INTERNATIONAL STANDARD

ISO 9349

First edition
1991-06-01

Preinsulated ductile iron pipeline systems

Systèmes de canalisations préisolées en fonte ductile

Reference number
ISO 9349:1991(E)

Contents

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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.

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.

International Standard ISO 9349 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*.

Annexes A, B, C and D form an integral part of this International Standard.

Preinsulated ductile iron pipeline systems

Section 1: General

1.1 Scope

The International Standard specifies the requirements and test methods applicable to preinsulated ductile iron pipelines for buried and above-ground systems and for laying in precast or cast-in situ concrete channels.

These pipeline systems convey water and other liquids under pressure (e.g. hot water pipelines and cold-weather insulation pipelines), operate as open or closed circuits, and include

- a conveying pipe and fitting made of ductile iron, in accordance with ISO 2531, with sockets and push-in joints or flanged joints, of nominal diameter DN 60 to DN 600 inclusive (extensions to larger diameters are possible),
- thermal insulation applied in the factory, and
- external protection.

Preinsulated pipelines for conveying hot liquids are normally supplied for a maximum service temperature of 120 °C, with admissible peak temperatures not exceeding 140 °C. They can be used for service pressures up to 3 MPa (30 bar) for DN $\leqslant$ 300 and up to 2,5 MPa (25 bar) for DN $>$ 300.

When these pipeline systems are used for protection against freezing temperatures (cold-weather insulation pipelines), they may have different requirements, in particular concerning joints and thermal insulation.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 161-1:1978, *Thermoplastics pipes for the transport of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series.*

ISO 306:1987, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature.*

ISO/R 527:1966, *Plastics — Determination of tensile properties.*

ISO 559:1991, *Steel tubes for water and sewage.*

ISO 844:1978, *Cellular plastics — Compression test of rigid materials.*

ISO 845:1988, *Cellular plastics and rubbers — Determination of apparent (bulk) density.*

ISO 857:1990, *Welding, brazing and soldering processes — Vocabulary.*

ISO 1163-2:1980, *Plastics — Unplasticized compounds of homopolymers and copolymers of vinyl chloride — Part 2: Determination of properties.*

ISO 1183:1987, *Plastics — Methods for determining the density and relative density of non-cellular plastics.*

ISO 1872-2:1989, *Plastics — Polyethylene (PE) and ethylene copolymer thermoplastics — Part 2: Preparation of test specimens and determination of properties.*

ISO 2531:1991[1], *Ductile iron pipes, fittings and accessories for pressure pipelines.*

ISO 3041:1975, *Welding requirements — Categories of service requirements for welded joints.*

ISO 3088:1975, *Welding requirements — Factors to be considered in specifying requirements for fusion welded joints in steel (technical influencing factors).*

ISO 3606:1976, *Unplasticized polyvinyl chloride (PVC) pipes — Tolerances on outside diameters and wall thicknesses.*

ISO 3607:1977, *Polyethylene (PE) pipes — Tolerances on outside diameters and wall thicknesses.*

ISO 4422:1990, *Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications.*

ISO 4439:1979, *Unplasticized polyvinyl chloride (PVC) pipes and fittings — Determination and specification of density.*

ISO 4633:1983, *Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials.*

ISO 6892:1984, *Metallic materials — Tensile testing.*

ISO 8497:—[1], *Thermal insulation — Determination of steady-state thermal transmission properties of thermal insulation for circular pipes.*

ISO 9631:—[1], *Rubber seals — Joint rings for hot water supply pipelines up to 100 °C — Specification for the material.*

1.3 Definitions

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

1.3.1 conveying pipe: Pipe conveying the fluid.

1.3.2 conveying fitting: Pipeline component conveying the fluid and corresponding to a change in direction, to a diversion, or to a blanking off of the pipeline.

1.3.3 push-in joint: Joint of conveying pipes and fittings where the spigot of one component is inserted by force into the socket of the next component.

1.3.4 gasket: Joint sealing ring of conveying pipes and fittings.

1.3.5 thermal insulation: Thermal insulation layer applied to conveying pipes and fittings.

1.3.6 external protection: External protection of the thermal insulation against moisture ingress and mechanical damage (e.g. casing, sprayed protective sheath, etc.).

1.3.7 preinsulated pipe: Factory-produced pipe comprising a conveying pipe, thermal insulation and external protection.

1.3.8 preinsulated fitting: Factory-produced fitting comprising a conveying fitting, thermal insulation and external protection.

1.3.9 pipeline operating in closed circuit: Pipeline in which the fluid conveyed is not for consumption. It comprises a flow branch and a return branch.

1.3.10 pipeline operating in open circuit: Pipeline in which the fluid conveyed is consumed. It has only a flow branch.

1.3.11 hot water pipelines: Preinsulated pipelines for conveying water at temperatures above 60 °C.

1.3.12 cold-weather insulation pipelines: Preinsulated pipelines for protection against freezing temperatures.

