BRITISH STANDARD

BS EN
10208-1:1998

Steel pipes for pipelines for combustible fluids — Technical delivery conditions —

Part 1: Pipes of requirement class A

The European Standard EN 10208-1:1997 has the status of a British Standard

ICS 23.040.10

National foreword

This British Standard is the English language version of EN 10208-1:1997.

The UK participation in its preparation was entrusted by Technical Committee PSE/17, Materials and equipment for the petroleum and natural gas industries, to Subcommittee PSE/17/1, Linepipe, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible 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 subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

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Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

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EUROPEAN STANDARD

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Descriptors: Metal tubes, steel tubes, welded tubes, pressure pipes, fluid pipelines, fuels, delivery, classifications, designation, manufacturing, chemical composition, mechanical properties, dimensions, dimensional tolerances, tests, inspection, marking

English version

Steel pipes for pipelines for combustible fluids — Technical delivery conditions — Part 1: Pipes of requirement class A

Tubes en acier pour conduites de fluides combustibles — Conditions techniques de livraison — Partie 1: Tubes de la classe de prescription A

Stahlrohre für Rohrleitungen für brennbare Medien — Technische Lieferbedingungen — Teil 1: Rohre der Anforderungsklasse A

This European Standard was approved by CEN on 26 September 1997.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 10208-1:1997 E

Foreword

This European standard 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 EN 10208-1 has been established by ECISS/TC 29/SC 2, Steel tubes and fittings for steel tubes — Line pipe, in co-operation with ISO/TC 67/SC 1, Material and equipment for petroleum and natural gas industries — Line pipe, which is responsible for the international standard for line pipe ISO 3183-1 [1].

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 May 1998, and conflicting national standards shall be withdrawn at the latest by May 1998.

There are some principal differences between EN 10208-1 and ISO 3183-1 concerning:

a) *The concept.*

This EN 10208-1 covers steel grades of low and medium strength level up to 360 N/mm^2 yield strength in a basic quality (see introduction).

ISO 3183-1 covers the full range of strength levels up to 555 N/mm^2 yield strength and provides, in addition to the general requirements which correspond in this case with those of the main part of ANSI/API 5L [2], for agreement at the time of enquiry and order, a series of supplementary requirements also taken from ANSI/API 5L.

b) *Formal items*:

– normative references (see clause **2**);

– this European standard uses steel numbers in accordance with EN 10027-2 (see Tables 2 and 4);

– this European standard uses the standardized code numbers and terms of EURONORM 168 for the structure and the content of inspection documents.

Annex F contains national A-deviations specifying the restrictions for the application of this European standard in Sweden.

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

Contents

Introduction

In the preparation of this European standard the competent committee was unanimous in seeking to avoid specifying the quality of line pipe to be used for a particular application. However, the committee recognized that there are several broad quality levels commonly used, and has differentiated between these quality levels as follows.

Firstly, the committee recognized the need to provide a basic quality level broadly similar to that specified in the main part of ANSI/API 5L [2]. This is designated quality level A, and considered in this EN 10208-1.

Secondly, many purchasers impose requirements additional to the basic standard, for instance concerning toughness and non-destructive testing. This approach is common, for example, for transmission pipelines. Such enhanced requirements are addressed in requirement class B and considered in EN 10208-2.

Thirdly, there are certain particularly demanding applications where very stringent requirements on quality and testing are imposed. Such requirements are reflected in requirement class C and considered in EN 10208-3.

In this part 1 of EN 10208 no impact properties are specified. The Charpy energy requirements in EN 10208-2 have been derived from established data in accordance with EPRG recommendations [3] to avoid long running shear fracture in pipelines transporting lean, dry natural gas. It is the responsibility of the designer to decide whether these energy requirements suffice for the intended application. For example, rich gas or two-phase fluids may require enhanced properties.

The selection of the requirement class depends on many factors. The properties of the fluid to be conveyed, the service conditions, design code and any statutory requirements should all be taken into consideration. Therefore this standard gives no detailed guidelines. It is the ultimate responsibility of the user to select the appropriate requirement class for the intended application.

NOTE This European standard combines a wide range of product types, dimensions and technical restrictions. In some areas of application, the absence of a single European pipeline design standard has resulted in differing national regulations imposing conflicting requirements on the users, thus making technical harmonization difficult.

Consequently, it may be necessary to vary certain requirements of this European standard to satisfy various national design codes. However, this European standard shall be the basic reference document. Such amendments should be specified at the time of enquiry and order (see clause **5**).

1 Scope

1.1 This European standard EN 10208-1 specifies the technical delivery conditions for unalloyed seamless and welded steel pipes. It includes quality and testing requirements lower than those specified in EN 10208-2 and applies to pipes which are normally used for the distribution of combustible fluids within the maximum allowable operating pressure given in the appropriate design code.

NOTE 1 Pipes according to EN 10208-1 are also applied to water piping in the oil and gas industries.

NOTE 2 This European standard does not apply to cast steel pipe.

Other parts of this European standard are:

EN 10208-2, *Steel pipes for pipelines for combustible fluids — Technical delivery conditions — Part 2: Pipes of requirement class B*

EN 10208-3, *Steel pipes for pipelines for combustible fluids — Technical delivery conditions — Part 3: Pipes of requirement class C*

1.2 In addition to the requirements of this European standard the general technical delivery conditions specified in EN 10021 apply.

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.

The requirements of this European standard rule when they differ from those in the standards and documents referred to below.

CR 10260, *Designation systems for steel; Additional symbols for steel names*
(CEN Report)

EN 287-1, *Approval testing of welders — Fusion welding — Part 1: Steels*

EN 288-1, *Specification and approval of welding procedures for metallic materials — Part 1: General rules for fusion welding*

EN 288-2, *Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure specification for arc welding*

EN 473, *Qualification and certification of NDT personnel — General principles*

EN 910, *Destructive tests on welds in metallic materials — Bend test*

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

EN 10003-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

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

EN 10021, *General technical delivery conditions 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 10052, *Vocabulary of heat treatment terms for ferrous products*

EN 10079, *Definition of steel products*

EN 10109-1, *Metallic materials — Hardness test — Part 1: Rockwell test (scales A, B, C, D, E, F, G, H, K) and Rockwell superficial test (scales 15N, 30N, 45N, 15T, 30T and 45T)*

EN 10204, *Metallic products — Types of inspection documents*
(includes amendment A1:1995)

EN 10233, *Metallic materials — Tube — Flattening 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 10246-7, *Non-destructive testing of steel tubes — Part 7: Automatic full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal imperfections*

EN ISO 9001, *Quality systems — Model for quality assurance in design/development, production, installation and servicing*
(ISO 9001:1994)

EN ISO 9002, *Quality systems — Model for quality assurance in production, installation and servicing*
(ISO 9002:1994)

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

EURONORM 168[1)], *Iron and steel products — Inspection documents — Contents*

IC 2[2)], *Weldable fine-grained structural steels; Recommendations for processing, in particular for welding*

ISO 1027, *Radiographic image quality indicators for non-destructive testing — Principles and identification*

ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels*

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

prEN 10246-3[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*

prEN 10246-5[3)], *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*

prEN 10246-8[3)], *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*

prEN 10246-9[3)], *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*

prEN 10246-10[3)], *Non-destructive testing of steel tubes — Part 10: Radiographic testing of the weld seam of submerged arc-welded steel tubes for the detection of imperfections*

prEN 10246-17[3)], *Non-destructive testing of steel tubes — Part 17: Ultrasonic testing of tube ends of seamless and welded steel tubes for the detection of laminar imperfections*

prEN 10256[3)], *Non-destructive testing of steel tubes — Qualification and competence of level 1 and level 2 NDT personnel*

prEN ISO 377[3)], *Steel and steel products — Location of samples and test pieces for mechanical testing*
(ISO/DIS 377:1996)

[1)] Until this EURONORM is transformed into a European standard it can either be implemented or the corresponding national standard shall be agreed at the time of enquiry and order.

[2)] Information Circular of the European Committee for Iron and Steel Standardization (ECISS), published by the members of CEN.

[3)] 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.

3 Definitions

3.1 General

For the purpose of this European standard the definitions in **3.2** to **3.4** shall apply when additional to or differing from those given for the:

– classification of steels in EN 10020;
– definition of steel products in EN 10079;
– heat treatment in EN 10052; and
– for types of sampling procedures, inspection and inspection documents in prEN ISO 377, EN 10021 and EN 10204.

3.2 Types of pipes and welds

3.2.1

seamless (S) **pipe**

the tubular product is manufactured in a hot forming process which may be followed by sizing (see **6.4**) or cold finishing (see **3.3.4**) to produce the desired dimensions

3.2.2 Welded (W) **pipe**

3.2.2.1

electric welded (EW) **pipe**

the tubular product is manufactured by forming from strip and welding the abutting edges without addition of filler metal. The longitudinal seam is generated by current applied by induction or conduction

3.2.2.2

continuous welded (BW) **pipe**

the tubular product is manufactured by forming from strip heated in a furnace and mechanically pressing the formed edges together, wherein successive coils of strip had been joined together to provide a continuous flow of steel for the welding mill. (This process implies a type of butt-welding)

3.2.2.3

submerged arc-welded (SAW) **pipe**

the tubular product is manufactured by forming from strip or plate and welding the abutting edges by addition of filler metal. The pipe having a longitudinal (SAWL) or helical (SAWH) seam is produced by the automatic submerged arc process (but see also **6.2**). At least one pass is made on the inside and at least one pass on the outside of the pipe. An intermittent or continuous single pass tack weld made by the gas metal arc-welding process is permitted

3.2.2.4

combination gas metal arc and submerged arc-welded (COW) **pipe**

the tubular product is manufactured by forming from strip or plate and welding the abutting edges by addition of filler metal. The pipe having one longitudinal (COWL) or one helical (COWH) seam is produced by a combination of gas metal arc-welding and submerged arc-welding. The gas metal arc-welding process is continuous and first, followed by the automatic submerged arc-welding process with at least one pass on the inside and at least one pass on the outside of the pipe

3.2.3

strip end weld

a weld that joins strip ends together

3.2.4

jointer

two pieces of pipe joined together by a circumferential weld

3.2.5

pipe body

for welded pipe the entire pipe excluding the weld(s) and heat affected zone(s); for seamless pipe the entire pipe

3.3 Treatment condition

3.3.1

normalizing forming

a forming process in which the final deformation is carried out within 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

the abbreviated form of this delivery condition is N

3.3.2

thermomechanical forming

a forming 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. Subsequent heating above 580 °C may lower the strength values

the abbreviated form of this delivery condition is M

NOTE 1 Thermomechanical forming, leading to the delivery condition M, may include processes of increased cooling rates, without or with tempering, including self-tempering, but excluding definitively direct quenching and quenching and tempering.

