INTERNATIONAL STANDARD

ISO 3183-3

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Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions —

Part 3:
Pipes of requirement class C

Industries du pétrole et du gaz naturel — Tubes en acier pour le transport des fluides combustibles — Conditions techniques de livraison —

Partie 3: Tubes de la classe de prescription C

Reference number
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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 3183 was prepared by Technical Committee ISO/TC 67, *Materials and equipment for petroleum and natural gas industries*, Subcommittee SC 1, *Line pipe*.

Together with the other parts, this part of ISO 3183 cancels and replaces ISO 3183:1980, which has been technically revised.

ISO 3183 consists of the following parts, under the general title *Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions*:

— *Part 1: Pipes of requirement class A*

— *Part 2: Pipes of requirement class B*

— *Part 3: Pipes of requirement class C*

Annexes B, C and D form a normative part of this part of ISO 3183. Annex A is for information only.

Introduction

In the preparation of ISO 3183, the committee responsible was unanimous in seeking to avoid specifying the quality level 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 need was recognized to provide a basic quality level which corresponds to that specified in ANSI/API 5L [2]. This is designated requirement class A and is considered in ISO 3183-1.

Secondly, many purchasers impose requirements different from or additional to the basic standard, for instance concerning toughness and non-destructive testing. This approach is common, for example, for transmission pipelines. Such overall enhanced requirements are addressed in requirement class B and are considered in ISO 3183-2.

Thirdly, there are certain particularly demanding applications, such as sour service, offshore service, and low-temperature service, where very stringent requirements are imposed. Such requirements are reflected in requirement class C and are considered in this part of ISO 3183.

For toughness properties, ISO 3183-3 offers a choice of requirement modules which correspond to concepts for avoidance of either brittle fracture or long-running shear fracture. The drop-weight tear test is part of those requirement modules which are considered typical for gas lines.

The Charpy energy requirements to avoid long-running shear fracture have been derived from established data in accordance with EPRG recommendations [3] for pipelines transporting lean, dry natural gas. It is recognized that rich gas or two-phase fluids may require enhanced toughness properties which can only be determined case by case.

It is the responsibility of the designer to select the appropriate toughness requirement module and to decide whether the specified energy requirements suffice for the intended application or whether the use of pipe with enhanced toughness properties and/or the use of mechanical crack arrestors is necessary.

For pipes of this requirement class C, a weld efficiency factor of 1,0 may be used in pipeline design calculations because of the conditions specified for the manufacture of the pipes and for the testing of the seam welds.

The selection of the requirement class depends on many factors. The properties of the fluid to be conveyed, the service conditions, the design code and any statutory requirements should all be taken into consideration. It is therefore the ultimate responsibility of the user to select the appropriate requirement class for the intended application.

NOTE This part of ISO 3183 combines a wide range of product types, dimensions and technical restrictions. In some areas of application, the absence of a single international pipeline design standard has resulted in differing national regulations imposing conflicting requirements on users, thus making technical harmonization difficult. Consequently, it may be necessary to amend certain requirements of this part of ISO 3183 to satisfy various national design codes. However, this part of ISO 3183 remains the basic reference document and such amendments should be specified at the time of enquiry and order. (See for example the note to 8.2.3.3.1.)

The steel names used in this part of ISO 3183 do not comply with the regulations given in ISO/TR 4949 [1] for the formation of steel names. They have been established using the principle agreed between ISO/TC 67/SC 1 and ECISS/TC 29/SC 2 for the International Standard ISO 3183, and for the European Standard EN 10208, in order to avoid misunderstandings which could arise from different steel names for the same grade.

Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions —

Part 3:
Pipes of requirement class C

1 Scope

This part of ISO 3183 specifies the technical delivery conditions for unalloyed and alloyed (except stainless) seamless and welded steel pipes. It includes requirements overall more stringent than those specified in ISO 3183-1 and ISO 3183-2 [4]. This part of ISO 3183 applies to pipes that are normally used for the transmission of combustible fluids under particularly arduous conditions, such as offshore service, low temperature service and/or sour service (see 3.5).

