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BRITISH STANDARD

BS EN 10217-3:2002
Incorporating Amendment No. 1

Welded steel tubes for pressure purposes — Technical delivery conditions —

Part 3: Alloy fine grain steel tubes

The European Standard EN 10217-3:2002, with the incorporation of amendment A1:2005, has the status of a British Standard

ICS 23.040.10; 77.140.75

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BSI British Standards

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National foreword

This British Standard is the official English language version of EN 10217-3:2002, including amendment A1:2005. Together with BS EN 10217-5:2002 it supersedes BS 3602-2:1991 which is withdrawn.

The start and finish of text introduced or altered by CEN amendment is indicated in the text by tags [A1⟩ ⟨A1]. Tags indicating changes to CEN text carry the number of the CEN amendemnt. For example, text altered by CEN amendment A1 is indicated by [A1⟩ ⟨A1].

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.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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EUROPEAN STANDARD

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Foreword

This document (EN 10217-3:2002) 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of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.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 1: Non-alloy steel tubes with specified room temperature properties.

Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties.

Part 4: Electric welded non-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 10217-3:2002/A1:2005) 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 10217-3:2002 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.

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

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1 Scope

This Part of EN 10217 specifies the technical delivery condition in two test categories for welded tubes of circular cross section, made of weldable alloy fine grain steel.

2 Normative References

This European Standard 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 this European Standard 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 this European Standard 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 10002-5, *Metallic materials - Tensile testing - Part 5 : Method of testing at elevated 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 10236, *Metallic materials - Tubes - Ring expanding test.*

EN 10237, *Metallic materials - Tubes - Ring tensile 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.*

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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 10246-6, *Non-Destructive Testing of steel tubes - Part 6 : Automatic full peripheral ultrasonic testing of seamless steel tubes for the detection of transverse imperfections*

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 10246-14, *Non-Destructive Testing of steel tubes - Part 14:Automatic ultrasonic testing of seamless and welded (except submerged arc welded) steel tubes for the detection of laminar imperfections.*

EN 10246-15, *Non-Destructive Testing of steel tubes - Part 15: Automatic ultrasonic testing of strip/ plate used in the manufacture of welded steel tubes for the detection of laminar imperfections.*

EN 10246-16, *Non-Destructive Testing of steel tubes - Part 16: Automatic ultrasonic testing of the area adjacent to the weld seam of welded steel tubes for the detection of laminar imperfections.*

EN 10246-17, *Non-Destructive Testing of steel tubes - Part 17: Ultrasonic testing of tube ends of seamless and welded steel tubes for the detection of laminar 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*

EURONORM 103[2)] , *Microscopic determination of ferritic grain size of steel.*

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.*

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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.

2) Until this EURONORM is transformed into an a European Standard, it can be implemented or the corresponding national standard should be agreed at the time of enquiry and order.

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3 Terms and definitions

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

3.1
test category
classification that indicates the extent and level of inspection and testing.

3.2
employer
organisation for which a person works on a regular basis.

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

3.3
fine grain steel
steel having a ferritic grain size equal to or finer than 6 in accordance with EURONORM 103.

3.4
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.

3.5
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.

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 7.3.1 and 7.3.3.)

— TC test category.

5 Classification and designation

5.1 Classification

5.1.1 This Part of EN 10217 covers steel grades in four qualities (see Tables 2 and 4):

— the basic quality (P ... N);

— the elevated temperature quality (P ... NH);

— the low temperature quality (P ... NL1);

— the special low temperature quality (P ... NL2).

5.1.2 In accordance with the classification system in EN 10020, the steel grades P275NL1, P355N, P355NH and P355NL1 are classified as alloy quality steels and the other steel grades are classified as alloy special steels.

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5.2 Designation

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

— the number of this Part of EN 10217;

plus either:

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

or:

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

5.2.2 The steel name is designated by

— the capital letter P for pressure purposes;

— the indication of the specified minimum yield strength for the lowest applicable wall thickness T group expressed in MPa (see Table 4);

— one of the additional symbols N, NH, NL1or NL2 (see 5.1.1, Tables 2 and 4).

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, wall thickness T) (see Table 8 and 9);

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

e) the test category (see 9.3).

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 route (see 7.3.2).

2) Restriction on copper and tin content (see Table 2).

3) Product analysis (see 8.2.2).

4) Verification of elevated temperature properties of NH-grades (see 8.3).

5) Verification of elevated temperature properties of NL-grades (see 8.3).

6) Selection for leak-tightness test method (see 8.4.3.1).

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7) Non-Destructive Testing for test category 2 HFW tubes for detection of transverse imperfections (see 8.4.3.2).

8) Non-Destructive Testing for test category 2 tubes for detection of laminar imperfections (see 8.4.3.2).

9) Special end preparation (see 8.6).

10) Exact lengths (see 8.7.3).

11) Type of inspection document other than the standard document (see 9.2.1).

12) Transverse weld tensile test for SAW tubes (see Table 15).

13) Additional impact test at test temperature different from standard test temperature (see Table 15).

14) Transverse weld tensile test for HFW tubes (see Table 15).

15) Test pressure for hydrostatic leak-tightness test (see 11.9.1).

16) Wall thickness measurement away from the ends (see 11.10).

