
**Petroleum and natural gas industries —
Corrosion-resistant alloy seamless tubes
for use as casing, tubing and coupling
stock — Technical delivery conditions**

*Industries du pétrole et du gaz naturel — Tubes sans soudure en acier allié
résistant à la corrosion utilisés comme tubes de cuvelage, tubes de
production et tubes-ébauches pour manchons — Conditions techniques de
livraison*

iTeh STANDARD REVIEW
(standards.iteh.ai)

ISO 13680:2000

[https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-
cf1c949deb43/iso-13680-2000](https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000)



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 13680:2000

<https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000>

© ISO 2000

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

	Page	
1	Scope	1
2	Normative references	1
3	Terms and definitions, symbols and abbreviated terms	3
3.1	Terms and definitions	3
3.2	Symbols	5
3.3	Abbreviated terms	5
4	Classification.....	6
5	Information to be supplied by the purchaser	6
6	Material design qualification	7
7	Manufacturing process	7
7.1	Manufacturing of corrosion-resistant alloys	7
7.2	Tube manufacturing process	7
8	Requirements	8
8.1	General.....	8
8.2	Chemical composition	8
8.3	Mechanical properties	9
8.4	Corrosion properties	11
8.5	Microstructure properties	11
8.6	Visual inspection	11
8.7	Non-destructive examination	12
8.8	Hydrostatic test.....	12
9	Dimensions, masses and tolerances.....	13
9.1	Outside diameter, wall thickness and mass	13
9.2	Length	15
9.3	Tolerances	16
10	Inspection and testing.....	18
10.1	Types of inspection document.....	18
10.2	Type and frequency of tests	19
10.3	Purchaser inspection	20
10.4	Testing of chemical composition.....	20
10.5	Testing of mechanical and other characteristics	20
10.6	Inspection of dimensions	23
10.7	Visual inspection	23
10.8	Non-destructive examination (NDE)	23
10.9	Invalidation of the tests.....	23
10.10	Retests	23
10.11	Sorting or reprocessing	23
11	Test methods.....	23
11.1	Chemical analysis.....	23
11.2	Tensile test	23
11.3	Hardness test	24
11.4	Impact test	25
11.5	Corrosion test	25
11.6	Microstructure examination.....	25
11.7	Visual inspection	26
11.8	Non-destructive examination	26
11.9	Dimensional testing.....	27

11.10	Hydrostatic test.....	29
12	Marking	29
12.1	General.....	29
12.2	Marking on tubes for casing, tubing and coupling stock.....	29
12.3	Colour code identification.....	30
13	Surface treatment	32
13.1	General.....	32
13.2	Group 1	32
13.3	Groups 2, 3 and 4.....	32
14	Surface protection	32
15	Handling, packing and storage.....	33
15.1	General.....	33
15.2	Handling.....	33
15.3	Packing	33
15.4	Storage.....	33
15.5	Complaints after delivery	33
	Bibliography	34

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 13680:2000](https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000)

<https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000>

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.

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

International Standard ISO 13680 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, Subcommittee SC 5, *Casing, tubing and drill pipe*.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 13680:2000](https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000)

<https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 13680:2000

<https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000>

Petroleum and natural gas industries — Corrosion-resistant alloy seamless tubes for use as casing, tubing and coupling stock — Technical delivery conditions

1 Scope

This International Standard specifies the technical delivery conditions for corrosion-resistant alloy seamless tubes for casing, tubing and coupling stock.

This International Standard is applicable to the following four groups of tube product:

- **Group 1**, comprised of stainless alloy with a martensitic or martensitic/ferritic structure;
- **Group 2**, comprised of stainless alloy with a ferritic-austenitic structure, such as duplex and super duplex stainless alloy;
- **Group 3**, comprised of stainless alloy with an austenitic structure (iron base);
- **Group 4**, comprised of nickel-based alloys with an austenitic structure (nickel base).

This International Standard contains no provisions relating to the connection or other methods by which individual lengths of tube are joined to form a string.

NOTE The connection or joining method can influence the corrosion performance of the materials specified in this International Standard.

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 International Standard 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, *Steel — Charpy impact test (V-notch)*.

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

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

ISO 643, *Steels — Micrographic determination of the ferritic or austenitic grain size*.

ISO 783, *Metallic materials — Tensile testing at elevated temperature*.

ISO 3545-1, *Steel tubes and fittings — Symbols for use in specifications — Part 1: Tubes and tubular accessories with circular cross-section*.