This part of ISO 3183 is not suitable for cast steel pipes.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 3183 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 148:1983, *Steel — Charpy impact test (V-notch).*

ISO 377:1997, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing.*

ISO 404:1992, *Steel and steel products — General technical delivery requirements.*

ISO 1027:1983, *Radiographic image quality indicators for non-destructive testing — Principles and identification.*

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

ISO 3183-1:1996, *Petroleum and natural gas industries — Steel pipe for pipelines — Technical delivery conditions — Part 1: Pipes of requirement class A.*

ISO 4885:1996, *Ferrous products — Heat treatments — Vocabulary.*

ISO 4948-1:1982, *Steels — Classification — Part 1: Classification of steels into unalloyed and alloy steels based on chemical composition.*

ISO 4948-2:1982, *Steels — Classification — Part 2: Classification of steels into unalloyed and alloy steels according to main quality classes and main property or application characteristics.*

ISO 6507-1:1982, *Metallic materials — Hardness test — Vickers test — Part 1: HV 5 to HV 10.*

ISO 6508:1986, *Metallic materials — Hardness test — Rockwell test (scales A-B-C-D-E-F-G-H-K).*

ISO 6892:1984, *Metallic materials — Tensile testing.*

ISO 6929:1987, *Steel products — Definitions and classification.*

ISO 7438:1985, *Metallic materials — Bend test.*

ISO 7539-2:1989, *Corrosion of metals and alloys — Stress corrosion testing — Part 2: Preparation and use of bent-beam specimens.*

ISO 8492:1986, *Metallic materials — Tube — Flattening test.*

ISO 8501-1:1988, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.*

ISO 9303:1989, *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Full peripheral ultrasonic testing for the detection of longitudinal imperfections.*

ISO 9304:1989, *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Eddy current testing for the detection of imperfections.*

ISO 9305:1989, *Seamless steel tubes for pressure purposes — Full peripheral ultrasonic testing for the detection of transverse imperfections.*

ISO 9402:1989, *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Full peripheral magnetic transducer/flux leakage testing of ferromagnetic steel tubes for the detection of longitudinal imperfections.*

ISO 9598:1989, *Seamless steel tubes for pressure purposes — Full peripheral magnetic transducer/flux leakage testing of seamless ferromagnetic steel tubes for the detection of transverse imperfections.*

ISO 9764:1989, *Electric resistance and induction welded steel tubes for pressure purposes — Ultrasonic testing of the weld seam for the detection of longitudinal imperfections.*

ISO 9765:1990, *Submerged arc-welded steel tubes for pressure purposes — Ultrasonic testing of the weld seam for the detection of longitudinal and/or transverse imperfections.*

ISO 10124:1994, *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes — Ultrasonic testing for the detection of laminar imperfections.*

ISO 10543:1993, *Seamless and hot stretch-reduced welded steel tubes for pressure purposes — Full peripheral ultrasonic thickness testing.*

ISO 10474:1991, *Steel and steel products — Inspection documents.*

ISO 11484:1994, *Steel tubes for pressure purposes — Qualification and certification of non-destructive testing (NDT) personnel.*

ISO 11496:1993, *Seamless and welded steel tubes for pressure purposes — Ultrasonic testing of tube ends for the detection of laminar imperfections.*

ISO 12094:1994, *Welded steel tubes for pressure purposes — Ultrasonic testing for the detection of laminar imperfections in strip/plates used in the manufacture of welded tubes.*

ISO 12096:1996, *Submerged arc-welded steel tubes for pressure purposes — Radiographic testing of longitudinal and spiral welds for the detection of imperfections.*

ISO 12135:1996, *Metallic materials — Unified method of test for the determination of quasistatic fracture toughness.*

