

Welded steel tubes for pressure purposes — Technical delivery conditions —

Part 1: Non-alloy steel tubes with specified room temperature properties

The European Standard EN 10217-1:2002, with the incorporation of amendment A1:2005, has the status of a British Standard

ICS 23.040.10

National foreword

This British Standard is the official English language version of EN 10217-1:2002, including amendment A1:2005. Together with BS EN 10216-1:2002 it supersedes BS 3601:1987 and BS 3059-1:1987 which are withdrawn.

The start and finish of text introduced or altered by CEN amendment is indicated in the text by tags $\boxed{A1}$ $\langle A1 \rangle$. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated in the text by $\boxed{A1}$ $\langle A1 \rangle$.

The UK participation in its preparation was entrusted by Technical Committee ISE/73, Steels for pressure purposes, to Subcommittee ISE/73/1, Steel tubes for pressure purposes, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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English version

**Welded steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties
(includes amendment A1:2005)**

Tubes soudés en acier pour service sous pression -
Conditions techniques de livraison - Partie 1: Tubes en
acier non allié avec caractéristiques spécifiées à
température ambiante
(inclut l'amendement A1:2005)

Geschweißte Stahlrohre für Druckbeanspruchungen -
Technische Lieferbedingungen - Teil 1: Rohre aus
unlegierten Stählen mit festgelegten Eigenschaften bei
Raumtemperatur
(enthält Änderung A1:2005)

This European Standard was approved by CEN on 25 April 2002. Amendment A1 was approved by CEN on 9 December 2004.

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Foreword

This document (EN 10217-1:2002) has been prepared by Technical Committee ECISS/TC 29, "Steel tubes and fittings for steel tubes", the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this document.

Other parts of EN 10217 are:

- Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties.
- Part 3: Alloy fine grain steel tubes.
- Part 4 : Electric welded non-alloy and alloy steel tubes with specified low temperature properties
- Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties.
- Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties.
- Part 7: Stainless steel tubes.

Another European Standard series covering tubes for pressure purposes is:

EN 10216: Seamless steel tubes for pressure purposes.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Foreword to amendment A1

This document (EN 10217-1:2002/A1:2004) has been prepared by Technical Committee ECISS/TC 29 "Steel tubes and fittings for steel tubes", the secretariat of which is held by UNI.

This Amendment to European Standard EN 10217-1:2002 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2005, and conflicting national standards shall be withdrawn at the latest by July 2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 97/23/EC.

EN 10217-1:2002 (E)

For relationship with EU Directive 97/23/EC, see informative Annex ZA, which is an integral part of this document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 SCOPE

This Part of EN 10217 specifies the technical delivery conditions for two qualities TR1 and TR2 of welded tubes of circular cross section, made of non-alloy quality steel and with specified room temperature properties.

2 NORMATIVE REFERENCES

EN 10217 incorporates by date or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For date references, subsequent amendments to or revisions of, any of these publications apply to EN 10217 only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

The requirements of EN 10217 rule when they differ from those in the standards and documents referred to below:

EN 760, *Welding consumables - Fluxes for submerged arc welding – Classification*

EN 895, *Destructive tests on welds in metallic materials - Transverse tensile test*

EN 910, *Destructive tests on weld in metallic materials -Bend test*

EN 1321, *Destructive tests on welds in metallic materials - Macroscopic and microscopic examination of welds*

EN 10002-1, *Metallic materials - Tensile testing - Part 1 : Method of test (at ambient temperature)*

EN 10020, *Definitions and classification of grades of steel*

EN 10021, *General technical delivery requirements for steel and iron products*

EN 10027-1, *Designation systems for steels - Part 1 : Steel names, principle symbols.*

EN 10027-2, *Designation systems for steels Part 2 : Numerical systems.*

EN 10045-1, *Metallic materials - Charpy impact test - Part 1 : Test method*

EN 10052, *Vocabulary of heat treatment terms for ferrous products*

EN 10204, *Metallic products - Types of inspection documents*

ENV 10220, *Seamless and welded steel tubes - Dimensions and masses per unit length*

EN 10233, *Metallic materials - Tubes - Flattening test*

EN 10234, *Metallic materials - Tubes - Drift expanding test*

EN 10246-1, *Non-Destructive Testing of steel tubes Part 1 : Automatic electromagnetic testing of seamless and welded (except submerged arc welded) ferromagnetic steel tubes for verification of hydraulic leak-tightness*

EN 10246-3, *Non-Destructive Testing of steel tubes - Part 3 :Automatic eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections*

EN 10246-5, *Non-Destructive Testing of steel tubes – Part 5: Automatic full peripheral magnetic transducer/flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal imperfections*

EN 10217-1:2002 (E)

EN 10246-7, *Non-Destructive Testing of steel tubes - Part 7 : Automatic full peripheral ultrasonic testing of seamless and welded (except submerged arc welded) steel tubes for the detection of longitudinal imperfections*

EN 10246-8, *Non-Destructive Testing of steel tubes – Part 8: Automatic ultrasonic testing of the weld seam of electric welded tubes for the detection of longitudinal imperfections*

EN 10246-9, *Non-Destructive Testing of steel tubes – Part 9: Automatic ultrasonic testing of the weld seam of submerged arc-welded steel tubes for the detection of longitudinal and/or transverse imperfections*

EN 10246-10, *Non-Destructive Testing of steel tubes – Part.10: Radiographic testing of the weld seam of automatic fusion arc-welded steel tubes for the detection of imperfections.*

EN 10256, *Non-Destructive Testing of steel tubes - Qualification and competence of level 1 and level 2 NDT personnel*

prEN 10266 ¹⁾, *Steel tubes, fittings and structural hollow sections - Symbols and definition of terms for use in product standards*

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

prEN 10168 ¹⁾, *Iron and steel products - Inspection documents - List of information and description*

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

ISO 14284, *Steel and iron - Sampling and preparation of samples for the determination of chemical composition*

CR 10260, *Designation systems for steel - Additional symbols*

CR 10261, *ECISS Information Circular IC 11 - Iron and steel - Review of available methods of chemical analysis.*

3 TERMS AND DEFINITIONS

For the purposes of this Part of EN 10217, the definitions given in EN 10020, EN 10021, EN 10052, prEN 10266 and the following apply.

3.1 employer

organisation for which a person works on a regular basis.

NOTE The employer may be either the tube manufacturer or a third party organisation providing Non-Destructive Testing (NDT) services.

3.2 qualification of welding procedure

testing and inspection of the welding procedure for submerged arc welded (SAW) tubes by the manufacturer in accordance with annex A .

3.3 approval of welding procedure

testing and inspection of the welding procedure for SAW tubes witnessed and approved in accordance with Annex A by an authorised body.

1) In preparation; until this document is published as a European standard, a corresponding national standard should be agreed at the time of enquiry and order.

4 SYMBOLS

For the purposes of this Part of EN 10217, the symbols given in prEN 10266 and the following apply:

- C1, C2 category conformity indicators (see clauses 7.3.1 and 7.3.3.)
- TC test category.

5 CLASSIFICATION AND DESIGNATION

5.1 Classification

In accordance with the classification system in EN 10020, the steel grades are classified as non-alloy quality steels.

