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English Version

Welded steel tubes for pressure purposes - Technical delivery conditions - Part 3: Electric welded and submerged arc welded alloy fine grain steel tubes with specified room, elevated and low temperature properties

Tubes soudés en acier pour service sous pression - Conditions techniques de livraison - Partie 3: Tubes en acier en acier allié à grains fins, soudés électriquement et soudés à l'arc immergé avec caractéristiques spécifiées à basse température et température élevée

Geschweißte Stahlrohre für Druckbeanspruchungen - Technische Lieferbedingungen - Teil 3: Elektrisch geschweißte und unterpulvergeschweißte Rohre aus legierten Feinkornbaustählen mit festgelegten Eigenschaften bei Raum-, erhöhten und tiefen Temperaturen

This European Standard was approved by CEN on 25 February 2019.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 10217-3:2019) has been prepared by Technical Committee CEN/TC 459 "ECISS - European Committee for Iron and Steel Standardization"[1], the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by October 2019, and conflicting national standards shall be withdrawn at the latest by October 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 10217-3:2002.

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 2014/68/EU.

For relationship with EU Directive 2014/68/EU (formerly 97/23/EC), see informative Annex ZA, which is an integral part of this document.

This European Standard consists of the following parts, under the general title *Welded steel tubes for pressure purposes – Technical delivery conditions*:

Part 1: Electric welded and submerged arc welded 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 3: Electric welded and submerged arc welded alloy fine grain steel tubes with specified room, elevated and low 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 organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia,

[1] Through its subcommittee SC 10 "Steel tubes, and iron and steel fittings" (secretariat: UNI)

France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document specifies the technical delivery conditions for two test categories of electric welded and submerged arc longitudinally (SAWL) or helically (SAWH) welded tubes of circular cross section, made from weldable fine grain steel.

NOTE 1 These tube grades are intended to support the essential requirements of EU Directive 2014/68/EU in respect of pressure equipment covered under all relevant Categories as set out in Article 13 of that Directive.

NOTE 2 Once this standard is published in the Official Journal of the European Union (OJEU), presumption of conformity to the Essential Safety Requirements (ESR) of Directive 2014/68/EU is limited to the technical data for the materials in this standard and does not presume adequacy of the material for a specific item of pressure equipment. Consequently, the assessment of the technical data stated in this material standard against the design requirements of a specific item of equipment to verify that the ESRs of the Pressure Equipment Directive are satisfied, needs to be done by the designer or manufacturer of the pressure equipment, taking also into account any subsequent processing procedures which may affect properties of the base materials.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

EN 10021:2006, *General technical delivery conditions for steel products*

EN 10027-1, *Designation systems for steels — Part 1: Steel names*

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

EN 10168:2004, *Steel products — Inspection documents — List of information and description*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 10220, *Seamless and welded steel tubes — Dimensions and masses per unit length*

CEN/TR 10261, *Iron and steel — European standards for the determination of chemical composition*

EN 10266, *Steel tubes, fittings and structural hollow sections — Symbols and definitions of terms for use in product standards*

EN ISO 148-1:2016, *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1:2016)*

EN ISO 377:2017, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing (ISO 377:2017)*

EN ISO 643:2012, *Steels — Micrographic determination of the apparent grain size (ISO 643:2012)*

EN ISO 2566-1:1999, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels (ISO 2566-1:1984)*

EN ISO 4885, *Ferrous materials — Heat treatments — Vocabulary (ISO 4885)*

EN ISO 5173:2010, *Destructive tests on welds in metallic materials — Bend tests (ISO 5173:2009)*

EN ISO 6892-1:2016, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2016)*

EN ISO 6892-2:2018, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature (ISO 6892-2:2018)*

EN ISO 8492:2013, *Metallic materials — Tube — Flattening test (ISO 8492:2013)*

EN ISO 8493:2004, *Metallic materials — Tube — Drift-expanding test (ISO 8493:1998)*

EN ISO 8495:2013, *Metallic materials — Tube — Ring-expanding test (ISO 8495:2013)*

EN ISO 8496:2013, *Metallic materials — Tube — Ring tensile test (ISO 8496:2013)*

EN ISO 10893-1:2011, *Non-destructive testing of steel tubes — Part 1: Automated electromagnetic testing of seamless and welded (except submerged arc-welded) steel tubes for the verification of hydraulic leaktightness (ISO 10893-1:2011)*

EN ISO 10893-2:2011, *Non-destructive testing of steel tubes — Part 2: Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections (ISO 10893-2:2011)*

EN ISO 10893-3:2011, *Non-destructive testing of steel tubes — Part 3: Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections (ISO 10893-3:2011)*

EN ISO 10893-6:2011, *Non-destructive testing of steel tubes — Part 6: Radiographic testing of the weld seam of welded steel tubes for the detection of imperfections (ISO 10893-6:2011)*

EN ISO 10893-7:2011, *Non-destructive testing of steel tubes — Part 7: Digital radiographic testing of the weld seam of welded steel tubes for the detection of imperfections (ISO 10893-7:2011)*

EN ISO 10893-8:2011, *Non-destructive testing of steel tubes — Part 8: Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections (ISO 10893-8:2011)*

EN ISO 10893-9:2011, *Non-destructive testing of steel tubes — Part 9: Automated ultrasonic testing for the detection of laminar imperfections in strip/plate used for the manufacture of welded steel tubes (ISO 10893-9:2011)*

EN ISO 10893-10:2011, *Non-destructive testing of steel tubes — Part 10: Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections (ISO 10893-10:2011)*

EN ISO 10893-11:2011, *Non-destructive testing of steel tubes — Part 11: Automated ultrasonic testing of the weld seam of welded steel tubes for the detection of longitudinal and/or transverse imperfections (ISO 10893-11:2011)*

EN ISO 14174:2012, *Welding consumables — Fluxes for submerged arc welding and electroslag welding — Classification (ISO 14174:2012)*

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

EN ISO 17639:2013, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds (ISO 17639:2003)*

ISO 11484:2009, *Steel products — Employer's qualification system for non-destructive testing (NDT) personnel*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10020, EN 10021, EN 10266, EN ISO 4885 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

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 1 to entry: The employer may be either the tube manufacturer or a third party organization providing services, such as Non-Destructive Testing (NDT).

3.3
EW
electric welded tube
tubular product having one longitudinal seam weld produced by electric (resistance) welding where the strip edges to be welded are mechanically pressed together and the heat for the welding process is generated by the resistance to flow of low or high frequency electric current applied by either a conduction or induction process

3.4
HFW
high frequency welded tube
EW tube produced specifically using a welding current frequency equal to or greater than 100kHz

3.5
SAW
submerged-arc welded tube
tubular product having one or two longitudinal seams, or one helical seam, produced using the submerged-arc welding process

3.6
SAWH
submerged-arc helical welded tube
tubular product having one helical weld seam produced using the submerged-arc welding process

3.7
SAWL
submerged-arc longitudinal welded tube
tubular product having one or two longitudinal weld seams produced using the submerged-arc welding process

4 Symbols

For the purposes of this document, the symbols given in EN 10266 apply.

