BRITISH STANDARD

BS EN
10296-1:2003

Welded circular steel tubes for mechanical and general engineering purposes — Technical delivery conditions —

Part 1: Non-alloy and alloy steel tubes

The European Standard EN 10296-1:2003 has the status of a British Standard

ICS 77.140.75

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 10296-1:2003. It supersedes BS 6323-7:1982 and BS 6323-2:1982 which will be withdrawn. Together with BS EN 10305-3 and BS EN 10305-5 it superseded BS 6323-5:1982, which will be withdrawn upon publication of the three standards. Together with BS EN 10296-2, BS EN 10297-1, BS EN 10305-1, BS EN 10305-2, BS EN 10305-3, BS EN 10305-4, BS EN 10305-5 and BS EN 10305-6 it will supersede BS 6323-1:1982, which will be withdrawn upon publication of the other standards.

The UK participation in its preparation was entrusted to Technical Committee ISE/8, Steel pipes, 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 the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

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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 Management Centre has the same status as the official versions.

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Foreword

This document (EN 10296-1:2003) 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of an identical text or by endorsement, at the latest by December 2003, and conflicting national standards shall be withdrawn at the latest by December 2003.

Another part of EN 10296 in course of preparation is :

— Part 2: Stainless steel tubes

Another European Standard series covering seamless steel tubes for mechanical and general engineering purposes is currently being prepared.

— EN 10297: Seamless circular steel tubes for mechanical and general engineering purposes — Technical delivery conditions.

Other European Standard series being prepared in this area are prEN 10294 for hollow bars for machining and prEN 10305 for steel tubes for precision applications.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This Part of EN 10296 specifies the technical delivery conditions for electric welded, laser beam welded and submerged arc welded tubes of circular cross section made of non-alloy and alloy steels for mechanical and general engineering purposes.

2 Normative references

This European Standard incorporates by dated 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 dated 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).

EN 910, *Destructive tests on welds in metallic materials - Bend tests.*

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

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

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

EN 10027-1, *Designation systems for steel - Part 1: Steel names, principal symbols.*

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

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

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

prEN 10168[1)], *Steel products - Inspection documents – List of information and description.*

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

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

EN 10232, *Metallic materials - Tube (in full section) - Bend test.*

EN 10233, *Metallic materials - Tube - Flattening test.*

EN 10234, *Metallic materials - Tube - Drift expanding test.*

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

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

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

EN 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.*

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.

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

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

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

EN 10256, *Non-destructive testing of steel tubes – Qualification and competence of level 1 and 2 non-destructive testing personnel.*

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

prEN 10266[2)], *Steel tubes, fittings and structural hollow sections – Symbols and definitions 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).*

EN ISO 643 , *Steels - Micrographic determination of the apparent grain size (ISO/DIS 643:2003).*

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

3 Terms and definitions

For the purposes of this Part of EN 10296, the terms and definitions given in EN 10020, EN 10021, EN 10052 and prEN 10266 and the following apply.

3.1
fine grain steel
steel having an austenitic/ferritic grain size equal to or finer than 6 when measured in accordance with EN ISO 643.

3.2
normalizing rolling
rolling process in which the final deformation is carried out in a certain temperature range leading to a material condition equivalent to that obtained after normalizing so that the specified values of the mechanical properties are retained even after normalizing (+N)

3.3
thermomechanical rolling
rolling process in which the final deformation is carried out in a certain temperature range leading to a material condition with certain properties which cannot be achieved or repeated by heat treatment alone

NOTE 1 The abbreviated form of this delivery condition is M.

NOTE 2 Subsequent heating above 580°C may lower the strength values. If temperatures above 580°C are needed reference should be made to the supplier.

NOTE 3 Thermomechanical rolling leading to the delivery condition M can include processes with an increasing cooling rate with or without tempering including self-tempering but excluding direct quenching and tempering.

3.4
hot reducing
process in which the outside diameter of a tube is reduced by a rolling and/or stretching process after heating into the austenitic region (i.e. above Ac3)

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2) 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.

NOTE The thickness can be increased or decreased during processing.

3.5
annealing
heat treatment at a temperature slightly below Ac1 (+A)

3.6
employer
organisation for which the person works on a regular basis

NOTE The employer may be either the tube manufacturer or a third party organisation providing non-destructive testing (NDT) services.

4 Symbols

For the purpose of this Part of EN 10296, the symbols given in prEN 10266 and CR 10260 apply.

5 Classification and designation

5.1 Classification

In accordance with EN 10020 the grades in Table 2 and the grade E275K2 are non-alloy quality steels, grade E355K2 is an alloy quality steel, grade E460K2 and the grades in Table 4 are alloy special steels.

5.2 Designation

5.2.1 For tubes covered by this Part of EN 10296 the steel designation consists of :

— the number of this part of EN 10296 (EN 10296-1);

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;

The steel name is designated by:

— the capital letter E for engineering steels;

— the specified minimum yield strength (R_e) MPa for $T \leq 16$ mm;

NOTE The specified minimum yield strength varies with delivery condition and may be higher or lower than the designated value.

— the alphanumeric K2 for steels with specified impact energy of 40 J at - 20°C;

— the letter M when the strip or plate is produced by a thermomechanical rolling process.

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:

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

2) the term "tube";

3) the dimensions (outside diameter, wall thickness) (see 8.7);

4) the steel designation according to this Part of EN 10296 (see 5.2).

