm	DN
26,9	20	168,3	150	813,0	800
33,7	25	219,1	200	914,0	900
42,4	32	273	250	1016,0	1000
48,3	40	323,9	300	1067,0	1050
60,3	50	355,6	350	1118,0	1100
76,1	65	406,4	400	1219,0	1200
88,9	80	457	450	1422,0	1400
114,3	100	508	500	1626,0	1600
139,7	125	610	600	1829,0	1800
		711	700	2032,0	2000
				2235,0	2200
				2540,0	2500
				2642,0	2600
				2743,0	2700

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Annex C
(informative)

Jointing

C.1 General

C.1 to C.5 give information on the more commonly used types of joint for piping systems carrying aqueous liquids, except for the preparation for butt welding, requirements for which are given in 7.10 of this European Standard.

Where appropriate, guidance is given in this annex on the preparation of tubes and fittings to accommodate the types of joint described.

NOTE This annex will be shortly superseded by EN 10311.

C.2 Sleeve joints for welding

C.2.1 General

Sleeve joints for welding should comply with C.2.2 or C.2.3.

The joints shown in Figure C.1 may differ in detail from one manufacturer to another, however the minimum dimensions identified should be respected.

On tubes and fittings of outside diameter smaller than 711 mm the joint should be welded on the outside only. On tubes with outside diameter 711 mm and larger, welding may be either inside, or outside, or both inside and outside.

The dimensions recommended for sleeve joints for welding apply when they are shaped or made on tubes and/or fittings.

C.2.2 Type 1 joints

For type 1 joints (see Figure C.1) the tubes should be supplied with spigot end parallel and sleeve end either parallel or with the diameter tapered by approximately 0,8 mm on diameter per 25 mm length of sleeve.

For outside diameters up to and including 168,3 mm the minimum length of sleeve should be 50 mm. For outside diameters greater than 168,3 mm the minimum length of sleeve should be 75 mm.

The depth of penetration of the spigot into the sleeve anywhere around the circumference should be not less than 30 mm but should also be sufficient to accommodate any holes made in the sleeve to permit testing of the joint if applicable. When used to accommodate small changes in pipeline direction, the spigot should additionally penetrate the sleeve around the whole circumference to an average depth of not less than 40 mm.

At maximum penetration, the spigot may locate in the undimensioned transition area between the sleeve and the tube body. Care should be taken in expanding the tube end to prevent excessive weld gaps between the spigot and sleeve.

Specific details of the end preparation of tubes and fittings for use with these types of joint should be agreed between the purchaser and manufacturer at the time of enquiry and order.

Assembly of sleeve joints on site in preparation for welding may require mechanical aids e.g. props, jacks, wedges.

C.2.3 Type 2 joints

For type 2 joints (see Figure C.1) the tubes should be supplied with the spigot end and the sleeve end parallel. The collar forming the sleeve should be fabricated with not more than one longitudinal weld and should be welded externally and internally to the sleeve tube. The minimum sleeve length should be (150 + 2T) mm, where T is the wall thickness of the sleeve, to ensure an adequate space between the spigot end and the internal collar weld to effect the inside joint weld, if required.

C.2.4 Welding collars

Welding collars should be as shown in Figure C.2 and should be at least equal in thickness to the adjoining components; the length of sleeve should be not less than 250 mm.

When positioned for welding the collar should be a good fit on the outside diameter of the components to be joined. To ensure good welding conditions the gap should be not greater than 6 mm.

C.3 Flange joints

C.3.1 Flange joints should have flanges in accordance with EN 1092-1 or prEN 1759-1, as appropriate to the design conditions (see Figure C.3).

The purchaser should specify the type of flange required.

C.3.2 Welding should be carried out to procedures in accordance with EN 288 Parts 1, 2 and 3 by welders qualified to EN 287-1.