5 Classification and designation

5.1 Classification

5.1.1 This document 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 tube grades in this standard are classified as follows:

— P275NL1, P355N, P355NH and P355NL1 are alloy quality steels;

— The other grades are alloy special steels.

5.2 Designation

5.2.1 For the tubes covered by this document, the steel designation consists of:

— the number of this European Standard, e.g. EN 10217-3;

plus either:

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

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, total length or number of tubes of set length);

b) the term ‘tube’ and tube type, HFW, SAWL or SAWH;

c) the dimensions (outside diameter D, wall thickness T) (see Tables 8 and 9);

d) the random length range (see 8.8.3);

e) for tubes with a $D/T > 100$, out of roundness limits (see 8.8.4.6).

f) the designation of the steel grade in accordance with this document (see 5.2);

g) the test category (see 9.3).

6.2 Options

A number of options are specified in this document 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 7.2.1);

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

3) Product analysis (see 8.2.2);

4) Determination of grain size according to EN ISO 643 (see 8.3);

5) Verification of elevated temperature mechanical properties for NH-grades (see 8.4);

6) Verification of mechanical properties at elevated temperature for NL-grades (see 8.4 and Annex B);

7) Selection of method for verification of leak-tightness (see 8.5.3.1);

8) Non-Destructive Testing of test category 2 HFW tubes for detection of transverse imperfections (see 8.5.3.2);

9) Non-Destructive Testing of test category 2 tubes for detection of laminar imperfections (see 8.5.3.2);

10) Special end preparation (see 8.7);

11) Exact lengths (see 8.8.3);

12) Inspection document 3.2 in place of the standard 3.1 Inspection Certificate (see 9.2.1);

13) Verification of tensile strength of the weld in the transverse direction for tubes with $219{,}1 < D \leq 508$ mm (see Table 15);

14) Additional verification of impact energy at a temperature different from the standard

15) Agreement of a different 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) Additional marking (see 12.2);

20) Protection (see Clause 13).

6.3 Example of an order

500 m of HFW 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, in 6 m random lengths, with a 3.2 inspection certificate in accordance with EN 10204:

500 m – HFW -Tube - 168,3 × 4,5 - EN 10217–3 — P355N -TC 1 - 6m - Option 12: 3.2

7 Manufacturing process

7.1 Steelmaking process

The steelmaking process is at the discretion of the steel or tube manufacturer with the exception that steel produced by the open hearth (Siemens-Martin) process shall not be employed unless in combination with a secondary steelmaking or ladle refining process.

Steels shall be fully killed and contain nitrogen binding elements, details of which shall be reported.

NOTE This excludes the use of rimming, balanced or semi-killed steel.

7.2 Tube manufacture and delivery conditions

7.2.1 Tube manufacturing shall be 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 from Table 1 is specified by the purchaser.*

Electric welded tubes shall be manufactured by a process employing high frequency welding (HFW), of minimum frequency 100 kHz.

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 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 the welds used to join together the strip or plate prior to forming, except for SAWH tubes to test category 1, where this is permitted only when the welding procedure for the weld joining the strip or plate has been qualified in accordance with Annex A and has also been subjected to the same inspection and testing regime as the helical pipe welds and base material to test category 2 (see 11.12.2.3).

7.2.2 Tube production welding shall be carried out by qualified personnel in accordance with documented procedures. For tubes to be used in pressure equipment under European legislation, manufacturers shall employ an established procedure for the approval of welding operatives.

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

7.2.4 The production (welding) process for HFW tubes shall be qualified and approved under the tube manufacturer's own QA system. Only HFW tubes (see 3.4) shall be supplied for pressure equipment under European legislation.

7.2.5 The delivery conditions for tubes covered by this document are shown in Table 1.

7.2.6 For grades P355N and P355NH full body normalizing may be replaced by normalizing rolling or by a hot (stretch) reduction process carried out within the normalizing temperature range.

7.2.7 For grade P460 it may be necessary to apply accelerated cooling and/or an additional tempering treatment after normalizing.

Table 1 — Tube manufacturing processes, route and delivery condition

Route N° (according to Part 1)	Manufacturing process		Manufacturing route		Acceptable delivery condition [a]	Applicable for Quality [c]
	Process	Symbols	Starting material	Forming operation		
1c	Electric Welded (HFW process) [b]	HFW [b]	Hot rolled strip	Cold formed and welded	NP [d]	A
1d					NR [d]	B
2b			Normalized rolled strip		NW	B
2c					NP [d]	A
2d					NR	B
4b	Submerged arc welded Longitudinal seam or Helical seam	SAW: -SAWL -SAWH	Hot rolled plate or strip		NP [d]	A
5a			Normalized rolled plate or strip		as welded [f]	B
6a			Full body normalized plate or strip			A
7a			Hot rolled plate or strip	Normalized formed and welded [e]	as welded [f]	A
8a			Normalized rolled plate or strip		as welded [f]	A
9a			Full body normalized plate or strip		as welded [f]	A

[a] As welded = as formed and welded with no subsequent heat treatment; NW = normalized weld zone; NP = tube full body normalized; NR = normalized rolled or hot (stretch) reduced within the normalizing temperature range;

[b] Only HFW tubes (see 3.4), minimum welding frequency 100kHz, (symbol = HFW) are permitted;

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

[d] see 7.2.6 and 7.2.7;

[e] Only applicable to SAWL tubes;

[f] Stress relieving treatment on the weld is permissible.

7.3 Non Destructive Testing Personnel Requirements

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

7.3.2 The qualification for levels 1 and 2 personnel shall be in accordance with ISO 11484 or, at least, an equivalent to it.

7.3.3. It is recommended for the level 3 personnel to be suitably certified, either in accordance with EN ISO 9712 or, at least, an equivalent to it.

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

7.3.5 All NDT operations shall be authorised by a level 3 NDT technician approved by the employer.

NOTE The definition of levels 1, 2 and 3 can be found in appropriate standards, e.g. EN ISO 9712 and ISO 11484.

8 Requirements

8.1 General

The tubes shall conform to the requirements of this document when supplied in a delivery condition in accordance with Table 1 and inspected in accordance with the specified requirements in Table 15.

Tubes shall be suitable for hot and cold bending.

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 shall conform to the requirements of Table 2.

When welding tubes produced in accordance with this document, account should be taken of the fact that the behaviour of the steel during and after welding is dependent not only on the steel analysis, but also on the welding process, including heat input, any 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	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				0,020										
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					0,020										
P460NL2	1.8918					0,015										

[a] Elements not quoted 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, which would have a negative impact on the mechanical properties, ageing and the suitability of the material.

[b] For Al/N ratios ≥ 2, if nitrogen is fixed by niobium, titanium or vanadium, details of which shall be reported, this requirement does not apply except that when using titanium, the steel producer shall verify that (Al+Ti/2) ≥ 0,020 %;

[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 operations, 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.