5.2 Designation

5.2.1 For the tubes covered by this Part of EN 10217 the steel designation consists of:

- a) the number of this Part of EN 10217;

plus either:

- a) the steel name in accordance with EN 10027-1 and CR 10260;

or:

- a) the steel number allocated in accordance with EN 10027-2 .

5.2.2 The steel name is designated by:

- a) the capital letter P for pressure purposes;
- b) the indication of the specified minimum yield strength for thickness less than or equal to 16 mm, expressed in MPa (see Table 4);

plus either:

- a) the alphanumeric TR1 for qualities without specified aluminium content, impact properties and specific inspection and testing requirements (see 9.1);

or:

- a) the alphanumeric TR2 for qualities with specified aluminium content, impact properties and specific inspection and testing requirements.

6 INFORMATION TO BE SUPPLIED BY THE PURCHASER

6.1 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order :

- a) the quantity (mass or total length or number);
- b) the term 'tube';
- c) the dimensions (outside diameter D and wall thickness T) (see Table 5).

d) the designation of the steel grade in accordance with this Part of EN 10217 (see 5.2);

6.2 Options

A number of options are specified in this Part of EN 10217 and these are listed below. In the event that the purchaser does not indicate a wish to implement any of these options at the time of enquiry and order, the tubes shall be supplied in accordance with the basic specification (see 6.1):

- 1) Tube manufacturing process and/or route (see 7.3.2).
- 2) Selection of the delivery condition (see 7.3.5).
- 3) Restriction on copper and tin content (see Table 2).
- 4) Product analysis (see 8.2.2).
- 5) Longitudinal impact testing at $-10\text{ }^{\circ}\text{C}$ for quality TR2 (see Table 4).
- 6) Selection of leak-tightness test method (see 8.4.3.1).
- 7) Special end preparation (see 8.6).
- 8) Exact lengths (see 8.7.3).
- 9) Specific inspection for quality TR1 (see 9.1).
- 10) Type of inspection document other than the standard document (see 9.2.1).
- 11) Tensile test on the weld for tubes with $219,1 < D \leq 508\text{ mm}$ (see Table 11).
- 12) Test unit restriction for tubes with $D \leq 76,1\text{ mm}$ of quality TR2 (see 10.1.1).
- 13) Wall thickness measurement away from the ends (see 11.9).
- 14) Non-Destructive Testing method (see either 11.11.1 or 11.11.2).
- 15) Additional marking (see 12.2).
- 16) Protection (see 13).

6.3 Example of an order

100 t of welded steel tube with an outside diameter of 168,3 mm, a wall thickness of 4,5 mm in accordance with EN 10217-1, made of steel grade P235TR2 with a 3.1.C inspection certificate in accordance with EN 10204:

100 t – Tube – 168,3 × 4,5 – EN 10217-1 – P235TR2 – Option 10: 3.1.C

7 MANUFACTURING PROCESS

7.1 Steelmaking process

The steelmaking process is at the discretion of the manufacturer.

7.2 Deoxidation process

Steels shall be fully killed.

7.3 Tube manufacture and delivery conditions

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

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

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

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

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

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

For pressure equipment in categories III and IV (of Directive 97/23-EC) the personnel shall be approved by a recognised third-party organisation. Tubes not conforming to this requirement shall be marked "C 2", unless a requirement to mark "C1" (see **7.3.3**) applies

7.3.2 The tubes shall be manufactured by the manufacturing processes and routes as specified in Table 1.

Unless Option 1 is specified the manufacturing process and route is at the discretion of the manufacturer.

Option 1: *The manufacturing process and/or route is specified by the purchaser.*

The submerged arc weld of SAW tubes shall be made using at least one weld run on the inside and one weld run on the outside of the tube.

The strip used for the manufacture of the helically submerged arc welded (SAWH) tubes shall have a width of not less than 0.8 times or more than 3.0 times the outside diameter of the tube.

The finished tubes shall not include welds used for joining together lengths of the hot or cold rolled strip or plate prior to forming except that for helically welded.

For helically welded submerged arc welded (SAWH) tubes, when the weld joining lengths of strip are part of the delivered tube, they shall have the welding procedure qualified in accordance with annex A and the weld shall be subjected to the same inspection and testing as the helical weld.

7.3.3 Welding shall be carried out by suitably qualified personnel in accordance with suitable operating procedures.

For pressure equipment in categories II, III, and IV, (of Directive 97/23 EC) the operating procedures and the personnel shall be approved by a competent third-party. Tubes not conforming to this requirement shall be marked "C 1".

7.3.4 The welding procedure for SAW tubes shall be qualified in accordance with Annex A.

7.3.5 The delivery conditions of tubes covered by this Part of EN 10217 are shown in Table 1.

Unless Option 2 is specified at the time of enquiry and order the choice of the delivery condition is at the discretion of the manufacturer.

Option 2: *The delivery condition is chosen by the purchaser.*

Table 1 — Tube manufacturing process, route and delivery condition

Route N°	Manufacturing Process		Manufacturing routes		Delivery Condition ^a	Applicable for quality			
	Process	Symbol	Starting material	Forming operation		TR1	TR2		
1a	Electric welded ^b	EW	As (hot) rolled strip	Cold formed (+ welded)	As welded	X	—		
1b					NW	x	—		
1c					NP	x	x		
2a					As welded	x	—		
2b			NW		x	x			
2c			NP		x	x			
3			As (hot) rolled or normalising rolled strip		Cold formed (+ welded) + hot stretch reduced at a controlled temperature to give a normalised condition	NR	x	x	
4			Cold rolled + stress relieved		Cold formed (+ welded)	NP	x	x	
11a	Submerged arc- welded - Longitudinal seam or - helical seam	SAW: -SAWL -SAWH	As (hot) rolled plate or strip	Cold formed (+ welded)	As welded	x	—		
11b					NW	x	—		
11c					NP	x	x		
12a			Normalising rolled plate or strip		Cold formed (+ welded)	As welded	x	x	
12b						NW	x	x	
12c						NP	x	x	
13a			As in lines 11 or 12			Normalising-formed (+ welded)	As welded	x	x
13b							NW	x	x
13c							NP	x	x
21			Continuous welded, only for steel grades P195 and P235 with D ≤ 114,3 mm				BW	As (hot) rolled strip	Hot forming (+ welded)

^a As welded = no heat treatment; NP = Full pipe normalised ; NW = Normalised weld zone; NR= Normalised rolled

^b For tubes of quality TR2 , only high-frequency welding, minimum frequency 100 kHz, (symbol = HFW) is permitted.

8 Requirements

8.1 General

When supplied in a delivery condition indicated in 7.3 and inspected in accordance with clauses 9, 10 and 11, the tubes, shall conform to the requirements of this Part of EN 10217.

In addition, the general technical delivery requirements specified in EN 10021 shall apply.

8.2 Chemical composition

8.2.1 Cast analysis

The cast analysis reported by the steel producer shall apply and conform to the requirements of Table 2.

NOTE When welding tubes produced in accordance with this Part of EN 10217, 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 applied heat treatment and the conditions of preparing for and carrying out the welding.