17) Non-Destructive Testing method for the inspection of the weld seam of HFW tubes (see 11.12.1.1)

18) Non-Destructive Testing method for the inspection of the weld seam of SAW tubes (see 11.12.2.1).

19) Image quality class R1 of EN 10246-10 for the non-destructive radiographic inspection of the weld seam (see 11.12.2.1).

20) Additional marking (see 12.2).

21) Protection (see 13).

6.3 Example of an order

500 m of welded tube with an outside diameter of 168,3 mm, a wall thickness of 4,5 mm in accordance with EN 10217-3, made of steel grade P355N, test category 1, with a 3.1.C inspection certificate in accordance with EN 10204:

500 m - Tube - 168,3 x 4,5 - EN 10217-3 - P355N -TC 1 - Option 11: 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 and be made to fine grain practice (see 3.3).

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.

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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.

7.3.6 In case of steel grade P355 and P355NH normalising may be replaced by normalising forming.

7.3.7 For steel grade P460 delayed cooling or additional tempering may be necessary to apply after normalising.

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Table 1 — Tube manufacturing processes, route and delivery condition

Route N°	Manufacturing process		Manufacturing route		Delivery	Applicable
	Process	Symbols	Starting material	Forming operation	Condition	for[a]
1a	High frequency welded	HFW [e]	Normalising rolled strip	Cold formed (+ welded)	Normalised weld zone	B
1b					Normalised [b] (entire tube)	A
2a			As (hot) rolled or Normalising rolled strip	Cold formed (+ welded)	Normalised [b] (entire tube)	A
2b				Cold formed (+ welded) + hot stretch reduced	Normalised [b] (entire tube)	A
2c				Cold formed (+ welded) + hot stretch reduced at a controlled temperature to give a normalised condition	Normalised rolled	B
3	Submerged arc welded -longitudinal seam -helical seam	SAW -SAWH -SAWL	As (hot) rolled plate or strip	Cold formed (+ welded)	Normalised [b] (entire tube)	A
4a			Normalising rolled plate or strip	Cold formed (+ welded)	Without subsequent heat treatment[c]	B
4b			Normalising plate or strip			A
5			As (hot) rolled plate or strip- Normalising or Normalising rolled plate or strip	Normalising formed[d] (+ welded)	Without subsequent heat treatment[c]	A

[a] A = all steel grades; B= for grades P355N and P355NH only.

[b] see 7.3.7.

[c] Stress relieving treatment on the weld is permissible

[d] Only applicable to SAWL tubes

[e] A minimum frequency of 100 kHz

8 Requirements

8.1 General

When supplied in a delivery condition indicated in clause 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.

Tubes shall be suitable for hot and cold bending provided the bending is carried out in an appropriate manner.

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

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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.

8.2.2 Product analysis

Option 3: *A product analysis for the tubes shall be supplied*

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

8.3 Mechanical properties

The mechanical properties at and below room temperature of the tubes shall conform to the requirements in Tables 4, 5, 6, Annex B, 7 and in clauses 11.3, 11.4 11.5, 11.6 and 11.7.

Option 4: *Elevated temperature properties given in Tables 5 and 6 on base material shall be verified for NH-grades at 400 °C.*

The properties at elevated temperature given in Tables 5 and 6 for steel grades P355NH and P460NH may be applicable for the corresponding low and special low temperature quality steels if option 5 is specified.

The properties at elevated temperature given in Annex B for steel grades P275NL1 and P275NL2 may be applicable, if option 5 is specified.

Option 5: *Elevated temperature properties given in Tables 5, 6 and Annex B on base material shall be verified for NL grades at 400°C.*

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

Steel grade		C	Si	Mn	P	S	Cr	Mo	Ni	Al_{tot} [b]	Cu	N	Nb	Ti	V	Nb+Ti+V
Steel name	Steel number	max	max		max	max	max	max	max	min	max	max	max	max	max	max
P275NL1	1.0488	0,16	0,40	0,50 to1,50	0,025	0,020	0,30 [c]	0,08 [c]	0,50	0,020	0,30 [c d]	0,020	0,05	0,03	0,05	0,05
P275NL2	1.1104					0,015										
P355N	1.0562	0,20	0,50	0,90 to1,70	0,025	0,020	0,30 [c]	0,08 [c]	0,50	0,020	0,30 [c d]	0,020	0,05	0,03	0,10	0,12
P355NH	1.0565															
P355NL1	1.0566	0,18														
P355NL2	1.1106					0,015										
P460N	1.8905	0,20	0,60	1,00 to 1,70	0,025	0,020	0,30	0,10	0,80	0,020	0,70 [e]	0,020	0,05	0,03	0,20	0,22
P460NH	1.8935															
P460NL1	1.8915															
P460NL2	1.8918					0,015										

[a] 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] $Al/N \geq 2$, if nitrogen is fixed by niobium, titanium or vanadium the requirement for Al_{tot} and Al/N do not apply.

[c] The sum of the percentage by mass of the three elements chromium, copper and molybdenum shall not exceed 0,45 %.

[d] Option 2: In order to facilitate subsequent forming operation, an agreed maximum copper content lower than indicated and an agreed specified maximum tin content shall apply.

[e] If the percentage by mass of copper exceeds 0,30 %, the percentage by mass of nickel shall be at least half the percentage by mass of copper.