ISO 13663:1995, *Welded steel tubes for pressure purposes — Ultrasonic testing of the area adjacent to the weld seam for the detection of laminar imperfections.*

ISO 13664:1997, *Magnetic particle inspection of tube ends of seamless and welded ferromagnetic steel tubes for the detection of laminar imperfections.*

ISO 13665:1997, *Magnetic particle inspection of the tube body of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections.*

ISO 14284:1996, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition.*

ANSI/ API RP 5L3:1996, *Recommended practice for conducting drop-weight tear tests on line pipe.*

ASME Sect. IX:1995, *ASME Boiler and pressure vessel code — Section IX: Qualification standard for welding and brazing procedures, welders, brazers, and welding and brazing operators.*

ASTM A 370-96 (1996), *Standard test methods and definitions for mechanical testing of steel products.*

EN 288-3:1992, *Specification and approval of procedures for welding metallic materials — Part 3: Welding procedure tests for the arc welding of steel.*

NACE TM0177-96 (1996), *Standard test method — Laboratory testing of metals for resistance to specific forms of environmental cracking in H_2S environments.*

NACE TM0284-96 (1996), *Standard test method — Evaluation of pipeline steels and pressure vessel steels for resistance to hydrogen-induced cracking.*

3 Terms and definitions

3.1 General

For the purposes of this part of ISO 3183, the terms and definitions apply for the

— classification of steels in ISO 4948-1 and ISO 4948-2;

— definition of steel products in ISO 6929;

— heat treatment in ISO 4885 and for

— types of sampling procedures, inspection and inspection documents in ISO 377, ISO 404 and ISO 10474.

The terms and definitions in 3.2 to 3.6 apply when complementary to or different from those given in the above.

3.2 Types of pipes and welds

3.2.1
seamless pipe
S pipe
tubular product manufactured in a hot forming process

NOTE The forming process may be followed by cold sizing (see 6.5) or cold finishing (see 3.3.5) to produce the desired dimensions.

3.2.2
high-frequency welded pipe
HFW pipe
tubular product, manufactured by forming from strip and welding the abutting edges without addition of filler metal, in which the longitudinal seam is generated by high-frequency (at least 100 kHz) current applied by induction or conduction

3.2.3
submerged arc-welded pipe
SAW pipe
tubular product, manufactured by forming from strip or plate and welding the abutting edges by addition of filler metal, in which the longitudinal (SAWL) or helical (SAWH) seam is produced by the automatic submerged-arc welding process

cf. 6.3.

NOTE At least one pass is made on the inside and at least one pass on the outside of the pipe. A single pass tack weld prior to the deposition of the submerged arc-weld metal is permitted (see 6.3.3).

3.2.4
strip [plate] end weld
weld that joins strip [plate] ends together

3.2.5
jointer
two pieces of pipe joined together by a circumferential weld

3.2.6
pipe body
⟨welded pipe⟩ the entire pipe excluding the weld(s) and heat-affected zone(s)

3.2.7
pipe body
⟨seamless pipe⟩ the entire pipe

3.3 Treatment condition

3.3.1
normalizing forming
forming 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

NOTE 1 With normalizing forming, the specified values of the mechanical properties are retained even after normalizing.

NOTE 2 The abbreviated form of this delivery condition is N.

3.3.2
thermomechanical forming
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

NOTE 1 Subsequent heating above 580 °C may lower the strength values.

NOTE 2 The abbreviated form of this delivery condition is M.

NOTE 3 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.

3.3.3
quenching and tempering
heat treatment consisting of quench hardening followed by tempering

NOTE 1 Quench hardening implies austenitization followed by cooling, under conditions such that austenite transforms more or less completely into martensite and possibly into bainite.

NOTE 2 Tempering implies heating to a specific temperature below the lower transformation temperature (Ac_1) one or more times or holding this temperature, followed by cooling at an appropriate rate so that the structure is modified and the specified properties are achieved.