6.2 Options

A number of options are specified in EN 10296-1, and are listed below with appropriate clause references. In the event that the purchaser does not indicate his wish to implement any of these options at the time of enquiry and order the tube shall be supplied in accordance with the basic specification (see 6.1).

1) Process of tube manufacture (see 7.3.1);

2) delivery condition of EW (see 7.3.2);

3) tube shall be supplied descaled (see 7.3.2);

4) EW tubes shall be produced from pickled strip (see 7.3.2);

5) non-destructive testing of the weld (see 8.4.2);

6) a leak tightness test (see 8.4.2);

7) random lengths (see 8.7.2);

8) exact lengths (see 8.7.2);

9) restriction of the residual height of the internal weld bead of EW tube (see 8.7.3.1);

10) specific inspection and testing for tube made of non-alloy quality steel (see 5.1 and 9.1);

11) inspection document type 2.2 (see 9.2.1);

12) inspection document type 3.1.A, 3.1.C or 3.2 (see 9.2.1);

13) flattening test or drift expanding or bend test (whole tube) (see 9.3);

14) selection of leak tightness test method for EW tube (see 11.8.1);

15) special coating for transit and storage (see clause 13).

6.3 Example of an order

Fifteen tonnes of tube with specified outside diameter of 60,3 mm and a specified wall thickness of 3,6 mm made of steel in accordance with EN 10296-1 grade E275 supplied with specific inspection and testing.

15 t Tube 60,3 x 3,6 EN 10296-1 E275 Option 10

7 Manufacturing process

7.1 Steelmaking process

The steelmaking process is at the discretion of the manufacturer.

Elements not included in Tables 2, 3 or 4 for the relevant grade 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 steelmaking process.

7.2 Deoxidation process

The steels shall be fully killed and additionally those grades in Tables 3 and 4 shall contain nitrogen-binding elements and are fine grain steels.

7.3 Tube manufacture and delivery conditions

7.3.1 Tubes shall be produced by an EW, EW hot reduced (EWHR), laser beam welded (LBW) or submerged arc welded (SAW) process. The process is at the discretion of the manufacturer unless option 1 is specified.

Option 1: The process of tube manufacture is specified by the purchaser from those mentioned in the above paragraph.

A Table of typical dimension ranges for the different manufacturing processes is given for information in annex A.

EW tubes shall not include welds used for joining lengths of the strip prior to forming the tube.

Laser beam welded and submerged arc welded tubes may be longitudinally or helically welded. Strip used for the manufacture of helically, laser beam welded (LBWH) or 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. Longitudinal welded LBW or SAW tubes shall not include welds used for joining together lengths of the strip prior to forming. LBWH or SAWH tubes may include the weld joining together lengths of the strip prior to forming, provided this weld is subject to the same inspection and testing as the helical weld.

SAWL tubes may be cold sized by cold expanding (see Table 1).

7.3.2 Tubes shall be delivered in one of the delivery conditions shown in Table 1.

The delivery condition of EW tube including heat treatment is at the discretion of the manufacturer unless option 2 is specified.

Option 2 : The delivery condition of EW tube is specified by the purchaser from those shown in Table 1.

When option 3 is specified tube shall be supplied descaled . The amount of scale shall be agreed at the time of enquiry and order. The method is at the discretion of the manufacturer.

Option 3: Tubes shall be supplied descaled.

The starting material for tubes is at the discretion of the manufacturer unless option 4 is specified.

Option 4: EW tubes shall be produced from pickled strip.

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

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

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

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

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

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

Table 1 — Tube manufacturing process and delivery condition

Method of manufacture	Starting material	Forming operation	Delivery condition	Symbol for delivery condition
Electric welded (EW)	Hot rolled strip or Normalized/ Normalized rolled strip or Cold rolled strip (may be pickled)	Cold formed [a]	As welded [b c] As welded [b d] Annealed Full tube Normalized Normalized welded zone	+U +CR +A +N +NW
	Thermomechanically rolled strip [e]	Cold formed [a]	As welded [b]	None
EW Hot reduced (EWHR)	Hot rolled strip	Cold formed + hot reduced or Hot formed + hot reduced	Hot reduced	+U
Laser beam welded - longitudinal (LBWL) or - Helical (LBWH) seam	Hot rolled strip/plate or normalized rolled strip/plate	Cold formed or hot formed	As welded [c f]	+U
	Thermomechanically rolled strip/plate [e]	Cold formed [a]	As welded	None
Submerged arc-welded - longitudinal (SAWL)or - helical (SAWH) seam	Hot rolled strip/plate or normalized rolled strip/plate	Cold formed or Hot formed	As welded [c f]	+U
	Thermomechanically rolled strip/plate [e]	Cold formed [a]	As welded	None

[a] Includes cold sized/cold finished at manufacturers discretion.

[b] An appropriate heat treatment of the weld zone is permitted.

[c] An as welded product from which the +N properties can be achieved after heat treatment.

[d] An as welded product from which the +N properties may not be achieved after heat treatment.

[e] Only available in conjunction with steels from Table 4.

[f] Tubes may be supplied hot sized or cold sized (with or without heat treatment) at the discretion of the manufacturer.

8 Requirements

8.1 General

The tubes, when supplied in a delivery condition indicated in Tables 6, 7, 8 and 9 and inspected in accordance with clause 9 shall conform to the requirements of this Part of EN10296. In addition, the general technical delivery requirements specified in EN 10021 apply.

