



SLOVENSKI STANDARD

SIST EN 14870-4:2023

01-september-2023

Industrija za predelavo nafte in zemeljskega plina - Indukcijska cevna kolena, fitingi in prirobnice za naftovodne transportne sisteme - 4. del: Tovarniško hladno upognjena cevna kolena (ISO 15590-4:2019, spremenjen)

Petroleum and natural gas industries - Induction bends, fittings and flanges for pipeline transportation systems - Part 4: Factory cold bends (ISO 15590-4:2019, modified)

Erdöl- und Erdgasindustrie - Induktionsbögen, Zubehörteile und Flansche für Fernleitungen - Teil 4: Durch werkseitige Kaltverformung gefertigte Rohrbögen (ISO 15590-4:2019, modifiziert)

Industries du pétrole et du gaz naturel - Coudes d'induction, raccords et brides pour systèmes de transport par conduites - Partie 4 : Coudes fabriqués à froid en usine (ISO 15590-4:2019, modifiée)

Ta slovenski standard je istoveten z: EN 14870-4:2023

ICS:

75.200	Oprema za skladiščenje nafte, naftnih proizvodov in zemeljskega plina	Petroleum products and natural gas handling equipment
83.140.30	Polimerne cevi in fitingi za snovi, ki niso tekočine	Plastics pipes and fittings for non fluid use

SIST EN 14870-4:2023

en,fr,de

EUROPEAN STANDARD

EN 14870-4

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2023

ICS 75.200

English Version

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This European Standard was approved by CEN on 10 April 2023.

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EN 14870-4:2023 (E)**European foreword**

This document (EN 14870-4:2023) has been prepared by Technical Committee CEN/TC 12 “Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries”, the secretariat of which is held by NEN and CYS.

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of an identical text or by endorsement, at the latest by December 2023, and conflicting national standards shall be withdrawn at the latest by December 2023.

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

A list of all parts in the EN 14870 series can be found on the CEN website.

The text of ISO 15590-4:2019 has been adopted by CEN/TC 12 with some modifications to exclude the aspects that are covered by CEN/TC 234 “Gas infrastructure”. These modifications are indicated by a vertical line in the left margin of the text.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

[SIST EN 14870-4:2023](https://standards.iteh.ai/catalog/standards/sist/f36e1dd3-d7cf-415f-9b14-ccd164cbc768/sist-en-14870-4-2023)

<https://standards.iteh.ai/catalog/standards/sist/f36e1dd3-d7cf-415f-9b14-ccd164cbc768/sist-en-14870-4-2023>

Introduction

This document makes reference to line pipe and bends with delivery conditions based on ISO 3183.

This document contains additional requirements for special applications as follows:

- Manufacturing procedure specification (Annex A);
- PSL 2S cold bends ordered for sour service (Annex B).

The requirements of the annexes apply only where they are specified on the purchase order. This document does not provide guidance on when it is necessary to specify the above supplementary requirements defined in the annexes. It is the responsibility of the purchaser to specify, based upon the intended use and design requirements, the supplementary requirements that will apply for a particular purchase order.

Further or differing requirements can be needed for individual applications. This document is not intended to inhibit a manufacturer 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 the responsibility of the manufacturer to identify and provide details of any variations from this document.

ISO 15590-4:2019, developed within ISO/TC 67/SC 2, has been adopted as EN 14870-4:2023 (ISO 15590-4:2019, modified).

The scope of ISO/TC 67/SC 2 is pipeline transportation systems for the petroleum and natural gas industries without exclusions. However, in CEN the scopes of CEN/TC 12 and CEN/TC 234 overlapped until 1995. This scope overlap caused problems for the parallel procedure for the above-mentioned item. The conflict in scope was resolved when both the CEN Technical Committees concerns and the CEN Technical Board decided to amend the scope of CEN/TC 12 by explicitly excluding “*on-land supply systems used by the gas supply industry excluding gas infrastructure from the input of gas into the on-shore transmission network up to the inlet connection of gas appliances*”.