NOTE 2 As a consequence of lower carbon content and carbon equivalent values, material in the delivery condition M has improved weldability properties.

3.3.3

quenching and tempering

a heat treatment consisting of quench hardening followed by tempering. Quench hardening implies austenitization followed by cooling, under conditions such that austenite transforms more or less completely into martensite, and possibly into bainite. Tempering implies heating to a specific temperature ($< Ac_1$) one or more times, or holding at these temperatures, followed by cooling at an appropriate rate so that the structure is modified and the specified properties are achieved

the abbreviated form of this delivery condition is Q

3.3.4

cold forming and cold finishing

in this context cold forming implies a process by which a flat product is formed to a pipe without heating. Cold finishing is a cold working operation (normally cold drawing) with a permanent strain greater than 1,5 %, which differentiates it from sizing operations specified in **6.4**

3.4

imperfections and defects

3.4.1

imperfections are irregularities in the wall or on the pipe surfaces detectable by methods described in this European standard. Imperfections with a size and/or population density that are within the acceptance criteria defined in this European standard are considered to have no practical implication on the intended use of the product

3.4.2

defects are imperfections with a size and/or population density that are greater than the acceptance criteria defined in this European standard. Defects are considered to adversely affect or limit the intended use of the product

3.5

agreement

unless otherwise indicated "by agreement" means by agreement between manufacturer and purchaser at the time of enquiry and order

3.6

margin symbols

the following symbols are used in the margin of pages or Tables for indicating optional delivery conditions:

M mandatory agreement [see **5.2**a)];

U unless otherwise agreed left to the discretion of the manufacturer [see **5.2**b)];

O optional agreement [see **5.2**c)].

4 Classification and designation

4.1 Classification

The steels specified in this European standard are non-alloy quality steels in accordance with EN 10020.

4.2 Designation

The steels specified in this European standard are designated with steel names and steel numbers. Their designation in accordance with EN 10027-1, EN 10027-2 and CR 10260 is given in Tables 2 and 4.

NOTE A comparison of basic steel names with those specified in ANSI/API 5L [2] using the basis of minimum yield strength values is given in annex A.

5 Information to be supplied by the purchaser

5.1 Mandatory information

The purchaser shall state in his enquiry and order the following minimum information:

1) quantity ordered (e.g. total tonnage or total length of pipe);

2) product form (i.e. pipe);

3) type of pipe (seamless (S) or welded (W));

4) number of this part of this European standard;

5) steel name or number (see Table 2 or 4);

6) pipe outside diameter and wall thickness in millimetres (see **7.6.1.2**);

7) random length group or, if a fixed length is required, the length in millimetres (see **7.6.3.3** and Table 8);

8) type of inspection document (see **8.1.2**).

5.2 Other information

This European standard offers to the purchaser and manufacturer the possibility to agree additional information (see note to **7.3**), or, in addition to the normally applicable delivery conditions, other conditions in accordance with items a) to c) as follows. The need for additional information or the options required shall be clearly indicated at the enquiry stage and stated in the order and in the confirmation of the order.

a) Mandatory agreement: option which shall be agreed when applicable (indicated in the margin by M):

1) diameter tolerances for seamless pipe with wall thickness > 25 mm (see Table 6, footnote 2);

2) diameter tolerances for pipe with outside diameter > 1430 mm (see Table 6);

3) party to issue the inspection document 3.2 (see note 2 to **8.1.2**).

b) Unless otherwise agreed, left to the discretion of the manufacturer (indicated in the margin by U):

1) process of manufacture for welded pipe (see **6.2**);

2) choice of the heat treatment condition (see **6.3**);

3) choice of welding process for jointers (see **B.1**);

4) radiographic inspection for the detection of longitudinal imperfections [see **D.4.2**a)].

c) Optional agreement: option which may be agreed (indicated in the margin by O):

1) manufacture of SAWL pipes with two seams (see **6.2**);

2) delivery of jointers (see **6.6**);

3) application of the diameter tolerance to the inside diameter (see Table 6, footnote 3);

4) application of the diameter tolerance to the outside diameter (see Table 6, footnote 4);

5) special bevel configuration (see **7.6.4.2**);

6) threaded ends or belled ends (see **7.6.4.3**);

7) offset of strip end welds (see Table 10, footnote 1);

8) test piece direction (see Table 13, footnote 2);

9) use of round test pieces (see **8.2.2.2.2**);

10) use of flattened and heat treated test coupons (see **8.2.2.2.2**);

11) non-destructive leak-tightness test instead of hydrostatic test (see **8.2.3.6.4**);

12) use of special devices for measuring the pipe diameter (see **8.2.3.8.1**);

13) use of (cold) die stamping (see **9.1.3**);

14) special marking (see **9.2**);

15) coating and lining (see clause **10**);

16) degree of staggering of pipe weld seams in jointers (see **B.1**);

17) verification of quality requirement for laminar imperfections (see **D.2.3**);

18) use of fixed depth notches for equipment calibration [see **D.4.1.1**d)];

19) use of hole penetrameters instead of the ISO wire penetrameter [see **D.4.3.1a**)];

20) use of fluoroscopic inspection [see **D.4.3.1**b)].

5.3 Example of ordering

The information should preferably be given in the way indicated in the following example of ordering:

– 1000 m pipe, W, EN 10208-1-L235GA-219, 1 × 6, 3-r2, inspection document EN 10204-2.2.

6 Manufacturing

6.1 General

6.1.1 The pipe manufacturer and the stockist, where products are supplied through a stockist, shall operate a quality system in accordance with EN ISO 9002[4].

6.1.2 All non-destructive testing (NDT) activities shall be carried out by qualified and competent level 1 and/or level 2 NDT personnel approved by the employer[5]. At the discretion of the manufacturer these personnel may be qualified in accordance with prEN 10256 or certificated in accordance with EN 473. Level 1 and 2 personnel and NDT operations shall be authorized by a level 3 individual, approved by the employer and certificated in accordance with EN 473 (see **8.2.3.10** and annex D).

6.2 Pipe manufacturing

Acceptable types of pipe are described in **3.2** and listed together with acceptable manufacturing routes in Table 1. Unless otherwise agreed, the process of manufacture (type of pipe) for welded pipe is left to the discretion of the manufacturer. For all types of pipe the choice of the process route in accordance with Table 1 is left to the discretion of the manufacturer. U

SAWH pipe shall be manufactured using strip with a width not less than 0,8 or more than 3,0 times the pipe outside diameter.

SAWL pipe may be manufactured with two seams by agreement. O

6.3 Heat treatment condition

The pipes shall be delivered in one of the heat treatment conditions given in Table 1. Unless otherwise agreed, the choice of the heat treatment condition is left to the discretion of the manufacturer. U

6.4 Sizing

The pipes may be sized to their final dimensions by expanding or reducing. This shall not produce excessive permanent strain. Where no further heat treatment or only a heat treatment of the weld area is carried out, the sizing ratio s_r achieved by this cold working shall not exceed 0,015. It shall be calculated according to the formula:

$$s_r = \frac{|D_a - D_b|}{D}$$

where

D_a is the outside diameter after sizing;

D_b is the outside diameter before sizing;

D is the specified outside diameter.

6.5 Strip end welds

6.5.1 For helical seam welded pipe, the strip end weld shall be located at least 200 mm from the pipe end.

6.5.2 For welded pipe with a longitudinal seam strip end welds are not permitted in the pipe.

6.6 Jointers

The delivery of jointers is permitted, by agreement, provided the lengths of pipe used have fulfilled the requirements of this European standard and the special requirements in annex B are complied with. O

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[4] This requirement is also fulfilled by a quality system in accordance with EN ISO 9001.

[5] Employer: is the organization for which the person works on a regular basis. The employer may be either the tube manufacturer or a third party organization providing NDT services.

Table 1 — Type of pipe and manufacturing route (starting material, pipe forming and heat treatment conditions)

Type of pipe	Starting material	Pipe forming[1)]	Heat treatment condition
Seamless (S)	Ingot or billet	Hot rolling	(As rolled)
			Normalized or normalizing formed
			Quenched and tempered
		Hot rolling and cold finishing	Normalized
			Quenched and tempered
Electric welded (EW)	Normalizing rolled strip	Cold forming	—[2)]
			Stress relieved (weld area)[2)]
			Normalized (weld area)
		Cold forming and cold finishing	Normalized (entire pipe)
	Thermomechanically rolled strip	Cold forming	Heat treated (weld area)
	Hot rolled or normalizing rolled strip	Cold forming	Normalized (entire pipe)
		Cold forming and hot stretch reducing under controlled temperature resulting in a normalized condition	—
Submerged arc-welded (SAW) – longitudinal seam (SAWL) – helical seam (SAWH) Combination welded (COW) – longitudinal seam (COWL) – helical seam (COWH)	Normalized or normalizing rolled plate or strip	Cold forming	—
	Thermomechanically rolled plate or strip	Cold forming	—
	As rolled plate or strip	Normalizing forming	—
	Normalized or normalizing rolled plate or strip		
	As rolled plate or strip	Cold forming	—[4)]
Continuous welded (BW)[3)]	Hot rolled or normalizing rolled strip	Hot forming	(As welded; normalized if necessary)

[1)] See **3.3.4**.