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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 % by mass	Permissible deviation of the product analysis % by mass
C	≤ 0,20	+ 0,02
Si	≤ 0,40	+ 0,05
	>0,40 ≤ 0,60	+ 0,06
Mn	≤ 1,70	+ 0,10 - 0,05
P	≤ 0,025	+ 0,005
S	≤ 0,015	+ 0,003
	>0,015 ≤ 0,020	+ 0,005
Al	≥ 0,020	- 0,005
Cr	≤ 0,30	+ 0,05
Cu	≤ 0,70	+ 0,05
Mo	≤ 0,10	+ 0,03
N	≤ 0,020	+ 0,002
Nb	≤ 0,05	+ 0,005
Ni	≤ 0,80	+ 0,05
Ti	≤ 0,03	+ 0,01
V	≤ 0,20	+ 0,02

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Table 4 — Mechanical properties at room temperature[a]

Steel grade		Heat Treatment condition	Tensile properties							
			Upper yield strength or proof strength R_{eH} or $Rp_{0,2}$ min. for wall thickness T in mm			Tensile strength R_m for wall thickness T in mm		Elongation [b] A min	
Steel Name	Steel number		≤ 12	> 12 to ≤ 20	> 20 to ≤ 40	≤ 20	> 20 to ≤ 40	l	t
			Mpa *			Mpa *		%	
P 275NL 1	1.0488	+ N	275			390 to 530	390 to 510	24	22
P 275NL 2	1.1104								
P 355N	1.0562	+N [c]	355		345	490 to 650	490 to 630	22	20
P 355NH	1.0565								
P 355NL1	1.0566	+ N							
P 355NL2	1.1106								
P 460N	1.8905	+N [d]	460	450	440	560 to 730		19	17
P 460NH	1.8935								
P 460NL1	1.8915								
P 460 NL2	1.8918								

a For wall thickness T ≤ 16 mm for HFW tubes and ≤ 40 mm for SAW tubes.

b l = longitudinal; t = transverse;

c see 7.3.6;

d see 7.3.7

* 1 MPa = 1 N/mm^2

Table 5 — Minimum 0,2 %-proof strength (Rp0,2) at elevated temperature [a b]

Steel grade		Wall thickness [b]	$Rp_{0,2}$ Mpa *						
Steel name	Steel number	T mm	Temperature °C						
			100	150	200	250	300	350	400
P 355 NH	1.0565	≤ 20	304	284	255	235	216	196	167
		> 20 to ≤ 40	294	275	255	235	216	196	167
P 460 NH	1.8935	≤ 12	402	373	343	314	294	265	235
		> 12 to ≤ 20	392	363	343	314	294	265	235
		> 20 to ≤ 40	382	353	333	304	284	255	226

a For wall thickness T ≤ 16 mm for HFW tubes and ≤ 40 mm for SAW tubes.

b See 8.3

* 1 MPa = 1 N/mm^2

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Table 6 — Minimum tensile strength at elevated temperature [a] [b]

Steel grade		Wall thickness [b]	R_m MPa [*]						
Steel	Steel	T	Temperature ° C						
name	number	mm	100	150	200	250	300	350	400
P 355 NH	1.0565	≤ 30	440	430	410	410	410	400	390
		> 30 to ≤ 40	420	410	390	390	390	380	370
P 460 NH	1.8935	≤ 30	510	490	480	480	480	470	460
		> 30 to ≤ 40	490	470	460	460	460	450	440

a For wall thickness T≤ 16 mm for HFW tubes and ≤ 40 mm for SAW tubes.

b See 8.3

* 1 MPa = 1 N/mm^2

Table 7 — Minimum Impact energy [a]

Steel grades		Minimum average impact energy KV J													
Steel	Steel	longitudinal direction							transverse direction						
name	number	at a temperature of °C													
		- 50	- 40	- 30	- 20	- 10	0	+ 20	- 50	- 40	- 30	- 20	- 10	0	+ 20
P355N P355NH P460N P460NH	1.0562 1.0565 1.8905 1.8935	-	-	-	40	43	47	55	-	-	-	27	31	35	39
P275NL1 P355NL1 P460NL1	1.0488 1.0566 1.8915	-	40	47	53	60	65	70	-	27	31	35	39	43	47
P275NL2 P355NL2 P460NL2	1.1104 1.1106 1.8918	40	50	60	70	80	90	100	27	33	40	47	53	60	70

a For wall thickness T ≤ 16 mm for HFW tubes and ≤ 40 mm for SAW tubes.

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.

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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 Any surface imperfection, which is demonstrated to be deeper than 5 % of the wall thickness T or 3 mm whichever is the smaller, shall be dressed.

This requirement does not apply to surface imperfection with a depth equal or less 0,3 mm.

8.4.2.5 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.

8.4.2.6 Repairs to the weld seam of HFW 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 11.9.1) or electromagnetic test (see 11.9.2) for leak-tightness

Unless option 6 is specified, the choice of the test method shall is the discretion of the manufacturer.

Option 6: *The test method for verification of leak-tightness in accordance with 11.9.1 or 11.9.2 is specified by the purchaser.*

NOTE Submerged arc welded tubes cannot be tested in accordance with 11.9.2.

