INTERNATIONAL STANDARD

ISO 11960

Sixth edition
2020-03

Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells

Industries du pétrole et du gaz naturel — Tubes d'acier utilisés comme cuvelage ou tubes de production dans les puits

Reference number
ISO 11960:2020(E)

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Published in Switzerland

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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).

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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 sixth edition cancels and replaces the fifth edition (ISO 11960:2014), which has been technically revised. The main changes compared to the previous edition are as follows:

— deletion of Groups;

— deletion of Product Specifications Levels (PSL) and re-integration of the main requirements into the body of the text or into Annex A as a supplementary requirement;

— addition of Annex H on high collapse requirements;

— modification of NDT requirements for sour service grades.

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.

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Introduction

Users of this document are advised 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 can be particularly applicable where there is innovative or developing technology. Where an alternative is offered, it is advisable that the vendor identify any variations from this document and provide details.

This document includes statements of various nature. These are identified by the use of certain verbal forms:

— "Shall" is used to indicate that a provision is mandatory;

— "Should" is used to indicate that a provision is not mandatory but recommended as good practice;

— "May" is used to indicate that a provision is optional.

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Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells

1 Scope

This document specifies the technical delivery conditions for steel pipes (casing, tubing and pup joints), coupling stock, coupling material and accessory material.

By agreement between the purchaser and manufacturer, this document can also be applied to other plain-end pipe sizes and wall thicknesses.

This document is applicable to the following connections:

— short round thread casing (SC);

— long round thread casing (LC);

— buttress thread casing (BC);

— non-upset tubing (NU);

— external upset tubing (EU);

— integral-joint tubing (IJ).

NOTE 1 For further information, see API Spec 5B.

For such connections, this document specifies the technical delivery conditions for couplings and thread protection.

NOTE 2 Supplementary requirements that can optionally be agreed for enhanced leak resistance connections (LC) are given in A.9 SR22.

This document can also be applied to tubulars with connections not covered by ISO or API standards.

This document is applicable to products including the following grades of pipe: H40, J55, K55, N80, L80, C90, R95, T95, P110, C110 and Q125.

This document is not applicable to threading requirements.

NOTE 3 Dimensional requirements on threads and thread gauges, stipulations on gauging practice, gauge specifications, as well as, instruments and methods for inspection of threads are given in API Spec 5B.

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

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

ISO 6506-1:2004, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6506-2, *Metallic materials — Brinell hardness test — Part 2: Verification and calibration of testing machines*

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ISO 6508-1:2006, *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 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

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 9513, *Metallic materials — Calibration of extensometer systems used in uniaxial testing*

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

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 10893-5, *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 10893-10, *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 10893-11, *Non-destructive testing of steel tubes — Part 11: Automated ultrasonic testing of the weld seam of welded steel tubes for the detection of longitudinal and/or transverse imperfections*

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

ISO 13678, *Petroleum and natural gas industries — Evaluation and testing of thread compounds for use with casing, tubing, line pipe and drill stem elements*

ANSI/NACE TM0177-2016, *Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking and Stress Corrosion Cracking in H_2S Environments*

API RP 5A3, *Recommended Practice on Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements*

API TR 5C3, *Technical Report on Equations and Calculations for Casing, Tubing, and Line Pipe Used as Casing or Tubing; and Performance Properties Tables for Casing and Tubing*

Spec API 5B, *Specification for Threading, Gauging and Thread Inspection of Casing, Tubing, and Line Pipe Threads*

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

ASTM A751, *Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products*

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

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*

ASTM E4, *Standard Practices for Force Verification of Testing Machines*

ASTM E10-18, *Standard Test Method for Brinell Hardness of Metallic Materials*

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ASTM E18-19, *Standard Test Methods for Rockwell Hardness 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 E83, *Standard Practice for Verification and Classification of Extensometer Systems*

ASTM E112, *Standard Test Methods for Determining Average Grain Size*

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

ASTM E273, *Standard Practice for Ultrasonic Testing of the Weld Zone of Welded Pipe and Tubing*

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

ASTM E543, *Standard Specification for Agencies Performing Nondestructive Testing*

