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**Petroleum and natural gas industries - Induction bends, fittings and flanges for pipeline transportation systems - Part 1: Induction bends (ISO 15590-1:2001 modified)**

Petroleum and natural gas industries - Induction bends, fittings and flanges for pipeline transportation systems - Part 1: Induction bends (ISO 15590-1:2001 modified)

Erdöl- und Erdgasindustrie - Im Induktionsverfahren gefertigte Rohrbögen, Fittings und Flansche für Rohrleitungs-Transportsysteme - Teil 1: Im Induktionsverfahren gefertigte Rohrbögen (ISO 15590-1:2001 modifiziert)

Industries du pétrole et du gaz naturel - Coudes d'induction, raccords et brides pour systèmes de transport par conduites - Partie 1: Coudes d'induction (ISO 15590-1:2001 modifiée)

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**Petroleum and natural gas industries - Induction bends, fittings  
and flanges for pipeline transportation systems - Part 1:  
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Industries du pétrole et du gaz naturel - Coudes d'induction,  
raccords et brides pour systèmes de transport par  
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gefertigte Rohrbögen, Fittings und Flansche für  
Rohrleitungstransportsysteme - Teil 1: Im  
Induktionsverfahren gefertigte Rohrbögen (ISO 15590-  
1:2001 modifiziert)

This European Standard was approved by CEN on 15 July 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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## Explanatory Note

ISO 15590-1:2001, developed within ISO/TC 67 SC 2, has been adopted as EN 14870-1:2004 (ISO 15590-1 : 2001 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 items. The conflict in scope was resolved when both the CEN/Technical Committees and the CEN/BT took the following resolution:

**Resolution BT 38/1995:**

**Subject: Revised scope of CEN/TC 12**

**“BT endorses the conclusions of the coordination meeting between CEN/TC 12 “Materials, equipment and offshore structures for petroleum and natural gas industries” and CEN/TC 234 “Gas supply” and modifies the CEN/TC 12 scope, to read:**

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**“Standardization of the materials, equipment and offshore structures used in drilling, production, refining and the transport by pipelines of petroleum and natural gas, excluding on-land supply systems used by the gas supply industry and those aspects of offshore structures covered by IMO requirement (ISO/TC 8).**

**The standardization is to be achieved wherever possible by the adoption of ISO Standards.”**

Resulting from Resolution BT 38/1995, **“gas supply on land”** has been excluded from the scope of ISO 15590-1 : 2001 for the European adoption by CEN/TC 12.

## EN 14870-1:2004 (E)

## Foreword

The text of ISO 15590-1:2001 has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum and natural gas industries" of the International Organization for Standardization (ISO) and has been taken over as EN 14870-1:2004 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 AFNOR.

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 April 2005, and conflicting national standards shall be withdrawn at the latest by April 2005.

International Standard ISO 15590-1 was prepared by Technical Committee ISO/TC 67, Materials, equipment and offshore structures for petroleum and natural gas industries, Subcommittee SC 2, Pipeline transportation systems.

EN 14870 consists of the following parts, under the general title *Petroleum and natural gas industries — Induction bends, fittings and flanges for pipeline transportation systems* :

- *Part 1 : Induction bends*
- *Part 2 : Fittings*
- *Part 3 : Flanges*

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

## Introduction

Users of this part of EN 14870 should be aware that further or differing requirements may be needed for individual applications. This part of EN 14870 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, the manufacturer should identify any variations from this part of EN 14870 and provide details.

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**EN 14870-1:2004 (E)****1 Scope**

This part of EN 14870 specifies the technical delivery conditions for bends made by the induction bending process for use in pipeline transportation systems for the petroleum and natural gas industries as defined in ISO 13623.

This part of EN 14870 is applicable to induction bends made from seamless and welded pipe of unalloyed or low-alloy steels.

This part of EN 14870 specifies three classes of induction bend corresponding to increasing quality requirements in accordance with the technical delivery conditions of ISO 3183 for pipe as indicated in Table 1 (see also ISO 3183-3:1999, Introduction).

**Table 1 — Induction bend class and corresponding pipe standard**

Induction bend class	Corresponding pipe standard
Class A	ISO 3183-1
Class B	ISO 3183-2
Class C	ISO 3183-3

This part of EN 14870 is not applicable to the selection of the induction bend class.

This part of EN 14870 is not applicable to pipeline bends made by other manufacturing processes.

On-land supply systems used by the gas supply industry are excluded from the scope of this standard.

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**2 Normative references**

The following referenced documents are indispensable for the application 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 148, *Steel – Charpy impact test (V-notch)*.

EN ISO 377, *Steel and steel products - Location and preparation of samples and test pieces for mechanical testing (ISO 377:1997)*

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

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

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

ISO 3183-2, *Petroleum and natural gas industries – Steel pipe for pipelines – Technical delivery conditions – Part 2 : Pipes of requirement class B*.

ISO 3183-3:1999, *Petroleum and natural gas industries – Steel pipe for pipelines – Technical delivery conditions – Part 3 : Pipes of requirement class C*.