8.4.3.2 Non-Destructive Testing

The full length of the weld seam of all HFW tubes of test category 1 shall be subjected to a Non-Destructive Testing for the detection of longitudinal imperfections, in accordance with clause 11.12.1.1.

The full length of the weld seam of all SAW tubes of test category 1 shall be subjected to a Non-Destructive Testing for the detection of imperfections in accordance with clauses 11.12.2.1.

The full length of the weld seam of tubes and the body of HFW tubes of test category 2 shall be subjected to a Non-Destructive Testing for the detection of longitudinal imperfections, in accordance with clause 11.12.1.2.

Additionally the edges of plate or strip, the body and the ends of SAW tubes of test category 2 shall be subjected to a Non-Destructive Testing for the detection of laminar imperfections in accordance with clauses 11.12.2.

Option 7: *HFW tubes of test category 2 shall be subjected to a Non-Destructive Testing for the detection of transverse imperfections in accordance with clause 11.12.1.3.*

Option 8: *HFW tubes of test category 2 shall be subjected to a Non-Destructive Testing for the detection of the laminar imperfections in accordance with clause 11.12.1.4.*

8.5 Straightness

The deviation from straightness, of any tube length L shall not exceed 0,0015 L. Deviations from straightness over any one meter 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 9: The tubes shall be delivered with bevelled ends (see figure 1). The bevel shall have an angle a of $30° \, ^{+5°}_{0°}$ with a root face C of 1,6 mm ± 0,8 mm, except that for wall thickness T greater than 20 mm, an agreed alternative bevel may be specified

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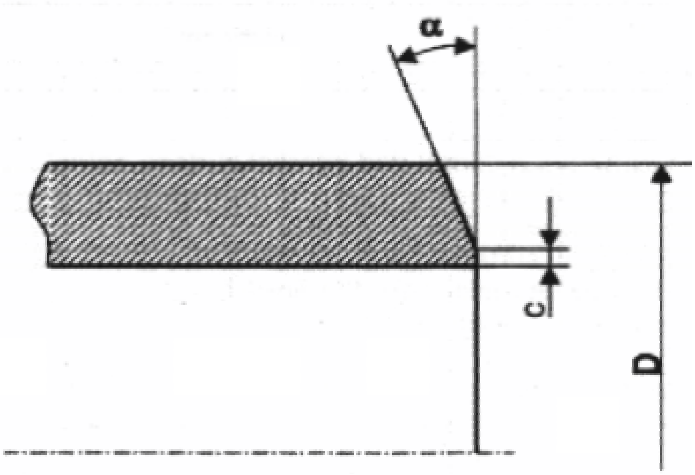

Figure 1 — Tube end bevel

8.7 Dimensions, masses and tolerances

8.7.1 Diameters and wall thickness

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

Preferred outside diameters D and wall thickness T have been selected from ENV 10 220 and are given in Table 8 for HFW tubes and in Table 9 for SAW tubes.

NOTE Dimensions which are different from those in Tables 8 and 9 may be agreed.

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Table 8 — Preferred dimensions of electric welded steel tubes

dimensions in mm

Outside diameter D Series [a]			Wall thickness T																				
1	2	3	1,4	1,6	1,8	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5	14,2	16
10,2																								
	12																							
	12,7																							
13,5																								
		14																						
	16																							
17,2																								
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	32																							
33,7																								
		35																						
	38																							
	40																							
42,4																								
		44,5																						
48,3																								
	51																							
		54																						
	57																							
60,3																								
	63,5																							

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Table 8: continues

dimensions in mm

Outside diameter D Series [a]			Wall thickness T																				
1	2	3	1,4	1,6	1,8	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5	14,2	16
	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																								

[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.

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Table 9 — Preferred dimensions of submerged arc welded steel tubes

dimensions in mm

Outside diameter D Series [a]			Wall thickness T																					
1	2	3	4	4,5	5	5,6	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
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																								
	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.

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8.7.2 Mass

For the mass per unit length the provision of ENV 10220 applies.

8.7.3 Lengths

Unless option 10 is specified, the tubes shall be delivered in random lengths. The delivery range shall be agreed at the time of enquiry and order.

Option 10: *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.*

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 10.

Table 10 — Tolerances on outside diameter and wall thickness

dimensions in mm

Outside Diameter	Tolerance on outside diameter	Tolerance on wall thickness T [a]	
D	D	T ≤ 5	5 < T ≤40
D ≤ 219,1	± 1,0 % 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 11 and 12.

Table 11 — Maximum height of the weld seam for HFW tubes

Outside weld seam	Inside weld seam
Trimmed	0,5 mm + 0,05T

Table 12 — Maximum height of the weld seam for SAW tubes

Wall thickness T (mm)	Maximum height of the outside and inside weld seam (mm)
T ≤ 12,5	3
T > 12,5	4

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

The radial offset of the abutting plate or strip edges of SAW tubes shall within the limits indicated in Table 13.

Table 13 — Maximum radial offset of the abutting plate or strip

dimensions in mm

Thickness T	Maximum radial offset
T ≤ 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

Misalignement of the weld seam of SAW tubes 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 14.

Table 14 — Tolerances on exact length

dimensions in mm

Length	Tolerances for outside diameter D	
L	< 406,4	≥ 406,4
L ≤ 6000	+ 10 0	+ 25 0
6000 < L ≤ 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:

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

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 ≤ 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 ≤ 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.