ISO 13680:2000(E)

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

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

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

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T).*

ISO 6892, *Metallic materials — Tensile testing at ambient temperature.*

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

ISO 7539-1, *Corrosion of metals and alloys — Stress corrosion testing — Part 1: General guidance on testing procedures.*

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

ISO 7539-3, *Corrosion of metals and alloys — Stress corrosion testing — Part 3: Preparation and use of U-bend specimens.*

ISO 7539-4, *Corrosion of metals and alloys — Stress corrosion testing — Part 4: Preparation and use of uniaxially loaded tension specimens.*

ISO 7539-5, *Corrosion of metals and alloys — Stress corrosion testing — Part 5: Preparation and use of C-ring specimens.*

ISO 7539-6, *Corrosion of metals and alloys — Stress corrosion testing — Part 6: Preparation and use of pre-cracked specimens.*

ISO 7539-7, *Corrosion of metals and alloys — Stress corrosion testing — Part 7: Slow strain rate testing.*

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

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

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

ISO 9402, *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 9712, *Non-destructive testing — Qualification and certification of personnel.*

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

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

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

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

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

ISO 11845, *Corrosion of metals and alloys — General principles for corrosion testing.*

ISO 11960, *Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells.*

ISO 13665, *Seamless and welded steel tubes for pressure purposes — Magnetic particle inspection of the tube body for the detection of surface imperfections.*

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

ASTM E 112, *Standard test methods for determining average grain size.*

ASTM E 562, *Standard method for determining volume fraction by systematic manual point count.*

ASTM G 48, *Test method for pitting and crevice corrosion resistance of stainless steels and related alloys by the use of ferric chloride solution.*

ASTM G 78, *Guide for corrosion testing of iron base and nickel base stainless alloys in seawater and other chloride aqueous environments.*

NACE TM-01-77, *Standard test method — Laboratory testing of resistance to sulphide stress cracking in H₂S environments.*

[ISO 13680:2000](https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000)

<https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000>

3 Terms and definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 377, ISO 404, ISO 4885, ISO 4948-1, ISO 4948-2, ISO 6929, ISO 10474 and the following apply.

3.1.1

coupling stock

tubular stock used for the manufacture of coupling blanks

3.1.2

casing

tube used in wells to seal off the bore hole

3.1.3

tubing

tube used in wells to conduct fluid from the well's producing formation into the Christmas tree or vice versa

3.1.4

quench hardening

quenching

heat treatment requiring austenitization followed by cooling, under conditions such that austenite transforms into martensite

NOTE 1 Quench hardening is often followed by tempering.

ISO 13680:2000(E)

NOTE 2 Adapted from ISO 4885.

3.1.5

tempering

heating, one or more times, to a specific temperature below the lower critical temperature and holding at that temperature

NOTE 1 Tempering is often preceded by quench hardening.

NOTE 2 Adapted from ISO 4885.

3.1.6

solution annealing

heating to a suitable temperature, holding at that temperature long enough to cause one or more constituents to enter into solid solution, then cooling rapidly enough to hold such constituents in solution

[ISO 4885]

3.1.7

cold finishing

cold-working operation which results in a permanent strain if a final solution annealing is not performed

NOTE The percentage of cold work depends on the specified strength level for each material grade, as shown in Table 3 for the cold-worked condition.

3.1.8

imperfection

discontinuity or irregularity in the product detected by methods outlined in this International Standard

3.1.9

linear imperfection

imperfection including, but not limited to, seams, laps, cracks, plug scores, cuts and gouges

3.1.10

defect

imperfection having sufficient magnitude to warrant rejection of the product based on the stipulations of this International Standard

3.1.11

corrosion-resistant alloy

alloy intended to be resistant to general and localized corrosion and/or environmental cracking in environments that are corrosive to carbon and low-alloy steels

3.1.12

hot finishing

deforming metal plastically at such a temperature and strain rate that recrystallization takes place simultaneously with the deformation, thus preventing permanent strain hardening

3.1.13

test unit

unit formed by tubes from the same heat, with the same outside diameter and wall thickness, the same grade, the same manufacturing process, the same final heat-treatment conditions and the same cold-working parameters

iTeh STANDARD PREVIEW
(standards.itih.ai)

ISO 13680:2000

<http://standards.itih.ai/abstracts/publications/171-511-ed10-401-0681-c1c949deb43/iso-13680-2000>

3.2 Symbols

For the purposes of this International Standard, the symbols given in ISO 3545-1 and ISO 6892 apply. For the convenience of the reader, those symbols applicable are shown below.

<i>d</i> :	Inside diameter of the tube, expressed in millimetres
<i>D</i> :	Outside diameter of the tube, expressed in millimetres
<i>T</i> :	Wall thickness of the tube, expressed in millimetres
<i>M</i> :	Mass per unit length, expressed in kilograms per metre
<i>P_E</i> :	Test pressure, expressed in pascals (additionally in bar, if desired)
<i>R_m</i> :	Tensile strength, expressed in megapascals
<i>R_{p0,2}</i> :	Proof strength (0,2 % non-proportional elongation), expressed in megapascals
<i>A</i> :	Percentage elongation after fracture

