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

*Industries du pétrole et du gaz naturel — Systèmes de transport
par conduites*

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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 13623 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for the petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

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This second edition cancels and replaces the first edition (ISO 13623:2000), which has been technically revised. Major revisions include replacement of various references to national standards with references to International Standards; replacement of sections on coatings and cathodic protection with ISO references; revision of design to accommodate line pipe above L555 in the new edition of ISO 3183; and the addition of a section on life extension.

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Introduction

Significant differences exist between member countries in the areas of public safety and protection of the environment, which cannot be reconciled into a single preferred approach to pipeline transportation systems for the petroleum and natural gas industries. Reconciliation was further complicated by the existence in some member countries of legislation that establishes requirements for public safety and protection of the environment. Recognizing these differences, ISO/TC 67/SC 2 concluded that this International Standard, ISO 13623, should allow individual countries to apply their national requirements for public safety and the protection of the environment.

This International Standard is not a design manual; rather, it is intended for use in conjunction with sound engineering practice and judgment. This International Standard allows the use of innovative techniques and procedures, such as reliability-based limit state design methods, providing the minimum requirements of this International Standard are satisfied.

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Petroleum and natural gas industries — Pipeline transportation systems

1 Scope

This International Standard specifies requirements and gives recommendations for the design, materials, construction, testing, operation, maintenance and abandonment of pipeline systems used for transportation in the petroleum and natural gas industries.

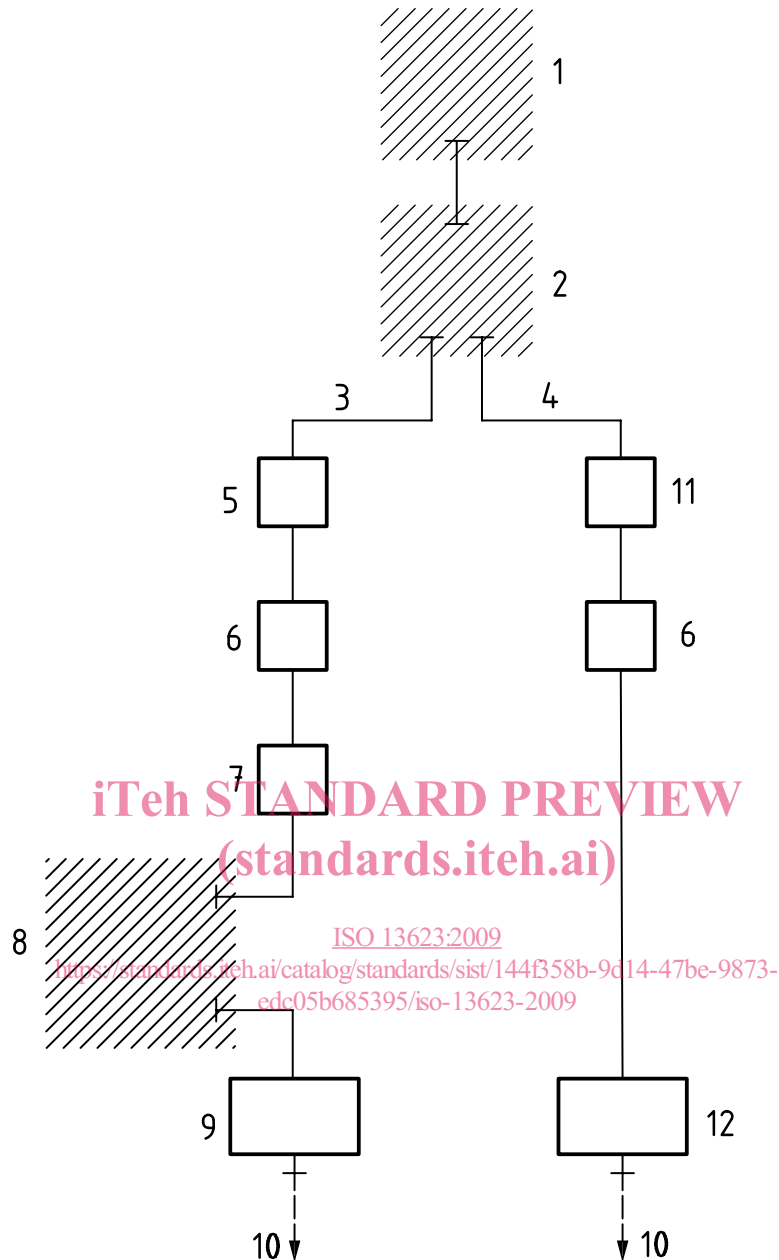
It applies to pipeline systems on land and offshore, connecting wells, production plants, process plants, refineries and storage facilities, including any section of a pipeline constructed within the boundaries of such facilities for the purpose of its connection. The extent of pipeline systems covered by this International Standard is illustrated in Figure 1.

