INTERNATIONAL STANDARD

ISO 7005-1

Second edition
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Pipe flanges —

Part 1: Steel flanges for industrial and general service piping systems

Brides de tuyauteries —

Partie 1: Brides en acier pour systèmes de canalisations industrielles et d'utilisation générale

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 7005-1 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 10, *Metallic flanges and their joints*.

This second edition cancels and replaces the first edition (ISO 7005-1:1992), which has been technically revised.

ISO 7005 consists of the following parts, under the general title *Pipe flanges*:

— *Part 1: Steel flanges for industrial and general service piping systems*

It also consists of the following parts, under the general title, *Metallic flanges*:

— *Part 2: Cast iron flanges*

— *Part 3: Copper alloy and composite flanges*

Introduction

This part of ISO 7005 makes normative reference to a family of two distinct steel flange series, each of which has sectorial relevance in noteworthy global marketplaces. Each is widely used within these regional entities. Each of these individual flange series, taken separately, represents a very large installed flange population and as such, it is not an economically viable option to compel replacement with a single flange series.

The steel flange harmonization specified in the previous edition did not achieve the anticipated market acceptance. This can be attributed firstly to the fact that this part of ISO 7005 has not, prior to this revision, been updated and, secondly, that this part of ISO 7005 lacked normative requirements for many materials and their corresponding pressure/temperature ratings. In addition, dimensional compromises made during the drafting of the previous edition have not been acknowledged in important market sectors. While this part of ISO 7005 remained unchanged for many years, sectorial flange standards have kept pace and by doing so maintained market prominence. With this revision, normative reference requirements are added for the two most prominent sectorial flange series, each endowed with significant market presence.

The revision of this part of ISO 7005 is intended to more readily accommodate and expand regional and national standardization needs by providing ready access to a sectorial series whose requirements are contemporaneous with regional imperatives.

Pipe flanges —

Part 1:
Steel flanges for industrial and general service piping systems

1 Scope

This part of ISO 7005 establishes a base specification for pipe flanges suitable for general purpose and industrial applications including, but not limited to, chemical process industries, electric power generating industries, petroleum and natural gas industries. It places responsibility for the selection of a flange series with the purchaser.

It is applicable to flanges within facilities engaged in the processing or handling of a wide variety of fluids, including steam, pressurized water and chemical, petroleum, natural gas or related products.

EXAMPLE Steam power plant, petroleum refinery, loading terminal, natural gas processing plant (including liquefied natural gas facilities), offshore oil and gas production platforms, chemical plant, bulk plant, compounding plant, tank farm.

This part of ISO 7005 is also applicable to packaged equipment piping, which interconnects individual pieces or stages of equipment within a packaged equipment assembly for use within facilities engaged in the processing or handling of a variety of fluids, including steam and chemical, petroleum, natural gas or related products.

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.

EN 1092-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories — PN designated — Part 1: Steel flanges*

ANSI/ASME B16.5, *Pipe Flanges and Flanged Fittings — NPS 1/2 through NPS 24 Metric/Inch Standard*

ANSI/ASME B16.47, *Large Diameter Steel Flanges — NPS 26 Through NPS 60 Metric/Inch Standard*

3 Terms and definitions

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

3.1
ambient temperature
temperature of the surrounding atmosphere in the immediate vicinity of the flange used in a piping system

3.2
design pressure
most severe pressure, taking into account its corresponding temperature selected for the design of the piping to which the flange is attached

NOTE The piping design pressure, taking into account the flange material and its application temperature, is not permitted to exceed the maximum allowable pressure listed in the tables of pressure/temperature ratings of the reference flange standard.

3.3
design temperature
maximum temperature, at design pressure, likely to be reached in operation as either the temperature of the flowing fluid or the temperature at the mid-thickness of the piping wall to which the flange is attached, as specified by the purchaser

NOTE The piping design temperature, taking into account the flange material and its application pressure, is not permitted to exceed the maximum allowable temperature listed in the tables of pressure/temperature ratings of the reference flange standard.

3.4
fabricator
erector
individual or organization that takes responsibility for fabrication or installation of piping in accordance with the owner's piping engineering design specification and in accordance with the requirements of the governing piping code or standard

NOTE When so designated by the owner, he may be recognized as the purchaser; not to be confused with a flange manufacturer.

3.5
flanged joint
joint that is composed of interrelated components (flanges, gasket and bolting), which are assembled with good practice to provide both mechanical strength and leaktightness

3.6
flange nominal size
⟨PN series⟩ alphanumeric designation of size, used for reference purposes, which is common for components used in a piping system, comprising the letters DN followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connection, as appropriate

NOTE 1 The number following DN does not represent a measurable value and is not used for calculation purposes. The use of the prefix DN is applicable to steel flanges bearing PN designations.