Table 2 — Chemical composition (cast analysis) ^a, in % by mass

Steel grade		C	Si	Mn	P	S	Cr ^b	Mo ^b	Ni ^b	Al ^{tot}	Cu ^{b c}	Nb ^b	Ti ^b	V ^b	Cr+Cu+Mo+Ni ^b
Steel name Steel number		max.	max.	max.	max.	max.	Max.	max.	max.	min.	max.	max.	max.	max.	max.
P195TR1	1.0107	0,13	0,35	0,70	0,025	0,020	0,30	0,08	0,30	-	0,30	0,010	0,04	0,02	0,70
P195TR2	1.0108	0,13	0,35	0,70	0,025	0,020	0,30	0,08	0,30	0,02 ^d	0,30	0,010	0,04	0,02	0,70
P235TR1	1.0254	0,16	0,35	1,20	0,025	0,020	0,30	0,08	0,30	-	0,30	0,010	0,04	0,02	0,70
p235TR2	1.0255	0,16	0,35	1,20	0,025	0,020	0,30	0,08	0,30	0,02 ^d	0,30	0,010	0,04	0,02	0,70
P265TR1	1.0258	0,20	0,40	1,40	0,025	0,020	0,30	0,08	0,30	-	0,30	0,010	0,04	0,02	0,70
P265TR2	1.0259	0,20	0,40	1,40	0,025	0,020	0,30	0,08	0,30	0,02 ^d	0,30	0,010	0,04	0,02	0,70

^b Elements not included in this Table 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 to prevent the addition of undesirable elements from scrap or other materials used in the steel making process.

^b The content of these elements need not be reported unless intentionally added to the cast.

^c **Option 3:** In order to facilitate subsequent forming operation, an agreed maximum copper content lower than indicated and an agreed specified maximum tin content shall apply.

^d This requirement is not applicable provided the steel contains a sufficient amount of other nitrogen binding elements, which shall be reported.

8.2.2 Product analysis

Option 4: Tubes of quality TR2 shall have a product analysis supplied; for tubes with outside diameter equal or less than 76,1 mm this option applies only in combination with **option 12**.

Table 3 specifies the permissible deviations of the product analysis from the specified limits on cast analysis given in Table 2.

Table 3 — Permissible deviations of the product analysis from specified limits on cast analysis given in Table 2

Element	Limiting value for the cast analysis in accordance with Table 2	Permissible deviation of the product analysis
	% by mass	% by mass
C	≤ 0,20	+ 0,02
Si	≤ 0,40	+ 0,05
Mn	≤ 1,40	+ 0,10
P	≤ 0,025	+ 0,005
S	≤ 0,020	+ 0,005
Al	≥ 0,020	− 0,005
Cr	≤ 0,30	+ 0,05
Cu	≤ 0,30	+ 0,05
Mo	≤ 0,08	+ 0,02
Nb	≤ 0,010	+ 0,005
Ni	≤ 0,30	+ 0,05
Ti	≤ 0,04	+ 0,01
V	≤ 0,02	+ 0,01

8.3 Mechanical properties

The mechanical properties of the tubes shall conform to the requirements of Table 4 and 11.4, 11.5 and 11.6.

Table 4 — Mechanical properties ^a

Steel grades		Tensile properties					Impact properties		
Steel name	Steel number	Upper yield strength R _{eH} ^b min for T mm		Tensile Strength R _m MPa *	Elongation A min. % ^{b c}		Minimum average absorbed energy KV J at a temperature of °C ^c		
		T ≤ 16	16 < T ≤ 40		l	t	0	-10	0
P195TR1 ^e	1.0107	195	185	320-440	27	25	-	-	-
P195TR2	1.0108	195	185	320-440	27	25	40	28 ^d	27
P235TR1 ^e	1.0254	235	225	360-500	25	23			-
P235TR2	1.0255	235	225	360-500	25	23	40	28 ^d	27
P265TR1 ^e	1.0258	265	255	410-570	21	19	-	-	-
P265TR2	1.0259	265	255	410-570	21	19	40	28 ^d	27

^a For wall thickness greater than 40 mm the mechanical properties are subject to agreement.

^b See 11.2.

^c l = longitudinal; t = transverse.

^d **Option 5:** Additionally, longitudinal impact strength shall be verified at - 10 °C.

^e Tubes made to these material grades are unlikely to support the essential requirements of Directive 97/23/EC unless other criteria are taken into account, see Annex I section 7.5 of this Directive

* 1 MPa = 1 N/mm²

8.4 Appearance and internal soundness

8.4.1 General

The weld area shall be free from cracks, lack of fusion and lack of penetration.

8.4.2 Appearance

8.4.2.1 The tubes shall be free from external and internal surface defects that can be detected by visual examination.

8.4.2.2 The internal and external surface finish of the tubes shall be typical of the manufacturing process and, where applicable, the heat treatment employed. Normally the finish and surface condition shall be such that any surface imperfections requiring dressing can be identified

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

8.4.2.4 Surface imperfections which encroach on the specified minimum wall thickness shall be considered defects and tubes containing these shall be deemed not to conform to this Part of EN 10217.

8.4.2.5 Repairs to the weld seam of EW or BW tubes are not permitted. Repairs to the weld seam of SAW tubes are permitted in accordance with an established and agreed procedure.

8.4.3 Internal soundness

8.4.3.1 Leak-tightness

The tubes shall pass a hydrostatic test (see 11.8.1) or electromagnetic test (see 11.8.2) for leak-tightness.

Unless Option 6 is specified the choice of the test method is at the discretion of the manufacturer.

Option 6: *The test method for verification of leak-tightness in accordance with 11.8.1 or 11.8.2 is specified by the purchaser.*

NOTE SAW tubes cannot be tested in accordance with 11.8.2.

8.4.3.2 Non-Destructive Testing

The full length of the weld seam of all EW and BW tubes shall be subjected to a Non-Destructive test for the detection of longitudinal imperfections, in accordance with 11.11.1.

The full length of the weld seam of all SAW tubes shall be subjected to a Non-Destructive test for the detection of imperfections in accordance with 11.11.2.

8.5 Straightness

The deviation from straightness, of any tube length L , shall not exceed $0,0015 L$. Deviations from straightness over any one metre length shall not exceed 3 mm.

8.6 Preparation of ends

Tubes shall be delivered with square cut ends. The ends shall be free from excessive burrs.

Option 7: *The tubes shall be delivered with bevelled ends (see figure 1). The bevel shall have an angle α of $30^{\circ} \begin{smallmatrix} +5^{\circ} \\ 0^{\circ} \end{smallmatrix}$ with a root face C of $1,6 \text{ mm} \pm 0,8 \text{ mm}$, except that for wall thickness T greater than 20 mm, an agreed alternative bevel may be specified.*

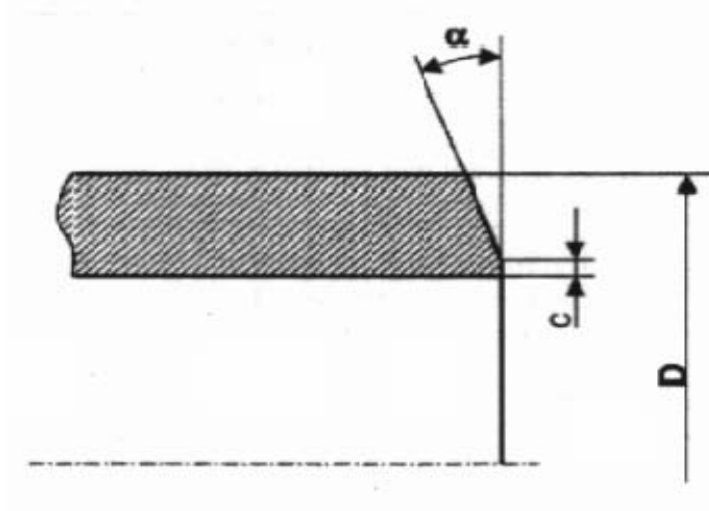


Figure 1 — Tube end bevel

8.7 Dimensions, masses and tolerances

8.7.1 Diameter and wall thickness

Tubes shall be delivered by outside diameter D and wall thickness T.

