FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/FDIS
15590-3**

ISO/TC **67**/SC **2**

Secretariat: **UNI**

Voting begins on:
2021-12-03

Voting terminates on:
2022-01-28

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

Part 3: Flanges

Industries du pétrole et du gaz naturel — Coudes d'usine, raccords et brides pour systèmes de transport par conduites —

Partie 3: Brides

Reference number
ISO/FDIS 15590-3:2021(E)

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

Published in Switzerland

Contents

Page

Foreword ..... **iv**
Introduction ..... **vi**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **2**
4 Symbols and abbreviated terms **3**
4.1 Symbols 3
4.2 Abbreviated terms 4
5 Designation of flanges **4**
6 Pressure class and design **5**
7 Information supplied by the purchaser **6**
7.1 Principal information 6
7.2 Supplementary information 6
8 Manufacturing **6**
8.1 Manufacturing procedure specification 6
8.2 Starting material 7
8.3 Hubs 7
8.4 Heat treatment 7
9 Testing and inspection **7**
9.1 General requirements 7
9.2 Extent of testing and inspection 7
9.3 Chemical composition 8
9.4 Physical testing 9
9.4.1 Preparation of test pieces 9
9.4.2 Tensile testing 9
9.4.3 Charpy V-notch impact tests 11
9.4.4 Hardness requirements 12
9.4.5 Metallographic examination 13
9.4.6 HIC tests 13
9.4.7 SSC tests 13
9.5 Non-destructive testing 13
9.5.1 NDT procedures and personnel 13
9.5.2 Forging preparation 13
9.5.3 Visual inspection 13
9.5.4 MT/PT inspection 14
9.5.5 Ultrasonic inspection 14
9.6 Dimensions 14
9.6.1 Flange dimensions 14
9.6.2 Tolerances 15
9.6.3 Flange-face finish 15
9.7 Hydrostatic testing 15
9.8 Weldability 15
9.9 Repair welding 15
10 Documentation **16**
10.1 Inspection document 16
10.2 Manufacturing record book 16
11 Marking **16**
Bibliography **18**

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 2 *Pipeline transportation systems*.

This second edition cancels and replaces the first edition (ISO 15590-3:2004), which has been technically revised. The main changes compared to the previous edition are as follows:

a) changed title;

b) added the possibility to execute NDE following the International Standards and EN and ASTM standards;

c) updated pressure-containment calculations in line with ASME VIII Division 1 or Division 2;

d) updated manufacturing of Hubs, now in line with ASME B16.5;

e) updated heat treatment subclause;

f) modified the chemical analysis in Table 4;

g) reviewed forging preparation requirements;

h) modified dimension of flanges to be in accordance with ASME B16.5, ASME B16.36, ASME B16.47, ANSI/MSS SP-44;

i) reviewed tolerances to be in accordance with manufacturing standard;

j) reviewed flange-face finish to be in accordance with manufacturing standard;

k) updated applicable standards relating to HIC and SSC;

l) modified Marking to be in accordance with ASME B16.5 requirements.

A list of all parts in the ISO 15590 series can be found on the ISO website.

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

Further or differing requirements might 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, the manufacturer should identify any variations from this document and provide details.

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

Part 3: Flanges

1 Scope

This document specifies the technical requirements for carbon steel and low-alloy steel forged flanges for use in pipeline transportation systems for the petroleum and natural gas industries as defined in ISO 13623.

This document applies to weldneck and blind flanges (full face, raised face, and RTJ groove) as well as anchor, swivel-ring flanges and orifice flanges.

This document designates those categories of flanges that meet the industry's need to match ISO 3183 pipe. These flanges are for normal and low-temperature service and include supplementary requirements where required for sour service.

Materials for, or the attachment of, factory-welded extensions, bolting materials, gaskets, slip-on flanges or flanged fittings are not covered by this document.

This document is not applicable to integrally cast or forged flanges for valves, pumps or other equipment.

This document does not cover the selection of the flange category or pressure class. Sizes and pressure classes listed in ISO 7005-1 and applicable to this document are as follows:

— DN 10 (NPS 1/2) to DN 1500 (NPS 60);

— PN 20 (class 150), PN 50 (class 300), PN 100 (class 600), PN 150 (class 900), PN 250 (class 1500), PN 420 (class 2500).

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

ISO 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

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

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

ISO 4885, *Ferrous materials — Heat treatments — Vocabulary*

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 6507-1:2018, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 7005-1, *Pipe flanges — Part 1: Steel flanges for industrial and general service piping systems*

ISO/TS 7705:2017, *Guidelines for specifying Charpy V-notch impact prescriptions in steel specifications*

ISO 9327-1, *Steel forgings and rolled or forged bars for pressure purposes — Technical delivery conditions — Part 1: General requirements*

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 13623, *Petroleum and natural gas industries — Pipeline transportation systems*

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

ISO 15590-2, *Petroleum and natural gas industries — Factory bends, fittings and flanges for pipeline transportation systems — Part 2: Fittings*

ISO 15590-4, *Petroleum and natural gas industries — Factory bends, fittings and flanges for pipeline transportation systems — Part 4: Factory cold bends*

EN 10204, *Metallic components: Types of inspection documents*

EN 10228-1, *Non-destructive testing of steel forgings — Part 1: Magnetic particle inspection*

EN 10228-2, *Non-destructive testing of steel forgings — Part 2: Penetrant testing*