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

ASTM E709, *Standard Guide for Magnetic Particle Testing*

ASNT-SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing

IADC/SPE 11396, *B.A. Dale, M.C. Moyer, T.W. Sampson, A Test Program for the Evaluation of Oilfield Thread Protectors, IADC/SPE Drilling Conference, New Orleans, LA, 20-23 February 1983*

MIL-STD-810c, Military Standard: Environmental Test Methods, 10 March 1975

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in 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* (3.1.5) or tubing, or seamless thick-walled tubes or mechanical tubes, or bar stock or hot forgings used for the manufacture of accessories

3.1.2
API threads
threads as specified in API Spec 5B

3.1.3
arc burn
localized point of surface melting caused by arcing between an electrode or ground (earth) and the product surface

Note 1 to entry: Contact marks, which are intermittent marks adjacent to the weld line of EW pipe resulting from electrical contact between the electrodes supplying the welding current and the pipe surface, or contact marks resulting from the use of a spectrometer for the detection of steel chemical composition, are not arc burns.

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3.1.4
carload
quantity of product loaded on a railway car for shipment from the product-making facilities

3.1.5
casing
pipe run from the surface and intended to line the walls of a drilled well

3.1.6
connection
threaded assembly of tubular components

3.1.7
controlled cooling
cooling from an elevated temperature in a pre-determined manner to avoid hardening, cracking or internal damage, or to produce a desired microstructure or mechanical properties

3.1.8
coupling
internally threaded cylinder for joining two lengths of threaded pipe

3.1.9
coupling blank
unthreaded material used to produce an individual *coupling* (3.1.8)

3.1.10
coupling material
thick-walled seamless tube used to manufacture *coupling blanks* (3.1.9)

Note 1 to entry: The main difference between coupling material and coupling stock is that coupling material has no mandatory NDE inspection requirements (see 10.15). See Clause 9 for mandatory NDE requirements for finished couplings.

3.1.11
coupling stock
coupling material that meets the coupling stock requirements

3.1.12
defect
imperfection of sufficient magnitude to warrant rejection of the product based on criteria defined document

3.1.13
electric-welded pipe
pipe having one longitudinal seam formed by electric-resistance or electric-induction welding, without the addition of filler metal, wherein the edges to be welded are mechanically pressed together and the heat for welding is generated by the resistance to flow of electric current

3.1.14
full-body
complete cross-section of the product

3.1.15
full-length
complete length of the product (end-to-end)

3.1.16
heat
metal produced by a single cycle of a batch melting process

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3.1.17
heat analysis
chemical analysis representative of a heat as reported by the metal producer

3.1.18
imperfection
discontinuity in the product wall or on the product surface that can be detected by a specific NDE method

Note 1 to entry: See NDE method included in Table C.42 or Table E.42.

3.1.19
inspection
process of measuring, examining, testing, gauging or otherwise comparing a unit of product with the applicable requirements

3.1.20
inspection lot
lot
definite quantity of product manufactured under conditions that are considered uniform for the attribute to be inspected

3.1.21
inspection lot sample
one or more units of product selected from an *inspection lot* (3.1.20) to represent that inspection lot

3.1.22
lot size
inspection lot size
number of units of product in an *inspection lot* (3.1.20)

3.1.23
interrupted quenching
quenching in which the product being quenched is removed from the quenching medium while the product is at a temperature substantially higher than that of the quenching medium

3.1.24
label 1
dimensionless designation for the size or specified outside diameter that can be used when ordering pipe

3.1.25
label 2
dimensionless designation for the mass per unit length that can be used when ordering pipe

3.1.26
length
piece of pipe that can be plain-end, threaded, or threaded and coupled, that is in accordance with specific length requirements

Note 1 to entry: See requirements in 8.6, Table C.27 or Table E.27.

3.1.27
linear imperfection
imperfection which includes, but is not limited to, seams, laps, cracks, plug scores, cuts and gouges

Note 1 to entry: See API Std 5T1.

3.1.28
manufacturer
one or more of the following, depending on the context: pipe mill; processor; threader; coupling manufacturer, pup-joint manufacturer; accessory manufacturer

Note 1 to entry: See Clause 14.

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3.1.29
non-linear imperfection
imperfection which includes, but is not limited to, pits and round-bottom die stamping

Note 1 to entry: See API Std 5T1.