8.2 Chemical composition

The cast analysis reported by the steel producer shall apply and shall conform to the requirements of Table 2, 3 and 4.

In case of dispute the permissible deviations of the product analysis from the specified analysis limits are given in Table 5

NOTE 1 The chemical analysis method used should be agreed between manufacturer and purchaser, taking into account CR 10261.

NOTE 2 When welding tubes, according to this part of EN 10296 are produced, account should be taken of the fact that the behaviour of the steel during and after welding is dependent not only on the steel and the delivery condition but also on the conditions of preparing for and carrying out the welding.

Table 2 — Chemical composition (cast analysis) non-alloy engineering steels in % by mass [a]

Steel grade		C	Si	Mn	P	S
Steel name	Steel number	max.	max.	max.	max.	max.
E155	1.0033	0,11	0,35	0,70	0,045	0,045
E190 [b]	1.0031	0,10	0,35	0,70	0,045	0,045
E195	1.0034	0,15	0,35	0,70	0,045	0,045
E220 [b]	1.0215	0,14	0,35	0,70	0,045	0,045
E235	1.0308	0,17	0,35	1,20	0,045	0,045
E260 [b]	1.0220	0,16	0,35	1,20	0,045	0,045
E275	1.0225	0,21	0,35	1,40	0,045	0,045
E320 [b]	1.0237	0,20	0,35	1,40	0,045	0,045
E355 [c]	1.0580	0,22	0,55	1,60	0,045	0,045
E370 [b c]	1.0261	0,21	0,55	1,60	0,045	0,045

[a] See also 7.1.

[b] For T > 6mm the C maximum value may be increased by 0,01%.

[C] Additions of Nb, V and Ti are permitted at the discretion of the manufacturer, the content of these elements shall be reported.

Table 3 — Chemical composition (cast analysis) engineering steels with specified impact properties ,in % by mass [a]

Steel grade		C	Si	Mn		P	S	Al Total [b]	N	Cr	Cu [c]	Mo	Nb	Ni	Ti	V
Steel name	Steel number	max.	max.	min.	max.	max.	max	min.	max.	max.	max.	max.	max.	max.	max.	max.
E275K2	1.0456	0,20	0,40	0,50	1,40	0,035	0,030	0,020	0,015	0,30	0,35	0,10	0,050	0,30	0,03	0,05
E355K2	1.0920	0,20	0,50	0,90	1,65	0,035	0,030	0,020	0,015	0,30	0,35	0,10	0,050	0,50	0,03	0,12
E460K2	1.8891	0,20	0,60	1,00	1,70	0,035	0,030	0,020	0,025	0,30	0,70	0,10	0,050	0,80	0,03	0,20

[a] See also 7.1.

[b] If sufficient other N-binding elements are present, the minimum total Al content does not apply.

[c] If the copper content is greater than 0,30% then the nickel content shall be at least half of the copper content.

Table 4 — Chemical composition (cast analysis) engineering steels with specified impact properties thermomechanically rolled strip/plate, in % by mass [a]

Steel grade		C	Si	Mn	P	S	Mo [b]	Ni	Al Total [c]	N	Nb	Tl	V
Steel name	Steel number	max.	max.	max.	max.	max.	max.	max.	min.	max.	max.	max.	max.
E275M	1.8895	0,13	0,50	1,50	0,035	0,030	0,20	0,30	0,020	0,020	0,050	0,050	0,08
E355M	1.8896	0,14	0,50	1,50	0,035	0,030	0,20	0,30	0,020	0,020	0,050	0,050	0,10
E420M	1.8897	0,16	0,50	1,70	0,035	0,030	0,20	0,30	0,020	0,020	0,050	0,050	0,12
E460M	1.8898	0,16	0,60	1,70	0,035	0,030	0,20	0,30	0,020	0,025	0,050	0,050	0,12

a See also 7.1.

b The total sum of Cr, Cu and Mo shall not be higher than 0,60%.

c If sufficient N-binding elements are present, the minimum total Al content does not apply.

Table 5 — Permissible deviations of the product analysis from the specified limits on cast analysis

Element	Limiting values for the cast analysis according to Tables 2 3 and 4	Permissible deviation of the product analysis
	% by mass	% by mass
C	≤ 0,22	+ 0,02
Si	≤ 0,60	+ 0,05
Mn	≤ 1,70	+ 0,10 - 0,05
P	≤ 0,045	+ 0,005
S	≤ 0,045	+ 0,005
Cr	≤ 0,30	+ 0,05
Mo	≤ 0,20	+ 0,03
Ni	≤ 0,80	+ 0,05
Al total	≥ 0,020	- 0,005
Cu	≤ 0,35	+ 0,05
	> 0,35 ≤ 0,70	+ 0,07
N	≤ 0,025	+ 0,002
Nb	≤ 0,050	+ 0,010
Ti	≤ 0,050	+ 0,01
V	≤ 0,20	+ 0,02

8.3 Mechanical properties

For tubes, with $T \leq 40$ mm, made of steels covered by Tables 2, 3, and 4 the mechanical properties for the relevant delivery condition in Tables 6, 7 ,8 and 9 and where applicable, clause 11 apply. For $T > 40$ mm (see 8.7.1) the mechanical properties shall be agreed at the time of enquiry and order.

