INTERNATIONAL STANDARD

**ISO 15649**

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# Petroleum and natural gas industries — Piping

*Industries du pétrole et du gaz naturel — Tuyauterie*



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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 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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15649 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, Subcommittee SC 6, *Processing equipment and systems*.

Annexes A and B of this International Standard are for information only.

## Introduction

This International Standard makes normative reference to ANSI/ASME B31.3, which is presently the worldwide basis for current standards and practices for piping systems for the petroleum and natural gas industries. It should be noted that ANSI/ASME B 31.3 itself does allow supplementary requirements if necessary for the particular application or service intended.

Users of this International Standard should be aware that further or differing requirements may be needed for individual applications. This International Standard is not intended to inhibit a vendor from offering, or the purchaser from accepting alternative equipment or engineering solutions for the individual application. This may be particularly appropriate where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this International Standard and provide details.

# Petroleum and natural gas industries — Piping

## 1 Scope

**1.1** This International Standard specifies the requirements for design and construction of piping for the petroleum and natural gas industries, including associated inspection and testing.

**1.2** This International Standard is applicable to all piping within facilities engaged in the processing or handling of chemical, petroleum, natural gas or related products.

EXAMPLE 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.

**1.3** This International Standard 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 chemical, petroleum, natural gas or related products.

**1.4** This International Standard is not applicable to transportation pipelines and associated plant.

EXAMPLE Pipeline pump station, pipeline compressor station, pipeline tank farm, offshore platform risers up to and including pig launching facility.



## 2 Normative reference



The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. 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 edition of the normative document 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.

ANSI/ASME B31.3, *Process Piping*.

## 3 Terms and definitions

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

**3.1**
**ambient temperature**
temperature of the surrounding atmosphere in the immediate vicinity of the piping system

**3.2**
**chemical plant**
industrial plant for the manufacture or processing of chemicals, or of raw materials or intermediates for such chemicals

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

**3.3**
**design minimum temperature**
lowest temperature, at the mid-thickness of the piping wall, expected in service

**3.4**
**design pressure**
pressure used in calculating the thickness and the rating of piping components

**3.5**
**design temperature**
maximum temperature likely to be reached in operation, at the mid-thickness of the nominal piping wall, at design pressure

**3.6**
**designer**
individual or organization that takes responsibility for the engineering design of piping in accordance with any requirements established by the owner and in accordance with this International Standard

**3.7**
**fabricator and/or erector**
individual or organization that takes responsibility for the fabrication and/or installation of piping in accordance with the engineering design and in accordance with the requirements of this International Standard

**3.8**
**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

**3.9**
**manufacturer**

individual or organization that takes responsibility for the manufacture of piping in accordance with the engineering design and in accordance with the requirements of this International Standard

NOTE If a manufacturer employs subcontractors or fabricators and/or erectors for certain items, he has full control over their work.



**3.10**
**mechanical joint**
joint for the purpose of mechanical strength or leak resistance or both, in which the mechanical strength is developed by threaded, grooved, rolled, flared or flanged pipe ends, or by bolts, pins, toggles or rings, and the leak resistance is developed by threads and compounds, gaskets, rolled ends, caulking, or machined and mated surfaces

**3.11**
**owner**
individual or organization responsible for establishing the requirements for design, construction, examination, inspection and testing which govern the entire fluid handling or process facility of which the piping is part

NOTE The owner is normally the individual or organization that purchases the piping system and/or is responsible for operating the facility.

**3.12**
**packaged equipment**
assembly of individual pieces or stages of equipment, complete with interconnecting piping and connections for external piping

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

**3.13**
**petroleum refinery**
industrial plant for the processing or handling of petroleum and products derived directly from petroleum

NOTE A petroleum refinery may be an individual gasoline recovery plant, a treating plant, a gas processing plant (including liquefaction) or an integrated refinery having various process units and attendant facilities, and may include supporting and service facilities such as storage, utility and waste treatment units.

**3.14**
**pipe**
pressure-tight cylinder used to convey a fluid or to transmit a fluid pressure

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

**3.15**
**piping**
assemblies of piping components used to convey, distribute, mix, separate, discharge, meter, control or snub fluid flows

NOTE Piping also includes pipe-supporting elements, but does not include support structures such as building frames, bents or foundations.

**3.16**
**piping component**
mechanical element suitable for joining together or assembly into pressure-tight fluid-containing piping systems

EXAMPLE Pipe, tubing, fittings, flanges, gaskets, bolting, valves and devices such as expansion joints, flexible joints, pressure hoses, traps, strainers, in-line portions of instruments, and separators.

**3.17**
**piping system**
interconnected piping subject to the same set or sets of design conditions



## 4 Metallic industrial piping



### 4.1 General

**4.1.1** Piping shall be designed, manufactured, fabricated, erected, inspected and tested in accordance with ANSI/ASME B31.3 and in accordance with the further requirements of this International Standard. Where ANSI/ASME B31.3 specifies requirements by reference to standards, the requirements of other standards may be substituted where determined to be appropriate by the designer and if agreed by the owner.