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1 Scope

This document specifies the technical delivery conditions for bends made by the cold bending process for bend with radii $5 \times OD$ or higher for use in pipeline transportation systems for the petroleum and natural gas industries as defined in ISO 13623. Short radius factory cold bends should not be used for pipeline.

NOTE 1 ISO 13623 is modified adopted as EN 14161 to exclude on-land supply systems used by the European gas supply industry from the input of gas into the on-land transmission network up to the inlet connection of gas appliances.

This document also specifies the requirements for the manufacture of two product specification levels (PSLs) of cold bends corresponding to product specification levels given for pipe in ISO 3183. This document is applicable to cold bends made from seamless and welded pipe of unalloyed or low-alloy steels.

NOTE 2 These are typically C-Mn steels or low-alloy steels that are appropriate for the corresponding level and grade of line pipe in accordance with ISO 3183.

This document is not applicable to the selection of the cold bend product specification level. It is the responsibility of the purchaser to specify the PSL, based upon the intended use and design requirements.

NOTE 3 See also ISO 3183:2012, Introduction.

This document is not applicable to field cold bends and pipeline bends made by other manufacturing processes.

On-land supply systems used by the European gas supply industry from the input of gas into the on-land transmission network up to the inlet connection of gas appliances are excluded from the scope of this document.

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.

EN 10204, *Metallic products — Types of inspection documents*

ISO 80000-1:2009, *Quantities and units — Part 1: General*

ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 3183:2012, *Petroleum and natural gas industries — Steel pipe for pipeline transportation systems*¹

ISO 6507 (all parts), *Metallic materials — Vickers hardness test*

ISO 6508 (all parts), *Metallic materials — Rockwell hardness test*

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 7438, *Metallic materials — Bend test*

¹ This document is superseded by ISO 3183:2019 after publication of ISO 15590-1:2018. As ISO 3183:2019 is published as ISO supplement to API Spec 5L, this document maintains the references to particular sections in ISO 3183:2012, which are considered still accurate.

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

ISO 8501-1:2007, *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 10474, *Steel and steel products — Inspection documents*

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 10893-9, *Non-destructive testing of steel tubes — Part 9: Automated ultrasonic testing for the detection of laminar imperfections in strip/plate used for the manufacture of welded steel tubes*

ISO 10893-10:2011, *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 10893-11:2011, *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*

<https://standards.iteh.ai/catalog/standards/sist/f36e1dd3-d7cf-415f-9b14-ccd164cbc768/sist-13623>, *Petroleum and natural gas industries — Pipeline transportation systems²*

ASNT SNT-TC-1A, *Recommended Practice No. SNT-TC-1A: Personnel Qualification and Certification in Nondestructive Testing*

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

ASTM A435, *Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates*

ASTM A578/A578M, *Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications*

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

ASTM E92, *Standard Test Method for Vickers Hardness of Metallic Materials*

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

ASTM E165, *Standard Test Method for Liquid Penetrant Examination*

² This document is modified adopted as EN 14161 to exclude on-land supply systems used by the European gas supply industry from the input of gas into the on-land transmission network up to the inlet connection of gas appliances.

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

ASTM E214, *Standard Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing*

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

ASTM E709, *Standard Guide for Magnetic Particle Testing*

ASTM E797, *Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method*

ASTM G39, *Standard Practice for Preparation and Use of Bent-Beam Stress-Corrosion Test Specimens*

NACE TM0177:2016, *Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking in Hydrogen Sulfide (H₂S) Environments*

NACE TM0284:2016, *Standard Test Method — Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 <https://www.electropedia.org/>

3.1**arc**

curved portion of a bend [teh.ai/catalog/standards/sist/f36e1dd3-d7cf-415f-9b14-ccd164cbc768/sist-en-14870-4-2023](https://www.iso.org/obp/standard/isostd:14870-4:2023/en-14870-4-2023)

3.2**agreed**

agreed upon by the *manufacturer* (3.17) and *purchaser* (3.21), and specified in the purchase order

3.3**bend angle**

amount of directional change through the cold bend

3.4**bend qualification test**

qualification test that produces a cold bend in accordance with the *MPS* (3.18) and demonstrates that bends that meet the specified requirements of this document can be produced

3.5**bend radius**

distance from the centre of curvature to the centreline axis of the bent pipe

3.6**chord**

line segment connecting start and stop points of the bend zone measured at the centreline axis

3.7**defect**

imperfection (3.11) of a size and/or population density greater than specific acceptance criteria

Note 1 to entry: The specific acceptance criteria are specified in ISO 3183.