Table 6 — Mechanical properties for tubes made of some of the steel grades specified in Table 2, in delivery conditions +U or +A or +N

Steel grade		Minimum tensile properties for delivery condition							
		+U [a b]			+A		+N		
Steel name	Steel number	Yield strength (R_{eH}) MPa	Tensile strength (R_m) MPa	A [c] %	Tensile strength (R_m) MPa	A [c] %	Yield strength (R_{eH}) MPa	Tensile strength (R_m) MPa	A [c] %
E155	1.0033	175	290	15	260	28	155	270	28
E195	1.0034	250	330	8	300	28	195	300	28
E235	1.0308	300	390	7	315	25	235	340	25
E275	1.0225	340	440	6	390	21	275	410	21
E355	1.0580	400	540	5	490	22	355	490	22

[a] For outside diameters ≥ 168,3 the values for the normalized condition apply.

[b] Includes delivery condition +NW.

[c] Values are for longitudinal testing and are reduced by 2% for transverse testing.

Table 7 — Mechanical properties for tubes made of some of the steel grades specified in Table 2, in delivery condition +CR

Steel grade		Minimum tensile properties for delivery condition			
Steel name	Steel number	Yield strength (R_{eH}) MPa	Tensile strength (Rm) MPa	A %	
				l	t
E190	1.0031	190	270	26 [a]	24
E220	1.0215	220	310	23 [a]	21
E260	1.0220	260	340	21 [a]	19
E320	1.0237	320	410	19 [a]	17
E370	1.0261	370	450	15	13

[a] For outside diameters ≤ 76,1 mm and D/T ratios ≤ 20 the value is 17 % min.

NOTE l = longitudinal ; t = transverse

Table 8 — Mechanical properties for tubes made of the steel grades specified in Table 3

Steel Grade		Minimum tensile properties					Impact properties
		Yield strength (R_{eH}) MPa		Tensile strength (R_m) MPa	*A* [a] %		Impact energy at a test temperature of - 20°C *KV* J min
Steel name	Steel number	f or *T* in mm ≤ 16	f or *T* in mm > 16		l	t	
E275K2	1.0456	275	265	370	24 [b]	22	40
E355K2	1.0920	355	345	470	22 [b]	20	40
E460K2	1.8891	460	440	550	17	15	40

[a] For thicknesses less than 3 mm the values of percentage elongation to be achieved shall be agreed at the time of enquiry and order.

[b] For outside diameters ≤ 76,1 mm and *D*/*T* ratios ≤ 20 the value is 17% min.

NOTE l = longitudinal ; t = transverse.

Table 9 — Mechanical properties for tubes made of the steel grades specified in Table 4

Steel grade		Minimum tensile properties					Impact properties
		Yield strength (R_{eH}) MPa		Tensile strength (R_m) MPa	*A* %		Impact energy at a test temperature of - 20°C *KV* J min
Steel name	Steel number	For *T* in mm ≤ 16	For *T* in mm > 16 ≤ 40		l	t	
E275M	1.8895	275	265	360	24 [b]	22	40
E355M	1.8896	355	345	450	22 [b]	20	40
E420M	1.8897	420	400	500	19 [b]	17	40
E460M	1.8898	460	440	530	17	15	40

[a] For thicknesses less than 3 mm the values of percentage elongation to be achieved shall be agreed at the time of enquiry and order.

[b] For outside diameters ≤ 76,1 mm and *D*/*T* ratios ≤ 20 the value is 17% min.

NOTE l = longitudinal ; t = transverse.

8.4 Appearance and soundness

8.4.1 Appearance

8.4.1.1 Tubes shall be free from external and internal surface defects that can be established by visual examination.

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

8.4.1.3 It shall only be permissible to remove surface imperfections, by grinding or machining, provided that, after so doing, the tube 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.

8.4.1.4 Surface imperfections, which encroach on the minimum wall thickness, shall be considered defects and tubes containing these shall be deemed not to conform to this part of EN 10296.

8.4.1.5 Repairs to the weld seam of EW tube are not permitted. Repairs to the weld seam of LBW or SAW tubes are permitted in accordance with an established procedure.

8.4.2 Soundness

When option 5 is specified the seam weld of tubes supplied with specific inspection and testing shall pass a non-destructive test of the weld (see option 5).

Option 5: The weld seam of each tube shall be non-destructively tested in accordance with 11.11 over the full length.

When option 6 is specified, tubes supplied with specific inspection and testing shall pass a leak tightness test (see option 6).

Option 6: Leak tightness testing of each tube shall be carried out in accordance with 11.8.

8.5 Straightness

The deviation from straightness of tubes with an outside diameter equal to or greater than 33,7 mm shall not exceed 0,0015 *L* (*L* = Length of the tube). The deviation from straightness, for tubes with D less than 33,7 mm, is not specified.

NOTE This is not specified due to bending during processing and subsequent handling, however tube should be reasonably straight.

8.6 End preparation

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

8.7 Dimensions, masses, tolerances and sectional properties

8.7.1 Outside diameters, wall thicknesses and masses

Preferred outside diameters and wall thicknesses have been selected from EN 10220 and are given in Table 10.

The masses for these dimensions are given in EN 10220 or shall be calculated using the formulae in annex B

NOTE Dimensions, which are not included in Table 10, may be agreed at the time of enquiry and order.

