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**Petroleum and natural gas industries —  
Induction bends, fittings and flanges for  
pipeline transportation systems —**

**Part 1:  
Induction bends**

**iTeh STANDARD PREVIEW**

*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

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# Contents

Page

Foreword.....	iv
Introduction .....	v
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	3
4 Symbols and abbreviated terms .....	4
5 Designation .....	4
6 Pressure rating and design .....	5
7 Information to be supplied by the purchaser .....	5
7.1 Principal information .....	5
7.2 Supplementary information .....	5
7.3 Information on the mother pipe.....	6
8 Manufacturing .....	7
8.1 Manufacturing procedure specification.....	7
8.2 Mother pipe .....	8
8.3 MPS qualification .....	8
8.4 Production bending .....	8
8.5 Post-bending heat treatment .....	8
8.6 Forming and sizing after bending .....	9
8.7 Strip/plate end welds .....	9
8.8 Jointers and girth welds .....	9
8.9 End preparation.....	9
9 Testing and inspection.....	10
9.1 General requirements .....	10
9.2 Extent of testing and inspection.....	10
9.3 Chemical composition.....	10
9.4 Physical testing.....	10
9.5 Non-destructive testing .....	17
9.6 Dimensions .....	19
9.7 Gauging.....	22
9.8 Hydrostatic testing.....	22
10 Inspection document.....	22
11 Marking .....	22

## 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 part of ISO 15590 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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*.

ISO 15590 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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## Introduction

Users of this part of ISO 15590 should be aware that further or differing requirements may be needed for individual applications. This part of ISO 15590 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 ISO 15590 and provide details.

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# Petroleum and natural gas industries — Induction bends, fittings and flanges for pipeline transportation systems —

## Part 1: Induction bends

### 1 Scope

This part of ISO 15590 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 ISO 15590 is applicable to induction bends made from seamless and welded pipe of unalloyed or low-alloy steels.

This part of ISO 15590 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 ISO 15590 is not applicable to the selection of the induction bend class.

This part of ISO 15590 is not applicable to pipeline bends made by other manufacturing processes.

### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 15590. 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 783, *Metallic materials — Tensile testing at elevated temperature*.

ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels*.

## ISO 15590-1:2001(E)

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.*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method.*

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

ISO 7438, *Metallic materials — Bend test.*

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

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 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.*

European Federation of Corrosion, Publication No. 16:1995, *Guidelines on materials requirements for carbon and low alloy steels for H<sub>2</sub>S containing environments in oil and gas production.*



### 3 Terms and definitions

For the purposes of this part of ISO 15590, the following terms and definitions apply.

#### 3.1

##### **arc**

curved portion of a bend

#### 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

#### 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

#### 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 ISO 15590, 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
$R_{t\,0,5}$	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.

## 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:

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

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;

- c) maximum wall thickness;
- d) special dimensional requirements;
- e) requirements for supplementary inspection and testing;
- f) requirements for gauging and other measurements of dimensions if different from this part of ISO 15590;
- g) pipeline design standard or design factors, if different from ISO 13623;
- h) pipeline operating conditions;
- i) whether post-bending heat treatment is to be applied;
- j) mechanical property requirements at the maximum design temperature;
- k) requirements for proof, burst or hydrostatic testing;
- l) hold-points for witness and approval by purchaser;
- m) surface condition;
- n) coating or painting requirements;
- o) marking requirements if different from this part of ISO 15590;
- p) packaging and shipping instructions;
- q) third-party inspection organization;
- r) standard designation in accordance with ISO 10474 of inspection document required;
- s) requirements for format and additional content of the inspection document.

### **7.3 Information on the mother pipe**

If the mother pipe is supplied by the purchaser, the following information on the mother pipe shall be provided to the manufacturer:

- a) purchasing specification;
- b) pipe diameter (inside or outside);
- c) pipe wall thickness (nominal or minimum);
- d) pipe lengths;
- e) pipe manufacturer;
- f) inspection documents with complete chemical composition, mechanical properties, results of NDT and dimensions;
- g) welding procedure specification and weld metal chemical composition for SAW and SAWH pipe;
- h) weld seam repair welding procedure specification for SAW and SAWH pipe.