[2)] Steel grades L210GA, L235GA, L245GA and L290GA only.

[3)] Steel grades L210GA and L235GA and ≤ 114,3 mm outside diameter for distribution pipelines only.

[4)] Steel grades L210GA, L235GA and L245GA only.

7 Requirements

7.1 General

The requirements specified in this European standard apply on condition that the relevant specifications for test piece selection, test piece preparation and test methods given in **8.2.2** and **8.2.3** are complied with.

NOTE Table 12 gives a survey of the tables and clauses containing requirements and specifications for testing.

7.2 Chemical composition

7.2.1 *Cast analysis*

The cast analysis of the steel shall comply with the requirements in Table 2.

7.2.2 *Product analysis*

The permissible deviations from the specified chemical composition of the cast analysis given in Table 2, shall be as given in Table 3.

7.3 Mechanical and technological properties

The pipes shall, as far as applicable (see Table 12, column 2), conform with the requirements given in Table 4.

NOTE In the case of hot forming and/or subsequent field heat treatment of pipes delivered in the quenched and tempered or thermomechanically rolled condition adverse change of mechanical properties can occur (see, for example, **3.3.2**). Where appropriate the purchaser should contact the manufacturer for more detailed information.

7.4 Weldability

In view of the processes of the manufacture of the pipes and of pipe lines the requirements for the chemical composition of the steels are specified so that the steels delivered in accordance with this European standard are weldable.

However, account should be taken of the fact that the behaviour of the steel during and after welding is dependent not only on the steel, but also on the welding consumables used and on the conditions of preparing for and carrying out the welding.

7.5 Surface condition, imperfections and defects

7.5.1 The manufacturer shall take adequate precautions to minimize the presence of pipe damage and imperfections.

7.5.2 The surface finish produced by the manufacturing process shall allow the detection of surface imperfections that can be disclosed by visual inspection.

Table 2 — Chemical composition[1)] of the cast analysis

Steel designation		Maximum content %					
Name	Number	C	Si	Mn	P	S	Others
L210GA	1.0319	0,21	0,40	0,90	0,030	0,030	[2)]
L235GA	1.0458	0,16	0,40	1,20	0,030	0,030	
L245GA	1.0459	0,20	0,40	1,15	0,030	0,030	
L290GA	1.0483	0,20	0,40	1,40	0,030	0,030	[3)]
L360GA	1.0499	0,22	0,55	1,45	0,030	0,030	

[1)] The steels shall be fully killed with 0,015 % ≤ Al_{total} < 0,060 %.

[2)] Other elements shall not be added intentionally.

[3)] V, Nb, Ti and combinations thereof may be added at the discretion of the manufacturer. The sum of these elements shall not exceed 0,15 %.

Table 3 — Permissible deviations on product analysis from the specified chemical composition limits given in Table 2

Element	Permissible deviation
C	+0,02
Si	+0,05
Mn	+0,10
P	+0,005
S	+0,005
Al	±0,005
V + Nb + Ti	+0,02

Table 4 — Requirements for the results of tensile and bend test and for the hydrostatic test

Steel		Pipe body (seamless and welded pipe)			Weld seam		Entire pipe
Name	Number				EW, BW, SAW, COW	SAW, COW	
		Yield strength, $R_{t0,5}$ N/mm^2 min.	Tensile strength, R_m N/mm^2 min.	Elongation[1], A ($L_0 = 5{,}65\sqrt{S_0}$) % min.	Tensile strength, R_m N/mm^2 min.	Diameter of the mandrel for bend test[2] (see **8.2.3.3**)	Hydrostatic test (see **8.2.3.6**)
L210GA	1.0319	210	335 to 475	25	The same values as for the pipe body apply.	2T	Each length of pipe shall withstand the test without showing leakage or visible deformation.
L235GA	1.0458	235	370 to 510	23			
L245GA	1.0459	245	415 to 555	22		3T	
L290GA	1.0483	290	415 to 555	21		3T	
L360GA	1.0499	360	460 to 620	20		4T	

[1] These values apply to transverse specimens taken from the pipe body. When longitudinal specimens are tested (see Table 13), the values of elongation shall be 2 units higher.

[2] T = specified wall thickness of the pipe.

7.5.3 Surface imperfections disclosed by visual inspection shall be investigated, classified and treated as follows.

a) Imperfections with a depth equal to or less than 12,5 % of the specified wall thickness, and which do not encroach on the specified minimum wall thickness, shall be classified as acceptable imperfections and treated in accordance with **C.1**.

b) Imperfections with a depth greater than 12,5 % of the specified wall thickness, and which do not encroach on the specified minimum wall thickness, shall be classified as defects and shall either be dressed-out by grinding in accordance with **C.2** or treated in accordance with **C.3** as appropriate.

c) Imperfections which encroach on the specified minimum wall thickness shall be classified as defects and treated in accordance with **C.3**.

7.5.4 For undercuts disclosed by visual inspection of SAW and COW pipes, the acceptance criteria given in **D.4.3.2**d) to **D.4.3.2**f) shall apply.

7.5.5 The acceptance criteria for imperfections detected by non-destructive testing, as required by **8.2.3.10**, are specified in annex D.

7.5.6 All pipes shall be free from defects (see **3.4.2**).

7.5.7 Geometric deviations from the normal cylindrical contour of the pipe which occur as a result of the pipe forming process or manufacturing operations (e.g. dents, flat spots, peaks) shall not exceed the following limits:

– 3 mm for flat spots, peaks and cold formed dents with sharp bottom gouges;

– 6 mm for other dents.

These limits refer to the gap between the extreme point of the deviation and the prolongation of the normal contour of the pipe.

For the measurement of flat spots and peaks see **8.2.3.8.3**. For dents, the length in any direction shall not exceed one half of the pipe outside diameter.

7.5.8 Any hard spot exceeding 50 mm in any direction shall have a hardness value less than 35 HRC (357 HB) (see **8.2.3.7**).

7.6 Dimensions, masses and tolerances

7.6.1 *Dimensions*

7.6.1.1 The pipes shall be delivered to the dimensions specified in the enquiry and order, within the tolerances given in **7.6.3** to **7.6.6**.

7.6.1.2 The outside diameters and wall thicknesses given in Table 5 are selected from ENV 10220 and should preferably be ordered. Other dimensions may be chosen.

7.6.1.3 For the length of the pipes see **7.6.3.3**, and for the finish of the pipe ends see **7.6.4.**

7.6.2 *Masses*

The mass per unit length (in kg/m) for plain end pipes shall be calculated using the following formula:

$$M = (D - T) \times T \times 0{,}0246615$$

where

M is the mass per unit length;

D is the specified outside diameter in millimetres (mm);

T is the specified wall thickness in millimetres (mm).

The formula is based on a density equal to 7,85 kg/dm^3.

7.6.3 *Tolerances on the pipe*

7.6.3.1 *Diameter and out-of-roundness*

The outside diameter and the out-of-roundness, as defined in **8.2.3.8.2**, shall be within the tolerances given in Table 6.

Table 5 — Preferred outside diameters and wall thicknesses (indicated by the enframed field including the frame itself)