Table 10 — Preferred dimensions of welded steel tubes

Dimensions in millimetres

D	Wall thickness																				
	0,5	0,6	0,8	1	1,2	1,4	1,6	1,8	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,4	5,6	6,3	7,1
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																					
44,5																					
48,3																					
51																					
54																					
57																					
60,3																					
63,5																					
70																					
73																					
76,1																					
82,5																					
88,9																					
101,6																					
108																					
114,3																					
127																					
133																					
139,7																					
141,3																					
152,4																					
159																					
168,3																					
177,8																					
193,7																					
219,1																					
244,5																					
273																					
323,9																					
355,6																					
406,4																					
457																					
508																					
559																					
610																					
660																					
711																					
762																					
813																					
864																					
914																					
1016																					

Table 10 — Preferred dimensions of welded steel tubes (continued)

Dimensions in millimetres

D	Wall thickness																				
	4.5	5	5.4	5.6	6.3	7.1	8	8.8	10	11	12.5	14.2	16	17.5	20	22.2	25	28	30	32	36	40
26.9	■	■	■	■	■	■	■															
30	■	■	■	■	■	■	■															
31.8	■	■	■	■	■	■	■															
32	■	■	■	■	■	■	■															
33.7	■	■	■	■	■	■	■	■														
35	■	■	■	■	■	■	■	■														
38	■	■	■	■	■	■	■	■	■													
40	■	■	■	■	■	■	■	■	■													
42.4	■	■	■	■	■	■	■	■	■													
44.5	■	■	■	■	■	■	■	■	■	■	■											
48.3	■	■	■	■	■	■	■	■	■	■	■											
51	■	■	■	■	■	■	■	■	■	■	■											
54	■	■	■	■	■	■	■	■	■	■	■	■										
57	■	■	■	■	■	■	■	■	■	■	■	■										
60.3	■	■	■	■	■	■	■	■	■	■	■	■	■									
63.5	■	■	■	■	■	■	■	■	■	■	■	■	■									
70	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
73	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
76.1	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
82.5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
88.9	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
101.6	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
108	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
114.3	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
127	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
133	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
139.7	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
141.3	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
152.4	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
159	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
168.3	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
177.8	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
193.7	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
219.1	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
244.5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
273	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
323.9	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
355.6	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
406.4	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
457	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
508	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
559	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
610	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
660	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
711	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
762	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
813	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
864	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
914	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1016	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1067	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1118	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1067	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1118	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1168		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1219		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1321				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1422				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1524						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1626						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1727							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1829							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1930								■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2032								■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2134									■	■	■	■	■	■	■	■	■	■	■	■	■	■
2235									■	■	■	■	■	■	■	■	■	■	■	■	■	■
2337										■	■	■	■	■	■	■	■	■	■	■	■	■
2438										■	■	■	■	■	■	■	■	■	■	■	■	■
2540										■	■	■	■	■	■	■	■	■	■	■	■	■

8.7.2 Length

Tubes shall be supplied in standard lengths of 6000 mm or 6400 mm, unless option 7 or 8 is specified, the manufacturer shall inform the purchaser of the length to be supplied at the time of enquiry and order. Lengths between 3000 mm and 12000 mm may be specified at the time of enquiry and order, the tolerances shall be as for standard lengths.

NOTE Longer lengths may be available by agreement.

The tolerances for all types of lengths are given in Table 11.

Option 7: Random lengths shall be supplied. The range of length shall be agreed at the time of enquiry and order.

Option 8: Exact lengths shall be supplied. The length required shall be specified at the time of enquiry and order.

Table 11 — Type of lengths and tolerances on length

Dimensions in millimetres

Type of Length	Length (*L*)	Tolerance
Standard	6000 or 6400	+100 0
Random	By agreement	
Exact	≤ 6000	+10 0
	6000 < *L* ≤ 12000	+15 0
	>12000	0 / +by agreement

8.7.3 Tolerances on outside diameter (*D*) and wall thickness (*T*)

The tolerance specified in this Part of EN 10296 is dependent upon the method of manufacture and the delivery condition.

8.7.3.1 Hot reduced EW tube

The tolerance on *D* including out of roundness shall be ± 1% or ± 0,5 mm whichever is the greater.

The tolerance on *T* excluding the weld area shall be ± 10%.

The outside weld bead shall be removed completely i.e. flush with the outside surface of the tube. The internal weld bead need not be removed unless option 9 is specified. The minimum thickness in the weld area shall be not less than that permitted in the body of the tube.

Option 9: The residual height of the internal weld bead shall be restricted to 0,30 mm.

8.7.3.2 As welded or heat treated EW tube

The tolerance on *D*, including out of roundness, is dependent upon delivery condition and D/T ratio and shall be as given in Table 12.

Table 12 — Tolerance on *D* for EW tube, (as welded or heat treated)

D **mm**	**As welded with *D*/*T* ≤ 40 and +A and +N condition with *D*/*T* ≤ 20**	**+A and +N condition with, 20 < *D*/*T* ≤ 40**	**All conditions *D*/*T* > 40**
D ≤ 170	± 0,5% of *D* or ± 0,15 mm whichever is greater	± 0,75% of *D* or ± 0,20 mm whichever is greater	± 1,0% of *D* or ± 0,30 mm whichever is greater
D > 170	± 0,75% of *D*	± 1% of *D*	± 1,5% of *D*

The tolerance on *T*, excluding the weld area, shall be :

— for *T* less than 3 mm : ± 10% or ± 0,1 mm whichever is the greater;

— for T 3 mm and over : ± 8% or ± 2 mm whichever is the smaller.