Preferred outside diameters D and wall thicknesses T have been selected from ENV 10220 and are given in Table 5.

NOTE Dimensions which are different from those in Table 5 may be agreed.

8.7.2 Masses

For the mass per unit length the provisions of ENV 10220 apply.

8.7.3 Lengths

Unless the Option 8 is specified the tubes shall be delivered in random lengths. The delivery range shall be agreed at the time of enquiry and order.

Option 8: *The tubes shall be delivered in exact lengths, the length to be specified at the time of enquiry and order. For tolerances see 8.7.4.5.*

Table 5 — Preferred dimensions

dimensions in mm

Outside diameter D series ^a			Wall thickness T																		
1	2	3	0,5	0,6	0,8	1	1,2	1,4	1,6	1,8	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	
10,2																					
	12																				
	12,7																				
13,5																					
	16	14																			
17,2																					
	19	18																			
	20																				
21,3																					
	25	22																			
	25,4																				
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																					
1 016																					
1 067																					
1 118																					
	1 168																				
1 219																					
	1.321																				
1.422																					

^a series 1 = diameters for which all the accessories needed for the construction of piping system are standardised;
series 2 = diameters for which not all the accessories are standardised;
series 3 = diameters for special application for which very few standardised accessories exist.

Table 5 - Preferred dimensions (concluded)

dimensions in mm

Outside diameter D series ^a			Wall thickness T																		
1	2	3	6,3	7,1	8	8,8	10	11	12,5	14,2	16	17,5	20	22,2	25	28	30	32	36	40	
		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																					
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		864																			
914																					
1 016																					
1 067																					
1 118																					
		1 168																			
1 219																					
		1 321																			
1 422																					
		1 524																			
1 626																					
		1 727																			
1 829																					
		1 930																			
2 032																					
		2 134																			
2 235																					
		2 337																			
		2 438																			
2.540																					

^a series 1 = diameters for which all the accessories needed for the construction of piping system are standardised;
series 2 = diameters for which not all the accessories are standardised;
series 3 = diameters for special application for which very few standardised accessories exist.

8.7.4 Tolerances

8.7.4.1 Tolerances on diameter and thickness

The diameter and the wall thickness of the tubes shall be within the tolerance limits given in Table 6.

Table 6 — Tolerances on outside diameter and wall thickness

dimension in mm

Outside diameter D	Tolerance on		
	outside diameter D	wall thickness T ^a	
		T ≤ 5	5 < T ≤ 40
D ≤ 219,1	± 1% or ± 0,5 whichever is the greater	± 10 % or ± 0,3 whichever is the greater	± 8 % or ± 2 whichever is the smaller
D > 219,1	± 0,75 % or ± 6 whichever is the smaller		

^a The plus tolerance excludes the weld area (see 8.7.4.2).

8.7.4.2 Height of the weld seam

The height of the external and internal weld seam shall be within the limits indicated in Tables 7 and 8.

Table 7 — Maximum height of the weld seam for EW and BW tubes

dimensions in mm

Manufacturing Process	Quality TR1		Quality TR2	
	Outside	Inside	Outside	Inside
EW	Trimmed	1,5	Trimmed	0,5 + 0,05 T
BW	As rolled	0,5 + 0,05T	--	--

Table 8 — Maximum height of the weld seam for SAW tubes

dimensions in mm

Wall thickness T	Maximum height of the weld seam	
	Inside	Outside
T ≤ 12,5	3,5	3,5
T > 12,5	4,8	4,8

8.7.4.3 Radial offset of plate or strip edges at the weld for SAW tubes

The radial offset of the abutting plate or strip edges shall be within the limits indicated in Table 9.

Table 9 — Maximum radial offset of the abutting plate or strip
dimensions in mm

Wall Thickness T	Maximum radial offset
$T \leq 12,5$	1,6
$T > 12,5$	$0,125 T$ with a max. of 3,2

8.7.4.4 Misalignment of the weld seam of SAW tubes

Misalignment of the weld seam shall be acceptable provided complete penetration and complete fusion are achieved.

8.7.4.5 Tolerances on exact length

The tolerances for exact lengths shall be as given in Table 10.

Table 10 — Tolerances on exact length

Length	Tolerances on exact length for outside diameter (D)	
	< 406,4	≥ 406,4
L		
$L \leq 6000$	+10 0	+25 0
$6000 < L \leq 12000$	+15 0	+50 0
$L > 12000$	+ by agreement 0	

8.7.4.6 Out-of-roundness

The out-of-roundness O shall be calculated using the following equation:

$$O = \frac{D_{\max} - D_{\min}}{D} 100 \quad (1)$$

where:

O = out-of-roundness in %

D = specified outside diameter in mm

D max, D min. = maximum and minimum outside diameter measured in the same plane in mm

For tubes of outside diameter $D \leq 406,4$ mm, out-of-roundness, shall be included in the limits of the diameter tolerances.

For tubes of outside diameter $D > 406,4$ mm and with $D/T \leq 100$, out-of-roundness shall not exceed 2 %.

For tubes with a $D/T > 100$ the values for out-of-roundness shall be agreed at the time of enquiry and order.

A1 9 Inspection

9.1 Types of inspection

Conformity to the requirements of the order, for tubes in accordance with this Part of EN 10217, shall be checked by:

- non-specific inspection for quality TR1;
- specific inspection for quality TR2.

When an inspection document 3.1.B is specified, the manufacturer shall state in the confirmation of the order whether he is operating according to a “quality assurance system”, certified by a competent body established within the community, and having undergone a specific assessment for materials and processes relevant to manufacture of metal tubes, including welding procedure approvals, welder/weld operator approval and NDT operator approval.

NOTE See Directive 97/23/EC Annex I section 4.3 third paragraph.

Option 9: Specific inspection shall be carried out for quality TR1.

9.2 Inspection documents

9.2.1 Types of inspection documents

The following inspection documents, in accordance with EN 10204, shall be issued;

- test report 2.2 for quality TR1;
- inspection certificate 3.1.B for quality TR2.

Option 10: *One of the following inspection documents, specified by the purchaser, shall be issued:*

- for quality TR1 if specific inspection is ordered, an inspection document type 3.1.A, 3.1.B, 3.1.C or 3.2;
- for quality TR2, an inspection document 3.1.A, 3.1.C or 3.2.

If 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 organisation or person who is to carry out the inspection and produce the inspection document. In the case of the inspection report 3.2 it shall be agreed which party shall issue the certificate.