NOTE 3 The abbreviated form of this delivery condition is Q.

3.3.4
cold forming
process by which a flat product is formed to a pipe without heating

3.3.5
cold finishing
cold working operation (normally cold drawing) with a permanent strain greater than 1,5 %

NOTE The level of permanent strain differentiates it from cold sizing operations specified in 6.5.

3.4 Imperfections and defects

3.4.1
imperfection
irregularity in the wall or on the pipe surface detectable by methods described in this part of ISO 3183

NOTE Imperfections with a size and/or population density that are within the acceptance criteria defined in this part of ISO 3183 are considered to have no practical implication on the intended use of the product.

3.4.2
defect
imperfection of a size and/or population density greater than the acceptance criteria defined in this part of ISO 3183

NOTE Defects are considered to adversely affect or limit the intended use of the product.

3.5
service conditions
conditions of use which depend on the design of the pipeline as specified by the purchaser in relationship with the intended application

NOTE Within this part of ISO 3183, the terms “sour service”, “offshore service” and “low-temperature service” indicate service conditions.

3.6
by agreement
unless otherwise indicated, agreed between manufacturer and purchaser at the time of enquiry and order

3.7 Margin symbols

The following symbols are used in the margin of pages or tables to indicate options for 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 part of ISO 3183 are non-alloy or alloy special steels. Their classification in accordance with ISO 4948-1 and ISO 4948-2 is indicated in Table 1.

4.2 Designation

The steels specified in this part of ISO 3183 are designated with steel names given in Table 1.

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

Table 1 — Classification and designation of steels

Heat treatment condition	Steel class in accordance with ISO 4948-1 and ISO 4948-2	Steel name [a]
Normalized or normalizing formed	Non-alloy special steel	L245NC
		L290NC
		L360NC
Quenched and tempered	Non-alloy special steel	L290QC
	Alloy special steel	L360QC
		L415QC
		L450QC
		L485QC
		L555QC
Thermomechanically formed	Non-alloy special steel	L290MC
		L360MC
		L415MC
	Alloy special steel	L450MC
		L485MC
		L555MC

[a] In the steel name designations N, Q and M refer to the treatment condition given in 3.3, where:
N = Normalized or normalizing formed;
Q = Quenched and tempered;
M = Thermomechanically formed.

The additional letter S shall be added as a suffix to the steel name for sour service material to distinguish it from non-sour service material.
EXAMPLE: L450QCS

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:

a) quantity ordered (e.g. total mass or total length of pipe);

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

c) type of pipe (see Table 2, column 1);

d) number of this part of ISO 3183;

e) steel name (see Table 1) including service condition non-sour or sour (see Tables 3 and 4);

f) toughness requirements to be met (see 7.3.1);

g) pipe outside diameter and wall thickness, in millimetres (see 7.6.1.1);

h) offshore service, if applicable (see Table 11, footnotes e and f and 7.6.3.4.2);

i) for other than offshore pipe, the random length group or, if an exact length is required, the length in metres (see 7.6.3.4 and Table 13);

j) design temperature, if applicable [see 7.3.1 a) and 7.3.1 b) and 8.2.3.5];

k) type of inspection document required (see 8.1);

l) information on the type of intended subsequent coating, if applicable;

m) intended use as a mother pipe for factory bends, if applicable.

5.2 Other information

This part of ISO 3183 offers to the purchaser and manufacturer the possibility to agree upon additional information (see 7.3.1, note 1) or other conditions, in addition to the normally applicable delivery 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.