The outside weld bead of EW tube shall be removed completely i.e. flush with the outside surface of the tube. The internal weld bead need not be removed unless option 9 (see 8.7.3.1) is specified. The minimum thickness in the weld area shall be not less than that permitted in the body of the tube.

8.7.3.3 Laser beam welded and submerged arc-welded tube

The outside diameter of the body of the tube shall not deviate from D by more than ± 0,75% or ± 10 mm, whichever is the less.

Out of roundness shall be calculated using the following equation :

$$\text{Out of roundness} = \frac{D_{\max} - D_{\min}}{D} \times 100 \qquad (1)$$

For tubes having a diameter to thickness ratio not exceeding 100 out of roundness shall not exceed 2%. For diameter to thickness ratios greater than 100 maximum permissible out of roundness shall be agreed between manufacturer and purchaser at the time of enquiry and order.

The tolerance on T excluding any reinforcement at the weld shall be :

— $T \leq 5$ mm, ± 10% or ± 0,3 mm whichever is the greater ;

— 5 mm < $T \leq 40$ mm, ± 8% or ± 2 mm whichever is the lower.

The maximum height of the weld seam for LBW and SAW tubes shall be as specified in Table 13.

Table 13 — Maximum height of weld seam for LBW and SAW tubes

Dimensions in millimetres

T	Maximum height of the LBW weld seam	Maximum height of the SAW weld seam
T ≤ 12,5	1,0	3,5
T > 12,5	1,5	4,8

8.7.4 Sectional properties

The nominal sectional properties shall be calculated in accordance with annex B.

9 Inspection

9.1 Types of inspection

The conformity to the requirements of the order shall be checked by:

— non-specific inspection and testing (see EN 10021) for tubes made of steels in accordance with Table 2 unless option 10 is specified;

— specific inspection and testing (see EN 10021) for tubes made of steels in accordance with Tables 3 and 4.

Option 10: Tubes made of steels in accordance with Table 2 shall be supplied with specific inspection and testing.

9.2 Inspection documents

9.2.1 Types of inspection documents

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

— certificate of compliance with order 2.1 for tubes supplied with non-specific inspection and testing unless option 11 is specified;

Option 11: Inspection document type 2.2 shall be supplied.

— inspection certificate 3.1.B, for tubes supplied with specific inspection and testing unless option 12 is specified.

Option 12: Inspection document 3.1.A, 3.1.C or 3.2 shall be supplied, the type of document to be specified by the purchaser.

If an inspection documents 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 testing and produce the inspection document. In the case of inspection report 3.2 it shall be agreed which party issue the document.

9.2.2 Content of inspection documents

9.2.2.1 The content of the inspection document shall be in accordance with prEN 10168 as shown in 9.2.2.2, 9.2.2.3 and 9.2.2.4.

9.2.2.2 For tubes supplied with non-specific inspection and testing the certificate of compliance with the order shall contain the following codes and information:

A - commercial transactions and parties involved;

B - description of products to which the inspection document applies;

Z - validation.

9.2.2.3 For tubes supplied with non-specific inspection and testing the test report shall contain the following codes and information (see option 11) :

A - commercial transactions and parties involved;

B - description of products to which the inspection document applies;

C02 - direction of test pieces;

C10-C13 - tensile test;

C60-C69 - other tests (e.g. options invoked which require test pieces);

C71-C92 - chemical composition;

D01 - marking and identification, surface appearance, shape and dimensional properties;

Z - validation.

9.2.2.4 For tubes supplied with specific inspection and testing the inspection certificate type 3.1.A, 3.1.B or 3.1.C or inspection report type 3.2 shall contain the following codes and information:

A - commercial transactions and parties involved;

B - description of products to which the inspection document applies;

C02-C03 - direction of test pieces and test temperature if applicable;

C10-C13 - tensile test;

C40-C43 - impact test ; if applicable;

C50-C59 - bend test;

C60-C69 - other tests (e.g. options invoked which require test pieces);

C71-C92 - chemical composition;

D01 - marking and identification, surface appearance, shape and dimensional properties;

D02-D99 - other tests (e.g. options invoked which do not require test pieces);

Z - validation.

9.3 Summary of inspection and testing

Inspection and testing shall be carried out as stated in Table 14 for EW, and EWHR tube and in Table 15 for LBW and SAW tube.

Table 14 — Summary of inspection and tests for EW and EWHR tube

Types of inspection or test		Frequency of testing		Reference paragraph
		Non-specific inspection and testing	Specific inspection and testing	
Mandatory	Cast analysis	Manufacturers procedure	1/cast	8.2
	Tensile test	Manufacturers procedure	1/test unit	8.3, 11.1
	Impact test [a]	Not applicable	1 set/test unit	8.3, 11.7
	Dimensional inspection	See 11.9		
	Visual examination	See 11.10		
Optional	Flattening test or [b c]			83, 11.3
	Drift expanding test or [b c]	Not applicable	1/test unit	8.3, 11.4
	Bend test (whole tube) [b c]			8.3, 11.5
	Leak tightness test	Not applicable	individual	8.4, 11.8
	Non-destructive test of weld	Not applicable	individual	8.4, 11.11

[a] K2 and M grades only.

[b] The flattening or drift expanding or bend test (whole tube) is only carried out on annealed or normalized tubes. The type of test is at the discretion of the manufacturer See option 13.

[c] Option 13: A flattening or drift expanding or a bend test (whole tube) shall be carried out.