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9 Inspection

[A1] 9.1 Type of inspection

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

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 welded 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.

9.2 Inspection documents

9.2.1 Types of inspection documents

Unless Option 11 is specified an inspection certificate 3.1.B in accordance with EN 10204 shall be issued.

Option 11: *One of the inspection documents 3.1.A, 3.1.C or 3.2 in accordance with EN 10204 shall be issued.*

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.

NOTE Document 3.1.A is not acceptable for compliance with the Directive 97/23/EC.

9.2.2 Content of inspection documents

The content of the inspection document shall be in accordance with EN 10168.

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

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 location of the samples and direction of the test pieces and testing temperature;
— C10-C13 tensile test;
— C40-C43 impact test if applicable;
— C60-C69 other tests (e.g. flattening);
— 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; material identification;
— 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]

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9.3 Summary of inspection and testing

The tubes shall be inspected and tested in accordance with test category 1 or test category 2 as specified at the time of enquiry and order (see 6.1).

Inspection and testing to be carried out are summarised in Table 15.

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Table 15 — Summary of inspection and testing

Type of inspection and test		Frequency of testing	Refer to	Test category 1	Test category 2
Mandatory Tests	Cast analysis	one per cast	8.2.1 and 11.1	X	X
	Tensile test on the base material at room temperature	one per sample tube	8.3 and 11.2.1.1	X	X
	Tensile test on the weld at room temperature for SAW tubes with D > 508 mm [a]		8.3 and 11.2.2	X	X
	Flattening test [b] for D < 600 mm and T/D ratio ≤ 0,15 but T ≤ 40 mm or [c] for D > 150 mm ring tensile test for HFW tubes		8.3, 11.3 and 11.4	X	X
	Drift expanding test for D ≤ 150 mm and T ≤ 10 mm or [c] ring expanding test for D ≤114.3 mm and T ≤ 12,5 mm for HFW tubes		8.3, 11.5 and 11.6	X	X
	Weld bend test for SAW tubes		8.3 and 11.7	X	X
	Impact test on the base material [d]		8.3 and 11.8	X	X
	Impact test on the weld for SAW tubes [d]		8.3 - 11.8	X	X
	Leak tightness test	each tube	8.4.3.1 and 11.9	X	X
	Dimensional inspection	8.7 - 11.10		X	X
	Visual examination	11.11		X	X
	NDT on the weld of HFW tubes	each tube	8.4.3.2 and 11.12.1	X	--
	NDT on the weld of SAW tubes		8.4.3.2 and 11.12.2	X	X
	NDT on tube body and on the weld for the detection of longitudinal imperfections for HFW tubes		8.4.3.2 and 11.12.1	--	X
	NDT on base material for laminations for SAW tubes		8.4.3.2 and 11.12.2	--	X
	NDT of tube ends for laminations for SAW tubes		8.4.3.2 and 11.12.2	--	X
	NDT of plate/strip edges for laminations for SAW tubes		8.4.3.2 and 11.12.2	--	X
	Material identification		11.13	X	X
Optional Tests	Product analysis (option 3)	one per cast	8.2.2 and 11.1	X	X
	Tensile test at elevated temperature (option 4) and (option 5)	one per cast and same heat treatment condition	8.3 and 11.2.1	X	X
	Tensile test on the weld at room temperature for HFW tubes (option 14)[e]	one per sample tube	8.3 and 11.2.2	X	X
	Wall thickness T measurement away from tube end (option 16)	each tube	8.7 and 11.10	X	X
	NDT for the detection of transverse imperfections for HFW tubes (option 7)		8.4.3.2 and 11.12.1.3	--	X
	NDT for the detection of laminar imperfections of HFW tubes (option 8)		8.4.3.2 and 11.12.1.4	--	X

[a] ***Option 12:*** *For SAW tubes of outside diameter D less than or equal to 508 mm a transverse tensile test on the weld shall be carried out.*

[b] For the flattening test 2 test pieces shall be tested with the weld position at 0° and 90

[c] The choice of flattening test or ring tensile test and of drift expanding test or ring expanding test is at the discretion of the manufacturer.

[d] ***Option 13:*** *Additional to the testing at standard test temperature the impact test shall be performed at a temperature selected from those given in Table 7 for the relevant steel grade.*

[e] ***Option 14:*** *For HFW tubes of outside diameter D greater than 219,1 a transverse tensile test on the weld shall be carried out.*

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10 Sampling

10.1 Frequency of tests

10.1.1 Test unit

For tubes delivered without subsequent heat treatment or weld line heat treated tubes a test unit shall comprise tubes of the same specified diameter and wall thickness, the same steel grade, the same cast, the same manufacturing process.

For tubes which are furnace heat treated a test unit shall comprise tubes of the same specified diameter and wall thickness, the same steel grade, the same cast, the same manufacturing process, subjected to the same finishing treatment in a continuous furnace or heat treated in the same furnace charge in a batch-type furnace.

The number of tubes per test unit shall conform to Table 16:

Table 16 — Number of tubes per test unit

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

10.1.2 Number of sample tubes per test unit

The following number of sample tubes shall be selected from each test unit:

— test category 1: one sample tube per test unit;

— test category 2: two sample tubes per test unit; when the total number of tubes is less

than 20, only one tube shall be tested.