NOTE The parts of clauses or tables covering items listed in 5.2 are marked by the symbols M, U, O defined in 3.7.

a) **Mandatory agreement: option which shall be agreed if applicable (M)**

1) chemical composition of pipes with wall thicknesses > 25 mm (see Tables 3 and 4, text preceding footnotes);

2) mechanical properties of pipes with wall thicknesses > 25 mm (see Table 5, footnote a);

3) supply of information on hoop stress when option c). 6) is specified [see 7.3.1 c)];

4) impact and DWT test requirements for pipes with outside diameters > 1 430 mm and/or wall thicknesses > 25 mm (see Table 8, footnote a and Table 9, text preceding note);

5) diameter tolerances for the ends of seamless pipe with wall thicknesses > 25 mm (see Table 11, footnote b);

6) diameter tolerances for pipes with outside diameter > 1 430 mm (see Table 11);

7) out-of-roundness requirement for offshore pipe with $D/T > 75$ (see Table 11);

8) party to issue inspection document 3.2 (see 8.1);

9) marking of pipe intended for subsequent coating (see 9.1.4);

10) frequency and amount of testing for the manufacturing procedure qualification [see B.3 a)].

b) **Unless otherwise agreed, left to the discretion of the manufacturer (U)**

1) method to verify dimensional and geometrical requirements (see 8.2.3.14.4);

2) timing of NDT of seamless pipe (see D.2.2);

3) radiographic inspection for the detection of longitudinal imperfections [see D.5.4 a)].

c) **Optional agreement: option which may be agreed (O)**

1) alternative casting method for material for welded pipe (see 6.3.3);

2) manufacture of SAWL pipes with two longitudinal seams (see 6.3.3);

3) renunciation of cold expansion of SAWL pipe (see 6.5);

4) supply of SAWH containing plate end welds (see 6.6);

5) copper and/or molybdenum content (see Table 4, footnotes c and i);

6) specification of calculated impact energy values (see 7.3.1);

7) impact test temperature and, if applicable, DWT test temperature other than the standard test temperature shown in Tables 6, 8 and 9 (see 7.3.1, 8.2.3.3.1 and 8.2.3.4);

8) restricted yield strength range (see Table 5, footnote b);

9) increased $R_{t0,5}/R_m$ ratios (see Table 5, footnote c);

10) weldability data or weld tests (see 7.4.2);

11) application of the diameter tolerance to the inside diameter (see Table 11, footnote c);

12) application of the diameter tolerance to the outside diameter (see Table 11, footnote d);

13) length other than that specified in 7.6.3.4.1 and 7.6.3.4.2 (see 7.6.3.4.3);

14) special bevel configuration or end preparation (see 7.6.4.2);

15) trimming of the outside weld bead of SAW pipes (see 7.6.5.2.2);

16) transverse tensile test for seamless pipe (see Table 20, footnote b);

17) additional longitudinal tensile testing for deep water pipelay (see Table 20, footnote f);

18) use of round test pieces (see 8.2.2.3);

19) use of flattened and heat-treated test coupons (see 8.2.2.3);

20) use of alternative transverse impact test pieces (see 8.2.2.4);

21) use of hydraulic ring expansion test for transverse yield determination (see 8.2.3.2.3);

22) substitution of the macrographic alignment examination by an alternative test method (see 8.2.3.8.1);

23) hardness test during production and maximum hardness value for seam-heat-treated HFW pipe (see 8.2.3.8.2);

24) photomicrographs of reportable HIC cracks (see 8.2.3.9);

25) other SSC test methods and associated acceptance criteria for manufacturing procedure qualification (see 8.2.3.10);

26) hydrostatic test pressures and/or hoop stress greater than the standardized limit (see 8.2.3.12.1);

27) hydrostatic test pressure in accordance with ISO 3183-1 (see 8.2.3.12.3);

28) use of special devices for measuring the pipe diameter (see 8.2.3.14.1);

29) use of (cold) die stamping or vibro etching (see 9.1.3);

30) special marking (see 9.2);

31) temporary protection, including coating, lining, mill varnish or other temporary protection (see clause 10);

32) bead on pipe test for manufacturing procedure qualification [see B.3 d)];

33) SSC test for manufacturing procedure qualification [see B.3 e)];