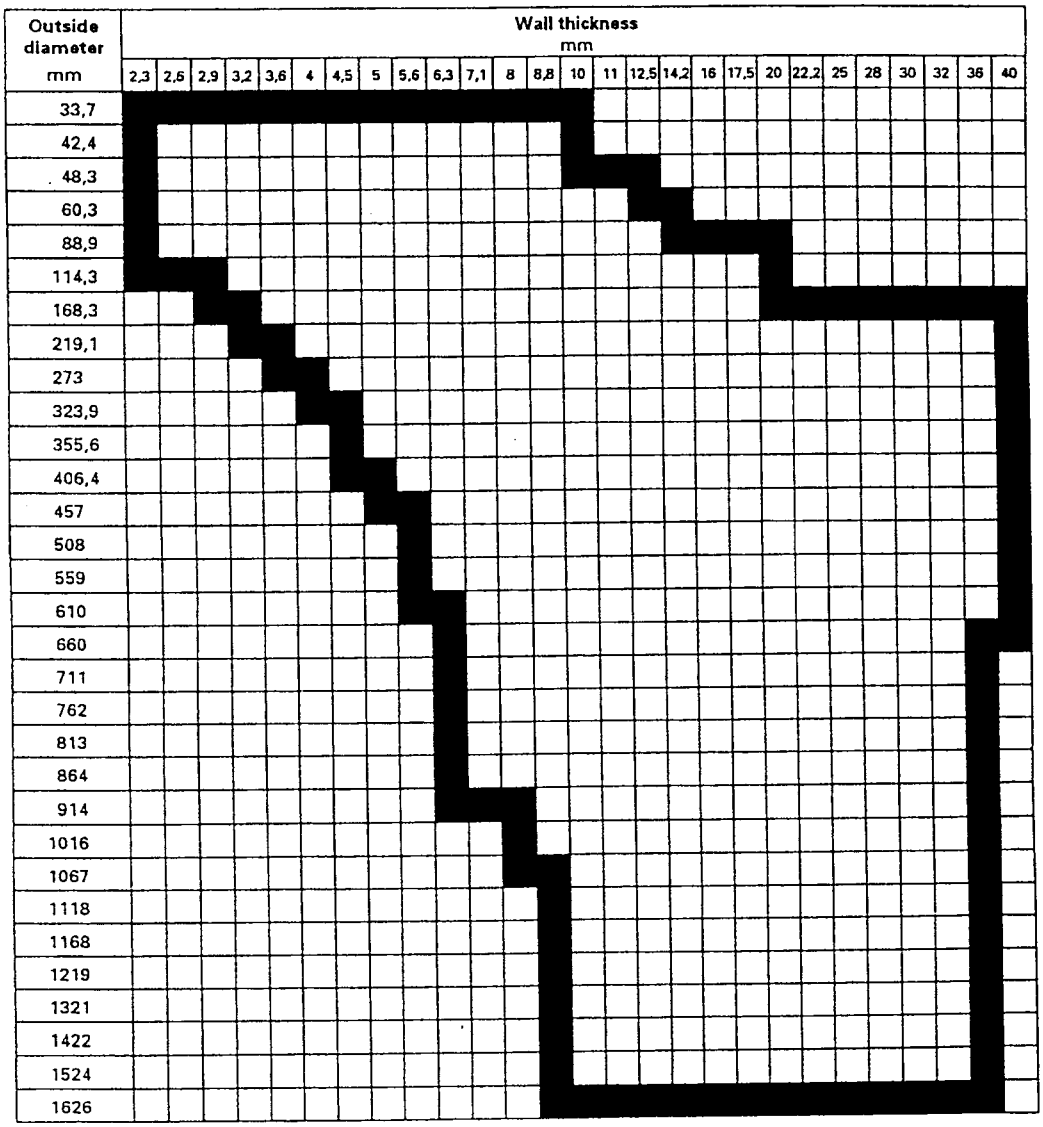


Table 6 — Tolerance on diameter and out-of-roundness

Outside diameter, D mm	Diameter tolerance				Out-of-roundness	
	Pipe except the end[1)]		Pipe end[1)2)]		Pipe except the end[1)]	Pipe end[1)2)5)]
	Seamless pipe	Welded pipe	Seamless pipe	Welded pipe		
$D \leq 60$	±0,5 mm ±0,75 % D (whichever is the greater)	±0,5 mm ±0,75 % D (whichever is the greater), but max. ±3 mm	±0,5 mm or ±0,5 % D[3)] (whichever is the greater), but max. ±1,6 mm		(Included in the diameter tolerance)	
$60 < D \leq 610$					2,0 %	1,5 %
$610 < D \leq 1430$	± 1 % D	±0,5 % D, but max. ±4 mm	±2,0 mm[4)]	±1,6 mm[4)]	1,5 % but max. 15 mm for $\frac{D}{T} \leq 75$ 2,0 % for $\frac{D}{T} > 75$	1,0 % for $\frac{D}{T} \leq 75$ 1,5 % for $\frac{D}{T} > 75$
$D > 1430$	By agreement		By agreement[4)]			By agreement[4)]

[1)] The pipe end shall be considered to include a length of 100 mm at the pipe extremities.

[2)] For seamless pipe the values apply for wall thicknesses ≤ 25 mm; for greater thicknesses by agreement.

[3)] Subject to agreement, the tolerance may be applied to the inside diameter for outside diameters >210 mm.

[4)] Unless otherwise agreed, the diameter tolerance applies to the inside diameter.

[5)] When the diameter tolerance is applied to the inside diameter, the inside diameter shall also be the basis for the out-of-roundness requirements.

7.6.3.2 *Wall thickness*

The wall thickness shall be within the tolerances given in Table 7.

Table 7 — Tolerances on wall thickness

Wall thickness, T mm	**Tolerance**
Seamless pipe[1)]	
$T \leq 4$	$^{+0,6}_{-0,6}$ mm
$4 < T < 25$	$^{+15}_{-12.5}$ %
$T \geq 25$	$^{+3,75}_{-3,0}$ mm or ± 10 % (whichever is the greater)
Welded pipe	
$T \leq 10$	$^{+1,0}_{-0,5}$ mm
$10 < T < 20$	$^{+10}_{-5}$ %
$T \geq 20$	$^{+2,0}_{-1,0}$ mm

[1)] For outside diameters ≥ 355,6 mm it is permitted to exceed the upper wall thickness locally by a further 5 % of the specified wall thickness. However, the mass tolerance in **7.6.6** applies.

7.6.3.3 *Length*

7.6.3.3.1 Depending on the order, the pipes are to be delivered in random lengths or in fixed lengths.

7.6.3.3.2 Random lengths shall be delivered in accordance with the requirements of the specified length groups (see Table 8).

7.6.3.3.3 Fixed lengths shall be delivered with a tolerance of ± 500 mm.

Table 8 — Requirements for random length groups

Dimensions in metres

Length group	**Length range for 90 % of order item**[1)]	**Minimum average length of order item**	**Shortest length of order item**
r1	6 to 11	8	4
r2	9 to 14	11	6
r3	10 to 16	13	7
r4	11 to 18	15	8

[1)] The upper limit is the maximum value for the length of each individual pipe.

7.6.3.4 *Straightness*

The total deviation from a straight line shall be ≤ 0,2 % of the whole pipe length. Any local deviation in straightness shall be < 4 mm/m.

7.6.4 ***Finish of pipe ends***

7.6.4.1 Unless otherwise agreed (see **7.6.4.3**) the pipe shall be delivered with plain ends. All pipe ends shall be cut square and be free from harmful burrs.

The out-of-squareness (see Figure 1) shall not exceed:

– 1 mm for outside diameters less than or equal to 220 mm;

– 0,005 D, but max. 1,6 mm, for outside diameters greater than 220 mm.

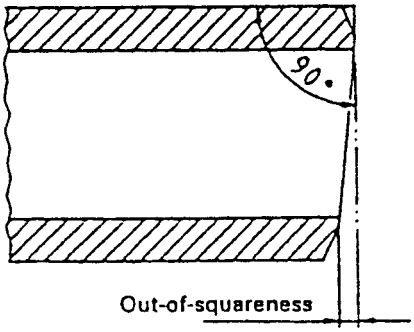


Figure 1 — Out-of-squareness

7.6.4.2 The end faces of pipes with a wall thickness greater than 3,2 mm shall be bevelled for welding. The angle of the bevel measured from a line drawn perpendicular to the axis of the pipe shall be 30° with a tolerance of $^{+5°}_{0}$. The width of the root face of the bevel shall be 1,6 mm with a tolerance of 0,8 mm.

Other bevel configurations may be agreed. O

Where internal machining or grinding is carried out the angle of the internal taper, measured from the longitudinal axis, shall be not greater than:

– as given in Table 9 (for seamless pipe);

– 7° (for welded pipe, greater than 114,3 mm outside diameter).

Table 9 — Maximum angle of internal taper for seamless pipe

Specified wall thickness, T mm	**Maximum angle of taper** degrees
$T < 10,5$	7
$10,5 \leq T < 14$	9,5
$14 \leq T < 17$	11
$T \geq 17$	14

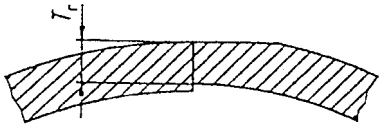
7.6.4.3 By agreement, the pipe may be delivered with threaded ends or with belled ends. O

NOTE Threaded and belled end pipes are in general only applied for distribution pipelines and/or under less critical service conditions.

7.6.5 ***Tolerances of the weld seam***

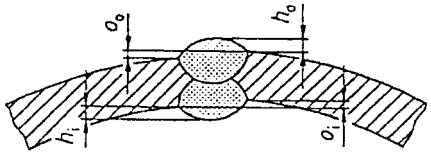
7.6.5.1 *Radial offset of plate or strip edges*

7.6.5.1.1 In the case of EW pipe the radial offset of strip edges shall not cause the remaining wall thickness T_r at the weld to be less than the specified minimum wall thickness [see Figure 2a)].



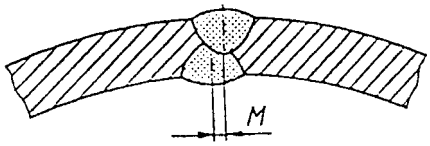
T_r: remaining wall thickness caused by radial offset

a) Radial offset of strip edges (EW pipe)



o_o, o_i: outside/inside radial offset
h_o, h_i: outside/inside height of the weld beads

b) Radial offset and height of the weld beads of plate/strip edges (SAW and COW pipe)



c) Misalignment M of the weld beads (SAW and COW pipe)

Figure 2 — Possible dimensional deviations of the weld seam

7.6.5.1.2 In the case of SAW and COW pipes the maximum radial offset, [see o_o and o_i in Figure 2 b)], of the plate/strip edges shall be as given in Table 10.

Table 10 — Maximum radial offset of SAW and COW pipes

Dimensions in millimetres

Specified wall thickness, T	Maximum radial offset[1)]
$T \leq 10$	1,0
$10 < T \leq 20$	0,1 T
$T > 20$	2,0

[1)] For strip end welds other requirements may be agreed.

7.6.5.2 *Height of the flash or weld bead (weld reinforcement)*

7.6.5.2.1 The outside flash of EW pipe shall be trimmed to an essentially flush condition. The inside flash of EW and BW pipe shall not extend above the contour of the pipe by more than 0,5 mm + 0,05 T, where T is the specified wall thickness. When trimming EW pipe, the wall thickness shall not be reduced below the minimum specified.

7.6.5.2.2 The inside weld bead of SAW and COW pipes shall be ground flush with a tolerance of $^{+0,5}_{0}$ mm for a distance of 100 mm from each pipe end (see h_i in Figure 2b).

The height of the weld bead of the remainder of the pipe shall not exceed the values given in Table 11.

Table 11 — Maximum height of the weld beads of SAW and COW pipes

Dimensions in millimetres

Specified wall thickness, T	Maximum height of the weld beads
$T \leq 12,7$	3
$T > 12,7$	4,8

7.6.5.2.3 The weld beads shall blend in smoothly with the parent metal and shall, for SAW and COW pipes, not come below the contour of the pipes, except that dressing out of undercuts is permitted [see **D.4.3.2**d)].

7.6.5.3 *Misalignment of the weld beads*

Misalignment of the weld bead of SAW and COW pipe [see Figure 2c)] shall not be cause for rejection provided complete penetration and complete fusion have been achieved [see **D.4.3.2**a)].

7.6.6 ***Mass tolerance***

The mass of any individual pipe shall not deviate from the nominal mass determined in accordance with **7.6.2** by more than $^{+10}_{-3,5}$ %.

8 Inspection

8.1 Types of inspection and inspection documents

8.1.1 The compliance with the requirements of the order shall be checked for products manufactured in accordance with this European standard either by non-specific or specific inspection and testing.