ASME BPVC *Section VIII-Rules for construction of pressure vessels division 1*

ASME BPVC *Section VIII-Rules for construction of pressure vessels division 2*

ASME B16.5-20, *Pipe flanges and flanged fittings — NPS 1/2 through NPS 24*

ASME B16.36, *Orifice flanges*

ASME B16.47, *Large diameter steel flange — NPS 26 through NPS 60*

ASTM E112, *Standard test methods for determining average grain size*

ASTM E165, *Standard practice for liquid penetrant testing for general industry*

ASTM E709, *Standard guide for magnetic particle testing*

ANSI/MSS SP-44, *Steel pipeline flanges*

NACE TM 0177-2016-SG, *Standard test method — Laboratory testing of metals for resistance to sulfide stress cracking and stress corrosion cracking in H_2S environments*

NACE TM 0284-2016-SG, *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 terminology 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
ANSI rating class
numerical pressure design class defined in ASME B16.5 and used for reference purposes

Note 1 to entry: The ANSI rating class is designated by the word “Class” followed by a number.

3.2
by agreement
agreed between manufacturer and purchaser

3.3
heat
batch of steel prepared in one steel-making process

[SOURCE: ISO 15590-1:2018, 3.9, modified]

3.4
imperfection
discontinuity or irregularity in the product wall or on the product surface that is detectable through by inspection methods

3.5
manufacturing procedure specification
MPS
document that specifies the process control parameters and the acceptance criteria applied for all manufacturing, inspection and testing activities performed during flange manufacture

[SOURCE: ISO 15590-2:2021, 3.5, modified]

3.6
matching pipe
specified pipe grade and thickness to which the flange will be attached

3.7
pressure class
numerical pressure design class expressed in accordance with either the nominal pressure class or the ANSI rating class

Note 1 to entry: In this document, the pressure class is stated by the nominal pressure class followed by the ANSI rating class between brackets.

3.8
test unit
flange or test piece of the same type, starting material wall thickness, heat, manufacturing procedure specification, and heat treatment condition

4 Symbols and abbreviated terms

4.1 Symbols

A_o original cross-sectional area of the parallel length of a test specimen

E_c carbon equivalent

P_{cm}	crack measurement parameter (see Table 4)
S	sour service
t	specified wall thickness at the welding ends for flanges
$T_{d,min}$	minimum design temperature
T_{max}	maximum Charpy V-notch test temperature

4.2 Abbreviated terms

CE	carbon equivalent
DN	nominal diameter
HIC	hydrogen-induced cracking
HV	Vickers hardness
MPS	manufacturing procedure specification
MT	magnetic particle testing
NDT	non-destructive testing
NPS	nominal pipe size
PN	nominal pressure
RTJ	ring type joint
SMYS	specified minimum yield strength
SMTS	specified minimum tensile strength
SSC	sulfide stress cracking
UT	ultrasonic testing

5 Designation of flanges

Designation of flanges according to this document, i.e. ISO 15590-3, shall take the form:

ISO 15590-3 YY,

where YY is a textual description of the type of flange designation as specified in Table 1.

Table 1 — Flange designations

Non-sour service		Sour service	
Temperature, $T_{d,min}$ °C	**Flange designation**	**Temperature**, $T_{d,min}$ °C	**Flange designation**
⩾0	(N)	⩾0	(NS)
<0	(L)	<0	(LS)
N: normal service NS: normal sour service L: low-temperature service LS: low-temperature sour service			

Flanges with a minimum design temperature lower than 0 °C shall demonstrate proven notch toughness in accordance with Clause 9.

Flanges intended for sour service shall be so specified by the purchaser and meet the applicable requirements of Clause 9.

6 Pressure class and design

The flange shall be capable of withstanding an internal pressure equal to the working pressure at the temperature range required. Maximum pressures for the various pressure classes against temperature are shown in Table 2.

Table 2 — Maximum pressures as a function of temperature

Temperature °C	**PN**											
	20		**50**		**100**		**150**		**250**		**420**	
	Class											
	150		**300**		**600**		**900**		**1 500**		**2 500**	
	MPa	(bar)	MPa	(bar)	MPa	(bar)	MPa	(bar)	MPa	(bar)	MPa	(bar)
−30 to 120	1,96	(19,6)	5,11	(51,1)	10,2	(102)	15,3	(153)	25,5	(255)	42,6	(426)
150	1,9	(19)	4,93	(49,3)	9,86	(98,6)	14,8	(148)	22,6	(226)	37,7	(377)
175	1,83	(18,3)	4,75	(47,5)	9,51	(95,1)	14,3	(143)	22,2	(222)	34,1	(341)
200	1,76	(17,6)	4,59	(45,9)	9,17	(91,7)	13,8	(138)	21,9	(219)	36,5	(365)
250	1,7	(17)	4,41	(44,1)	8,86	(88,6)	13,3	(133)	22,5	(225)	35,5	(355)
For any temperature below 30 °C, the rating shall be no greater than the rating shown for −30 °C. For intermediate temperatures, linear interpolation should be used. Ratings of flanges for temperatures greater than those given shall be by agreement.												

If there are any deviations from the flange dimensions specified in ASME B16.5 or ASME B16.47, pressure-containment calculations shall be made in accordance with an agreed pressure-vessel design standard such as ASME BPVC Section VIII, Division 1 or Division 2.

The design calculations shall be available for review.

For pipeline applications, the design criteria shall be in accordance with ISO 7005-1.

NOTE External loads or moments are not covered by this document. However, swivels and anchor flanges can experience external loads and can be designed using the equivalent pressure method.