This International Standard applies to rigid, metallic pipelines. It is not applicable for flexible pipelines or those constructed from other materials, such as glass-reinforced plastics.

This International Standard is applicable to all new pipeline systems and can be applied to modifications made to existing ones. It is not intended that it apply retroactively to existing pipeline systems.

It describes the functional requirements of pipeline systems and provides a basis for their safe design, construction, testing, operation, maintenance and abandonment.

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Key

- | | | | | | |
|---|---|---|---------------|----|----------------------------|
| 1 | wellsite | 5 | pump station | 9 | depot |
| 2 | gathering station, treatment plant or process plant | 6 | valve station | 10 | distribution |
| 3 | liquid | 7 | tankage | 11 | compressor station |
| 4 | gas | 8 | refinery | 12 | pressure-reduction station |

- Pipeline elements covered by this International Standard
- | Connections with other facilities. The pipeline system should include an isolation valve at connections with other facilities and at branches.
- |- - - Pipeline elements not covered by this International Standard.
- ▨ Station/plant area, offshore installation not covered by this International Standard.
- Station/plant area covered by this International Standard.

NOTE The pipeline system should include an isolation valve at connections with other facilities and at branches.

Figure 1 — Extent of pipeline systems covered by this International Standard

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) corrigendum, and maintenance agency output applies.

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

ISO 3183:2007, *Petroleum and natural gas industries — Steel pipe for pipeline transportation systems*

ISO 3977 (all parts), *Gas turbines — Procurement*

ISO 10439, *Petroleum, chemical and gas service industries — Centrifugal compressors*

ISO 10474:1991, *Steel and steel products — Inspection documents*

ISO 13707, *Petroleum and natural gas industries — Reciprocating compressors*

ISO 13709, *Centrifugal pumps for petroleum, petrochemical and natural gas industries*

ISO 13710, *Petroleum, petrochemical and natural gas industries — Reciprocating positive displacement pumps*

ISO 13847, *Petroleum and natural gas industries — Pipeline transportation systems — Welding of pipelines*

ISO 14313, *Petroleum and natural gas industries — Pipeline transportation systems — Pipeline valves*

ISO 14723, *Petroleum and natural gas industries — Pipeline transportation systems — Subsea pipeline valves*

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ISO 15156-1, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 1: General principles for selection of cracking-resistant materials*

ISO 15156-2, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 2: Cracking-resistant carbon and low alloy steels, and the use of cast irons*

ISO 15156-3, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys*

ISO 15589-1, *Petroleum and natural gas industries — Cathodic protection of pipeline transportation systems — Part 1: On-land pipelines*

ISO 15589-2, *Petroleum and natural gas industries — Cathodic protection of pipeline transportation systems — Part 2: Offshore pipelines*

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 — Induction bends, fittings and flanges for pipeline transportation systems — Part 2: Fittings*

ISO 15590-3, *Petroleum and natural gas industries — Induction bends, fittings and flanges for pipeline transportation systems — Part 3: Flanges*

ISO 15649, *Petroleum and natural gas industries — Piping*

ISO 13623:2009(E)

ISO 16708, *Petroleum and natural gas industries — Pipeline transportation systems — Reliability-based limit state methods*

ISO 21809-1, *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems — Part 1: Polyolefin coatings (3-layer PE and 3-layer PP)*

ISO 21809-2, *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems — Part 2: Fusion-bonded epoxy coatings*

ISO 21809-3, *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems — Part 3: Field joint coatings*

ISO 21809-4, *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems — Part 4: Polyethylene coatings (2-layer PE)*

ISO 21809-5, *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems — Part 5: External concrete coatings*

IEC 60034-1, *Rotating electrical machines — Part 1: Rating and performance*

IEC 60079-10, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas*

IEC 60079-14, *Electrical apparatus for explosive gas atmospheres — Part 14: Electrical installations in hazardous areas (other than mines)*

API¹⁾ 620, *Design and Construction of Large, Welded, Low-Pressure Storage Tanks*

API 650, *Welded Steel Tanks for Oil Storage*

ASME B16.5, *Pipe Flanges and Flanged Fittings — NPS 1/2 Through NPS 24*

ASME Boiler and Pressure Vessel Code, Section VIII, Division I, *Rules for Construction of Pressure Vessels (BPVC)*

MSS²⁾ SP-25, *Standard Marking System for Valves, Fittings, Flanges and Unions*

MSS SP-44, *Steel Pipeline Flanges*

NFPA³⁾ 30, *Flammable and Combustible Liquids Code*

NFPA 220, *Standard on Types of Building Construction*

1) American Petroleum Institute, 1220 L Street, Northwest Washington, DC 20005-4070, USA.