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 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 piece for the tensile test at room temperature shall be prepared in accordance with the requirements of EN 10002-1.

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The test piece for the tensile test at elevated temperature shall be taken in accordance with the requirements of EN 10002-5.

At the manufacturer's discretion:

for tubes with an outside diameter D ≤ 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 the full tube section in 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 thickness of the tube; the weld bead may be removed.

10.2.2.4 Test pieces for flattening test, ring tensile test, drift expanding test, ring expanding test

The test piece for the flattening test, ring tensile test, drift expanding test, ring expanding test shall consist of a full tube section in accordance with EN 10233, EN 10237, EN 10234 or EN 10236 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 piece for the impact test on base material

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

~~-~~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.

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

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.

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Key:

1 Longitudinal test piece
2 transverse test piece

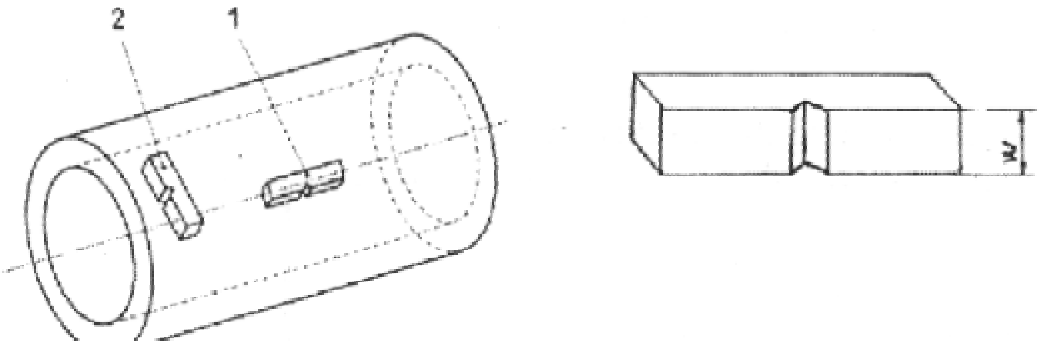

Figure 2 — Impact test piece orientation

10.2.2.7 Test pieces for impact test on the weld of SAW tubes

Three sets of three standard Charpy V-notch test pieces in accordance with EN 10045-1 shall be prepared. 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 5 mm width minimum test pieces cannot be obtained, these weld shall not be subject to impact testing.

The test pieces shall be taken transverse to the weld.

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 as follows :

in the middle of weld for one set;

at both side of the weld corresponding to the heat-affected zone for the other two sets.

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 CR10261.

11.2 Tensile test

11.2.1 Tensile test on the base material

11.2.1.1 At room temperature

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

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

11.2.1.2 At elevated temperature

The test shall be carried out in accordance with EN 10002-5 at the 400 °C and the following shall be determined:

— the 0,2% proof strength ($R_{p0,2}$);

— the tensile strength (R_m).

11.2.2 Transverse tensile test on the weld

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

11.3 Flattening test

The test 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 given by the following equation:

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

where :

— H is the distance between platens, in mm, to be measured under load;

— D is the specified outside diameter, in mm;

— T is the specified wall thickness, in mm;

— C is the constant factor of deformation the value of which is:

  — 0,07 for steel grades with specified minimum yield strength ≤ 355 MPa;

  — 0,05 for steel grades with specified minimum yield strength of 460 MPa.

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.

11.4 Ring tensile test

The test shall be carried out in accordance with EN 10237.

The tube section shall be subjected to strain in the circumference direction until fracture occurs.

After fracture the test pieces shall not show any visible cracks without the use of magnifying aids (excluding the fracture point).

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11.5 Drift expanding test

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 17 is reached.

Table 17 — Drift expanding test requirements

Steel grade	% increase in outside diameter for d/D [a]		
	≤ 0,6	> 0,6 ≤ 0,8	> 0,8
All steel grades	8	10	15
[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 justification for rejection.

11.6 Ring expanding test

The test shall be carried out in accordance with EN 10236.

The tube section shall be expanded with a conical tool until it breaks. The surface outside the fracture zone shall be free from cracks or breaks. However, slight incipient cracks at its edges shall not be regarded as justification for rejection.

11.7 Weld bend test for SAW tubes

The shall be carried out in accordance with EN 910 using a mandrel of a diameter of 3T. After testing the test piece shall show no cracks or flaws but slight premature failure at its edges shall not be regarded as a justification for rejection.

11.8 Impact test

11.8.1 The test shall be carried out in accordance with EN 10045-1, at - 20 °C for the basic and elevated temperature quality and at the relevant lowest temperature in accordance with Table 7 for the low and special low temperature quality.

11.8.2 The mean value of three test pieces shall meet the requirements given ŀin Table 7. One individual value may be below the specified value, provided that it is not less than 70 % of that value.

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

$$KVc = \frac{10xKVp}{W} \qquad (4)$$

where

— KV_c is the calculated impact energy, in J;

— KV_p is the measured impact energy, in J;

— W is the width of the test piece, in mm.

The calculated impact energy KV_c shall conform to the requirements given in 11.8.2.