9.2.2 Content of inspection documents

9.2.2.1 The content of the inspection document shall be in accordance with EN 10168 as shown in **9.2.2.2** and **9.2.2.3**.

In all types of inspection documents a statement of the conformity of the products delivered with the requirements of this specification and of the order shall be included.

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

- A commercial transactions and parties involved;
- B description of products to which the inspection document applies;
- C01–C02 location of the samples and direction of test pieces; **A1**

- ☐_{A1} — C10–C13 tensile test;
- C71–C92 chemical composition;
- D01 marking and identification, surface appearance, shape and dimensional properties;
- D02–D99 leak-tightness test, NDT of the weld seam;
- Z validation

9.2.2.3 For tubes supplied with specific inspection the inspection certificate or inspection report shall contain the following codes and information:

- A commercial transactions and parties involved;
- B description of products to which the inspection document applies;
- C01–C03 the location of the samples and direction of test pieces and testing temperature;
- C10–C13 tensile test;
- C40–C43 impact test, if applicable;
- C50–C59 bend test;
- C60–C69 other tests (e.g. flattening, drift expanding);
- C71–C92 chemical composition on cast analysis (product analysis if applicable);
- D01 marking and identification, surface appearance, shape and dimensional properties;
- D02–D99 leak-tightness test, NDT of the weld seam;
- Reference to welding procedure approval;
- Reference to welder and or welding operator approval;
- Reference to non-destructive testing operators approval;
- Z validation.

In addition for inspection document 3.1.B the manufacturer shall state the references to the certificate (see 9.1) of the appropriate “quality assurance system”, if applicable. ☐_{A1}

9.3 Summary of inspection and testing

Inspection and testing shall be carried out as stated in Tables **11**, **12** and **13** for tubes of quality TR1 or TR2 respectively.

Table 11 — Summary of inspection and testing for quality TR1

Type of inspection and test		Frequency of testing		Refer to
		Non-specific inspection	Specific inspection	
Mandatory Tests	Cast analysis	One representative result per delivery item	One per cast	8.2.1 and 11.1
	Tensile test on base material		One per test unit	8.3 and 11.2
	Transverse tensile test on weld for tubes with outside diameter (D) >508 mm			8.3 and 11.3
	Flattening test ^a for D < 600 mm and T/D ratio ≤ 0,15 but T ≤ 40 mm or ^b drift expanding test for D ≤ 150 mm and T ≤ 10 mm (EW and BW)	Manufacturer's procedure	Two per test unit	8.3, 11.4 and 11.5
	Weld bend test for SAW tubes			8.3 and 11.6
	Leak-tightness test	Each tube		8.4 and 11.8
	Dimensional inspection	See 11.9		
	Visual examination	See 11.10		
	NDT of the weld	Each tube		8.4 and 11.11
Optional tests	Tensile test on weld for tubes with outside diameter (D) 219,1 < D ≤ 508 mm (Option 11) ^c	See 8.3 and 11.3		
	Wall thickness measurement away from tube ends (Option 13)	See 11.9		

^a For the flattening test 2 test pieces shall be tested with the weld position at 0° and 90°

^b The test method is at the discretion of the manufacturer for outside diameters less than 150 mm.

^c **Option 11:** For tubes with outside diameter 219,1 mm < D ≤ 508 mm a transverse tensile test on the weld shall be carried out

Table 12 — Summary of inspection and testing for quality TR2

Type of inspection and test		Frequency of testing	Refer to
Mandatory tests	Cast analysis	One per cast	8.2.1 and 11.1
	Tensile test on base material	One per test unit	8.3 and 11.2
	Transverse tensile test on weld for tubes with outside diameter (D) >508 mm		8.3 and 11.3
	Flattening test ^a for D < 600 mm and T/D ratio ≤ 0,15 but T ≤ 40 mm or ^b drift expanding test for D ≤ 150 mm and T ≤ 10 mm (EW)	Two per test unit	8.3, 11.4 and 11.5
	Weld bend test for SAW tubes		8.3 and 11.6
	Impact test at 0° C	One per test unit	8.3 and 11.7
	Leak-tightness test	Each tube	8.4 and 11.8
	Dimensional inspection	See 11.9	
	Visual examination	See 11.10	
	NDT of the weld	Each tube	8.4 and 11.11
Optional tests	Product analysis (Option 4)	One per cast	8.2.2 and 11.1
	Longitudinal Impact test at -10°C (Option 5)	One per test unit	8.3 and 11.7
	Tensile test on weld for tubes with outside diameter (D) 219,1 < D ≤ 508 mm (Option 11) ^c	See 8.3 and 11.3	
	Wall thickness measurement away from tube ends (Option 13)	See 11.9	

^a For the flattening test 2 test pieces shall be tested with the weld position at 0° and 90°

^b The test method is at the discretion of the manufacturer for outside diameters less than 150 mm.

^c **Option 11:** For tubes with outside diameter 219,1 mm < D ≤ 508 mm a transverse tensile test on the weld shall be carried out

10 SAMPLING

10.1 Frequency of tests

10.1.1 Test unit

In case of specific inspection a test unit shall comprise:

- Quality TR1: Tubes of the same specified diameter and wall thickness, the same steel grade, the same manufacturing process and, if applicable, the same normalising treatment in a continuous furnace or heat treated in the same furnace charge in a batch-type furnace.
- Quality TR2: Tubes of the same specified diameter and wall thickness, the same steel grade, the same cast, the same manufacturing process and, if applicable, the same normalising treatment in a continuous furnace or heat treated in the same furnace charge in a batch-type furnace. Tubes with specified diameter $D \leq 76,1$ mm need not be separated by cast unless option 12 is specified.

The number of tubes per test unit shall conform to Table 13.

Option 12: Tubes with specified outside diameter less than or equal to 76,1 mm shall be separated by cast for quality TR2.

Table 13 — Number of tubes per test unit

Outside diameter (mm) D	Maximum number of tubes per test unit	
	Quality TR1	Quality TR2
$D \leq 114,3$	400	200
$114,3 < D \leq 323,9$	200	100
$323,9 < D \leq 660$	100	50
$D > 660$	50	50

10.1.2 Number of sample tubes per test unit

One sample tube shall be taken from each test unit.

10.2 Preparation of samples and test pieces**10.2.1 Selection and preparation of samples for product analysis**

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

10.2.2 Location, orientation and preparation of samples and test pieces for mechanical tests**10.2.2.1 General**

Samples and test pieces shall be taken at the tube ends and in accordance with the requirements of EN ISO 377.

10.2.2.2 Test pieces for tensile tests of the base material

The test pieces shall be taken in accordance with the requirements of EN 10002-1.

At the manufacturer's discretion :

- for tubes with an outside diameter $D \leq 219,1$ mm the test piece shall be either a full tube section or a strip section and shall be taken in a direction longitudinal to the axis of the tube;
- for tubes with an outside diameter $D > 219,1$ mm the test piece shall either a machined test piece with circular cross section from an unflattened sample or a strip section and be taken in a direction either longitudinal or transverse to the axis of the tube.

Except when a full tube section is used, the test piece shall be taken diametrically opposite the weld; for helically submerged arc-welded tubes (SAWH) the test piece shall be taken at 1/4 of the distance between the welds.