EN ISO 6507-1, *Metallic materials – Vickers hardness test – Part 1 : Test method (ISO 6507-1:1997)*



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

EN ISO 7438, *Metallic materials – Bend test (ISO 7438:1985).*

ISO/TR 7705:1991, *Guidelines for specifying Charpy V-notch impact prescriptions in steel specifications.*

EN 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 8501-1:1988).*

ISO 9305, *Seamless steel tubes for pressure purposes – Full peripheral ultrasonic testing for the detection of transverse 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, *Steel and steel products – Inspection documents.*

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

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

ISO 12095, *Seamless and welded steel tubes for pressure purposes – Liquid penetrant testing.*

ISO 13623, *Petroleum and natural gas industries – Pipeline transportation systems.*

ISO 13664, *Seamless and welded steel tubes for pressure purposes – Magnetic particle inspection of the tube ends for the detection of laminar imperfections.*

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

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

ASTM E 340, *Standard test method for macroetching metals and alloys.*

ASTM E 797, *Standard practice for measuring thickness by manual ultrasonic pulse-echo contact method.*

EN ISO 15156-2:2003, *Petroleum, petrochemical and natural gas industries - Materials for use in H<sub>2</sub>S-containing environments in oil and gas production - Part 2: Cracking-resistant carbon and low alloy steels, and the use of cast irons (ISO 15156-2:2003)*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 3.1

##### arc

curved portion of a bend

**EN 14870-1:2004 (E)****3.2****bend angle**

amount of directional change through the bend

**3.3****bend radius**

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

**3.4****by agreement**

agreed between manufacturer and purchaser

**3.5****extrados**

outer curved section of the bend arc

**3.6****heat**

batch of steel prepared in one steel-making operation

**3.7****induction bending**

continuous bending process which utilizes induction heating to create a narrow, circumferential, heated band around the material being bent

**3.8****intrados**

inner curved section of the bend arc

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**3.9****manufacturing procedure specification****MPS**

document which specifies the properties and description of the mother pipe, the bending procedure, the post-bending heat treatment equipment and cycle, the qualification bend testing results, the non-destructive testing procedures and the weld end bevel details used for the manufacture of the bends

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**3.10****mother pipe**

straight section of pipe from which an induction bend is made

**3.11****tangent**

straight section at the ends of an induction bend

**3.12****transition zone**

areas at the start and stop points of bending which include material that extends from the unheated mother pipe to the material that has been heated to the full bending temperature

**3.13****wall thinning**

amount of reduction from the original wall thickness of the pipe to the wall thickness in the extrados after bending

## 4 Symbols and abbreviated terms

For the purpose of this part of EN 14870, the following symbols and abbreviations apply.

$A$	Percentage of elongation of tensile test specimen after fracture
CE	Carbon equivalent
CTOD	Crack tip opening displacement testing
$D$	Specified diameter (outside or inside)
$D_{\max}$	Maximum measured diameter (outside or inside)
$D_{\min}$	Minimum measured diameter (outside or inside)
DWT	Drop-weight tear testing
HAZ	Heat-affected zone
HIC	Hydrogen-induced cracking
HFW	High-frequency welded
MT	Magnetic particle testing
NDT	Non-destructive testing
PT	Liquid penetrant testing
$R$	Bend centreline radius
$r$	Mean radius of the mother pipe
$R_m$	Ultimate tensile strength
$R_{t0,5}$	Yield strength for 0,5 % total elongation
RT	Radiographic testing
SAW	Submerged arc welding
SAWH	Helical seam SAW pipe
$S_0$	Initial cross-sectional area of the gauge length of a tensile test specimen
SSC	Sulfide stress-cracking
$T_{d \min}$	Minimum design temperature specified by the purchaser
$t_i$	Minimum wall thickness at the bend intrados
$t_{\min}$	Minimum wall thickness required in accordance with ISO 13623 for the straight pipe adjacent to the bend
UT	Ultrasonic testing
WPS	Welding procedure specification

## 5 Designation

Designation of induction bends shall take the form **IB xxx-A** or **B** or **C** or **CS**, where :

- xxx is the specified minimum yield strength, expressed in megapascals ;
- the suffix A, B, C identifies the technical delivery conditions class for induction bends in non-sour service ;
- the suffix CS identifies class C bends for use in sour-service conditions.

**EN 14870-1:2004 (E)****6 Pressure rating and design**

The hoop stress in the induction bend due to internal fluid pressure shall not exceed the hoop stress permitted in ISO 13623 for the adjacent straight pipe.

Compliance with this requirement shall be demonstrated either by calculations or by satisfying both of the following requirements.

- a) The wall thickness of the bend extrados shall be at least  $t_{\min}$ .
- b) The wall thickness at the bend intrados shall be at least :

$$t_i = t_{\min} \times \frac{2R-r}{2(R-r)}$$

For pipelines not designed in accordance with ISO 13623, it may be permitted for the wall thickness of the bend extrados to be less than  $t_{\min}$ .

The requirements in this clause address the design of a bend against internal pressure. Other loads, both static and dynamic, and pipeline test conditions also need to be considered by the designer to demonstrate compliance with the strength requirements of ISO 13623.

**7 Information to be supplied by the purchaser****7.1 Principal information**

The purchaser shall provide the following information, in the order given below :

- a) bend designation of each bend ;
- b) quantity of bends ;
- c) supply of mother pipe by the purchaser or the manufacturer ;
- d) required bend dimensions, including :
  - 1) diameter (inside or outside),
  - 2) minimum wall thickness,
  - 3) radius,
  - 4) bend angle,
  - 5) tangent lengths ;
- e) end preparation if different from square ends.

**7.2 Supplementary information**

If applicable, the purchaser should specify the following supplementary information :

- a) minimum design temperature ;
- b) maximum design temperature ;