8.2.2 Product analysis

Unless Option 3 is specified, only the cast analysis shall be reported.

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.

Table 3 — Permissible deviations of the product analysis from the 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
P	≤ 0,025	+ 0,005
S	≤ 0,015	+ 0,003
	> 0,015 ≤ 0,020	+ 0,005
Cr	≤ 0,30	+ 0,05
Mo	≤ 0,10	+ 0,03
Ni	≤ 0,80	+ 0,05
Al	≥ 0,020	- 0,005
Cu	≤ 0,70	+ 0,05
N	≤ 0,020	+ 0,002
Nb	≤ 0,05	+ 0,005
Ti	≤ 0,03	+ 0,01
V	≤ 0,20	+ 0,02
Cr + Cu + Mo	≤ 0,45	+ 0,025

8.3 Grain size

Tubes shall have a ferritic grain size equal to or finer than 6, in accordance with EN ISO 643.This need not be verified unless Option 4 is specified.

Option 4: Grain size in accordance with EN ISO 643 *shall be determined and reported.*

8.4 Mechanical properties

The mechanical properties of the tubes, in a specified delivery condition from Table 1, shall conform to the requirements of Tables 4 and 7 plus the relevant additional tests specified in 11.3 to 11.7, irrespective of whether the test results are actually verified or not (see Table 15 for a summary of the inspection and verification testing required).

The tensile properties at elevated temperature, for tube in grades P355NH and P460NH, are given in Tables 5 and 6, These do not have to be verified unless Option 5 is specified. By agreement, these properties can also be applied to the corresponding low and special low temperature quality steels (P355NL1 and NL2 or P460NL1 and NL2) if Option 6 is specified.

Option 5: *Elevated temperature tensile properties for the tube, given in Tables 5 and 6, shall be verified for NH-grades either at 400 °C or at an alternative temperature agreed at the time of enquiry and order.*

Elevated temperature tensile properties for steel grades P275NL1 and P275NL2 are given in Annex B. These do not apply unless Option 6 is specified.

Option 6: *Elevated temperature tensile properties for the tube shall be verified for NL grades, either at 400 °C or at an alternative temperature agreed at the time of enquiry and order. Values given in Tables 5 and 6 for P355NH and P460NH, shall be applied to the equivalent P355NL and P460NL grades. Specified properties for P275NL grades are set out in Annex B.*

Table 4 — Mechanical properties [a]

Steel grade		**Tensile properties at room temperature**						
Steel name	**Steel number**	**Upper yield strength or proof strength R_{eH} or $R_{p0,2}$ min. for specified wall thickness T mm**			**Tensile strength R_m for specified wall thickness T mm**		**Elongation [b] A min**	
		≤ 12	**> 12 to ≤ 20**	**> 20 to ≤ 40**	**≤ 20**	**> 20 to ≤ 40**	**l**	t
		MPa			MPa		**%**	
P275NL1	1.0488	275			390 to 530	390 to 510	24	22
P275NL2	1.1104							
P355N	1.0562	355		345	490 to 650	490 to 630	22	20
P355NH	1.0565							
P355NL1	1.0566							
P355NL2	1.1106							
P460N	1.8905	460	450	440	560 to 730		19	17
P460NH	1.8935							
P460NL1	1.8915							
P460NL2	1.8918							

a Applicable for wall thickness $T \leq 16$ mm for HFW tubes and ≤ 40 mm for SAW tubes.

b **l** = longitudinal; t = transverse

Table 5 — Minimum 0,2 % proof strength ($R_{p0,2}$) at elevated temperature [a] [b]

Steel grade		Wall thickness	$R_{p0,2}$ min. MPa at a temperature of °C						
Steel name	Steel number	T mm	100	150	200	250	300	350	400
P355NH	1.0565	≤ 20	304	284	255	235	216	196	167
		> 20 to ≤ 40	294	275	255	235	216	196	167
P460NH	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 Applicable for wall thickness T ≤ 16 mm for HFW tubes and ≤ 40 mm for SAW tubes.

b See 8.4.

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

Steel grade		Wall thickness	R_m min. MPa at a temperature of °C						
Steel name	Steel number	T mm	100	150	200	250	300	350	400
P355NH	1.0565	≤ 30	440	430	410	410	410	400	390
		> 30 to ≤ 40	420	410	390	390	390	380	370
P460NH	1.8935	≤ 30	510	490	480	480	480	470	460
		> 30 to ≤ 40	490	470	460	460	460	450	440

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

b See 8.4.

Table 7 — Impact properties [a]

Steel grades		Minimum average absorbed energy [c] KV_2 [b] J at a temperature of °C													
Steel name	Steel number	l							t						
		- 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] Applicable for wall thickness $T \leq 16$ mm for HFW tubes and ≤ 40 mm for SAW tubes.

[b] KV_2 = impact values obtained using a 2mm radius striker in accordance with EN ISO 148-1

[c] l = longitudinal t = transverse

8.5 Appearance and internal soundness

8.5.1 Weld seam

The weld area shall be free from cracks, lack of fusion and lack of penetration. Repairs to the weld seam of HFW tubes are not permitted. Repairs to the weld seam of SAW tubes shall be permitted if done in accordance with an agreed documented procedure.

NOTE For strip and plate alignment (radial offset) and tolerances in the weld region, see 8.8.4.2 for HFW tubes and 8.8.4.3 / 8.8.4.4 for SAW tubes.

8.5.2 Tube surface

8.5.2.1 The tubes shall be free from external and internal surface defects that can be detected by visual examination of the surfaces that are accessible without the use of special equipment.

8.5.2.2 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.

8.5.2.3 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.

8.5.2.4 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.

8.5.2.5 Surface imperfections which extend below the specified minimum wall thickness shall be considered defects and tubes containing these shall be deemed not to conform with this document and shall be rejected.

8.5.3 Internal soundness

8.5.3.1 Leak tightness

The tubes shall be assessed for leak tightness by either a hydrostatic test (see 11.9.1) or an electromagnetic test (see 11.9.2).

Unless Option 7 is specified, the choice of the test method shall is the discretion of the manufacturer.

Option 7: *The test method for verification of leak-tightness in accordance with 11.9.1 or 11.9.2 is specified by the purchaser.*

NOTE SAW tubes cannot be tested in accordance with 11.9.2.

8.5.3.2 Non-Destructive Testing

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

The full length of the weld seam of all SAW tubes of test categories 1 and 2 shall be subjected to Non-Destructive Testing for the detection of imperfections in accordance with 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 11.12.1.2.

Additionally the edges of the plate or strip, the body and the ends of SAW tubes supplied to test category 2 shall be subjected to Non-Destructive Testing for the detection of laminar imperfections in accordance with 11.12.2.2.

For test category 2 HFW tubes, if Options 8 or 9 are specified, additional NDT testing shall be applied.

