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

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

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 5, *Casing, tubing and drill pipe*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 13680:2010), which has been technically revised. The main changes compared to the previous edition are as follows:

- change of title and scope so that it includes accessory material and group 5;
- deletion of [Annex E](#);
- addition of new [Annex F](#), [Annex H](#) and [Annex I](#);
- update of warning statement;
- complete revision of the technical content.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Users of this document should be aware that further or differing requirements can be needed for individual applications. This document is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This is particularly relevant to innovative or developing technology. Where an alternative is offered, it is the responsibility of the vendor to identify any variations from this document and provide details.

In this document, the following verbal forms are used:

- a) “shall” indicates a requirement;
- b) “should” indicates a recommendation;
- c) “may” indicates a permission;
- d) “can” indicates a possibility or a capability.

Information marked as “NOTE” is for guidance in understanding or clarifying the associated requirement. “Notes to entry” used in [Clause 3](#) provide additional information that supplements the terminological data and can contain provisions relating to the use of a term.

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

WARNING — It is the purchaser's responsibility to specify the product specification level (PSL), corrosion-resistant alloy (CRA) group, category, grade, delivery conditions and any other requirement in addition to those specified herewith to ensure that the product is adequate for the intended service environment. The ISO 15156 series should be considered when making specific requirements for H₂S-containing environment; see [Annex G](#). Other variables which can contribute to hydrogen embrittlement should be considered. There are other sources of hydrogen besides H₂S containing environments, which are not addressed by the ISO 15156 series.

1 Scope

This document specifies the technical delivery conditions for corrosion-resistant alloy seamless tubular products for casing, tubing, coupling stock and accessory material (including coupling stock and accessory material from bar) for two product specification levels:

- PSL-1, which is the basis of this document;
- PSL-2, which provides additional requirements for a product that is intended to be both corrosion and cracking resistant for the environments and qualification method specified in [Annex G](#) and in the ISO 15156 series.

At the option of the manufacturer, PSL-2 products can be provided in lieu of PSL-1.

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

NOTE 2 For the purpose of this document, NACE MR0175 is equivalent to the ISO 15156 series.

NOTE 3 Accessory products can be manufactured from coupling stock and tubular material, or from solid bar stock or from bored and heat-treated bar stock as covered in [Annex F](#).

This document contains no provisions relating to the connection of individual lengths of pipe.

This document contains provisions relating to marking of tubing and casing after threading.

This document is applicable to the following five groups of products:

- a) group 1, which is composed of stainless alloys with a martensitic or martensitic/ferritic structure;
- b) group 2, which is composed of stainless alloys with a ferritic-austenitic structure, such as duplex and super-duplex stainless alloy;
- c) group 3, which is composed of stainless alloys with an austenitic structure (iron base);
- d) group 4, which is composed of nickel-based alloys with an austenitic structure (nickel base);
- e) group 5, which is composed of bar only ([Annex F](#)) in age-hardened (AH) nickel-based alloys with austenitic structure.

NOTE 4 Not all PSL-1 categories and grades can be made cracking resistant in accordance with the ISO 15156 series and are, therefore, not included in PSL-2.

2 Normative references

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

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 525, *Bonded abrasive products — General requirements*

ISO 643, *Steels— Micrographic determination of the apparent grain size*

ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

ISO 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 4885, *Ferrous materials — 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*

ISO 6508-2, *Metallic materials — Rockwell hardness test — Part 2: Verification and calibration of testing machines and indenters*

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

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

ISO 6929, *Steel products — Vocabulary*

ISO 8501-1, *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 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

ISO 9934-1, *Non-destructive testing — Magnetic particle testing — Part 1: General principles*

ISO 10423, *Petroleum and natural gas industries — Drilling and production equipment — Wellhead and christmas tree equipment*

ISO 10474, *Steel and steel products — Inspection documents*

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

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

ISO 10893-4, *Non-destructive testing of steel tubes — Part 4: Liquid penetrant inspection of seamless and welded steel tubes for the detection of surface imperfections*

ISO 10893-5, *Non-destructive testing of steel tubes — Part 5: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections*

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

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

ISO 10893-12, *Non-destructive testing of steel tubes — Part 12: Automated full peripheral ultrasonic thickness testing of seamless and welded (except submerged arc-welded) steel tubes*

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

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

ISO 15156 (all parts), *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production*

ISO 15156-3:2015, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys*

ISO 80000-1, *Quantities and units — Part 1: General*

API RP 578, *Guidelines for a Material Verification Program (MVP) for New and Existing Assets*

SPEC API, 6A, *Specification for Wellhead and Christmas Tree Equipment*

API Standard 6ACRA, *Age-hardened Nickel-based Alloys for Oil and Gas Drilling and Production Equipment*

ASNT SNT-TC-1A, *Recommended Practice — Non-Destructive Testing*

ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM A604/A604M, *Standard Practice for Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets*

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ASTM A941, *Standard Terminology Relating to Steel, Stainless Steel, Related Alloys and Ferroalloys*

ASTM E10, *Standard Test Method for Brinell Hardness of Metallic Materials*

ASTM E18, *Standard Test Methods for Rockwell Hardness of Metallic Materials*

ASTM E21, *Standard Test Methods for Elevated Temperature Tension Tests of Metallic Materials*

ASTM E23, *Standard Test Methods for Notched Bar Impact Testing of Metallic Materials*