3.8**extrados**

outer curved section of the *arc* (3.1)

3.9**heat**

batch of steel prepared in one steel-making operation

3.10**if agreed**

required to be as prescribed, or more stringent than is prescribed, if agreed upon by the *manufacturer* (3.17) and the *purchaser* (3.21) and specified in the purchase order

3.11**imperfection**

discontinuity or irregularity in the product wall or on the product surface that is detectable through inspection methods

3.12**indication**

evidence obtained by *non-destructive inspection* (3.20)

3.13**cold bending**

controlled bending process using presses at room temperature

3.14**inspection**

activities, such as measuring, examining, testing, weighing or gauging one or more characteristics of a product and comparing the results of such activities with the specified requirements in order to determine conformity

3.15**intrados**

inner curved section of the *arc* (3.1)

3.16**lamination**

internal metal separation that creates layers, generally parallel to the pipe/bend surface

3.17**manufacturer**

firm, company, or corporation responsible for making and marking the product

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3.18**manufacturing procedure specification****MPS**

document that specifies the properties and description of the *mother pipe* (3.19), the cold bending procedure, the post-bending heat treatment equipment and cycle, if applicable, the qualification bend testing results, the non-destructive testing procedures and the weld end bevel details used for the manufacture of the cold bends

3.19**mother pipe**

straight section of pipe from which a cold bend is made

3.20**non-destructive inspection**

inspection (3.14) to reveal *imperfections* (3.11), using radiographic, ultrasonic or other methods that do not involve disturbance, stressing or breaking of the materials

3.21**purchaser**

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

3.22**submerged-arc welding****SAW**

welding process that produces melting and coalescence of metals by heating them with an arc(s) between a bare metal consumable electrode(s) and the workpiece, wherein the *arc* (3.1) and molten metal are shielded by a blanket of granular flux

3.23**service condition**

condition of use that is specified by the *purchaser* (3.21) in the purchase order

Note 1 to entry: In this document, the terms “sour service” and “offshore service” are service conditions.

3.24**strip end weld**

weld that joins strip ends together

3.25**plate end weld**

weld that joins plate ends together

3.26**tangent**

straight section at the end of a cold bend

3.27**wall thinning**

amount of reduction from the actual wall thickness of the pipe to the wall thickness in the *extrados* (3.8) after *cold bending* (3.13)

4 Symbols and abbreviated terms

4.1 Symbols

A	elongation of tensile test specimen after fracture, expressed as a percentage
L_{CVD}	crest to valley depth
D_2 and D_4	outside diameters of two adjacent crests
D_3	outside diameter of the intervening valley
D	specified diameter, outside or inside
D_{max}	maximum measured diameter, outside or inside
D_{min}	minimum measured diameter, outside or inside
D_n	nominal pipe diameter
L	distance between adjacent crests for waving
O	out-of-roundness
R_b	bend centreline radius
R_p	nominal mid-thickness radius of the mother pipe
R_m	ultimate tensile strength
$R_{t0,5}$	yield strength for 0,5 % total elongation
t_i	minimum wall thickness at the bend intrados
t_{min}	minimum wall thickness required in accordance with ISO 13623, or other applicable design code, for the straight pipe adjacent to the bend, including any corrosion allowance

4.2 Abbreviated terms

BQT	bend qualification test
CB	cold bending
CTOD	crack tip opening displacement testing
CCVD	crest to valley depth
HAZ	heat-affected zone
HIC	hydrogen-induced cracking
HFW	high-frequency electric welding process for pipe during manufacturing
MPS	manufacturing procedure specification
MT	magnetic particle testing
NDT	non-destructive testing
OD	outside diameter
PSL	product specification level
PT	liquid-penetrant testing