Option 8: *HFW tubes of test category 2 shall be subjected to a Non-Destructive Testing for the detection of transverse imperfections in accordance with 11.12.1.3.*

Option 9: *HFW tubes of test category 2 shall be subjected to a Non-Destructive Testing for the detection of laminar imperfections in accordance with 11.12.1.4.*

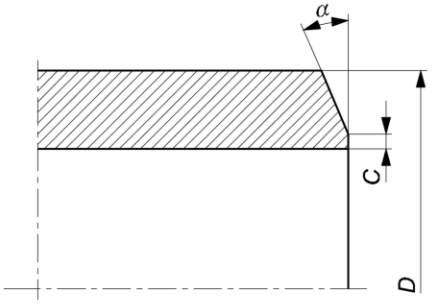
8.6 Straightness

The deviation from straightness of any tube length L shall not exceed 0,001 5 L. Deviations from straightness over any one metre length shall not exceed 3 mm.

8.7 Preparation of ends

Unless Option 10 is specified, tubes shall be delivered with square cut ends free from excessive burrs.

Option 10*: The tubes shall be delivered with bevelled ends (see Figure 1). The bevel shall have an angle α of 30°* $^{+5°}_{0°}$ *with a root face C of 1,6 mm ± 0,8 mm. Bevelling is applicable for specified wall thicknesses ≥ 3,2 mm, except that for wall thickness T ≥ than 20 mm, an agreed alternative bevel may be specified.*



Key

D outside diameter

α bevel angle

C root face of bevelled end

Figure 1 — Tube end bevel

8.8 Dimensions, masses and tolerances

8.8.1 Diameters and wall thickness

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

The preferred outside diameters D and wall thicknesses T have been selected from EN 10220 and are given in Table 8 for HFW tubes and in Table 9 for SAW tubes.

NOTE Dimensions other than those in Tables 8 and 9 may be agreed.

Table 8 — Preferred dimensions of HFW steel tubes

Dimensions in millimetres

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																								
		18																						
	19																							
	20																							
21,3																								
		22																						
	25																							
		25,4																						
26,9																								
		30																						
	31,8																							
	32																							
33,7																								
		35																						
	38																							
	40																							
42,4																								

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
		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																						

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
219,1																								
		244,5																						
273																								
323,9																								
355,6																								
406,4																								
457																								
508																								
610																								

[a] series 1 = diameters for which all the accessories needed for the construction of piping systems are standardised;
series 2 = diameters for which not all the accessories are standardised;
series 3 = diameters for special applications for which very few standardised accessories exist.

Table 9 — Preferred dimensions of SAW steel tubes

Dimensions in millimetres

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 systems are standardised;
series 2 = diameters for which not all the accessories are standardised;
series 3 = diameters for special applications for which very few standardised accessories exist.

8.8.2 Mass

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

8.8.3 Lengths

Unless option 11 is specified, the tubes shall be delivered in random lengths. The delivery range shall be agreed at the time of enquiry and order.

Option 11: *The tubes shall be delivered in exact lengths, the length to be specified at the time of enquiry and order. For tolerances, see 8.8.4.5.*

8.8.4 Tolerances

8.8.4.1 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 millimetres

Outside Diameter *D*	Tolerance on outside diameter	Tolerance on wall thickness [a]	
		$T \leq 5$	$5 < T \leq 40$
≤ 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
> 219,1	±0,75 % or ± 6 whichever is the smaller		

a The plus tolerance excludes the weld area (see 8.8.4.2).

8.8.4.2 Height of the weld seam

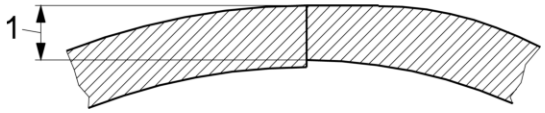
The height of the external and internal weld seams shall be within the limits indicated in Table 11 (for HFW tubes) and Table 12 (for SAW tubes).

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

Dimensions in millimetres

Outside	Inside
Trimmed Flush	Trimmed or 0,5 + 0,05 *T*

For HFW tubes, radial offset of the strip edges after weld trimming, see Figure 2, shall not cause the remaining wall thickness to be less than the minimum set out in Table 10.



Key

1 remaining wall thickness at the weld

Figure 2 — Radial offset of the strip edges (HFW tubes)

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

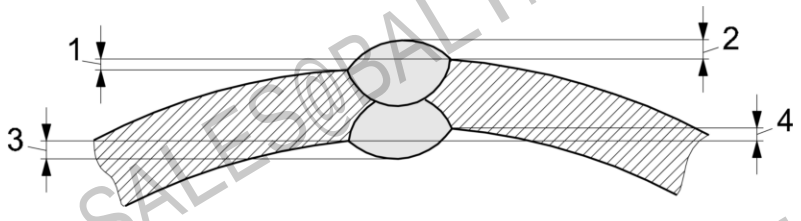
Dimensions in millimetres

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

For plate or strip alignment in SAW tubes see 8.8.4.3 and 8.8.4.4.

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

The radial offset of the abutting plate or strip edges, see Figure 3, shall be within the limits indicated in Table 13.



Key

1, 4 outside/inside diameter radial offset

2, 3 outside/inside height of the weld seam

Figure 3 — Radial offset of abutting plate/strip edges (SAW pipe)

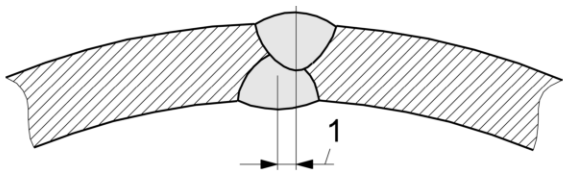
Table 13 — Maximum radial offset of the abutting plate or strip

Dimensions in millimetres

Thickness ***T***	Maximum radial offset
T ≤ 12,5	1,6
T > 12,5	0,125 ***T*** with a max. of 3,2

8.8.4.4 Misalignment of the weld seam of SAW tubes

Misalignment of the weld seams, see Figure 4, shall be acceptable provided complete penetration and complete fusion are achieved.



Key
1 misalignment

Figure 4 — Example showing the possible misalignment of the weld seams

8.8.4.5 Tolerances on exact length

The tolerances for exact lengths shall be as given in Table 14.

Table 14 — Tolerances on exact length

Dimensions in millimetres

Length range L	Tolerances for outside diameter D	
	< 406,4	≥ 406,4
$L \leq 6\,000$	+ 10 0	+ 25 0
$6\,000 < L \leq 12\,000$	+ 15 0	+ 50 0
$L > 12\,000$	+ by agreement 0	

8.8.4.6 Out-of-roundness

The out-of-roundness O shall be calculated using the following Formula (1):

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

where

O is the out-of-roundness in %;

D is the specified outside diameter in mm;

D_{max}, D_{min} are the maximum and minimum outside diameters measured in the same plane in mm.