C.4 Slip-on type couplings

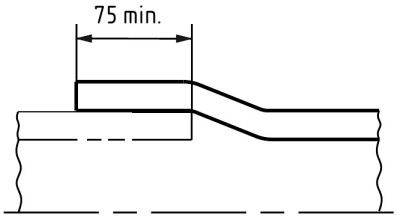
C.4.1 Slip-on type couplings for use with plain end tube should be of the general form shown in Figure C.4.

C.4.2 The lengths of the coupling sleeves (S) should be as given in Table C.1.

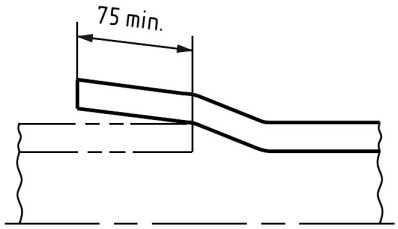
The details of the joint shown in Figure C.4 may differ from one manufacturer to another but the dimensions identified should be maintained.

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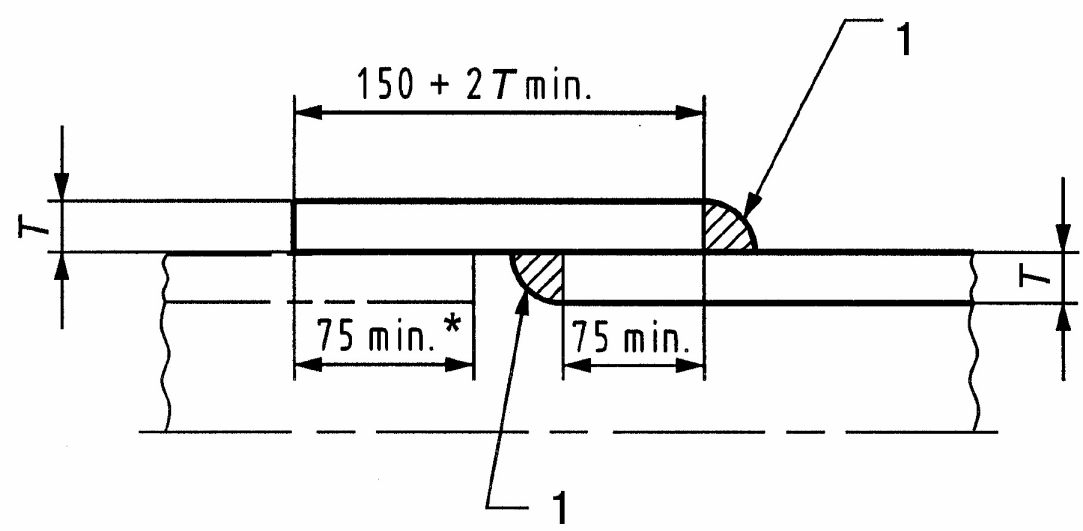
All dimensions are in millimetres



Type 1 (parallel sleeve)



Type 1 (taper sleeve: taper approximately 0,8 mm on diameter for each 25 mm on length of socket)



Type 2 (collar sleeve)

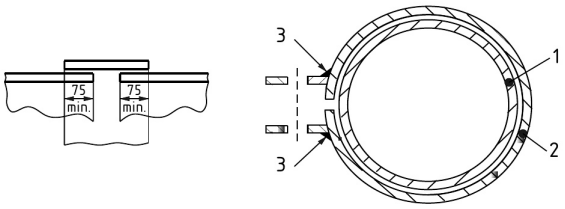
Key

1 Workshop fabrication weld

* For guidance

Figure C.1 — Sleeve welded joints (These figures are idealized and do not take into account tolerances or site assembly conditions)