8.1.2 The purchaser shall, taking into account the notes below, state which of the following types of inspection documents are required:

– EN 10204-2.2	for non-specific inspection and testing;
– EN 10204-3.1.A – EN 10204-3.1.B – EN 10204-3.1.C – EN 10204-3.2	for specific inspection and testing.

NOTE 1 When making his choice the purchaser should, where necessary, take into account the relevant requirements of standards or legal regulations for pipelines.

NOTE 2 If an inspection document 3.1.A, 3.1.C or 3.2 is ordered, the purchaser should also indicate in his order the address of the organization or person nominated by him to carry out the inspection and to issue and validate the inspection document. In the case of the document 3.2 it shall be agreed which party shall issue the document.

8.1.3 The inspection document shall cover in accordance with EURONORM 168:

a) the necessary information on:

– A: commercial transactions and parties involved;

– B: description of products to which the inspection document applies (see also **9.1**);

b) the data on test pieces, test conditions and test results required under:

– CO1-CO2: location of sample and direction of the test piece;

– D01: marking and verification of the surface appearance and dimensional properties;

– D02-D99: non-destructive inspection (where applicable) and the hydrostatic or non-destructive leak-tightness test,

and, depending on the type of document, non-specific or specific, results of:

– C10-C13: tensile test;

– C50-C69: bend or flattening test;

– C71-C92: cast analysis and, in the case of specific inspection, product analysis;

c) Z: authentication of the inspection document.

8.2 Non-specific and specific inspection and testing

8.2.1 *Type and frequency of tests*

The tests to be carried out and the frequency of test given in Table 12:

– for non-specific inspection and testing, in columns 2, 3 and 4; and

– for specific inspection and testing, columns 2, 3 and 5 apply.

8.2.2 *Selection and preparation of samples and test pieces*

8.2.2.1 *Samples and test pieces for the product analysis*

The samples shall be taken and the test pieces prepared in accordance with ISO 14284. At the discretion of the pipe manufacturer they shall be taken either from plate/strip or pipe.

8.2.2.2 *Samples and test pieces for the mechanical tests*

8.2.2.2.1 *General*

The samples for the:

– tensile test;

– bend test;

– flattening test;

shall be taken, and the corresponding test pieces prepared in accordance with the general conditions of prEN ISO 377, as far as applicable.

Samples for the various types of tests shall be taken from pipe ends in accordance with Figures 3 and 4 and Table 13, taking into account the supplementary details specified in **8.2.2.2.2** to **8.2.2.2.4**.

Table 12 — Survey of tests and requirements

1	2				3	4	5		6	7	8
	The specifications in columns 3 to 8 apply for[1]				Type of test or requirement	Frequency of testing			Sampling conditions see	Test method see	Requirements see
	S	EW, BW	SAW, COW			Inspection document 2.2	Inspection documents 3.1 A, 3.1 B, 3.1 C	Test pieces per sample			
			lgt.	hel.							
	Pipes										
a1	x	x	x	x	Cast analysis	x[3]	1 analysis/cast		Left to the discretion of the manufacturer		Table 2
a2	x	x	x	x	Product analysis	—	1 analysis/cast		**8.2.2.1**	**8.2.3.1**	Table 3
b1	x	x	x	x	Tensile test[2] – on the pipe body	x[3]	Except for strip end weld testing the test unit shall consist only of pipes of: – the same heat treatment condition; – the same dimension; and of: – 400 pipes (D ≤ 141,3 mm); – 200 pipes (141,3 mm < D ≤ 323,9 mm); – 100 pipes (D > 323,9 mm). For strip end welds the test unit shall consist of not more than 50 pipes containing strip end welds per order item. One sample shall be taken per test unit.	1	**8.2.2.2.1** and Table 13	**8.2.3.2**	Table 4
b2	—	x	x	x	– on the weld seam (D ≥ 210 mm)	x[3]		1			
b3	—	—	—	—	– on the strip end weld seam (D ≥ 210 mm)	x[3]		1			
e1	—	—	x	x	Bend test – on the weld seam	x[3]		2	**8.2.2.2.3**, Figure 5 and Table 13	**8.2.3.3**	Table 4 and **8.2.3.3.2**
e2	—	—	—	x	– on strip end weld	x[3]		2			
f	—	x	—	—	Flattening test	x[3]	4 tests per coil, plus 2 tests in the case of a weld stop		Figure 4 and **8.2.2.2.4**	**8.2.3.4**	**8.2.3.4.2**
g1	—	—	x	x	Macrographic and metallographic examination – Macrography	Once per shift or when pipe size is changed			**8.2.2.3**	**8.2.3.5.1**	**7.6.5.3**

Table 12 — Survey of tests and requirements

1	2				3	4	5		6	7	8
	The specifications in columns 3 to 8 apply for[1]				Type of test or requirement	Frequency of testing			Sampling conditions see	Test method see	Requirements see
	S	EW, BW	SAW, COW			Inspection document 2.2	Inspection documents 3.1 A, 3.1 B, 3.1 C	Test pieces per sample			
			lgt.	hel.							
	Pipes										
g2	—	x[4]	—	—	– Metallography	Once per shift or when pipe size or steel grade is changed			**8.2.2.3**	**8.2.3.5.2**	**8.2.3.5.2**
h	—	x	x	x	Hardness test	In cold formed pipe any hard spot exceeding 50 mm in any direction shall be tested			**—**	**8.2.3.7**	**7.5.8**
i	x	x	x	x	Hydrostatic test	Each pipe shall be tested			**—**	**8.2.3.6**	Tables 4 and 14 and **8.2.3.6.2**
j	x	x	x	x	Visual examination	Each pipe shall be examined			**—**	**8.2.3.7**	**7.5**
k1	x	x	x	x	Dimensional testing: – outside or inside diameter and out-of-roundness of pipe ends	x[3]	Dimensions of each pipe shall be verified		**—**	**8.2.3.8**	**7.6.3.1**
k2	x	x	x	x	– wall thickness at pipe ends	Dimensions of each pipe shall be verified					**7.6.3.2** and Table 7
k3	x	x	x	x	– other dimensional characteristics	x[3]	At random testing. In the case of specific testing the details are left to the discretion of the inspector.				**7.6.3.3**, **7.6.3.4**, **7.6.4**
k4	—	x	x	x	– weld seam						**7.6.5**
l	x	x	x	x	Weighing	Each pipe or lot shall be weighed			—	**8.2.3.9**	**7.6.6**
m	x	x	x	x	Non-destructive testing	See Table D.1.					

[1] S = Seamless; EW = Electric welded; BW = Continuous welded; SAW = Submerged arc-welded, COW = Combination welded; lgt. = longitudinal seam, hel. = helical seam.

[2] D = Outside diameter.

[3] Frequency of testing in accordance with the manufacturer's procedure.

[4] Only applicable for EW pipe with heat treated weld area.

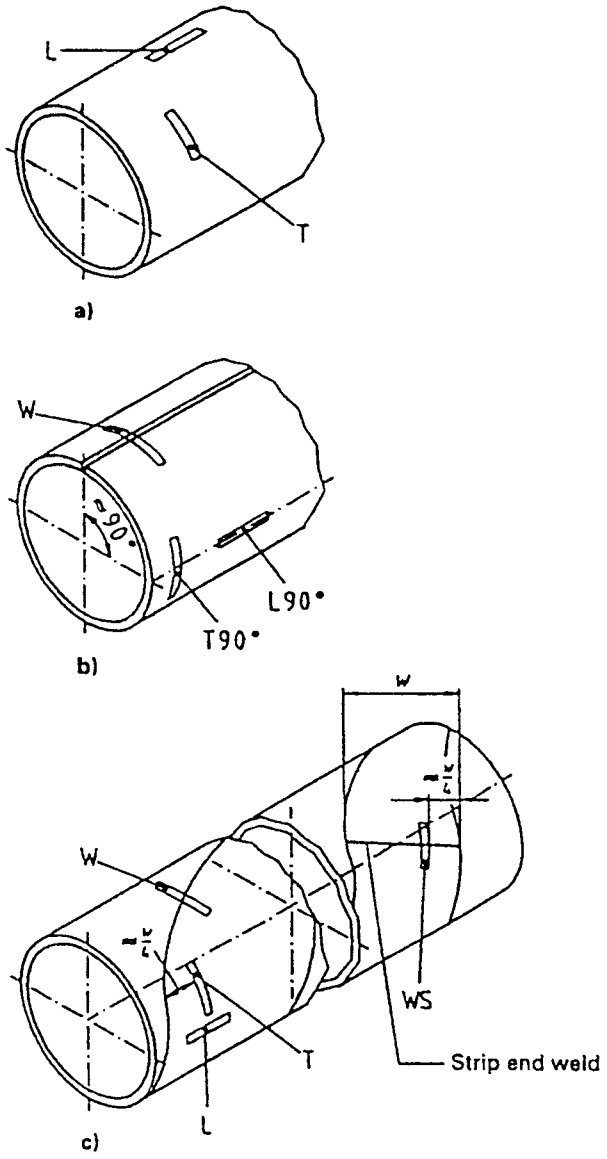
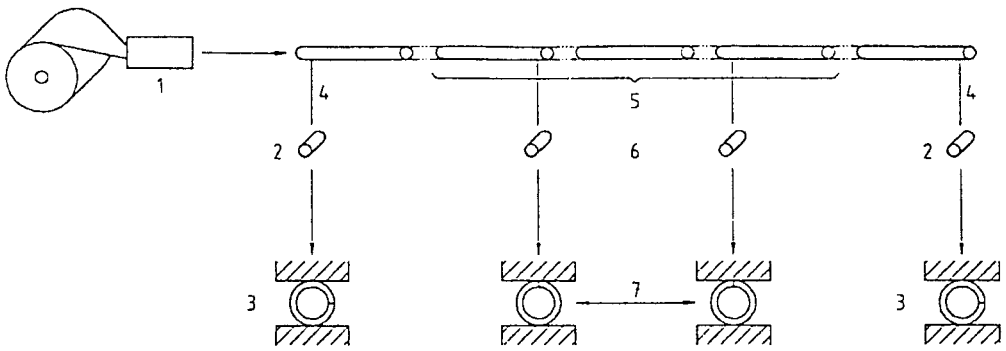