3.3 Abbreviated terms

AD:	Argon oxygen decarburization
CCT:	Critical crevice temperature
CPT:	Critical pitting temperature
CW:	Cold-worked
ESR:	Electro slag remelting
ET:	Electromagnetic inspection
HF:	Hot-finished
HRC:	Rockwell hardness scale C
L+T:	Longitudinal+transverse
MPS:	Manufacturing procedure specification
MT:	Magnetic particle inspection
NDE:	Non-destructive examination
PM:	Powder metallurgy
PRE:	Pitting-resistance equivalent number
QT:	Quenched and tempered
SA:	Solution-annealed
UT:	Ultrasonic testing
VAD:	Vacuum arc degassing
VAR:	Vacuum arc remelting
VIM:	Vacuum induction melting
VOD:	Vacuum oxygen decarburization

iTeH STANDARD PREVIEW
(standards.iteh.ai)

[ISO 13680:2000](https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000)

<https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-cf1c949deb43/iso-13680-2000>

4 Classification

The corrosion-resistant alloys included in this International Standard are special alloys in accordance with ISO 4948-1 and ISO 4948-2.

5 Information to be supplied by the purchaser

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

- a) quantity of tube;
- b) product designation: tube for casing, tubing or coupling stock;
- c) reference to this International Standard;
- d) material category and grade (Tables 2 and 3);
- e) dimensions, in millimetres (Table 7);
- f) length range (9.2);
- g) type of inspection document (10.1).

EXAMPLE For the following requirements,

- tubing quantity: 1 000 m,
- product: tubes for casing,
- material category and grade: 13-5-2/95,
- dimensions [expressed as outside diameter (in mm) × wall thickness (in mm) × length range]:
177,80 × 8,05 × R3,
- inspection document: Certificate 3.1.B according to ISO 10474:1991.

This information should preferably be given as:

1 000 m tube for casing ISO 13680 — 13-5-2/95 — 177,80 × 8,05 × R3 ISO 10474 — 3.1.B

5.2 This International Standard allows the purchaser and manufacturer to agree, in special cases, on other conditions instead of or in addition to the requirements of this International Standard. If the purchaser or manufacturer intends to make use of the following options, this shall be clearly indicated at the enquiry stage and stated in the purchase order and in the confirmation of the order:

- a) chemical composition (8.2);
- b) mechanical properties at room temperature (8.3.1);
- c) mechanical properties at elevated temperature (8.3.2);
- d) impact properties (8.3.3);
- e) internal surface roughness (8.6.1.1);
- f) NDE method (8.7);
- g) tolerances on outside diameter, wall thickness and mass of tubes for coupling stock (9.3.1.2);
- h) surface protection (14.2);
- i) hydrostatic test (8.8 and 11.10);
- j) corrosion tests (8.4).

6 Material design qualification

The manufacturer who developed the material shall test it and report physical and mechanical properties, product chemical composition and corrosion-resistance characteristics as specified in Table 12. Any documented assumptions, calculations and test results shall be included.

This documentation shall provide objective evidence for the environmental and operational conditions for which the manufacturer has developed the material.

When requested by the user, the supplier shall provide the above documentation to the user with the aim of assisting the user in assessing the suitability of the material for the user's application.

If requested by the user, all tests required to characterize anisotropy shall be part of the supplier material qualification.

NOTE Cold-worked materials are prone to anisotropy of proof strength, dependent on the amount of cold work and the manufacturing processes. This should be considered in any application.

7 Manufacturing process

7.1 Manufacturing of corrosion-resistant alloys

The alloys covered by this International Standard shall be made by the basic oxygen process or the electric furnace process followed by further refining operations such as AOD, VOD, VAR, ESR, VIM and VAD.

7.2 Tube manufacturing process (standards.iteh.ai)

Tube manufacturing processes, starting material and heat-treatment or cold-finished conditions are listed in Table 1.

[https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-](https://standards.iteh.ai/catalog/standards/sist/c171e511-ed40-4d0d-9681-c71c949deb43/iso-13680-2000)

Group 1 tubes and Group 2 solution-annealed tubes, as defined in Table 2, shall be full-length heat-treated after any upsetting, in accordance with 3.1.4 or 3.1.5.

Table 1 — Tube manufacturing process, starting material, tube-forming and heat-treatment conditions

Starting material	Tube-forming conditions	Heat-treatment or cold-worked conditions	Symbol
Ingot/billet or rolled/forged bar	Hot-finished — Hot-rolled or — Hot-extruded	Quenched and tempered	QT
		Solution-annealed	SA
Ingot/billet or rolled/forged/machined bar	Cold-finished ^a — Cold drawing or — Cold pilgering	Cold worked	CW
		Solution-annealed	SA
Hot-finished hollow	Cold-finished ^a — Cold drawing or — Cold pilgering	Cold worked	CW
		Solution-annealed	SA

^a For cold-finished products, there shall be a minimum reduction in area ratio of 3:1 between the cast ingot or billet and the last hot working or heat treatment.