3.1.30
pipe
casing (3.1.5), tubing and pup joints as a group

3.1.31
pipe mill
firm, company or corporation that operates pipe-making facilities

3.1.32
plain-end pipe
pipe, either upset or non-upset, furnished without threads

3.1.33
processor
firm, company or corporation that operates facilities capable of heat-treating products made by a pipe mill

3.1.34
product
pipe, *coupling* (3.1.8), coupling stock, coupling material, *coupling blank* (3.1.9) or *accessory material* (3.1.1), either individually or collectively as applicable

3.1.35
product test block
test block removed from the product, the tensile test specimen or through-wall hardness test ring

3.1.36
pup joint
casing (3.1.5) or tubing of length shorter than Range 1

Note 1 to entry: Range 1 is specified in Table C.27 or Table E.27.

3.1.37
purchaser
party responsible for both the definition of requirements for a product order and for payment for that order

3.1.38
quench crack
crack in steel resulting from stresses produced during the transformation from austenite to martensite

Note 1 to entry: This transformation is accompanied by an increase in volume.

3.1.39
seamless pipe
wrought steel tubular product made without a weld seam

Note 1 to entry: To produce the desired shape, dimensions and properties, it is manufactured by hot-working steel, and if necessary, by subsequently cold-working or heat-treating, or a combination of these operations.

3.1.40
skelp
hot-rolled steel strip used for manufacturing EW pipe

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3.1.41
special end-finish
threads with specific thread form and features, manufacturing specifications, dimensions, *connection* (3.1.6) make-up and performance properties

Note 1 to entry: The specificities of such threads are beyond the scope of this document.

3.1.42
standardized test block
test block, certified to a mean hardness number, used for the verification of the performance of hardness testing machines

3.1.43
thread protector
cap or insert used to protect threads and seals during handling, transportation and storage

3.1.44
tubing
pipe placed in a well to produce or inject fluids

3.1.45
upper critical temperature
Ar_3
temperature at which austenite begins to transform to ferrite during cooling

3.2 Symbols and abbreviated terms

BC	API Spec 5B buttress thread casing connection
B_f	maximum bearing face diameter
CS	coupling stock
C_V	Charpy V-notch impact test minimum absorbed energy
CVN	Charpy V-notch
D	specified outside diameter for pipe
d	calculated inside diameter
EMI	electromagnetic inspection
EU	API Spec 5B external upset tubing connection
EW	electric-welded process
HBW	Brinell hardness, when testing with a tungsten carbide ball
HRC	Rockwell hardness C-scale
ID	inside diameter
IJ	API Spec 5B integral tubing connection
k	a constant used in the calculation of elongation
LC	API Spec 5B long round thread casing connection
max.	maximum

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min.	minimum
N	heat-treat process full-body, full-length normalized
N&T	normalized and tempered
NDE	non-destructive examination
NU	API Spec 5B non-upset tubing connection
OD	outside diameter
PE	unthreaded pipe either upset or non-upset
Q	quenched and tempered
RC	regular coupling
S	seamless process (when not referencing the chemical element sulfur)
Sc	minimum acceptable result of the ANSI/NACE=TM0177- Method B test
SCC	special clearance coupling
SSC	sulfide stress cracking
SC	API Spec 5B short round thread casing connection
SR	supplementary requirement
SF	special end finishing
t	specified wall thickness
T&C	threaded and coupled
USC	United States customary (units)
UT	ultrasonic testing
W	specified outside diameter for regular couplings with API threads
W_c	specified outside diameter of special clearance couplings with API threads
YS_{max}	specified maximum yield strength
YS_{min}	specified minimum yield strength

4 Conformance

4.1 Dual referencing of normative references

In the interests of world-wide application of this document, ISO/TC 67 has decided, after detailed technical analysis, that certain normative documents listed in Clause 3 and prepared by ISO/TC 67 or other ISO Technical Committee are interchangeable in the context of the relevant requirement with the relevant document prepared by the American Petroleum Institute (API), the American Society for Testing and Materials (ASTM) or the American National Standards Institute (ANSI). These latter documents are cited in the running text following the ISO reference and preceded by “or”, for example “ISO XXXX or API YYYY”. Application of an alternative normative document cited in this manner will

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