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

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

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

9 Inspection

9.1 Type of inspection

Conformity to the requirements of the order, for tubes in accordance with this document, shall be verified by specific inspection.

9.2 Inspection documents

9.2.1 Types of inspection documents

Unless Option 12 is specified, an inspection certificate 3.1 in accordance with EN 10204 shall be issued. The tube manufacturer shall confirm in this whether they are operating according to a "quality assurance system", certified by a competent body established within the community, and have undergone a specific assessment for materials and processes relevant to the manufacture of welded tubes (see 7.2.2, 7.2.3, 7.2.4 and NOTE below).

Option 12*: An inspection certificate 3.2 in accordance with* EN 10204 *shall be issued.*

When an inspection certificate 3.2 is specified, this shall be prepared by the manufacturer's authorized representative(s). The purchaser shall notify the manufacturer of the name and address of the organization or person that will carry out the inspection and confirm who will validate and issue the inspection document.

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. The inspection documents shall include a statement confirming the conformity of the products to the requirements of this specification and to the order.

9.2.2.2 The inspection certificate 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(s);

— C40-C43 impact test results, if applicable;

— C50–C59 weld bend test, if applicable;

— C60-C69 other mechanical tests (e.g. flattening, drift expanding);

— C71-C92 cast analysis reported by the steel producer and product analysis, if applicable;

— D01 statement that marking and identification, surface appearance, shape and dimensional properties are satisfactory;

— D02-D99 statement confirming that leak tightness test and applicable NDT testing has been carried out, and the test results are satisfactory;

— Z validation.

— Reference to specific assessment under pressure equipment European legislation for materials and processes relevant to manufacture of welded tubes;

— Reference to welding process approval, where applicable;

— Reference to welder and or welding operator approval, where applicable;

— Reference to non-destructive testing operators approval, where applicable;

— In addition, where applicable, the manufacturer shall make reference to any certification of his "quality assurance system" by a competent body established within the community, see 9.2.1.

9.3 Summary of inspection and testing

Inspection and testing shall be carried out as stated in Table 15.

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).

Table 15 — Summary of inspection and verification testing

Type of inspection and test		Frequency of testing	Refer to	Test category	
				1	2
Mandatory tests	Cast analysis (reported by steel producer)	one per cast	8.2.1 and 11.1	X	X
	Tensile test on the tube body at room temperature	One per sample tube	8.4, 10.2.2.2 and 11.2.1.1	X	X
	Transverse tensile test at room temperature on the weld for tubes with outside diameter ***D*** > 508 mm		8.4, 10.2.2.3 and 11.2.2	X	X
	Flattening test for D < 600 mm and T/D ratio ≤ 0,15 but T ≤ 40 mm or [b] for ***D*** > 150 mm and T ≤40 mm ring tensile test for HFW tubes	Two per sample tube [a] or One per sample tube	8.4, 10.2.2.4, 11.3 and 11.4	X	X
	Drift expanding test for ***D*** ≤ 150 mm and T ≤ 10 mm or [b] ring expanding test for ***D*** ≤ 114,3 mm and T ≤ 12,5 mm for HFW tubes	One per sample tube	8.4, 10.2.2.4, 11.5 and 11.6	X	X
	Weld bend test for SAW tubes	One per sample tube	8.4, 10.2.2.5 and 11.7	X	X
	Impact test on the tube body	One set of tests per sample tube	8.4, 10.2.2.6 and 11.8	X	X
	Impact test on the weld for SAW tubes		8.4, 10.2.2.7 and 11.8	X	X
	Leak tightness test [d] (***Option 7 and Option 15***)	Each tube	8.5.3.1 and 11.9	X	X
	Dimensional inspection		11.10	X	X
	Visual examination		11.11	X	X
	NDT of the weld for HFW tubes [e]		8.5.3.2 and 11.12.1.1	X	–
	NDT of the weld for SAW tubes [f]		8.5.3.2 and 11.12.2.1	X	X
	NDT of tube body and weld for the detection of longitudinal imperfections in HFW tubes		8.5.3.2 and 11.12.1.2	–	X
	NDT of SAW feedstock for detection of laminations		8.5.3.2 and 11.12.2.2	–	X
	NDT of SAW tube ends for detection of laminations		8.5.3.2 and 11.12.2.2	–	X

Type of inspection and test		Frequency of testing	Refer to	Test category	
				1	2
	NDT of SAW plate/strip edges for detection of laminations		8.5.3.2 and 11.12.2.2	–	X
	NDT of plate / strip end welds for SAWH tubes	Each end weld	7.2.1, 8.5.3.2 and 11.12.2.3	X	X
	Material identification check to confirm steel grade	One tube per test unit	11.13	X	X
Optional tests	Product analysis **(O*ption 3*)**	One per cast	8.2.2 and 11.1	X	X
	Determination of grain size ***(Option 4)***	One per cast per delivery condition	Table 1, 8.3		
	Tensile test at elevated temperature (***Option 5***) and (***Option 6***)		Table 1, Table 5, Table 6, 8.4 and 11.2.1.2	X	X
	NDT for the detection of transverse imperfections for HFW tubes (***Option 8***)	Each tube	8.5.3.2 and 11.12.1.3	–	X
	NDT for the detection of laminar imperfections of HFW tubes (***Option 9***)		8.5.3.2 and 11.12.1.4	–	X
	Transverse tensile test on weld for tubes with outside diameter (***D***) 219,1 < ***D*** ≤ 508 mm ***(Option 13)***	One per sample tube	8.4 and 11.2.2	X	X
	Additional impact test at a different test temperature [c] ***(Option 14)***	One set of tests per sample tube	8.4, 10.2.2.6, 10.2.2.7 and 11.8	X	X
	Alternative hydrostatic test pressure for leak tightness assessment [d] ***(Option 15)***	each tube	11.9.1	X	X
	Wall thickness *T* measurement away from tube end (***Option 16***)		11.10	X	X

[a] For the flattening test two tests per sample tube shall be carried out, one with the weld positioned at 0° and one with the weld at 90°.

[b] 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.

[c] In addition to impact testing at the test temperature specified in 11.8.1, if Option 14 is specified, an additional impact test shall be performed, at a temperature selected from those given in Table 7, for the relevant steel grade.

[d] Where the manufacturer normally uses an electromagnetic test to assess leak tightness, Option 15 will only apply if the purchaser has specified hydrostatic testing in conjunction with Option 7.

[e] Method used is at discretion of manufacturer unless Option 17 is specified.

[f] Method used is at discretion of manufacturer unless Option 18 is specified.

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 maximum number of tubes per test unit shall conform to Table 16.

Table 16— Test unit details

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;

— test category 2: two sample tubes; when the total number of tubes is less than 20, only one sample tube shall be taken.

10.2 Preparation of samples and test pieces

10.2.1 Selection and preparation of samples for product analysis

When Option 3 is specified, one product analysis sample per cast shall be taken in accordance with EN ISO 14284. The product analysis can be carried out either on the sample tube, at the same location as for the mechanical test samples, or on the test pieces or samples after mechanical testing.