Figure 3 — Sample position and explanation of the symbols applied in Table 13 for specifying the test piece direction and position



Key

1 Welding
2 crop end, one sample
3 flatten with the weld at 3 o'clock position
4 end of coil position
5 intermediate position
6 two samples, one from each of two different intermediate lengths
7 flatten with the weld at 12 o'clock position

Figure 4 — Flattening test: Sampling and testing (schematically)
(See further details in **8.2.3.4.1**)

Table 13 — Number, direction and location of the test pieces to be taken per sample for the mechanical tests

Type of pipe[1]		**Test**	**Test pieces to be taken from**	**Outside diameters** mm			**For further information see**
				< 210	**≥ 210 < 500**	**≥ 500**	
				Number, direction and location of the test pieces (see explanation of the symbols in Figure 3)			
Seamless (see Figure 3a)		Tensile	Pipe body	1L	1L[2]	1L[2]	**8.2.2.2.2**
Longitudinal seam (see Figure 3b)	EW, BW, SAW, COW	Tensile	Pipe body	1L90	1T90	1T90	
			Seam[3]	—	1W	1W	
	SAW, COW	Bend	Seam[3]	2W	2W	2W	**8.2.2.2.3**
	EW, BW	Flattening	See Figure 4				**8.2.2.2.4**
Helical seam (see Figure 3c)	SAW, COW	Tensile	Pipe body	1L,$w/4$[2]	1T,$w/4$	1T,$w/4$	**8.2.2.2.2**
			Seam	—	1W	1W	
		Bend	Seam	2W	2W	2W	**8.2.2.2.3**
		Tensile	Strip end weld	—	1WS	1WS	**8.2.2.2.2**
		Bend		2WS	2WS	2WS	**8.2.2.2.3**

[1] EW = Electric welded; BW = Continuous welded; SAW = Submerged arc-welded; COW = Combination welded.

[2] By agreement 1T instead of 1L.

[3] If, by agreement (see **6.2**), pipes with two seams are delivered, both seams are to be subjected to the tests.

8.2.2.2.2 *Tensile test pieces*

Rectangular test pieces representing the full wall thickness of the pipe shall be taken in accordance with EN 10002-1 and Figure 3. Tranverse test pieces shall be flattened.

O Round test pieces machined from an unflattened sample may be used by agreement.

At the manufacturer's discretion, for testing the pipe body of pipes with $D \leq 210$ mm, a full pipe test piece may be used.

Weld beads shall be ground flush, local imperfections may be removed, but mill scale should not be removed from the test pieces.

O If the pipes are to be heat treated, test coupons may, by agreement, be taken and flattened before the heat treatment. The flattened test coupon shall then undergo the same heat treatment as the pipe.

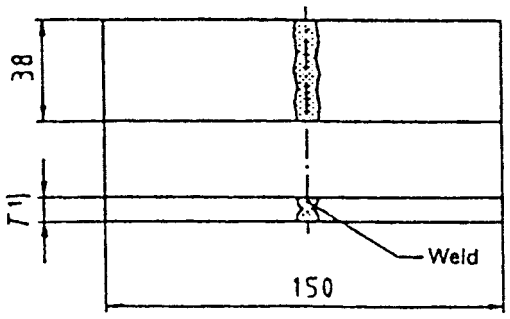
8.2.2.2.3 *Test pieces for the bend test*

The test pieces shall be taken in accordance with EN 910 and Figure 5. For pipes with a wall thickness > 20 mm, the test pieces may be machined to provide a rectangular cross-section having a thickness of 19 mm. Full wall thickness curved section test pieces are mandatory for pipe with a wall thickness ≤ 20 mm.

The weld reinforcement shall be removed from both faces.

The weld reinforcement shall be removed from both faces.

Dimensions in mm



[1)] Unless machined test pieces (see explanation in **8.2.2.2.3**) are used.

Figure 5 — Test piece for the bend test

8.2.2.2.4 *Test pieces for the flattening test*

The test pieces shall be taken in accordance with EN 10233. Minor surface imperfections may be removed by grinding.

8.2.2.3 *Samples for macrographic and metallographic tests*

The samples, including the weld cross-section, shall be taken and prepared in accordance with prEN ISO 377 as far as applicable.

8.2.3 ***Test methods***

8.2.3.1 *Chemical analysis (product analysis)*

The elements shall be determined in accordance with the methods considered in the corresponding European standards. Spectrographic analysis is permitted.

In cases of dispute, the method to be used for product analysis shall be agreed.

8.2.3.2 *Tensile test*

8.2.3.2.1 The tensile test shall be carried out in accordance with EN 10002-1.

The tensile strength (R_m), the yield strength for 0,5 % total elongation ($R_{t0,5}$) and the percentage elongation after fracture (A) shall be determined during the tensile test on the pipe body.

The percentage elongation after fracture shall be reported with reference to a gauge length of $5{,}65\sqrt{S_0}$ where S_o is the initial cross-sectional area of the gauge length. If other gauge lengths are used, the elongation referred to a gauge length of $5{,}65\sqrt{S_o}$ shall be determined in accordance with ISO 2566-1.

NOTE The $R_{t0,5}$ value is considered to be approximately equivalent to the R_{eH} or $R_{p0,2}$ value within the normal scatter band of test results.

8.2.3.2.2 In the tensile test transverse to the weld only the tensile strength (R_m) shall be determined.

8.2.3.3 *Bend test*

8.2.3.3.1 The bend test shall be carried out in accordance with EN 910. The mandrel dimension shall be as indicated in Table 4 for the appropriate steel grade. Both test pieces shall be bent through approximately 180°, one with the root of the weld, the other with the face of the weld, directly under the mandrel.

8.2.3.3.2 The specimens shall not:

a) fracture completely; nor

b) reveal any crack or rupture in the weld metal greater than 3 mm in length regardless of depth; nor

c) reveal any crack or rupture in the parent metal, the heat affected zone or the fusion line longer than 3 mm and deeper than 12,5 % of the specified wall thickness.

Cracks that occur at the edges of the specimen and that are less than 6 mm in length shall not be cause for rejection in b) or c), regardless of depth.

If the fracture or crack in a test piece is caused by imperfections, the test piece may be discarded and a new test piece substituted.

8.2.3.4 *Flattening test*

8.2.3.4.1 The flattening test shall be carried out in accordance with EN 10233 and Figure 4.

When a weld stop occurs, flattening tests with the weld in the 3 o'clock position shall be made from the crop ends resulting from each side of the weld stop and may be substituted for the intermediate flattening tests.

8.2.3.4.2 The flattening test shall be carried out in three steps with the following acceptance criteria:

– flatten to 2/3 of the original outside diameter; no weld opening shall occur;

– flatten to 1/3 of the original outside diameter; no crack or break shall occur other than in the weld;

– flatten until opposite walls of the pipe meet.

The presence of laminar imperfections or burnt metal shall not become apparent during the entire test.

8.2.3.5 *Macrographic and metallographic examination*

8.2.3.5.1 For SAW and COW pipes, the alignment of internal and external seams [see Figure 2c)] shall be verified by macrographic examination.

8.2.3.5.2 For EW pipe with seam heat treatment (see Table 1), it shall be verified by metallographic examination that the entire heat affected zone has been heat treated over the full wall thickness.

8.2.3.6 *Hydrostatic test*

8.2.3.6.1 The hydrostatic test pressure shall be calculated in accordance with **8.2.3.6.2**.

8.2.3.6.2 For the calculation of the test pressure the following formula applies:

$$p = \frac{20 \times S \times T}{D}$$

where

p is the hydrostatic test pressure in bar;

D is the specified outside diameter in millimetres (mm);

S is the stress in N/mm^2, equal to a percentage of the specified minimum yield strength for the steel grade concerned (see Table 14);

T is the specified wall thickness in millimetres (mm);

The test pressure shall be limited to a maximum of 207 bar.

Table 14 — Percentage of specified minimum yield strength (SMYS) for calculation of S

Steel grade/specified pipe outside diameter	Percentage of SMYS for calculation of S
L 210GA, L 235GA, L 245GA[1)]	60
L 290GA, L 360GA $D \leq 114{,}3$ mm	60
114,3 mm < $D \leq$ 219,1 mm	75
219,1 mm < $D <$ 508 mm	85
$D \geq$ 508 mm	90
[1)] All pipe sizes.	

8.2.3.6.3 The test pressure shall be held for not less than 5 s for pipes lower than or equal to 457 mm outside diameter and 10 s for pipes greater than 457 mm outside diameter.

In the case of pipes with outside diameters equal to or greater than 114,3 mm the test pressure versus time shall be recorded. This record shall be available for examination by the inspection representative.

8.2.3.6.4 For pipes with outside diameters less than 500 mm a non-destructive leak-tightness test according to EN 10246-1 may be agreed instead of the hydrostatic testing.

8.2.3.7 *Visual examination*

Each pipe shall be visually examined over the entire external surface. The internal surface shall be visually examined:

– from each end for pipe outside diameters less than 610 mm;

– over the entire internal surface for pipe outside diameters equal to or greater than 610 mm.

The examination shall be carried out under sufficient lighting conditions[6)] by trained personnel with satisfactory visual acuity to verify the conformity of the pipes with the requirements of **7.5**.

The surface of cold formed welded pipe shall be examined to detect geometric deviations in the contour of the pipe. When this examination fails to disclose mechanical damage as the cause of the irregular surface, but indicates that the irregular surface may be attributed to a hard spot, the dimensions of the area and, if necessary (see **7.5.8**), the hardness in this area shall be determined in accordance with EN 10003-1 or EN 10109-1. The choice of the test method is left to the discretion of the manufacturer. If dimensions and hardness exceed the acceptance criteria given in **7.5.8**, the hard spot shall be removed.