Dimension in millimetres

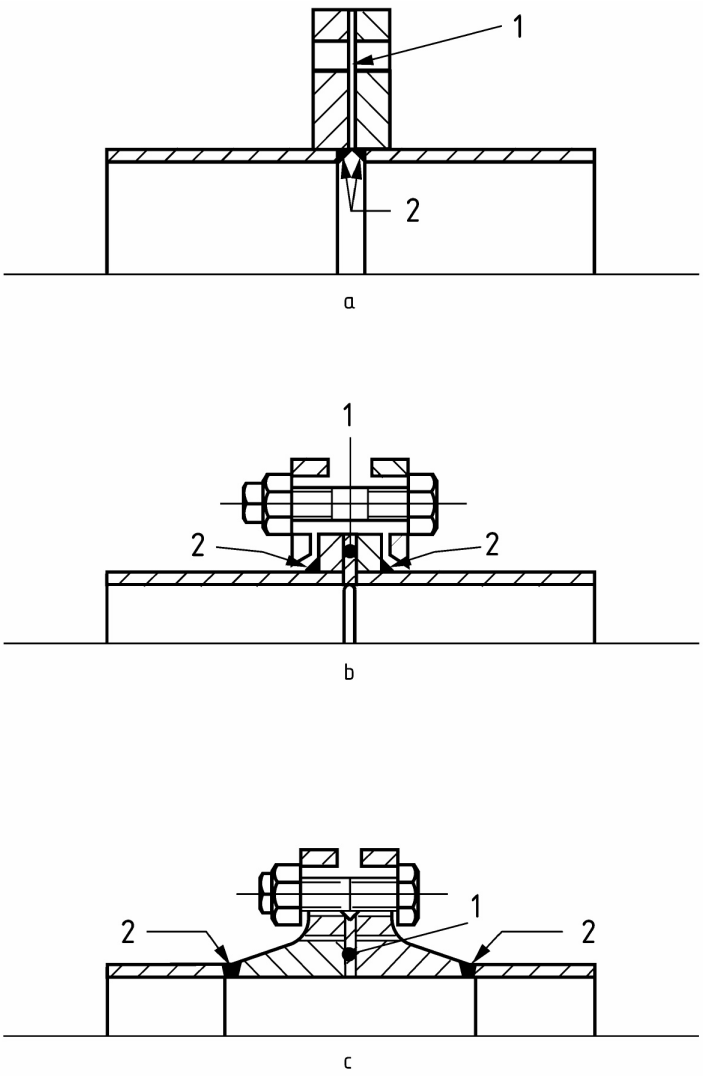


Key

1 Pipe
2 Collar
3 Weld

Figure C.2 — Welding collar

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Key

1 Gasket

2 Weld

a) Plate flange

b) Loose flange

c) Welded neck flange

Figure C.3 — Flange joints

Table C.1 — Slip on type couplings – lengths of coupling sleeves

Dimensions in millimetres

Tube Size outside diameter D	Sleeve length S	Tolerance on sleeve lengths
≤ 60,3	80	
76,1 to 323,9	100	± 3
355,6 to 914	150	
1016 to 1829	178	
2032 and 2743	254	
NOTE 1 Other sleeve lengths may be used for special service conditions but are not covered by this standard. NOTE 2 Coupling sleeves with a form of centre register may be specified by the purchaser.		

Table C.2 — Slip on type couplings - tolerances on outside diameter D over length L

Dimensions in millimetres

Tube Size outside diameter D	Tolerance on D	Length L over which tolerance applies
≤ 114,3	± 0,8	100
139,7 to 323,9	+ 1,6/- 0,8	100
355,6 to 1422	± 1,6	150
1524 to 1829	± 3	150
2032 to 2743	± 3	200

C.4.3 When slip on type couplings are used the tube ends for length L should be within the tolerances on outside diameter as specified in Table C.2 when checked by measuring the circumference and should permit the passage of a ring gauge which has a bore 1,6 mm larger than the maximum permissible diameter of the tube.

C.4.4 Surface irregularities such as peaks, flats or depressions should blend smoothly into the surface of the tube and their height or depth should not exceed 0,25 mm.