10.2.2.3 Test pieces for tensile tests on the weld

The test piece shall be taken transverse to the weld with the weld at the centre of the test piece. The test piece shall be a strip section with the full wall thickness of the tube; the weld bead may be removed.

10.2.2.4 Test pieces for flattening or drift expanding test

The test piece shall consist of a full tube section, in accordance with EN 10233 or EN 10234 respectively.

10.2.2.5 Test pieces for weld bend tests

The test pieces for the weld bend test at the root and face shall be taken and prepared in accordance with EN 910.

10.2.2.6 Test pieces for impact test

Three standard Charpy V-notch test pieces shall be prepared in accordance with EN 10045-1. If the wall thickness is such that standard test pieces cannot be produced without flattening of the section, then test pieces of width less than 10 mm, but not less than 5 mm shall be prepared; the largest obtainable width shall be used.

Where tests pieces at least 5 mm width cannot be obtained, the tubes shall not be subjected to impact testing.

Unless otherwise specified (see Option 5), the test pieces shall be taken transverse to the tube axis unless D_{min} , as calculated by the following equation, is greater than the specified tube outside diameter, in which cases longitudinal test pieces shall be used.

$$D_{min.} = (T-5) + [756,25 / (T-5)] \quad (2)$$

The test pieces shall be taken diametrically opposite the weld; for helically submerged arc-welded tubes (SAWH) the test piece shall be taken at 1/4 of the distance between the welds.

The test pieces shall be prepared such that the axis of the notch is perpendicular to the surface of the tube, see figure 2.

Key:

1 Longitudinal test piece

2 Transverse test piece

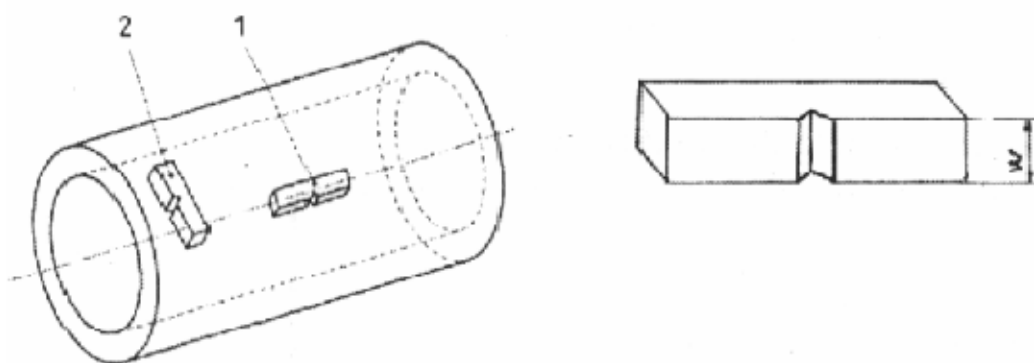


Figure 2 — Impact test piece orientation

11 TEST METHODS

11.1 Chemical analysis

The elements to be determined and reported shall be those specified in Table 2. The choice of a suitable physical or the chemical analytical method for the analysis shall be at the discretion of the manufacturer. In cases of dispute the method used shall be agreed between manufacturer and purchaser, taking into account CR 10261.

11.2 Tensile test on base material

The test shall be carried out at room temperature in accordance with EN 10002-1, and the following shall be determined:

- the tensile strength (R_m);
- the upper yield strength (R_{eH}) or if a yield phenomenon is not present the 0,2 % proof strength ($R_{p0,2}$);
- the percentage elongation after fracture with a reference to a gauge length (L_0) of $5,65 \cdot \sqrt{S_0}$; if a non-proportional test piece is used, the percentage elongation value shall be converted to the value for a gauge length $L_0 = 5,65 \cdot \sqrt{S_0}$ using the conversion tables in EN ISO 2566-1.

11.3 Transverse tensile test on the weld

The test shall be carried out in accordance with EN 10002-1 and the tensile strength (R_m) shall be determined.

11.4 Flattening test

The test is applicable to EW and BW tubes. It shall be carried out in accordance with EN 10233. The tube section shall be flattened in a press until the distance H between the platens reaches the value calculated by the following equation:

$$H = \frac{(1 + C)}{C + (T/D)} x T \quad (3)$$

where :

- H is the distance between platens to be measured under load, in millimetres .
- D is the specified outside diameter, in millimetres .
- T is the specified wall thickness, in millimetres .
- C is a constant, the value of which is:
 - 0,09 for steel grades P195TR1/TR2 and P235TR1/TR2;
 - 0,07 for steel grade P265TR1/TR2.

After testing, the test piece shall be free from cracks or breaks. However, slight incipient cracks at its edges shall not be regarded as justification for rejection.

11.5 Drift expanding test

This test is applicable to EW and BW tubes of outside diameter not greater than 150 mm and a wall thickness not greater than 10 mm.

The test shall be carried out in accordance with EN 10234. The tube section shall be expanded with a 60° conical tool, until the percentage increase in outside diameter shown in Table 14 is reached.

Table 14 — Drift expanding test requirements

Steel grade			% increase in outside diameter for d/D ^a	
Steel name	Steel number		≤ 0,8	> 0,8
P195	TR 1	1.0107	10	12
	TR 2	1.0108		
P235	TR 1	1.0254	10	12
	TR 2	1.0255		
P265	TR 1	1.0258	8	10
	TR 2	1.0259		

^a d = D – 2T

After testing, the test piece shall be free from cracks or breaks. However, slight incipient cracks at its edges shall not be regarded as a justification for rejection.

11.6 Weld bend test

This test is applicable to SAW tubes. It shall be carried out in accordance with EN 910 using a mandrel of a diameter of 3T, where T is the specified wall thickness in millimetres .

After testing, the test pieces shall show no cracks or flaws, but slight premature failure at its edges shall not be regarded as a justification for rejection.

11.7 Impact test

11.7.1 The test shall be carried out in accordance with EN 10045-1 at 0 °C and, if option 5 is specified, at -10 °C.

11.7.2 The mean value of the three test pieces shall meet the requirements given in Table 4. One individual value may be below the specified value, provided that it is not less than 70 % of that value.

11.7.3 If the width (W) of the test piece is less than 10 mm, the measured impact energy (KV_p) shall be converted to calculated impact energy (KV_c) using the following equation:

$$KV_c = \frac{10 \times KV_p}{W} \quad (4)$$

where:

- KV_c is the calculated impact energy, in Joules;
- KV_p is the measured impact energy, in Joules;
- W is the width of the test piece, in millimetres.

The calculated impact energy KV_c shall conform to the requirements given in 11.7.2.

11.7.4 If the requirements of 11.7.2 are not met, then an additional set of three test pieces may be taken at the discretion of the manufacturer from the same sample and tested. To consider the test unit as conforming, after testing the second set, the following conditions shall be satisfied simultaneously:

- the average value of the six tests shall be equal to or greater than the specified minimum value;
- not more than two of the six individual values may be lower than the specified minimum value;
- not more than one of the six individual values may be lower than 70 % of the specified value.

11.7.5 The dimensions in millimetres of the test pieces, the measured impact energy values and the resulting average value shall be reported.