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 on the tube body

The test piece for the tensile test at room temperature shall be prepared in accordance with the requirements of EN ISO 6892-1.

The test piece for the tensile test at elevated temperature shall be taken in accordance with the requirements of EN ISO 6892-2.

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 shall be taken in a direction either longitudinal or transverse to the axis of the tube.

The test pieces for HFW and SAWL tubes shall be taken diametrically opposite the weld except when a full tube section is used; for SAWH tubes the test pieces shall be taken at 1/4 of the distance between the welds.

10.2.2.3 Test pieces for tensile tests on the weld

Samples 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; for HFW tubes the internal weld bead may be removed and for SAW tubes the internal and external weld seam can be removed.

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

Test pieces for the flattening test, ring tensile test, drift expanding test, ring expanding test shall consist of a full tube section in accordance with EN ISO 8492, EN ISO 8496, EN ISO 8493 or EN ISO 8495 respectively.

10.2.2.5 Test pieces for weld bend tests (SAW tubes)

Test pieces for the weld bend test at the root and face shall be taken and prepared in accordance with EN ISO 5173.

10.2.2.6 Test pieces for impact tests on the tube body

Three standard Charpy V-notch test pieces shall be prepared in accordance with EN ISO 148-1. Unless otherwise specified (see below), the test pieces shall be taken transverse to the tube axis.

For HFW and SAWL tubes, the test pieces shall be taken diametrically opposite the weld; for SAWH tubes the test pieces shall be taken at 1/4 of the distance between the welds.

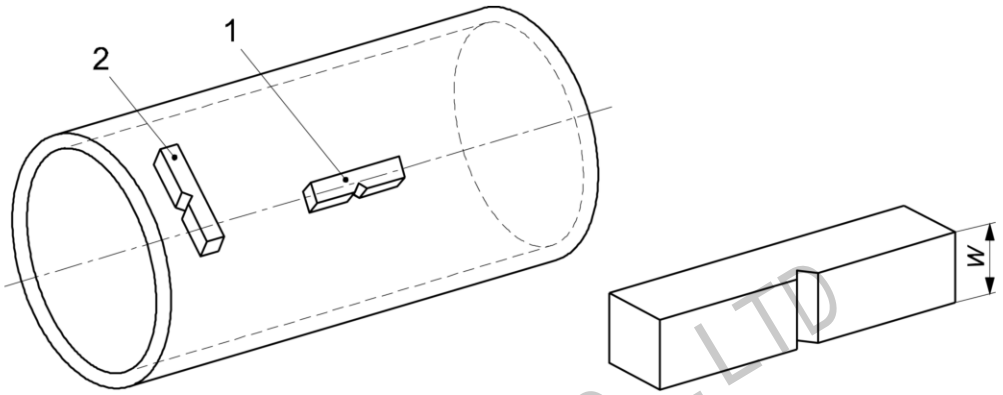
If the tube specified wall thickness is such that standard width test pieces cannot be produced without flattening of the section, then test pieces of standard width less than 10 mm, but not less than 5 mm shall be prepared; the largest obtainable standard width, either 7,5 mm or 5 mm, shall be used.

For guidance, transverse test pieces shall be taken 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.

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

Where the dimensions of the tube is such that 5mm wide longitudinal test pieces cannot be obtained, the tubes shall not be subjected to impact testing.

The test pieces shall be prepared such that the axis of the notch is through thickness, perpendicular to the surface of the tube, see Figure 5.



Key

1 longitudinal test piece

2 transverse test piece

W specimen width

Figure 5 — Impact test piece orientation

10.2.2.7 Test pieces for impact tests on the weld

The test pieces shall be taken transverse to the weld. Three sets of three standard Charpy V-notch test pieces in accordance with EN ISO 148-1 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 (either 7,5mm or 5mm) shall be used.

Where the tube size is such that 5 mm wide test pieces cannot be obtained, the weld shall not be subject to impact testing.

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 sides of the weld corresponding to the heat-affected zone for the other two sets.

11 Verification of 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 steel, plate, strip or tube manufacturer. If further clarification is required, relevant methods in accordance with CEN/TR 10261 shall be agreed between the manufacturer and purchaser.

11.2 Tensile test

11.2.1 Tensile test on the tube body

11.2.1.1 At room temperature

The test shall be carried out in accordance with EN ISO 6892-1, and the following 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 $5{,}65 \cdot \sqrt{S_o}$; if a non-proportional test piece is used, the percentage elongation value shall be converted to the value for a gauge length (L_o) = $5{,}65 \cdot \sqrt{S_o}$ 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 ISO 6892-2, either at 400 °C or at an alternative temperature from Tables 5 or 6 agreed at the time of enquiry and order (see 8.4), 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

This is applicable to tubes of D > 508 mm and to tubes with outside diameter 219,1 mm < D ≤ 508 mm if Option 13 applies (see Table 15). The test shall be carried out in accordance with EN ISO 6892-1 except that only the tensile strength (R_m) shall be determined. The tube weld will pass the test if the result obtained exceeds the minimum R_m value specified in Table 4. The maximum R_m value does not apply in this case.

11.3 Flattening test

This test is applicable to HFW tubes. It shall be carried out in accordance with EN ISO 8492. The tube section shall be flattened in a press until the distance H between the platens reaches the value given by the following Formula (3):

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

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 deformation factor, 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.

Two samples shall be tested, one with the weld at 0° and the other with the weld at 90°. After testing, the test piece shall be free from cracks or breaks. However, slight incipient cracks at the edges shall not be regarded as justification for rejection.

11.4 Ring tensile test

The test is applicable to tubes having an outside diameter exceeding 150 mm and a wall thickness no greater than 40 mm.

The test shall be carried out in accordance with EN ISO 8496. The tube section shall be subjected to strain in the circumference direction until fracture occurs.

After fracture the test pieces shall not display any cracks visible without the use of magnifying aids, excluding the fracture point.

11.5 Drift expanding test

This test is applicable to HFW tubes of outside diameter ≤ 150 mm and wall thickness ≤ 10 mm

The test shall be carried out in accordance with EN ISO 8493. 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 grades and qualities	8	10	15
a $d = D - 2T$			

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

11.6 Ring expanding test

This test is applicable to tubes of outside diameter 18 mm < D ≤ 150 mm and wall thickness 2 mm < T ≤ 16 mm.

The test shall be carried out in accordance with EN ISO 8495. 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 the edges shall not be regarded as justification for rejection.

11.7 Weld bend test

This test is applicable only to SAW (SAWL and SAWH) tubes. It shall be carried out in accordance with EN ISO 5173 using a former of diameter 3T, where T is the specified wall thickness in millimetres.

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

11.8 Impact test

11.8.1 Testing shall be carried out in accordance with EN ISO 148-1, using a 2 mm radius striker, at the following test temperatures:

— Qualities N and NH: - 20 °C.