Table 15 — Summary of inspection and tests for LBW and SAW tube

Types of inspection or test		Frequency of testing		Reference paragraph
		Non-specific inspection and testing	Specific inspection and testing	
Mandatory	Cast analysis	Manufacturers procedure	1/cast	8.2
	Tensile test	Manufacturers procedure	1/test unit	8.3, 11.1
	Transverse weld tensile test	Manufacturers procedure	1/test unit	8.3, 11.2
	Impact test [a]	Not applicable	1 set/test unit	8.3, 11.7
	Weld bend test	Manufacturers procedure	2/test unit [b]	8.3, 11 .6
	Dimensional testing	See 11.9		
	Visual inspection	See 11.10		
Optional	Leak tightness test	Not applicable	individual	8.4, 11.8
	Non-destructive test of weld	Not applicable	individual	8.4, 11.11

[a] Only for K2 and M grades.

[b] One root and one face test.

10 Sampling

10.1 Frequency of tests

10.1.1 Test unit

In the case of specific inspection and testing a test unit shall comprise tubes of the same steel grade and specified dimensions, manufactured by the same process, e.g. electric welding, submerged arc-welding, and in the same delivery condition.

The quantity of tubes per test unit shall conform to Table 16.

Table 16 — Quantity per test unit

Outside diameter *D*	Maximum mass of tubes per test unit
mm	tonnes
D ≤ 114,3	40
>114,3 < D≤ 323,9	50
D > 323,9	100

10.1.2 Number of sample tubes per test unit

One sample tube shall be taken from each test unit.

10.2 Preparation of samples and test pieces

10.2.1 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 Test piece for the tensile test on the parent material

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

— For tubes with *D* less than or equal to 219,1 mm, the test piece shall be either a full tube section or a strip section and be taken in a direction longitudinal to the axis of the tube;

— for tubes with *D* greater than 219,1 mm but less than or equal to 508 mm, the test piece shall be taken in a direction either longitudinal or transverse to the axis of the tube;

— for tubes with an outside diameter greater than 508 mm the test piece shall be taken in a direction transverse to the axis of the tube;

— for tubes with an outside diameter greater than 219,1 mm the test piece is either a machined test piece of circular cross-section from an unflattened sample or a flattened strip section.

The test piece shall be taken from opposite the weld except for helically laser beam welded (LBWH) or submerged arc-welded tubes (SAWH), for these tubes the test piece shall be taken at one quarter of the distance between the welds.

10.2.3 Test piece for the tensile test 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, which utilizes the full wall thickness of the tube. The weld bead may be removed.

10.2.4 Test piece for the flattening test or drift expanding test

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

10.2.5 Test pieces for bend test in full section tube

The test piece shall consist of a full section tube in accordance with EN 10232.

10.2.6 Test pieces for the weld bend test

The test pieces shall be in accordance with EN 910.

10.2.7 Test piece for the impact test

The direction of testing is at the discretion of the manufacturer, flattening of samples is not permitted. Three standard Charpy V-notch test pieces in accordance with EN 10045-1 shall be taken remote from the weld. If the nominal product thickness is such that standard test pieces cannot be produced without flattening of the section, the test shall be carried out using test pieces of width less than 10 mm but not less than 5 mm. In all cases the largest obtainable width shall be used.

Test pieces shall be taken and prepared such that the axis of the notch is perpendicular to the surface of the tube.

Tubes shall not be subject to impact testing where longitudinal test pieces of width 5 mm or greater cannot be obtained.

11 Test methods

11.1 Tensile test on the parent material

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

— the tensile strength (R_m) ;

— the upper yield strength (R_{eH}) ;

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

— the percentage elongation after fracture with reference to a gauge length L_0 of $5,65\sqrt{S_0}$;

If a non-proportional test piece is used, the percentage elongation value shall be converted to the value for a gauge length $L_0 = 5,65\sqrt{S_0}$ using the conversion Tables given in EN ISO 2566-1.

11.2 Transverse tensile test on the weld

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

— the tensile strength (R_m).

11.3 Flattening test

The test shall be carried out in accordance with EN 10233 with the weld placed at 90° to the direction of flattening. The tube section shall be flattened in a press until the distance H between the platens reaches 67% of the original outside diameter. 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 Drift Expanding Test

The test shall be carried out in accordance with EN 10234. The tube section shall be expanded with a conical mandrel with an angle β of 60° until the % increase of outside diameter reaches the applicable value shown in Table 17.

Table 17 — Drift expanding test requirements

d/*D* [a]	% increase of outside diameter
≤ 0,6	8
> 0,6 ≤ 0,8	10
> 0,8	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.

11.5 Bend test on full section tube

The test shall be carried out at room temperature in accordance with EN 10232. The angle of the bend shall be 180° and the diameter of the former 6 times the specified outside diameter of the tube. The tube shall contain no sign of a crack, detectable without using magnifying aids, after testing.

11.6 Weld Bend Test

The tests shall be carried out in accordance with EN 910 using a mandrel of diameter 6 *T*. One test shall be a root bend test and the other a face bend test. After testing the test piece shall show no cracks or flaws, however imperfections less than 3mm long on the specimen edges shall not be a cause for failure of the test.