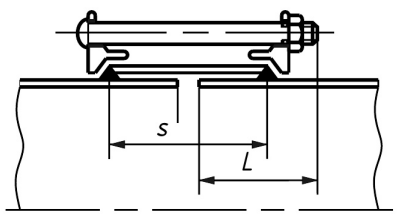


Figure C.4 — Slip-on type couplings

C.5 Push fit and gasket type couplings

C.5.1 Push fit and gasket type couplings should be of the general form shown in Figure C.5.

C.5.2 The insertion depth, socket size and wall thickness should be as given in Table C.3. The details of the joint shown in Figure C.5 may differ from one manufacturer to another.

The connection is produced by inserting the tube spigot end into the socket end which contains a rubber gasket. By inserting the spigot end into the socket, the rubber ring is deformed in an axial direction and seals the connection by the resilience present in the rubber ring.

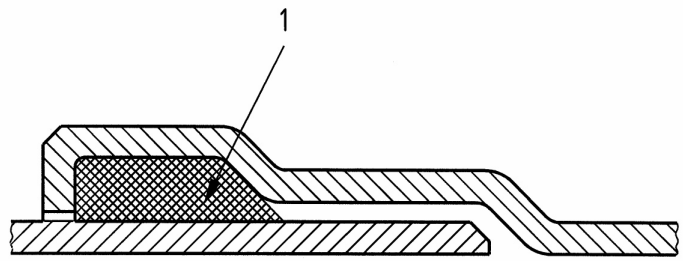
The connection in diameters up to and including 323,9 mm is suitable for operating pressures up to maximum 40 bar. For larger diameters the maximum operating pressure is related to the diameter and thickness of the tubes. To absorb axial forces in the connection, special rubber rings may be required.

Table C.3 — Insertion depths, socket sizes and wall thicknesses for push fit and gasket type couplings

Dimensions in millimetres

Tubes Outside diameter D	Nominal wall thickness T	Insertion depth	Socket Outside diameter
114,3	3,2	110	151
117,5	3,2	110	151
139,7	4,0	110	178
144	4,0	110	178
168,3	4,0	131	203
219,1	4,5	133	258
273	5,0	143	312
323,9	5,6	150	366
355,6	5-7,1[a]	120-150	405
406,4	5-7,1[a]	120-150	455
457	5-7,1[a]	120-150	510
508	5-7,1[a]	120-150	560
610	5-8[a]	120-200	660
610	8	200	690
711	8	200	791
813	8	200	893
914	8	200	994
1 016	8	200	1 096

[a] Dependent on maximum working pressure.



Key

1 Seal

Figure C.5 — — Push fit and gasket type couplings

C.6 Special joints

Other types of joint are available. If such joints are to be used any special requirements for the end preparation of the tube should be specified by the purchaser and agreed with the manufacturer at the time of enquiry and order.

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Annex D
(informative)

Coatings and linings

D.1 General

A1 A large number of external and internal coatings and linings are available for tubes and fittings. The following is a non-exhaustive list of some of the more common types used in conjunction with the tubes and fittings specified in this document. A1

D.2 Coatings

a) Bitumen;

b) Coal tar;

c) Epoxy/Epoxy modified;

d) Polyethylene;

e) Polypropylene;

f) Polyurethane/Polyurethane modified;

g) Hot dip galvanising.

D.3 Linings

a) Cement mortar;

b) Epoxy/Epoxy modified;

c) Thermoplastic;

d) Hot dip galvanising.

For the transport of water intended for human consumption refer to Introduction.

Send your requirement

Send a drawing, product list, size, material grade, standard, schedule or wall thickness, testing and project document requirements.

EMAIL	info@lkpiping.com
WHATSAPP	+86 139 0327 9556
TECHNICAL RESOURCES	www.lkpiping.com/technical/

RESPONSE AND DOCUMENT COORDINATION

Initial enquiries are answered within 24 hours, including weekends, by email or WhatsApp. Drawing review, material/standard matching and project document requirements can be discussed and organized with the buyer. Third-party inspection can be buyer-nominated or coordinated on request.

ADDRESS

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