ASTM E29, *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*

ASTM E45, *Standard Test Methods for Determining the Inclusion Content of Steel*

ASTM E110, *Standard Test Method for Rockwell and Brinell Hardness of Metallic Materials by Portable Hardness Testers*

ASTM E112, *Standard Test Methods for determining the average Grain Size*

ASTM E165, *Standard Practice for Liquid Penetrant Examination for General Industry*

ASTM E213, *Standard Practice for Ultrasonic Testing of Metal Pipe and Tubing*

ASTM E309, *Standard Practice for Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation*

ASTM E340, *Standard Test Method for Macroetching Metals and Alloys*

ASTM E381, *Standard Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings*

ASTM E562, *Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count*

ASTM E570, *Standard Practice for Flux Leakage Examination of Ferromagnetic Steel Tubular Products*

ASTM E709, *Standard Guide for Magnetic Particle Testing*

ASTM E1245, *Standard Practice for Determining the Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis*

ASTM E1476, *Standard Guide for Metals Identification, Grade Verification, and Sorting*

ASTM G48, *Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution*

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 377, ISO 404, ISO 4885, ISO 4948-1, ISO 4948-2, ISO 6929, ISO 10474, ASTM A941 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1.1

accessory material

seamless *casing* (3.1.3) or *tubing* (3.1.23) or seamless thick-walled tube or *bar stock* (3.1.2) or hot forging used for the manufacture of accessories

3.1.2

bar stock

bar

material with a solid uniform cross-section along its whole *length* (3.1.14)

3.1.3

casing

tube intended to line the walls of a drilled well

3.1.4

cold-hardened

CH

material condition where the mechanical properties are obtained by a cold finishing process not followed by heat treatment

Note 1 to entry: Cold finishing is a plastic deformation of material at a temperature below the recrystallization temperature such that permanent strain hardening occurs.

3.1.5

corrosion-resistant alloy

CRA

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

3.1.6**coupling blank**

unthreaded material used to produce an individual coupling

3.1.7**coupling stock**

seamless thick-wall *tubular product* (3.1.18) used for the manufacture of *coupling blanks* (3.1.6)

3.1.8**defect**

imperfection (3.1.11) having sufficient magnitude to warrant rejection of the *length* (3.1.14)

3.1.9**heat**

material of the same category melted in the same manufacturing process at the same time sequence poured into multiple ingots or continuous strand cast

Note 1 to entry: In case of a remelted alloy, each ingot shall be considered a different heat.

3.1.10**hot-finished****HF**

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

3.1.11**imperfection**

discontinuity on the *product* (3.1.18) surface or in the product wall that can be detected by visual inspection or non-destructive examination

3.1.12**label 1**

dimensionless designation for the size or specified outside diameter that can be used when ordering *pipe* (3.1.17)

3.1.13**label 2**

dimensionless designation for the linear density that can be used when ordering *pipe* (3.1.17)

Note 1 to entry: Linear density is sometimes designated by the deprecated term “mass per unit length”.

3.1.14**length**

piece of *product* (3.1.18)

3.1.15**linear imperfection**

imperfection (3.1.11) including, but not limited to, seams, laps, cracks, plug scores, cuts and gouges

3.1.16**manufacturer**

firm, company or corporation that operates facilities for making seamless tubes for *casing* (3.1.3), *tubing* (3.1.23), *coupling stock* (3.1.7) or *accessory material* (3.1.1)

3.1.17**pipe**

plain end *casing* (3.1.3), *tubing* (3.1.23) and *pipe joint* (3.1.19) as group

3.1.18

product

tubular product

pipe (3.1.17) and/or *coupling stock* (3.1.7) and/or *accessory material* (3.1.1), either individually or collectively, as applicable

3.1.19

pup joint

casing (3.1.3) or *tubing* (3.1.23) shorter than range 1

3.1.20

solution annealing

heat treatment requiring 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

Note 1 to entry: Solution annealing may be performed as a part of the hot forming process or as a separate operation.

3.1.21

test lot

lot

<products other than bars or drilled bars> unit formed by *lengths* (3.1.14) from the same *heat* (3.1.9), with the same specified outside diameter and wall thickness, the same grade, the same manufacturing process, the same final heat-treatment conditions, process facilities and parameters for all heat-treatment stages, processed sequentially for continuous furnaces or simultaneously for batch furnaces, the same cold hardening parameters (if applicable) and the same range length

Note 1 to entry: The maximum number of lengths in a test lot is given in [Table A.22](#) or [Table C.22](#).

3.1.22

test lot

lot

<bars or drilled bars> unit formed by *lengths* (3.1.14) from the same *heat* (3.1.9), with the same specified outside diameter, the same wall thickness (if applicable), the same grade, the same manufacturing process facilities and parameters for all heat-treatment stages, processed sequentially for continuous furnaces or simultaneously for batch furnaces

Note 1 to entry: The maximum number of lengths in a test lot is given in [F.5.1](#).

3.1.23

tubing

tube placed in a well to produce or inject fluids

3.2 Abbreviated terms

AOD	argon oxygen decarburization
EDI	electronic data interchange
EMI	electromagnetic inspection
ESR	electro-slag remelting
HBW	Brinell hardness, when testing with a tungsten carbide ball
HRC	Rockwell hardness C-scale
ID	inside diameter