**4.1.2** Any substitute requirements shall be mutually consistent and coherent, and it shall be demonstrated that these will achieve at least the same fitness for purpose in the context of their application. ANSI/ASME B31.3 requirements of unlisted components and unlisted materials may be used for guidance in determining fitness for purpose. This may often be achieved by substituting the set of standards referenced by ANSI/ASME B31.3 with an alternative coherent set of standards that has been developed for the same subject areas. This may not be easy to demonstrate if substitute standards are selected from a variety of origins.

**4.1.3** Provision shall be made to safely contain or relieve any pressure to which the piping may be subjected. Piping not protected by a pressure-relieving device, or that can be isolated from a pressure-relieving device, shall be designed for at least the highest pressure that can be developed. It shall be ensured that all such measures remain adequate for the as-built condition.

NOTE Modifications to the measures necessary for adequate pressure resistance or relief may be required due to changes made during procurement of piping components, or during manufacture, fabrication and erection.

### 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 petroleum refinery or a chemical plant where the piping will be installed and operated. The owner shall establish the requirements for design, construction, examination, inspection and testing which govern the entire facility of which the piping and

piping systems are part. The owner shall ensure that any special service requirements are designated for the piping. The owner shall define the boundary for application of this International Standard, noting 1.4.

#### 4.2.2 Designer

The designer is responsible to the owner for assurance that the engineering design of piping meets the owner's requirements and is in accordance with this International Standard. The engineering design shall specify any unusual requirements for a particular service and shall specify any special measures necessary due to service requirements.

#### 4.2.3 Manufacturer

The manufacturer of piping shall manufacture pipe, piping and piping components including any mechanical joints in accordance with the material specifications and in accordance with the requirements of this International Standard.

#### 4.2.4 Fabricator and/or erector

The fabricator and/or erector shall fabricate and/or install pipes, piping, piping components and piping systems including mechanical joints in accordance with the engineering design and in accordance with the requirements of this International Standard.

### 4.3 Materials



#### 4.3.1 General

The designer shall take appropriate measures to ensure that the material used for piping is suitable for the application. The piping manufacturer shall take appropriate measures to ensure that the material used for piping conforms to the required material specification.



#### 4.3.2 Materials for pressurized parts

When selecting materials for pressure-containing piping components, the designer shall consider the following:

a) suitability of the materials for all operating and test conditions;

b) materials shall have sufficient ductility and toughness. Due care should be exercised in selecting materials in order to prevent brittle-type fracture where necessary; where for specific reasons brittle material has to be used, appropriate measures shall be taken. The requirements of ANSI/ASME B31.3 shall be the minimum requirements. Any additional requirements shall be specified in the engineering design;

c) materials shall be suitable for the fluid service. Materials shall be sufficiently chemically resistant to the fluid contained in the piping; the chemical and physical properties necessary for operational safety shall not fall below the minimum required within the planned lifetime of the equipment;

d) material performance due to ageing shall not fall below the minimum requirements;

e) materials shall be selected in order to avoid undesirable effects when the various materials are put together (e.g. galvanic corrosion);

f) materials shall be suitable for the intended processing procedures.

EXAMPLE Procedures that may be applicable are: regeneration, decoking, steam-out, auto-refrigeration, startup, shutdown or an interruption in normal operation of the process.

#### 4.3.3 Traceability

When specified in the engineering design, material certificates or test reports shall be provided for all piping components.

When material certificates or test reports are requested, suitable procedures should be established and maintained for identifying the material making up the pressure-containing components of the piping, from receipt, through production, up to the final test of the manufactured piping. For components such as commodity valves the material certificate should be provided when the component is delivered.

### 4.4 Measures against misuse

Where the potential for misuse is known or can be clearly foreseen, the piping shall be designed to minimize danger from such misuse. If that is not possible, adequate warning shall be given that the piping shall not be used in that way. The limitation of the piping system shall be clearly established and made known to the user.

Take-off points shall be clearly marked on the permanent side, indicating the fluid contained, in order to ensure that the risk of inadvertent discharge is minimized.

For dangerous fluids, a risk assessment shall be performed in order to determine isolation requirements for take-off pipes the size of which may represent a risk arising from the fluids contained in the piping.

### 4.5 Draining and venting

Adequate means shall be provided for the draining and venting of piping where necessary, to minimize harmful effects such as water hammer, vacuum collapse, corrosion and uncontrolled chemical reactions. All stages of operation and testing, particularly pressure testing, shall be considered, to permit cleaning, inspection and maintenance in a safe manner.



### 4.6 Design conditions

**4.6.1** Design conditions shall be based on the temperatures, pressures and loads applicable to the operation of piping, with due consideration of various effects and their consequent loadings.



**4.6.2** The design pressure shall be not less than the pressure at the most severe condition of coincident internal or external pressure and temperature expected during service, that results in the greatest required component thickness and the highest component rating.

NOTE By reference to ANSI/ASME B31.3 this International Standard permits occasional variations above design conditions for a limited period of time, subject to certain criteria, and with owner approval.

**4.6.3** Design conditions shall be determined with due consideration of the following:

a) design pressure and required pressure containment or relief;

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 support, anchor and terminal movements;

h) reduced ductility effects;

i) cyclic effects;

j) air condensation effects.