11.7 Impact test

11.7.1 The test shall be carried out in accordance with EN 10045-1 at - 20°C.

11.7.2 The mean value of the three test pieces shall meet the requirements given in Tables 8 and 9. One individual value may be below the specified value, provided that it is not less than 70% of that value

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

$$KV_c = \frac{10\ KV_p}{W} \qquad (2)$$

where :

KV_c is the calculated impact energy, in joules;

KV_p is the measured impact energy in joules;

W is the width of the test piece, in millimetres.

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

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

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

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

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

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

11.8 Leak tightness test

11.8.1 General

EW tubes shall be tested in accordance with 11.8.2 or 11.8.3. The choice of test method is at the discretion of the manufacturer unless option 14 is specified.

Option 14: The test method for verification of leak tightness of EW tubes according to 11.8.2 or 11.8.3 is chosen by the purchaser.

Laser beam welded and submerged arc-welded tubes shall be tested in accordance with 11.8.2.

11.8.2 Hydrostatic test

The hydrostatic test shall be carried out at a test pressure of 70 bar or P, calculated from the following equation, whichever is the lower.

$$P = \frac{20\ S\ T}{D} \qquad (3)$$

where :

P test pressure in bars;

D specified outside diameter in millimetres;

T specified wall thickness in millimetres;

S stress, in MPa squared, corresponding to 70% of the specified minimum yield strength (see Tables 6, 7, 8 and 9) for the steel grade concerned.

The test pressure shall be held for not less than 5 s for tubes with specified outside diameter less than or equal to 457 mm and for not less than 10 s for tubes with specified outside diameter greater than 457 mm.

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

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

11.8.3 Electromagnetic test

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

11.9 Dimensional inspection

Specified dimensions shall be verified.

A gauge is used normally for measuring the outside diameter. However, for measuring tubes with outside diameter equal to or greater than 406,4 mm a circumference tape may be used. The wall thickness shall be measured within 100 mm of the tube ends, outside diameter and out of roundness shall be measured more than 100 mm from the tube ends.

11.10 Visual examination

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

11.11 Non-destructive testing of the weld

Testing shall be carried out in accordance with one of the following non-destructive testing standards to the acceptance level indicated. Where the test method requires calibration with notches, only external reference notches shall be used.

— EN 10246-3 - acceptance level E4;

— EN 10246-5 - acceptance level F4;

— EN 10246-7 - acceptance level U4;

— EN 10246-8 - acceptance level U4;

— EN 10246-9 - acceptance level U4;

— EN 10246-10 - image quality class R2, except that radioscopic methods whose sensitivity can be demonstrated to be equivalent are permitted at the discretion of the manufacturer.

The choice from the list of methods as appropriate for the type of tube is at the discretion of the manufacturer.

11.12 Retests, sorting and reprocessing

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

12 Marking

12.1 Except as provided for in 12.2, for tubes which are supplied bundled, each tube shall be marked by suitable and durable methods such as painting, stamping, adhesive labels or attached tags with the following:

— the manufacturers name or trademark;

— the number of this part of EN 10296 (EN 10296-1);

— the steel name;

— the symbol for the delivery condition, except for those grades shown in Tables 7 and 9;

— in the case of specific inspection, the mark of the inspection representative and 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- EN 10296-1 - E275 +N - Y - Z

X manufacturers name or trademark;

Y mark of inspection representative;

Z identification number (e.g. order or item number).

12.2 Where the products are supplied bundled, the marking required in 12.1 may be on a label or tag, which shall be securely attached to the bundle. Additionally the label or tags shall identify the diameter, wall thickness and type of length of the tube.

13 Protection

The tubes shall be delivered without temporary corrosion protection unless option 15 is specified.

Option 15: Tubes shall be specially protected for transit and storage. The type of coating shall be agreed at the time of enquiry and order.

Annex A
(informative)

Typical range of dimensions for tube manufacturing processes

This annex gives typical dimensions, which can be achieved by the tube manufacturing processes covered by this part of EN 10296 (see Table 1).

NOTE All manufacturers will not be able to cover the full range for a given process, others may offer extended ranges.

Table A.1 —Typical range of dimensions for tube manufacturing processes

Method of manufacture	Typical dimension range mm	
	Outside diameter	Thickness
EW	up to 508	0,5 to 20
EWHR	up to 168,3	1,8 to 8
LBWL/LBWH	up to 1500	0,5 to 20
SAWL	406 to 2540	6,3 to 40
SAWH	168,3 to 2540	5 to 20

Annex B
(normative)

Formulae for calculation of nominal sectional properties

The nominal sectional properties for tubes are calculated from the following geometric properties using the formulae given below :

Specified outside diameter	D	mm
Specified thickness	T	mm
Calculated inside diameter	$d = D - 2T$	mm
Superficial area/unit length	$A_S = \frac{\pi D}{10^3}$	m^2/m
Cross sectional area	$A = \frac{\pi(D^2 - d^2)}{4 \times 10^2}$	cm^2
Mass per length	$M = 0{,}785\ A$	kg/m
Second moment of area	$I = \frac{\pi(D^4 - d^4)}{64 \times 10^4}$	cm^4
Radius of gyration	$i = \sqrt{\frac{I}{A}}$	cm
Elastic section modulus	$W_{el} = \frac{2I \times 10}{D}$	cm^3
Plastic section modulus	$W_{pl} = \frac{D^3 - d^3}{6 \times 10^3}$	cm^3
Torsional Inertia constant (polar moment of inertia)	$I_t = 2\ I$	cm^4
Torsional modulus constant	$C_t = 2\ W_{el}$	cm^3

Bibliography

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

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

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