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11.8.4 If the requirements of 11.8.2 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 average value;

— not more than two of the six individual values may be lower than the specified minimum average value;

— not more than one of the six individual values may be lower than 70 % of the specified minimum average value.

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

11.9 Leak tightness test

11.9.1 Hydrostatic test

The hydrostatic test shall be carried out at a test pressure of 70 bar[3)] or at a test pressure P ~~P~~calculated using the following equation, whichever is lower:

$$P = 20\frac{SxT}{D} \qquad (5)$$

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 less than or equal to 457 mm and for not less than 10 s for tubes with an outside diameter D ~~-~~greater than 457 mm.

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

Option 15: *A test pressure different from that specified in 11.9.1 and corresponding to stress below 90% of the specified minimum yield strength (see Table 4) for the steel grades concerned is specified.*

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

11.9.2 Electromagnetic test

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

3) 1 bar = 1 KPa

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11.10 Dimensional inspection

Specified dimensions, including straightness, shall be verified.

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

Unless option 16 is specified the wall thickness shall be measured at both tube ends.

Option 16: *The wall thickness shall be measured away from the tube ends in accordance with an greed procedure.*

11.11 Visual examination

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

11.12 Non-Destructive Testing

11.12.1 Non-Destructive Testing of the weld of HFW-tubes

11.12.1.1 The full length of the weld seam of tubes of test category 1 shall be tested in accordance with either EN 10246-3 to acceptance level E3, EN10246-5 to acceptance level F3, EN 10246-7 to acceptance level U3, sub-category C or EN 10246-8 to acceptance level U3.

Unless option 17 is specified, the selection of the test inspection method is at the discretion of the manufacturer.

Option 17: *The test inspection method is specified by the purchaser*

Weld seam at the tube ends not automatically tested shall either be subjected to manual/semi-automatic ultrasonic testing in accordance with EN 10246-8 to acceptance level U3 or be cropped off.

11.12.1.2 Tubes of test category 2 shall be submitted to ultrasonic testing for the detection of longitudinal imperfections, in accordance with EN 10246-7 to acceptance level U2, sub-category C.

Regions at the tube ends not automatically tested shall either be subjected to manual/semi-automatic ultrasonic testing in accordance with EN 10246-7 to acceptance level U2, sub-category C or be cropped off.

11.12.1.3 When option 7 (see 8.4.3.2) is specified, the tubes shall be subjected to ultrasonic testing for the detection of transverse imperfections in accordance with EN 10246-6 to acceptance level U2, sub-category C.

11.12.1.4 When option 8 (see 8.4.3.2) is specified, the tubes shall be subjected to ultrasonic testing for the detection of the laminar imperfections in accordance with EN 10246-14 to acceptance level U2.

11.12.2 Non-Destructive Testing of SAW-tubes

11.12.2.1 Non-Destructive Testing of the weld seam

The full length of the weld seam of tubes shall be tested in accordance with either EN 10246-9 to acceptance level U3 for test categories 1 and level U2 for test category 2 or to EN 10246-10 to image quality class R2.

Unless option 18 is specified, the test method used shall be at the discretion of the manufacturer.

Option 18: *The non-destructive test method is chosen by the purchaser*

Option 19:*The image quality class R1 of EN 10246-10 shall be applied for the radiographic inspection of the weld seam.*

Weld seam at the tube ends not automatically tested shall either be subjected either to manual/semiautomatic ultrasonic testing or to radiographic testing using the same method as specified above or be cropped off

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11.12.2.2 Non-Destructive Testing for the detection of laminations for tubes of test category 2,

The base material shall be tested in accordance with EN 10246-15 with acceptance level U2.

The tube ends shall be tested in accordance with EN 10246-17. Laminar imperfections greater than 6 mm in the circumferential direction are not permitted within 25 mm the tube ends.

The strip/plate edges adjacent to the weld seam shall be tested in accordance with either EN 10246-15 or

EN 10246-16 with acceptance level U2 within a 15 mm zone along the weld seam.

11.12.2.3 The plate or strip end welds for helically welded tubes shall be tested in accordance with 11.12.2.1 and 11.12.2.2.

11.13 Material identification

Each tube made of steel grade P460 shall be tested by an appropriate method to ensure that the correct grade is being supplied.

11.14 Retests, sorting and reprocessing

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

12 Marking

12.1 Marking to be applied

The marking shall be indelibly marked on each tubes at least at one end. For tubes with outside diameter D < 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 ;

— the type of the tubes (symbols in accordance with Table 1);

— the number of this European standard and the steel name (see 5.2);

— the test category;

— the category conformity indicator, if applicable (see , 7.3.1 and 7.3.3).

— the cast number or a code number;

— the mark of the inspection representative;

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

Example of marking:

X HFW - EN 10217-3 - P275NL1 - TC1 — C1 - Y - Z_1 - Z_2

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where:

— X is the manufacturer's mark;

— HFW is the type of the tubes;

— TC1 is the designation of the test category 1;

— C1 is the category conformity indicator

— Y is the cast number or a code number;

— Z_1 is the mark of the inspection representative;

— Z_2 is the identification number.

12.2 Additional marking

Option 20: *Additional marking, as agreed upon at the time of enquiry and order, shall be applied.*

13 Protection

The tubes shall be delivered without a temporary protective coating.