— Qualities NL1 and NL2: at the relevant lowest temperature shown in Table 7.

11.8.2 The mean value of each set of three test pieces shall meet the KV_2 requirements given in Table 7. One individual test result may be below the specified requirement, 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 values (KV_p) shall be converted to equivalent calculated impact energy values (KV_c) using the following Formula (4):

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

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

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 tube and tested. To consider the test unit as conforming after testing the second set, the following conditions shall be satisfied simultaneously:

— the average of the six test results shall be equal to or greater than the specified minimum average value;

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

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

11.8.5 The dimensions in millimetres of the test pieces, the actual impact test results and the resulting average value shall be reported in the inspection certificate.

11.9 Leak tightness test

11.9.1 Hydrostatic test

Unless Option 15 is specified, the hydrostatic test shall be carried out at a test pressure of 70 bar[2)] or at a test pressure P calculated using the following Formula (5), whichever is lower:

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

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 $D \leq 457$ 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.

Option 15: *A test pressure different from that specified above and corresponding to a stress below 90 % of the specified minimum yield strength (see Table 4) for the steel grade concerned is agreed at the time of enquiry and order.*

NOTE 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 ISO 10893-1.

11.10 Dimensional inspection

Specified dimensions, including straightness, shall be verified.

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2) 1 bar = 100 KPa

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

Unless Option 16 is specified the wall thickness shall also be measured at the tube ends.

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

11.11 Visual examination

Tubes shall be visually examined to ensure conformity to the requirements of 8.5.1 and 8.5.2.1.

11.12 Non-Destructive Testing

11.12.1 Non-Destructive Testing of HFW tubes

11.12.1.1 The full length of the weld seam of HFW tubes of test category 1 shall be tested in accordance with one of the following:

— EN ISO 10893-2 to acceptance level E3 or E3H;

— EN ISO 10893-3 to acceptance level F3;

— EN ISO 10893-10 to acceptance level U3 sub category C;

— EN ISO 10893-11 to acceptance level U3.

Where the testing procedure is not capable of assessing the weld seam at the tube ends, then this area shall either be subjected to manual / semi-automatic ultrasonic testing in accordance with EN ISO 10893-11:2011, Annex A, or equivalent, or shall be cropped off.

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

Option 17: *Non-Destructive Testing method for the inspection of the weld seam of HFW tubes is specified by the purchaser.*

11.12.1.2 HFW tubes of test category 2 shall be submitted to ultrasonic testing for the detection of longitudinal imperfections in accordance with the following:

— EN ISO 10893-10 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 ISO 10893-10, Annex B to acceptance level U2, sub-category C or shall be cropped off.

11.12.1.3 When Option 8 (see 8.5.3.2) is specified, tubes of test category 2 shall also be subjected to ultrasonic testing for the detection of transverse imperfections in accordance with EN ISO 10893-10 to acceptance level U2, sub-category C.

11.12.1.4 When Option 9 (see 8.5.3.2) is specified, tubes of test category 2 shall also be subjected to ultrasonic testing for the detection of laminar imperfections in accordance with EN ISO 10893-8 to acceptance level U2.

11.12.2 Non-destructive testing of SAW tubes

11.12.2.1Non-Destructive Testing of the weld seam

The full length of the weld seam of SAW tubes shall be tested in accordance with one of the following:

Test category 1:

— EN ISO 10893-6 to image quality class A;

— EN ISO 10893-7 to image quality class A;

— EN ISO 10893-11 to acceptance level U3 or U3H;

Test category 2:

— EN ISO 10893-6 to image quality class B;

— EN ISO 10893-7 to image quality class B;

— EN ISO 10893-11 to acceptance level U2 or U2H.

Where the testing procedure is not capable of assessing the weld seam at the tube ends, then this area shall either be subjected to manual / semi-automatic ultrasonic testing in accordance with EN ISO 10893-11:2011, Annex A, or equivalent, or shall be cropped off.

Unless Option 18 is specified, the selection of test method is at the discretion of the manufacturer.

Option 18: *The test method is specified by the purchaser.*

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

The strip or plate feedstock for test category 2 SAW tubes shall be subjected to testing for the detection of laminar imperfections in accordance with the following:

— EN ISO 10893-9 to acceptance level U2;

Additionally, either the strip/plate edges shall be tested in accordance with:

— EN ISO 10893-9 to acceptance level U2;

or the SAW tube shall be tested within a 15 mm zone adjacent to the weld seam in accordance with the following:

— EN ISO 10893-8 to acceptance level U2;

— EN ISO 10893-9 to acceptance level U2;

Testing of strip or plate base material may be carried out at the supplying mill.

In addition, the tube ends shall be tested in accordance with:

— EN ISO 10893-8; The acceptance criteria shall be no laminar imperfections greater than 6 mm in the circumferential direction within 25 mm of the tube ends.

11.12.2.3 Supply of strip end welds in SAWH tubes

The supply of test category 2 SAWH tubes containing plate or strip end welds is not permitted. Test category 1 SAWH tubes containing plate or strip end welds shall only be supplied when the strip welds have been tested in accordance with 11.12.2.1 and also 11.12.2.2 to test category 2 acceptance levels.

11.13 Material identification

Tubes shall be tested by an appropriate method to ensure that the correct grade is being supplied (see Table 15).

11.14 Retests, sorting and reprocessing

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

12 Marking

12.1 Marking to be applied

At least one end of each tube shall be indelibly marked by a suitable and durable method, such as an automated ink or paint marking process, paint stencil or hard stamping (using low stress or pin stamps) or a combination of these.

The marking shall include the following information:

— the manufacturer's name or trade mark, or product brand;

— the type of tube (HFW, SAWL or SAWH - symbols in accordance with Table 1);

— the number of this document (EN 10217-3);

— the steel name or steel number (see 5.2.1);

— the test category (see 9.3);

— the cast number and/or an identification number (e.g. an order or item number or manufacturing reference code) which permits correlation of the product or delivery unit to the related documentation;

— the mark of the inspection representative if applicable.

For tubes with outside diameter $D \leq 51$ mm the marking on the tubes may be replaced by marking on a label or tag, which shall be securely attached to the bundle or box. Additionally, the label or tag shall identify the tube diameter, wall thickness and length range.

NOTE Example of marking:

X SAWH - EN 10217–3 — P275NL1 - TC1 — Y - Z

where

X is the manufacturer's mark;

SAWH is the type of tube;

TC1 is the test category;

Y is the cast number or identification number or a code number;

Z is the mark of the inspection representative, if applicable.

12.2 Additional marking

Unless Option 19 is specified, no additional marking other than that specified in 12.1 need be applied.

Option 19: *Additional marking, as agreed upon at the time of enquiry and order, shall be applied.*

13 Protection

Unless Option 20 is specified, the tubes shall be delivered without any protective coating.