NOTE 2 Adapted from ISO 6708:1995, definition 2.1.

3.7
flange nominal size
⟨class series⟩ alphanumeric designation of size, used for reference purposes, which is common for components used in a piping system, comprising the letters NPS followed by a dimensionless number having an indirect correspondence to the physical size of the bore or outside diameter of the end connection, as appropriate

NOTE The dimensionless number may be used as a size identifier without the prefix NPS. This size identification number does not represent a measurable value and is not used for calculation purposes. The use of the prefix NPS is applicable to steel flanges bearing class designations.

3.8
flange rating designation
⟨PN series⟩ alphanumeric designation that is used for reference purposes, relating to flange pressure/temperature capability, taking into account flange material mechanical properties and component dimensional characteristics, comprising the letters PN followed by a dimensionless number

NOTE 1 The number following the letters PN does not represent a measurable value and is not used for calculation purposes except where specified in a relevant standard. Reference to PN is meaningful only when it is related to a relevant component. The use of the designation PN is applicable to all steel flanges bearing nominal size designations DN.

NOTE 2 It is the intent that all flange end equipment of the same nominal size (DN) designated by the same PN number have compatible mating dimensions.

NOTE 3 The maximum allowable pressure for a flange having a PN number depends on the flange material and its application temperature and is to be found in tables of pressure/temperature ratings in the reference flange standard.

NOTE 4 Adapted from ISO 7268.

3.9
flange rating designation
⟨class series⟩ alphanumeric designation that is used for reference purposes, relating to flange pressure/temperature capability, taking into account flange material mechanical properties and component dimensional characteristics comprising a dimensionless number that is frequently preceded by the word "class"

NOTE 1 The designation number does not represent a measurable value and is not used for calculation purposes except where specified in a relevant standard. Reference to a class is meaningful only when it is related to a relevant component. The use of the designation class is applicable to all steel flanges bearing size designations NPS.

NOTE 2 It is the intent that all flange end equipment of the same nominal size (NPS) designated by the same class number have compatible mating dimensions.

NOTE 3 The maximum allowable pressure for a flange having a class number depends on the flange material and its application temperature and is to be found in tables of pressure/temperature ratings in the reference flange standard.

3.10
flange series
series
classification system for flange designs having a common derivation

NOTE 1 This part of ISO 7005 specifics flanges of two series: PN series and class series.

NOTE 2 It is the intent that all flange end equipment of the same series having the same rating designation and the same nominal size have compatible mating dimensions.

3.11
flange style
style
name used within a flange series for designating dimensional features usually relating to an attachment method

EXAMPLE Threaded, socket, slip-on, lapped, blind or welding neck.

3.12
fluid service category
category concerning the application of a piping system, considering the combination of fluid properties, operating conditions and other factors which establish the basis for design of the piping system as determined by the purchaser

3.13
manufacturer
individual or organization that takes responsibility for the manufacture of flanges in accordance with the purchaser's instructions and in accordance with the requirements of this part of ISO 7005

NOTE 1 The manufacturer is not responsible for the selection of gaskets or bolting.

NOTE 2 If a manufacturer employs subcontractors for certain tasks, he is deemed to retain full control over their work.

NOTE 3 Adapted from ISO 15649.

3.14
minimum application temperature
lowest temperature of the flowing fluid at the mid-thickness of a piping wall to which a flange is attached, as determined by the purchaser

3.15
minimum application temperature
when specified by the user it may be the lowest service temperature at the mid-thickness of a piping wall to which a flange is attached

3.16
owner
individual or organization responsible for establishing the requirements for design, construction, examination, inspection and testing that govern the fluid handling or process facility of which the flanges is part

NOTE The owner is responsible for the selection of gaskets and bolting as well as the assembly of flanged joints.

3.17
packaged equipment
assembly of individual pieces or stages of equipment, complete with interconnecting piping using flanges for connections in external piping

NOTE 1 The assembly may be mounted on a skid or other structure prior to delivery.

NOTE 2 The owner can be the individual or organization that purchases flanges and/or, more often than not, that is responsible for operating the facility.

NOTE 3 Adapted from ISO 15649.

3.18
pipe
pressure-tight cylinder to which flanges may be attached, used to convey a fluid or to transmit a fluid pressure

NOTE 1 Pipe is ordinarily designated “pipe” in applicable material specifications. Materials designated “tube” or “tubing” in the material specifications are often treated as pipe when intended for pressure service.