11.8 Leak tightness test

11.8.1 Hydrostatic test

The hydrostatic test shall be carried out at a test pressure of 70 bar²⁾ or at a test pressure P calculated using the following equation, whichever is lower:

$$P = 20 \frac{S \times T}{D} \quad (5)$$

where :

- P is the test pressure, in bar;
- D is the specified outside diameter, in mm;
- T is the specified wall thickness, in mm;
- S is the stress, in MPa, corresponding to 70 % of the specified minimum yield strength (see Table 4) for the steel grade concerned.

The test pressure shall be held for not less than 5 s for tubes with an outside diameter $D \leq 457$ mm and for not less than 10 s for tubes with an outside diameter $D > 457$ mm.

The tubes shall withstand the test without showing leakage or visible deformation.

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

11.8.2 Electromagnetic test

The test shall be carried out in accordance with EN 10246-1.

2) 1 bar = 100 kPa

11.9 Dimensional inspection

Specified dimensions, including straightness shall be verified.

The outside diameter shall be measured at the tube ends. For tubes with outside diameter $D \geq 406,4$ mm, the diameter may be measured using a circumference tape.

Unless option 13 is specified the wall thickness shall be measured at both tube ends.

Option 13: *The wall thickness shall be measured away from the tube ends in accordance with an agreed procedure.*

11.10 Visual examination

Tubes shall be visually examined to ensure conformity to the requirements of 8.4.1 and 8.4.2

11.11 Non-Destructive Testing

The full length of the weld seam shall be non-destructively tested in accordance with 11.11.1 or 11.11.2.

Unless Option 14 is specified the selection of test method from 11.11.1 (for EW and BW tubes), or 11.11.2 (for SAW tubes), is at the discretion of the manufacturer.

Option 14: *The test method is specified by the purchaser.*

11.11.1 The weld seam of EW and BW tubes shall be tested in accordance with EN 10246-3, EN 10246-5, EN 10246-7 or EN 10246-8 to acceptance level 3, sub-category C, where applicable.

The weld seam of the tube ends not automatically tested shall either be subjected to manual/semi-automatic ultrasonic testing in accordance with EN 10246-8 or be cropped off.

11.11.2 The weld seam of SAW tubes shall be tested in accordance with EN 10246-9 to acceptance level 3 or to EN 10246-10 to image quality class R2.

The weld seam of the tube ends not automatically tested shall be subjected to either manual/semi-automatic ultrasonic testing in accordance with EN 10246-9 or radiography in accordance with EN 10246-10 or be cropped off.

11.11.3 Plate and strip end welds for helically welded tubes shall be tested in accordance with 11.11.2.

11.12 Retest, sorting and reprocessing

For retest, sorting and reprocessing the requirements of EN 10021 shall apply.

12 MARKING

12.1 Marking to be applied

The marking shall be indelibly marked on each tube at least at one end. For tubes with outside diameter $D \leq 51$ mm the marking on tubes, may be replaced by the marking on a label attached to the bundle or box.

The marking shall include the following information:

— the manufacturer's name or trade mark;

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- the type of tube (symbol in accordance with Table 1)
- the number of EN 10217 and the steel name (see 5.2);
- In case of specific inspection:
- the category conformity indicator if applicable (see 7.3.1 and 7.3.3);
- the cast number or a code number if applicable;
- the mark of the inspection representative.
- an identification number (e.g. order or item number) which permits correlation of the product or delivery unit to the related document;

Example of marking:

X – EW – EN 10217-1 - P265TR2 - C2 - Y - Z₁ - Z₂ -

where

- X is the manufacturer's mark;
- EW is the type of tube
- C2 is the category conformity indicator
- Y is the cast or a code number
- Z₁ is the mark of the inspection representative;
- Z₂ is the identification number.

12.2 Additional marking

Option 15: *Additional marking as agreed upon at the time of the enquiry and order, shall be applied.*

13 PROTECTION

The tubes shall be delivered without a temporary protective coating.

Option 16: *A temporary protective coating or a durable coating and/or lining shall be applied.*

Annex A (normative)

Qualification of welding procedure for SAW tube production

A.1 General

Submerged arc weld tube produced to this Part of EN 10217 shall be welded in accordance with set procedures which have been specified, qualified and/or approved in accordance with this annex.

This annex does not invalidate previous welding procedures qualified and/or approved to meet national standards or specification, providing the content of the requirements is satisfied and the previous procedure qualifications and/or approvals are relevant to the applications and production work on which they are to be employed.

This annex covers the requirements for the qualification and/or approval of weld procedures for the production of SAW tube including inspection and testing and also for other fusion welding processes used in SAW tube production.

A.2 Welding procedure specification

The qualification for the welding procedure shall be carried out in accordance with a welding procedure specification (WPS). The specification shall include the following information as a minimum requirement.

A.2.1 Parent metal

A.2.1.1 Steel name or number

The steel grade shall be identified in accordance with the requirements of this Part of EN 10217.

NOTE A welding procedure specification may cover a group of materials (see A.8.1).

A.2.1.2 Tube dimensions

Tube dimensions shall be supplied for the following:

- outside diameter D;
- wall thickness T.

A.2.2 Weld preparation

Details of the strip/plate edge profile prior to welding shall be given. This may be in the form of a dimensional sketch. Details of the methods of preparation and tack welding shall be included.

A.2.3 Filler wires and fluxes

A.2.3.1 The standard number and grade shall be referenced.

A.2.3.2 The number, dimensions and position of filler wire or wires and details of any additional filler metal shall be supplied. When specifying the position, any angular variation shall be included, if applicable.

A.2.3.3 If carried out, the flux recycling procedure shall be referenced.

A.2.4 Electrical parameters

Details of the electrical parameters shall include as a minimum:

- type of current (a.c. and/or d.c.) and polarity;
- nominal current, the range to be expressed as a plus and minus percentage;
- nominal arc voltage, the range to be expressed as a plus and minus percentage.

A.2.5 Mechanical parameters

Details of mechanical parameters shall include as a minimum :

- nominal travel speed, the range to be expressed as a plus and minus percentage;
- number and order of inside and outside weld runs.

A.2.6 Heat input (kJ/mm)

If required the maximum value achieved during the qualification/approval test shall be recorded.

A.2.7 Preheat temperature

If required the minimum preheat temperature shall be specified.

A.2.8 Interpass temperature

The maximum permissive interpass temperature shall be specified where applicable.

A.2.9 Postweld heat treatment

The delivery condition after welding shall be in accordance with Table 1 for the steel grade concerned.

Details of the heat treatment, where applicable, shall be included on the qualification documentation.

A.2.10 Example of welding procedure specification form

A typical weld procedure specification is shown in Table A.1, for information.

Table A.1 Example of typical welding procedure specification form

Welding procedure specification									
Ref. N. WPS:			Prepared by:			Checked by:			Date:
Parent metal:					Thickness/diameter:				
Weld preparation:					Pass location:				
Preparation method Machined/plasma or flame cut									
Pass n.	Wire n.	Welding position	Wire				Nominal current A	Nominal arc voltage V	Nominal travel speed mm/s
			Size mm	Code n.	Designation	Polarity			
Heat input ^a							Preheat	°C min	
Heat treatment			Stress relieving		Normalizing		Interpass temperature	°C max	
Heating rate							NDT		
Soaking temperature									
Soaking time									
Cooling rate									
Withdraw temperature									
Notes									
^a If required									

A.3 Preparation of sample tube and sample

A.3.1 Sample tube

Preparation and welding of sample tube shall be carried out in accordance with the WPS and under the general conditions of production welding which they shall represent.