8.2.3.8 *Dimensional testing*

8.2.3.8.1 The diameter of pipes shall be measured. At the discretion of the manufacturer, a circumferential tape or a caliper gauge may be used. By agreement, other approved measuring devices may be used. O

[6)] The light level should be of the order of 300 Lux.

8.2.3.8.2 The out-of-roundness O in percent shall be calculated by the formula:

$$O = 100 \times \frac{D_{max} - D_{min}}{D}$$

where

D_{max} is the greatest outside or inside diameter;

D_{min} is the smallest outside or inside diameter;

D is the specified outside diameter (or inside diameter calculated from the specified outside diameter and wall thickness).

To calculate the out-of-roundness of the pipe body, the greatest and smallest outside or inside diameter depending on the requirements of Table 6 shall be measured in the same cross-sectional plane. The determination of out-of-roundness of pipe ends shall be based on corresponding measurements of the inside or outside diameters depending on the manufacturing process.

8.2.3.8.3 The greatest deviation of flat spots or peaks from the normal contour of the pipe shall be measured:

– in the case of longitudinally welded pipe, with a template located transverse to the pipe axis;

– in the case of helically welded pipes, with a template parallel to the pipe axis.

The templates shall have a length of a quarter of the specified outside diameter but max. 200 mm.

8.2.3.8.4 For the verification of other dimensional and geometrical requirements, specified in **7.6**, suitable methods shall be used. The methods to be used are left to the discretion of the manufacturer.

8.2.3.9 *Weighing*

Each length of pipe with outside diameter equal to or greater than 141,3 mm shall be weighed separately. Lengths of pipe with outside diameters smaller than 141,3 mm shall be weighed either individually or in convenient lots at the discretion of the manufacturer.

8.2.3.10 *Non-destructive testing*

For non-destructive testing see annex D.

8.2.4 ***Retests, sorting and reprocessing***

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

9 Marking of the pipes

9.1 General marking

9.1.1 Pipe marking shall include the following minimum information:

a) the name or mark of the manufacturer of the pipe (X);

b) the number of this part of this European standard;

c) the steel name (see also **9.2**);

d) the type of pipe (S or W);

e) if an inspection document EN 10204-3.1.A, 3.1.B, 3.1.C or 3.2 is to be issued:

1) the mark of the inspection representative (Y);

2) an identification number which permits the correlation of the product or delivery unit with the related inspection document (Z).

EXAMPLE

X EN 10208-1 L360GA S Y Z

9.1.2 Unless die stamping is agreed (see **9.1.3**), the mandatory markings which shall be applied indelibly shall be as follows.

a) For pipe of outside diameters less than or equal to 48,3 mm: marked on a tag fixed to the bundle or painted on the straps or banding clips used to tie the bundle. Alternatively, at the discretion of the manufacturer, each pipe may be paint stencilled on one end.

b) For seamless pipe in all other sizes and welded pipe smaller than 406,4 mm outside diameter: paint stencilled on the outside surface starting at a point between 450 mm and 750 mm from one end of the pipe.

c) For welded pipe equal to or greater than 406,4 mm outside diameter: paint stencilled on the inside surface starting at a point no less than 150 mm from one end of the pipe.

9.1.3 Die stamping may be used by agreement within 150 mm of the pipe end and at least 25 mm from the weld. Cold die stamping (at temperatures lower than 100 °C) of plate/strip or pipe not subsequently heat treated is only permitted if especially agreed and, in this case, shall be done with rounded or blunt dies. O

9.1.4 If a protective coating is applied, marking shall be readable after coating.

9.2 Special marking

For pipes delivered in the quenched and tempered (Q) or thermomechanically treated (M) condition a letter "Q" or "M" respectively shall be added to the steel name (e.g. L360GA+Q or L360GA+M).

Any requirements for additional marking or for special locations or methods of marking are subject to agreement. O

10 Coating for temporary protection

Unless otherwise ordered the pipe shall be delivered with an external coating to protect it from rusting in transit.

If unprotected pipe or special coating and/or lining is required this shall be agreed at the time of enquiry and order. O

Annex A (informative)
Correspondence with API steel grades

The Table below gives the correspondence between the grades defined by this European Standard and similar grades in specification ANSI/API 5L (40th Edition) [2], based on a comparison of the yield strength. However, the grades shown as comparable may differ in other respects.

Steel grade in accordance with EN 10208-1	Steel grade in accordance with ANSI/API 4L
L210GA	A
L235GA	—
L245GA	B
L290GA	X 42
L360GA	X 52

Annex B (normative)
Specification of welded jointers

B.1 Welding

O Pieces of pipe used in making a jointer shall have a minimum length of 1,5 m. Pipe weld seams shall be staggered by between 50 mm and 200 mm unless otherwise agreed. The pipe lengths shall be welded by the manufacturer.

Welding shall be performed by approved and qualified welders (see EN 287-1) and in accordance with approved and qualified welding procedures (see EN 288-1 and EN 288-2).

U Unless otherwise agreed, the choice of the welding process shall be at the discretion of the manufacturer.

The completed jointers shall be straight within the limits of **7.6.3.4**.

B.2 Testing

B.2.1 Jointers shall be tested with a frequency of one out of a maximum of 50 jointers as specified for the strip end weld in Table 12 and Table 13.

B.2.2 Each jointer shall be submitted to a hydrostatic test in accordance with **8.2.3.6**.

B.2.3 The circumferential weld of jointers shall be completely radiographically inspected in accordance with prEN 10246-10 to image quality class R1. Welds failing to pass this test may be repaired in accordance with an approved and qualified weld repair procedure and re-radiographed as above.

B.3 Marking

Each jointer shall in addition to the requirements in clause **9** be marked using paint stencil to identify the welder.

Annex C (normative)
Treatment of imperfections and defects disclosed by visual examination

C.1 Treatment of surface imperfections
[see **7.5.3**a)]

At the manufacturer's discretion such imperfections not classified as defects are permitted to remain in the pipe without repair. Cosmetic grinding, however, is permitted.

C.2 Treatment of dressable surface defects
[see **7.5.3**b)]

All dressable surface defects shall be dressed-out by grinding. Grinding shall be carried out in such a way that the dressed area blends in smoothly with the contour of the pipe. Complete removal of defects shall be verified by local visual inspection, aided where necessary by suitable NDT methods. After grinding, the remaining wall thickness in the dressed area shall be checked for compliance with **7.6.3.2**.

C.3 Treatment of non-dressable surface defects
[see **7.5.3c**)]

Pipe containing non-dressable surface defects shall be given one of the following dispositions:

a) weld defects in SAW and COW pipes shall be repaired by welding in accordance with **C.4**;

b) the section of the pipe containing the surface defect shall be cut off, within the limits of the requirement on minimum pipe length;

c) the entire pipe length shall be rejected.

C.4 Repair of defects by welding

Repair by welding is only permitted for the weld of SAW and COW pipes. The total length of repaired zones on each pipe weld is limited to 10 % of the total weld length. Weld defects separated by less than 100 mm shall be repaired as a continuous single weld repair. Each single repair shall be carried out with a minimum of two layers/passes over a minimum length of 50 mm.

The weld repair work shall be performed using an approved and qualified procedure which, in the case of normalized or quenched and tempered steels, may be based on the recommendations given in IC 2.

After weld repair, the total area of the repair shall be ultrasonically inspected in accordance with **D.4.1.1** or radiographically inspected in accordance with **D.4.3**.

In addition, after repair, each repaired pipe length shall be hydrostatically tested in accordance with **8.2.3.6**.

Annex D (normative)
Non-destructive testing

D.1 Scope

This annex specifies non-destructive testing (NDT) requirements and acceptance levels. A survey of the tests is given in Table D.1.

D.2 General NDT requirements and acceptance criteria

D.2.1 *NDT Personnel*

For NDT personnel see **6.1.2**.

D.2.2 *Timing of NDT operations*

The sequence of all specified NDT operations shall be at the discretion of the manufacturer, as appropriate.

D.2.3 *Laminar imperfections at the pipe ends*

Laminar imperfections greater than 6 mm in the circumferential direction are not permitted within 25 mm of each end of the pipe.

O The verification of compliance with this requirement shall only be carried out by agreement. In such a case an ultrasonic test in accordance with prEN 10246-17 shall be used.

D.2.4 *Untested pipe ends*

It is emphasized that in many of the automatic NDT operations specified in this European standard, there may be a short length at both pipe ends which cannot be tested. In such cases:

a) the untested ends shall be cropped off; or

b) in the case of seamless, EW or BW pipe, the untested ends shall be subjected to a manual/semi-automatic test using the same technique, test sensitivity, test parameters, etc. as specified in the relevant clause of this part of EN 10208 where, for manual testing, the scanning speed shall not exceed 150 mm/s; or

c) in the case of SAW and COW pipe, the provisions of **D.4.2** shall apply.

D.2.5 *Suspect Pipe*

In all cases, pipes giving rise to indications producing a trigger/alarm condition as a result of the specified NDT operation(s) shall be deemed suspect.

Suspect pipe shall be dealt with in accordance with the clause “Acceptance” as given in the relevant European Standard for NDT of pipe, except where otherwise stated in this European Standard. Repair by welding is only permitted on the weld of SAW and COW pipe, provided that the provisions of **C.4** are fulfilled.

Where dressing is carried out, it shall be verified by any appropriate NDT method that the imperfections have been completely removed.

Any manual NDT applied to local suspect areas (dressed or not) shall use the same test sensitivity, test parameters and acceptance level (reference notch depth) as used during the test which originally deemed the pipe suspect. For manual ultrasonic testing, the scanning speed shall not exceed 150 mm/s.

D.3 NDT of the weld seam of EW and BW pipe

D.3.1 The full length of the weld seam of EW and BW pipe shall be ultrasonically inspected for the detection of longitudinal imperfections, at the discretion of the manufacturer, in accordance with EN 10246-7 or prEN 10246-8 to acceptance level U3/C.