NOTE 2 Adapted from ISO 15649.

3.19
piping
assemblies of piping components, such as flanges or components with flanges attached, used to convey, distribute, mix, separate, discharge, meter, control or snub fluid flows

3.20
piping component
mechanical element, such as a flange or flanged end component, suitable for joining together or assembly into pressure-tight fluid-containing piping systems

EXAMPLE Pipe, tubing, flanges, gaskets or bolting.

3.21
piping system
interconnected piping components, including flanges, subject to the same set or sets of design conditions

3.22
plant
industrial plant used for the purposes of generating electric power, manufacturing or processing of chemicals, or raw materials or intermediates for such chemicals, where such chemicals may also be petroleum products

EXAMPLE Power station, chemical plant or refinery.

NOTE A plant may include supporting and service facilities, such as storage, utility and waste treatment units.

3.23
purchaser
individual or organization that takes responsibility for specifying requirements for flanges or flanged components, including the designating of the flange series, used in piping system applications in accordance with any requirements established using this part of ISO 7005

NOTE The purchaser can be the owner of the plant or his designated agent.

4 Purchaser specification data

4.1 Specification details

4.1.1 General

The purchaser shall provide the flange manufacturer with the following information.

4.1.2 Flange series

Flange series shall be specified as PN or class.

— If PN series is specified, flanges shall be in accordance with EN 1092-1.

— If class series is specified, flanges shall be in accordance with ANSI/ASME B16.5 or ANSI/ASME B16.47 series A or B, as applicable.

4.1.3 Flange rating designation

Flange rating designation shall be specified as PN or class with the associated identifying dimensionless number that, along with the flange material, identifies the pressure/temperature rating that applies for a specific flange.

4.1.4 Flange size

Flange size designation shall be specified as DN or NPS with the associated identifying dimensionless number that relates to the piping size in which the flange is used.

— If PN series is specified, flange size shall be DN in accordance with EN 1092-1.

— If class series is specified, flange size shall be NPS in accordance with ANSI/ASME B16.5 or ANSI/ASME B16.47, as applicable.

4.1.5 Flange material

Flange material shall be specified in accordance with the flange series.

— If PN series is specified, flange material shall be in accordance with the material requirements of EN 1092-1.

— If class series is specified, flange material shall be in accordance with the material requirements of ANSI/ASME B16.5 or ANSI/ASME B16.47, as applicable.

4.1.6 Flange style

Flange design shall be specified. Each flange series has an array of flange designs including a variety of end connections for attaching to a pipe.

NOTE 1 PN series flanges are related to pipe outside diameter; see ISO 4200.

NOTE 2 Class series flanges are related to pipe outside diameter; see ANSI/ASME B36.10M.

4.2 Responsibilities

4.2.1 Owner

The owner is normally responsible for the operation of a fluid handling or process facility, such as a power plant, petroleum refinery, chemical plant or other facility where the piping is installed and operated. The owner or his designated agent has the responsibility for specifying flange material and the flange series, e.g. class or PN. The owner establishes requirements for design, construction, examination, inspection and testing which govern the entire facility of which the flanges are only a small part. It is the responsibility of the owner to ensure that any service requirements and limits are designated for the piping in which flanges are installed.

4.2.2 Manufacturer

The manufacturer of flanges shall manufacture these piping components in accordance with the requirements of this part of ISO 7005 and the purchaser specifications. The manufacturer of flanges is not responsible for the specification of flange material or of gaskets or bolting materials.

4.2.3 Fabricator and/or erector

The fabricator and/or erector of flanged joints should install pipes, piping, piping components and piping systems having flanged joints in accordance with the instructions specified by the owner.

5 Process

Flanges shall be manufactured, inspected and tested in accordance with the specified flange series, class or PN reference specification and in accordance with the further requirements of this part of ISO 7005. Where the specified flange series document stipulates requirements by reference to other standards, the requirements of those reference standards shall apply, provided that they are not in conflict with this part of ISO 7005.

6 Pressure limits

Flanges should be installed in systems where provision has been made to safely contain or relieve any excessive pressure to which the flanges may be subjected. Subject to applicable governing regulations or codes, flanges for flanged joints not protected by a pressure relieving device, or that can be inadvertently isolated from a pressure relieving device, should be selected having pressure/temperature ratings for at least the highest pressure that can be developed in the piping in which they are installed. See 8.2.

NOTE Measures necessary for adequate pressure resistance or relief are the responsibility of the owner, since piping changes can occur after or during flange procurement or manufacture.