Option 21: *A temporary protective coating or durable coating and/or lining shall be applied.*

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Annex A (normative)

Qualification of welding procedure for SAW tube production

A.1 General

Submerged arc weld tube produced to this ~~p~~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 ~~F~~flux recycling procedure~~,~~ shall be referenced.

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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 form

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

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 authorized 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.

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Table A.1 Example of typical welding procedure specification form

<table>
<tr><td colspan="11">Welding procedure specification</td></tr>
<tr><td colspan="3">Ref. N. WPS:</td><td colspan="3">Prepared by:</td><td colspan="4">Checked by:</td><td>Date:</td></tr>
<tr><td colspan="6">Parent metal:</td><td colspan="5">Thickness/diameter:</td></tr>
<tr><td colspan="6">Weld preparation:</td><td colspan="5">Pass location:</td></tr>
<tr><td colspan="3">Preparation method</td><td colspan="8">Machined/plasma or falme cut</td></tr>
<tr><td rowspan="2">Pass n.</td><td rowspan="2">Wire n.</td><td rowspan="2">Welding position</td><td colspan="5">Wire</td><td>Nominal current</td><td>Nominal arc voltage</td><td>Nominal travel speed</td></tr>
<tr><td>Size mm</td><td>Code n.</td><td>Designation</td><td>Polarity</td><td>Flux</td><td>A</td><td>V</td><td>mm/s</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="8">Heat imput [a]</td><td>Preheat</td><td></td><td>°C min</td></tr>
<tr><td colspan="3">Heat treatment</td><td colspan="3">Stress relieving</td><td colspan="3">Normalizing</td><td colspan="2">Interpass temperature</td><td>°C max</td></tr>
<tr><td colspan="3">Heating rate</td><td colspan="3"></td><td colspan="3"></td><td colspan="3" rowspan="5">NDT</td></tr>
<tr><td colspan="3">Soaking temperature</td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td colspan="3">Soaking time</td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td colspan="3">Cooling rate</td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td colspan="3">Withdraw temperature</td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td colspan="11">Notes</td></tr>
<tr><td colspan="11">[a] If required</td></tr>
</table>

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]	3 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)

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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 sets of three standard Charpy V-notch test pieces taken transverse to the weld shall be prepared in accordance with 10.2.2.7.

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 11.12.2.1.

A.6.3 Weld bend test

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

A.6.4 Macro-examination

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

A.6.5 Transverse weld tensile test

The transverse weld tensile test shall be carried out in accordance with 11.2.2.

A.6.6 Weld impact test

The weld impact test shall be carried out in accordance with 11.8.

A.7 Test acceptance levels

A.7.1 Visual examination

Cracks shall not be permitted.

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A.7.2 Radiographic test

This shall meet the acceptance requirements of 11.12.2.1.

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 11.7.

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 12 and 13 and clause 8.7.4.4 respectively.

A.7.5 Transverse weld tensile test

The value of R_m shall be determined and meet the requirements of 11.2.2 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 11.8 and Table 7 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.

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Table A.3 Example of typical test results form

Test results				
Manufacturer: Welding procedure Reference no: Visual examination: Pass/fail Penetrant/magnetic particle test Pass/fail				Examiner or examining body: Reference no: Radiographic test [a]: Pass/fail Ultrasonic examination [a]: Temperature: °C
Tensile tests				
Type /No.	Rm MPa	Fracture location		Remarks
Requirements				
Bend tests Former diameter				Macro examination
Type /No.	Bend angle	Results		
Impact test [a] Type:		Size:		Requirement:
Notch Location/Direction	Temperature °C	Values J		Remarks
		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.				

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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.

Table A.4: Grouping system for SAW steel tubes

Group	Type of steel	
	Steel name	Steel number
1	P275NL1	1.0488
	P275NL2	1.1104
	P355N	1.0562
	P355NH	1.0565
	P355NL1	1.0566
	P355NL2	1.1106
2	P460N	1.8905
	P460NH	1.8935
	P460NL1	1.8915
	P460NL2	1.8918

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 T of sample tube	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 wire covers other filler wires provided they meet the following requirement:

they shall be in the same group of steels as defined in Table A.4;

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 change 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).

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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 authorized 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.

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Annex B (Normative)

Elevated temperature properties for steel grades P275NL1 and NL2

Table B1 - Minimum 0,2 %- proof strength [a] [b]

Wall thickness T	$Rp_{0,2}$ (MPa) at a temperature of °C						
mm	100	150	200	250	300	350	400
≤ 20	255	235	206	186	157	137	118
> 20 to ≤40	245	226	206	186	157	137	118

[a] For wall thickness T ≤ 16 mm for HFW tubes and ≤ 40 mm for SAW tubes.

[b] see 8.3

Table B2 - Minimum tensile strength [a] [b]

Wall thickness T	R_m (MPa) at a temperature of °C						
mm	100	150	200	250	300	350	400
≤ 30	340	330	310	310	310	300	290
> 30 to ≤ 40	320	310	290	290	290	280	270

[a] For wall thickness T ≤ 16 mm for HFW tubes and ≤ 40 mm for SAW tubes.

[b] see 8.3

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A1 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 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
7.2 and 8.2 Table 2 and Table 5	4.1c	Ageing
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

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Bibliography

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

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