When an approved procedure is required the name and address of the authorised body shall be supplied.

A.3.2 Sample

A test sample sufficiently long to carry out the testing requirements in clause A.5 shall be taken from the end of the tube after welding, in the delivery condition specified in Table 1.

A.4 Inspection and testing of the weld

The test sample shall be subjected to the inspection or testing of Table A.2.

Table A.2 Inspection and testing of the weld

Type of inspection or test	Extent or number of test pieces
Visual examination of the weld ^a	100% of the sample
Radiographic examination of the weld	100% of the sample
Weld bend test	2 root and 2 face test pieces ^b
Macro-examination of weld cross section	1 specimen
Transverse weld tensile test	2 test pieces
Weld impact test ^c	1 set of three test pieces
^a Magnetic particle inspection or penetrant inspection may be used at the discretion of the manufacturer. ^b These tests may be replaced by 4 side bend tests for wall thickness greater than 12,5 mm, at the manufacturer's discretion. ^c This test is applicable only for group 2 steels (see TableA.4)	

A.5 Weld test pieces

A.5.1 Bend test pieces

The bend test pieces shall be prepared in accordance with 10.2.2.5.

A.5.2 Macro-examination

The sample shall be prepared in accordance with EN 1321.

A.5.3 Transverse tensile test

The transverse tensile test piece shall be prepared in accordance with EN 895.

A.5.4 Impact test

Three standard Charpy V-notch test pieces taken transverse to the weld shall be prepared in accordance with 10.2.2.6.

The test pieces shall be prepared such that the axis of the notch is perpendicular to the surface of the tube and the notch shall be placed in the middle of the weld.

A.6 Test methods

A.6.1 Visual examination

Visual examination of the test piece shall be carried out.

A.6.2 Radiographic test

The radiographic test shall be carried out in accordance with 11.11.2.

A.6.3 Weld bend test

The weld bend test shall be carried out in accordance with 11.6.

A.6.4 Macro-examination

The macro-examination shall be carried out at a magnification of $\times 5$.

A.6.5 Transverse weld tensile test

The transverse weld tensile test shall be carried out in accordance with 11.3.

A.6.6 Weld impact test

The weld impact test shall be carried out in accordance with 11.7.

A.7 Test acceptance levels

A.7.1 Visual examination

Cracks shall not be permitted.

A.7.2 Radiographic test

This shall meet the acceptance requirements of 11.11.2.

A.7.3 Weld bend test

The tested specimen shall be checked for lack of fusion and the results reported.

For acceptance the results shall meet the requirements of 11.6.

A.7.4 Macro-examination

The specimen shall be checked for the following:

- cracks;
- lack of penetration;
- lack of fusion;
- height of internal and external weld beads;
- radial offset of plate edges;
- misalignment of weld seam.

The result shall be recorded.

For acceptance the following apply:

- cracks and lack of penetration and fusion shall not be permitted;
- height of internal and external weld beads, radial offset of plate and strip edges and misalignment of weld seam shall comply with the requirements of Tables 8 and 9 and clause 8.7.3.4 respectively.

A.7.5 Transverse weld tensile test

The value of R_m shall be determined and meet the requirements of 11.3 and of Table 4 for the steel grade concerned. The position of the fracture shall be reported.

A.7.6 Weld impact test

The impact test results shall meet the requirements of 11.7 and Table 4 for the steel grade concerned.

A.7.7 Example of test result document

A typical test results form is shown in Table A.3, for information.

Table A.3 Example of typical test results form

Test results						
Manufacturer:			Examiner or examining body:			
Welding procedure			Reference no:			
Reference no:			Radiographic test ^a :			
Visual examination: Pass/fail			Pass/fail			
Penetrant/magnetic particle test Pass/fail			Ultrasonic examination ^a :			
			Temperature: °C			
Tensile tests						
Type /No.		Rm MPa	Fracture location			Remarks
Requirements						
Bend tests					Macro examination	
Former diameter						
Type /No.	Bend angle	Results				
Impact test ^a						
Type:		Size:		Requirement:		
Notch		Temperature °C	Values J			Remarks
Location/Direction			1	2	3	Average
Hardness test ^a						
Type/load:						
H. A. Z.:						
Weld Metal:						
Parent metal:						
Other tests:						
Remarks:						
Tests carried out in accordance with the requirements of:						
Examiner or examining body:						
Laboratory report reference no:						
Test results were acceptable/not acceptable (delete as appropriate)						
Test carried out in the presence of:						
Name:		Signature:			Date:	
^a If required.						

A.8 Range of use of qualified procedures

A.8.1 Materials Groups

In order to avoid unnecessary qualification of weld procedures similar types of material have been grouped together and are shown in Table A.4.

A procedure qualified for any material within a group covers all other materials within that group.

A procedure qualified for any material of group 2 covers all other materials of group 1.

Table A.4 Grouping system for SAW steel tubes

Group	Steel grade	
	Steel name	Steel number
1	P195TR1	1.0107
	P235TR1	1.0108
	P265TR1	1.0254
2	P195TR2	1.0255
	P235TR2	1.0258
	P265TR2	1.0259

A.8.2 Materials thickness

Qualification at a given wall thickness covers a range of wall thicknesses and these are shown in Table A.5.

Table A.5 Range of qualification based on wall thickness T

dimensions in mm	
Wall thickness of tube sample	Range of qualification
$T \leq 12,5$	3 to 2 T
$T > 12,5$	0,5 T to 2 T

A.8.3 Filler wire classification

The qualification of a filler wire covers other filler wires provided they meet the following requirements:

they shall be in the same group of tensile properties with procedures which include impact testing;

they shall have the same nominal chemical composition.

A.8.4 Welding flux

A change from one welding flux, as defined by EN 760, to one of a different classification shall require a separate welding procedure qualification.

A.8.5 Other parameters

Changes, singly or collectively, to the number of the welding wires or the type of current (e.g. from a.c. to d.c.) or a changes in the number of weld runs per side from single to multi-pass, or vice versa, shall require one or more separate welding procedure specification(s) and approval(s).

A.9 Qualification record

The manufacturer shall state that each welding procedure has been qualified and the procedure and qualification test results shall be documented and signed by his authorised representative (see Table A.3).

When the testing and inspection have been witnessed and approved by an authorised body the documentation shall contain the name and address of the person or company and be signed by the person approving the procedure.

Annex ZA (informative)

Relationship between this European Standard and the Essential Requirements of 97/23/EC

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 97/23/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in table ZA-1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations

Table ZA.1 — Correspondence between this and European standard and Directive 97/23/EC

Clauses/sub-clauses of this EN	Pressure Equipment Directive 97/23/EC Annex I	Content
7.3.3	3.1.2	Welding
7.3.1	3.1.3	NDT personnel
8.3	4.1a	Appropriate material properties
7.3 and 8.4	4.1d	Suitable for the processing procedures
9 and 10	4.3	Documentation

WARNING: Other requirements and other EC Directives may be applicable to the product(s) falling within the scope of this standard. A1

Bibliography

EN 473, *Non destructive testing - Qualification and certification of NDT personnel - General principles*

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