Option 20: *A temporary protective coating or durable coating and/or lining shall be applied.*

Annex A
(normative)

Qualification of welding procedure for SAW tube production

A.1 General

SAW tube produced to this document 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

A.2.1 General

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.2.2 Parent metal

A.2.2.1 Steel name or number

The steel grade shall be identified in accordance with the requirements of this document.

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

A.2.2.2 Tube dimensions

Tube dimensions shall be supplied for the following:

— outside diameter *D*;

— wall thickness *T*.

A.2.3 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.2.4 Filler wires and fluxes

A.2.4.1 The standard number and grade shall be referenced.

A.2.4.2 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.2.4.3 If carried out, the flux recycling procedure shall be referenced.

A.2.5 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.2.6 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.2.7 Heat input (kJ/mm)

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

A.2.8 Preheat temperature

If required the minimum preheat temperature shall be specified.

A.2.9 Interpass temperature

The maximum permissive interpass temperature shall be specified where applicable.

A.2.10 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.2.11 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 assessment

A.3.1 Sample tube

When required, preparation and welding of a sample tube shall be carried out in accordance with the WPS and under the general conditions of production welding which they shall represent. The sample tube shall be in the relevant delivery condition specified in Table 1.

Where an approved procedure is required the name and address of the authorized body shall also be supplied.

A.3.2 Sample assessment

Inspection and testing of the weld shall be in accordance with A.4. A test sample sufficiently long to carry out the tests specified in A.5 shall be taken from the end of the sample tube.

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="11">Preparation method Machined/plasma or flame 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 sets of three test pieces

[a] Magnetic particle inspection or dye 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 Weld 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 ISO 17639.

A.5.3 Transverse weld tensile test

The transverse tensile test piece shall be prepared in accordance with 10.2.2.3.

A.5.4 Weld 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 NDT test

The NDT test shall be carried out in accordance with 11.12.2.

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 x 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

Surface defects, as specified in 8.5.2, shall not be permitted.

A.7.2 NDT test

This shall meet the acceptance requirements of 11.12.2.

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 11.7.

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;

— heights of internal and external weld seams, radial offset of plate and strip edges and misalignment of weld seams shall comply with the requirements of 8.8.4.2, 8.8.4.3, 8.8.4.4 and Tables 12 and 13.

A.7.5 Transverse weld tensile test

The tube weld will pass the test if the result obtained exceeds the minimum R_m value specified in Table 4. The maximum R_m value does not apply in this case. 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.

Table A.3 — Example of typical test results form

<table>
<tr><td colspan="6">Test results</td></tr>
<tr><td colspan="3">Manufacturer:
Welding procedure
Reference no:
Visual examination: Pass/fail
Penetrant/magnetic particle test Pass/fail</td><td colspan="3">Examiner or examining body:
Reference no:
Radiographic test [a]: Pass/fail
Ultrasonic examination [a]:
Temperature: °C</td></tr>
<tr><td colspan="6">Tensile tests</td></tr>
<tr><td>Type /No.</td><td>Rm
MPa</td><td colspan="2">Fracture location</td><td colspan="2">Remarks</td></tr>
<tr><td>Requirements</td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="4">Bend tests

Former diameter</td><td colspan="2" rowspan="2">Macro examination</td></tr>
<tr><td>Type /No.</td><td>Bend angle</td><td colspan="2">Results</td></tr>
<tr><td></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="6">Impact test [a]
Type: Size: Requirement:</td></tr>
<tr><td rowspan="2">Notch
Location/Direction</td><td rowspan="2">Temperature
°C</td><td colspan="4">Values J</td><td rowspan="2">Remarks</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>Average</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">Hardness test [a]
Type/load:
H. A. Z.:
Weld Metal:
Parent metal:</td></tr>
<tr><td colspan="6">Other tests:</td></tr>
<tr><td colspan="6">Remarks:</td></tr>
<tr><td colspan="6">Tests carried out in accordance with the requirements of:</td></tr>
<tr><td colspan="6">Examiner or examining body:</td></tr>
<tr><td colspan="6">Laboratory report reference no:</td></tr>
<tr><td colspan="6">Test results were acceptable/not acceptable (delete as appropriate)</td></tr>
<tr><td colspan="6">Test carried out in the presence of:</td></tr>
<tr><td colspan="2">Name:</td><td colspan="2">Signature:</td><td colspan="2">Date:</td></tr>
<tr><td colspan="6">[a] If required.</td></tr>
</table>

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 also 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 millimetres

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 ISO 14174, 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).

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.

Annex B
(normative)

Elevated temperature properties for steel grades P275NL1 and NL2

Table B.1 — Minimum 0,2 %- proof strength [a] [b]

Wall thickness T	$R_{p\,0,2}$ (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 Applicable for wall thickness T ≤ 16 mm for HFW tubes and ≤ 40 mm for SAW tubes.

b See 8.4.

Table B.2 — 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 Applicable for wall thickness T ≤ 16 mm for HFW tubes and ≤ 40 mm for SAW tubes.

b See 8.4.

Annex C
(informative)

Technical changes from the previous edition

C.1 Introduction

This informative annex is intended to guide the user to places where significant technical changes have been introduced into the previous edition of this European Standard. Editorial changes are not included in this annex. References refer to the previous edition.

While this annex is intended to be comprehensive, users should satisfy themselves that they fully understand the changes which have been made. The user is ultimately responsible for recognizing any differences between this edition and the previous edition of the document.

C.2 Technical changes

— 1 Scope

— 2 Normative references

— 3 Terms and definitions

— 4 Symbols

— 6 Information to be supplied by the purchaser

  — 6.1 Mandatory information

  — 6.2 Options [4), 5), 6), 7), 12), 13), 15), 16), 17), 18), 19) and 20)]

  — 6.3 Example of an order

— 7 Manufacturing process

  — 7.1 Steelmaking process

  — 7.2 Tube manufacture and delivery conditions

  — Table 1

  — 7.3 Non-destructive testing personnel requirements

— 8 Requirements

  — 8.1 General

  — Table 2

  — Table 3

  — 8.4 Mechanical properties

  — Tables 4, 5, 6 and 7

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of 2014/68/EU

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 2014/68/EU.

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 Annex I of the Directive 2014/68/EU

Essential Requirements of the Directive 2014/68/EU	Clauses/sub-clauses of this EN	Remarks/Notes
3.1.2	7.2.2, 7.2.3, 7.2.4, Annex A	Welding For SAW & HFW tubes used for pressure equipment in categories II, III and IV, relevant operating procedures and personnel shall be approved by a notified body or a recognized third party organisation.
3.1.3	7.3	NDT personnel requirements For tubes to be used in pressure equipment under Categories III and IV the personnel shall be approved by a recognised third party organisation.
4.1.a	8.4	Appropriate material properties
4.1.c	7.1 and 8.2	Ageing
4.1.d	7.2.1, 7.2.5, 8.5	Suitable for the processing procedures.
4.3	Clause 9	Inspection documentation.

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the products falling within the scope of this standard.

Bibliography

EN ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel (ISO 9712)*