7 Material

7.1 General

The purchaser shall take appropriate measures to ensure that the material specified for flanges is suitable for the intended application. The flange manufacturer shall take appropriate measures to ensure that the material used conforms to the provided material specification.

7.2 Pressurized parts

When selecting materials for flanges, the following is recommended to the flange purchaser.

a) Materials should be suitable for the design, operating and test conditions.

b) Materials should have sufficient ductility and toughness. Due care should be exercised in selecting materials in order to prevent brittle-type fractures; where, for specific reasons, it is necessary to use brittle material, appropriate safety measures should be taken. See ISO 15649:2001, 4.3.2, for minimum requirements. Ductility or toughness requirements, as necessary, shall be specified in the flange purchasing documents.

c) Materials should be suitable for the fluid service. Materials should be sufficiently chemically resistant to the fluid contained in the piping; the chemical and physical properties necessary for operational safety should fall within the projected material lifetime of the flanges or flanged components.

d) Material function due to ageing should be taken into account.

e) Materials should be selected in order to avoid undesirable effects (e.g. galvanic corrosion) when various types of materials are joined.

f) Materials should be suitable for the intended fluid service and operating procedures.

7.3 Traceability

When specified in the flange purchaser's specification, material certificates or material test reports shall be provided.

When material certificates or material test reports are specified, the manufacturer shall have in place and continuously maintain suitable procedures for identifying the flange material. A purchaser's specification should include a note to the effect that the material certificates are to be provided at the time the flanges are delivered.

8 Application considerations

8.1 Pressure

Selection of flanges should be based on the temperatures and associated pressures along with due consideration of various other effects, such as water hammer, and their consequent loadings, as determined by the purchaser taking into account the requirements in ISO 15649.

8.2 Pressure/temperature specification

The pressure rating of flanges shall be not less than the pressure at the most severe condition of coincident internal pressure and temperature (minimum or maximum) expected during service.

NOTE By reference, ISO 15649 permits a limited number of occasional variations above flange design conditions. These variations are duration limited, subject to certain criteria and requiring owner concurrence.

9 Other considerations for specification

Due attention should be given to the following prior to flange procurement:

a) design pressure and required pressure containment or relief for the piping system;

b) design temperature and design minimum temperature, including consideration of internal or external insulation (if any), solar radiation, and heating or cooling, e.g. by tracing or jacketing;

c) ambient effects, including fluid cooling effects, fluid expansion effects, atmospheric icing, and low ambient temperature;

d) dynamic effects, including impact, wind, earthquake, vibration and forces due to let-down or discharge of fluids;

e) weight effects, including live loads and dead loads;

f) thermal expansion and contraction effects, including thermal loads due to restraints, loads due to temperature gradients and loads due to differences in expansion characteristics;

g) effects of piping support, anchor and terminal movements;

h) reduced ductility effects;

i) cyclic effects;

j) air condensation effects.

See Annex A for further specification items.

10 Installation guidance

For guidance and good practice for layout of piping in which flanges are customarily used, see ISO 15649 for onshore and buried service applications. For offshore piping considerations, see ISO 13703. For general installation and maintainance information, see ANSI/ASME PCC-1.

Annex A
(informative)

Information to be specified by the purchaser

Flange series: (PN or class) (see 4.1.1 and 4.1.2)

Flange rating designation: (PN or class) (see 4.1.3)

Nominal size: (DN or NPS) (see 4.1.4)

Flange material (see 4.1.5)

Flange style: (e.g. threaded, socket, welding neck) (see 4.1.6)

Material ductility or toughness requirements [see 7.2 b)]

Bibliography

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[3] ISO 7268, *Pipe components — Definition of nominal pressure*

[4] ISO 13703, *Petroleum and natural gas industries — Design and installation of piping systems on offshore production platforms*

[5] ISO 15649:2001, *Petroleum and natural gas industries — Piping*

[6] ANSI/ASME B36.10M, *Welded and seamless wrought steel pipe*

[7] ANSI/ASME B16.20, *Metallic gaskets for pipe flanges — Ring-joint, spiral-wound, and jacketed*

[8] ANSI/ASME B16.21, *Nonmetallic flat gaskets for pipe flanges*

[9] ANSI/ASME PCC-1, *Guidelines for pressure boundary bolted flange joint assembly*

[10] EN 1514-1, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 1: Non-metallic flat gaskets with or without inserts*

[11] EN 1514-2, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 2: Spiral wound gaskets for use with steel flanges*

[12] EN 1514-3, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 3: Non-metallic PTFE envelope gaskets*

[13] EN 1514-4, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 4: Corrugated, flat or grooved metallic and filled metallic gaskets for use with steel flanges*

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