2) Manufacturer's Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, VA 22180, USA.

3) National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101, USA.

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1

commissioning

activities associated with the initial filling of a pipeline system with the fluid being transported

3.1.2

design life

period for which the design basis is planned to remain valid

3.1.3

design pressure

maximum internal pressure of the pressure-containing components of the pipeline system designed in compliance with this International Standard

3.1.4

design strength

strength level to be used in design, based on material's specified minimum properties

3.1.5

fabricated assembly

grouping of pipe and components assembled as a unit and installed as a subunit of a pipeline system

3.1.6

fluid

medium being transported through the pipeline system

3.1.7

hot tapping

tapping, by mechanical cutting, of an in-service pipeline or piping

3.1.8

in-service pipeline

pipeline that has been commissioned for the transportation of fluid

3.1.9

lay corridor

corridor in which an offshore pipeline is being installed, usually determined prior to construction

3.1.10

location class

geographic area classified according to criteria based on population density and human activity

3.1.11

maintenance

all activities designed to retain the pipeline system in a state in which it can perform its required functions

NOTE These activities include inspections, surveys, testing, servicing, replacement, remedial works and repairs.

3.1.12

maximum allowable operating pressure

MAOP

maximum internal pressure at which a pipeline system, or parts thereof, is allowed to be operated in compliance with this International Standard

3.1.13

offshore pipeline

pipeline laid in maritime waters and estuaries seaward of the ordinary high water mark

3.1.14

pipeline

those components of a pipeline system connected together to convey fluids between stations and/or plants, including pipe, pig traps, components, appurtenances, isolating valves, and sectionalising valves

See Figure 1.

3.1.15

pipeline on land

pipeline laid on or in land, including lines laid under inland water courses

3.1.16

pipeline system

pipelines, stations, supervisory control and data acquisition system (SCADA), safety systems, corrosion protection systems, and any other equipment, facility or building used in the transportation of fluids

3.1.17

pipng

pipe, fittings and components inside stations and terminals, but not part of the pipeline

3.1.18

primary piping

piping conveying or storing the fluid transported by the pipeline

3.1.19

right-of-way

corridor of land within which the pipeline operator has the right to conduct activities in accordance with the agreement with the land owner

3.1.20

riser

that part of an offshore pipeline, including subsea spool pieces, that extends from the sea bed to the pipeline termination point on an offshore installation

3.1.21

secondary piping

piping carrying fluids other than those of the primary piping and pipeline, such as fuel gas, water, or lube oil

3.1.22

specified minimum tensile strength

SMTS

minimum tensile strength required by the specification or standard under which the material is purchased

3.1.23

specified minimum yield strength

SMYS

minimum yield strength required by the specification or standard under which the material is purchased

3.1.24

station

facility for the purpose of increasing pressure, decreasing pressure, storage, metering, heating, cooling or isolating the transported fluid

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3.2 Symbols

A_i	internal cross-sectional area of the pipe
A_s	cross-sectional area of pipewall
D	specified diameter (outside or inside)
D_{\max}	maximum measured diameter (outside or inside)
D_{\min}	minimum measured diameter (outside or inside)
D_o	nominal outside diameter
E	modulus of elasticity
f_h	hoop-stress design factor, obtained from Table 2 for pipelines on land and Table 3 for offshore pipelines;
F	pipe wall axial force
p_{id}	design pressure
p_{od}	minimum external hydrostatic pressure
O	ovality or out-of-roundness
t_{\min}	specified minimum wall thickness
T_1	installation temperature
T_2	maximum or minimum metal temperature during operation
ν	Poisson ratio
α	linear coefficient of thermal expansion
σ_{eq}	equivalent stress
σ_h	circumferential stress
σ_{hp}	circumferential hoop stress due to fluid pressure
σ_l	longitudinal stress
σ_y	specified minimum yield strength (SMYS) at the maximum design temperature
σ_D	design strength
τ	shear stress

4 General

4.1 Health, safety and the environment

The objective of this International Standard is that the design, material selection and specification, construction, testing, operation, maintenance and abandonment of pipeline systems for the petroleum and natural gas industries be safe and conducted with due regard to public safety and the protection of the environment.