D.3.2 Alternatively, at the discretion of the manufacturer, the full length of the weld seam shall be inspected using one of the following methods:

a) for pipes with a specified wall thickness < 10 mm: the flux leakage method in accordance with prEN 10246-5 to acceptance level F3;

b) for pipes with an outside diameter $D < 250$ mm, a specified wall thickness $T < 6$ mm and a ratio $T/D < 0{,}18$: the eddy current method (concentric or segment coil technique) in accordance with prEN 10246-3 to acceptance level E3.

Table D.1 — Survey of non-destructive tests

1	2	3	4		5
No.	**NDT operation**	**Tests status**[1)]	**Type of test and requirement, acceptance level**		**Reference**
Seamless and welded pipe					
1	Laminar imperfections at the pipe ends	O	Ultrasonic test prEN 10246-17, acceptance limit 6 mm max. circumferentially		**D.2.3**
Electric and continuous welded (EW and BW) pipe					
2	Longitudinal imperfections in the weld (including the pipe ends, where applicable, see **D.2.4**)	M		Ultrasonic test EN 10246-7 or prEN 10246-8, acceptance level U3/C (U3)	**D.3.1**
3			or	(at the manufacturer's discretion for $T < 10$ mm) Flux leakage test prEN 10246-5, acceptance level F3	**D.3.2**a)
4			or	(at the manufacturer's discretion for $D < 250$ mm; $T < 6$ mm; $\frac{I}{D} < 0{,}18$) Eddy current test prEN 10246-3, acceptance level E3	**D.2.3**b)
Submerged arc welded (SAW)/Combination welded (COW) pipe					
5	Longitudinal/transverse imperfections in the weld	M		Ultrasonic test prEN 10246-9, acceptance level U2/U2H; or 'two lambda' calibration method (also for the strip end weld of helically welded pipe)	**D.4.1**
6				Radiograph inspection prEN 10246-10, image quality class R1, acceptance limits as per **D.4.3**, for T-joints of helically welded pipe	**D.4.1.2**
7	NDT of the weld seam at pipe ends (untested ends)/repaired areas	M		Ultrasonic test prEN 10246-9 to requirements of **D.4.1.1** on longitudinal imperfections, acceptance level U2/U2H	**D.4.2, D.4.3**
8			or	(unless otherwise agreed) Radiographic inspection prEN 10246-10, image quality class R1 (see **D.4.3**) on longitudinal imperfections	
9			and	Ultrasonic test prEN 10246-9 or radiographic test prEN 10246-10 on transverse imperfections, acceptance limits as per **D.4.3**	

[1)] M = mandatory, O = optional test for mandatory requirement.

D.4 NDT of SAW and COW pipe

D.4.1 *Ultrasonic testing for longitudinal and transverse imperfections in the weld seam*

D.4.1.1 The full length of the weld seam of SAW and COW pipe shall be ultrasonically inspected for the detection of longitudinal and transverse imperfections in accordance with prEN 10246-9 to acceptance level U2/U2H, with the exceptions given in a) to e) below.

a) The maximum notch depth shall be 2,0 mm.

b) The use of internal and external longitudinal notches located on the centre of the weld seam for equipment calibration purposes is not permitted.

c) As an alternative to the use of the reference hole for equipment calibration for the detection of transverse imperfections, it is permitted to use acceptance level U2 internal and external notches, lying at right-angles to and centred over the weld seam. In this case, both internal and external weld reinforcements shall be ground flush to match the parent pipe contour in the immediate area and on both sides of the reference notches. The notches shall be sufficiently separated from each other in the longitudinal direction and from any remaining reinforcement, to give clearly identifiable separate ultrasonic signal responses. The full signal amplitude from each of these notches shall be used to set the trigger/alarm level of the equipment.

O d) As an alternative to the use of acceptance level U2 notches for equipment calibration, it is permitted, by agreement, to use a fixed depth internal and external notch and increase the test sensitivity by electronic means (i.e. increase in dB). In this case (known as the "two lambda" method) the depth of the notches shall be twice the wavelength at the ultrasonic frequency in use, given by:

$$\text{Wavelength} = \frac{\text{Ultrasonic velocity } (t_r)}{\text{Ultrasonic frequency}}$$

(for example, at 4 MHz test frequency, wavelength = 0,8 mm, i.e. notch depth = 1,6 mm).

The required increase in test sensitivity shall be based on pipe thickness and the manufacturer shall demonstrate to the satisfaction of the purchaser that the test sensitivity achieved is essentially equivalent to that when using acceptance level U2 notches.

e) The manufacturer may use one of the methods described in **D.4.2** to re-test suspect areas.

D.4.1.2 For helically welded pipes, the full length of the strip end weld shall be subjected to an ultrasonic test using the same ultrasonic test sensitivity and the same ultrasonic parameters as used on the primary helical weld seam in accordance with **D.4.1.1**.

In addition, the T-joints where the extremities of the strip end weld meet the primary weld seam, shall be subjected to radiographic inspection in accordance with **D.4.3** and with the acceptance limits given there.

D.4.2 *NDT of the weld seam at the pipe ends/repaired areas*

The length of the weld seam at the pipe ends which cannot be inspected by the automatic ultrasonic equipment, and repaired areas of the weld seam (see **C.4**), shall be subjected to the following:

a) for the detection of longitudinal imperfections, a manual or semi-automatic ultrasonic test using the same test parameters and test sensitivity as specified in **D.4.1.1** or, unless otherwise agreed, radiographic inspection in accordance with **D.4.3**. U

b) for the detection of transverse imperfections, at the discretion of the manufacturer, either a manual/semi-automatic ultrasonic test using the same test parameters and test sensitivity as specified in **D.4.1.1** or radiographic inspection in accordance with **D.4.3**.

When manual ultrasonic testing is carried out, the scanning speed shall not exceed 150 mm/s.

D.4.3 *Radiographic inspection of the weld seam*

D.4.3.1 Where applicable, radiographic inspection of the weld seam shall be conducted in accordance with prEN 10246-10 to image quality class R1, with the conditions given in a) to c) below:

a) the sensitivity requirements given in Table D.2, established on the base material, shall be verified by use of the ISO wire penetrameter according to ISO 1027 or, if so agreed, by use of an equivalent hole penetrameter;

b) only X-ray radiation, using fine-grain, high-contrast direct film with lead screen, shall be used. By agreement, fluoroscopic methods are permitted, but only when the manufacturer can demonstrate equivalence to the X-ray film technique;

c) the density of the radiograph shall not be less than 2,0, and shall be chosen so that the density through the thickest portion of the weld seam is not less than 1,5, and that maximum contrast for the type of film used is achieved.

Table D.2 — Sensitivity requirements for the radiographic inspection, image quality class R1 in accordance with prEN 10246-10

Dimensions in millimetres

Wall thickness		Visibility required	
Above	Up to	Of the hole with a diameter	Of the wire with a diameter
4,5	10	0,40	0,16
10	16	0,50	0,20
16	25	0,63	0,25
25	32	0,80	0,32
32	40	1,00	0,40

D.4.3.2 The acceptance limits for radiographic inspection of the weld seam shall be as given in a) to f) below.

a) Cracks, incomplete penetration and lack of fusion are not acceptable.

b) Individual circular slag inclusions and gas pockets up to 3,0 mm or $T/3$ in diameter (T = specified wall thickness), whichever is the smaller, are acceptable.

The sum of the diameters of all such permitted individual imperfections in any 150 mm or 12T of weld length, whichever is the smaller, shall not exceed 6,0 mm or 0,5T, whichever is the smaller, where the separation between individual inclusions is less than 4T.

c) Individual elongated slag inclusions up to 12,0 mm or 1T in length, whichever is the smaller, or up to 1,6 mm in width are acceptable.

The maximum accumulated length of such permitted individual imperfections in any 150 mm or 12T of weld length, whichever is the smaller, shall not exceed 12,0 mm, where the separation between individual inclusions is less than 4T.

d) Individual undercuts of any length having a maximum depth of 0,4 mm are acceptable.

Individual undercuts of a maximum length of $T/2$ having a maximum depth of 0,8 mm and not exceeding 10 % of the specified wall thickness are acceptable provided that there are not more than two such undercuts in any 300 mm of the weld length, and all such undercuts are dressed out.

e) Any undercuts exceeding the above limits shall be repaired (see **C.4**) or the suspect area shall be cropped off or the pipe shall be rejected.

f) Any undercuts on the inside and outside weld of any length and depth which are coincident in the longitudinal direction on the same side of the weld are not acceptable.

Annex E (informative)

Bibliography

[1] ISO 3183-1, *Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions — Part 1: Pipes of requirement class A.*

[2] American National Standard ANSI/API Spec 5L-1993, *Specification for line pipe*, 40th edition, November 1, 1992.

[3] Demofonti, G., Jones, D. G., Pistone, G., Re, G., Vogt, G., *EPRG recommendation for crack arrest toughness for high strength line pipe steels*, Presentation of the European Pipeline Research Group to the 8th Symposium on Line Pipe Research; Houston, Texas (1993-09-26/29); 13 pages, 7 figures, 3 tables. [To be ordered from: American Gas Association, Order and Billing Department, 1515 Wilson Boulevard, Arlington, Virginia 22209 USA].

Annex F (informative)

National A-deviations

A-deviation: National deviation due to regulations the alteration of which is for the time being outside the competence of the CEN/CENELEC member.

This European standard does not fall under any Directive of the EC. In the relevant CEN/CENELEC countries these A-deviations are valid instead of the provisions of this Part of this European standard until they have been removed.

Clause	Deviation
	Sweden (Ordinances AFS 1994:36 and AFS 1994:39)
General	Depending on the geographical location in Sweden, the cited Ordinances stipulate, for outdoor piping, design temperatures of −5 °C or −10 °C (buried pipelines) and of −30 °C or −40 °C (pipelines above ground) and specify impact energy values for the pipes to be used. Corresponding steel grades are not specified in EN 10208-1.

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