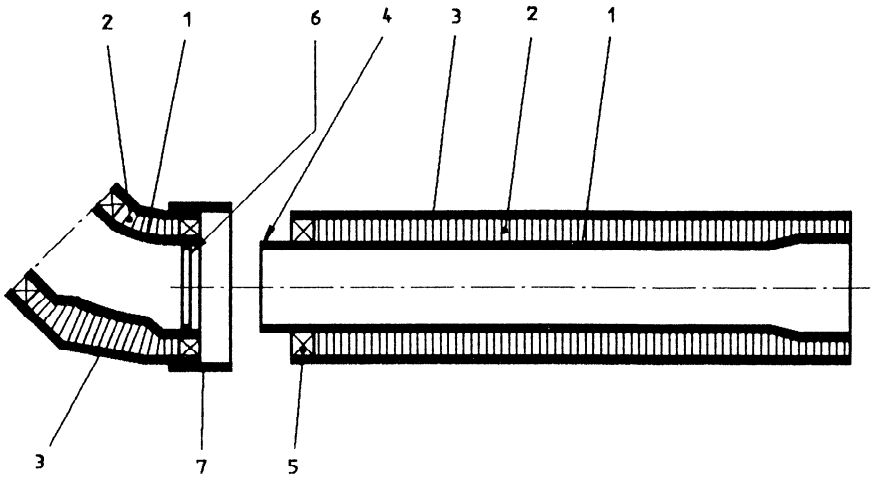
1.4 General description

See figure 1.

1.5 Cold-weather insulation pipelines

Cold-weather insulation pipelines shall be clearly identified by a specific marking.

1) To be published.



Key

1 Spheroidal graphite iron conveying pipe and fitting
2 Thermal insulation
3 External protection
4 External coating on surfaces not covered by thermal insulation
5 End piece
6 Gasket
7 Junction between preinsulated pipe and fitting

Figure 1

Section 2: General specifications for preinsulated pipeline components and test methods

2.1 Conveying pipes and fittings

2.1.1 General

Centrifugally cast ductile iron socketed pipes and ductile iron fittings, cast in sand moulds, which are the component parts of conveying pipelines, shall comply with the specifications of ISO 2531.

2.1.2 Tightness

Conveying pipes and fittings used for hot water pipelines shall withstand with no leakage an air tightness test under a pressure of 0,2 MPa (2 bar) applied for 2 min, or shall not leak when subjected to any equivalent test.

2.1.3 Internal lining

Pipes and fittings used on closed circuits do not need an internal lining. For pipes and fittings used on open circuits, the internal lining shall be compatible with the nature and temperature of the fluid to be conveyed.

2.1.4 External coating

2.1.4.1 Hot water pipelines

The end parts of the conveying pipes and fittings which are not covered with the thermal insulation layer shall be protected externally by a poly(vinylidene fluoride) (PVDF) coating.

This coating shall be holiday free when electrically brush tested at 2 500 V and shall have a minimum thickness of 0,4 mm.

At the spigot end, the coating shall be smooth in order to allow joint sliding movements.

The PVDF characteristics shall comply with the values given in table 1.

Table 1

Characteristic	Specified value	Test method
Density	1 800 kg/m³	ISO 1183
Yield strength		
— in tension	⩾ 55 MPa	ISO/R 527
— in compression	⩾ 95 MPa	ISO 844
Percentage elongation after fracture	20 %	ISO/R 527
Vicat softening temperature	145 °C to 151 °C	ISO 306

For service temperatures not exceeding 80 °C, the PVDF may be replaced by another coating material provided that it meets the service requirements.

2.1.4.2 Cold-weather insulation pipelines

In cold-weather insulation pipelines, very little thermal movement is to be expected, and no specific coating is required on the end parts of conveying pipes and fittings.

They may be supplied with a bitumen-based coating.

2.2 Thermal insulation

2.2.1 Polyurethane foam

The rigid polyurethane foam thermal insulation layer shall have a regular structure of fine pores. Specifications concerning the foam are given in table 2.

Table 2

Characteristic	Specified value (all uses)	Alternative specified value (cold-weather insulation pipelines only)	Test method
Average density	⩾ 80 kg/m³	⩾ 32 kg/m³ and ⩽ 50 kg/m³	ISO 845
Local density	⩾ 60 kg/m³	⩾ 25 kg/m³	ISO 845
Compressive strength	⩾ 0,3 MPa	⩾ 0,2 MPa	ISO 844
Thermal conductivity at 50 °C	⩽ 0,023 W/(m·K)	⩽ 0,021 W/(m·K)	ISO 8497

Slight visual imperfections in the foam, such as small holes, wrinkles or bubbles, which are not detrimental to the function are permitted.

2.2.2 Mineral wool

The characteristics of the mineral wool used for thermal insulation are given in table 3. Particular care shall be taken to ensure that there is no moisture ingress.

Table 3

Characteristic	Specified value	Test method
Gross density	$\geqslant$ 100 kg/m³	1)
Compressive strength	$\geqslant$ 0,03 MPa	—
Thermal conductivity at 50 °C	$\leqslant$ 0,04 W/(m·K)	1)

1) Will form the subject of a future International Standard.

2.3 External protection

The external protection provides mechanical protection of the thermal insulation and proofing against moisture ingress.

It is used on buried and above-ground pipelines.

It comprises a prefabricated casing or sheath applied onto the prefabricated thermal insulation layer, in accordance with the specifications given in sections 3, 4 and 5.

2.3.1 Casings

2.3.1.1 General

Casings are made from existing pipes or casings. The main characteristics of casings materials are given in table 4.

2.3.1.2 PE-HD pipes

PE-HD pipes shall comply ISO 1872-2 for the material, and with ISO 161-1 and ISO 3607 for the dimensions.

For preinsulated pipelines laid above ground, the PE-HD pipe used as a casing shall be resistant to ultraviolet radiation.

2.3.1.3 PVC pipes

PVC pipes shall comply with ISO 1163-2 and ISO 4439 for the material and ISO 161-1, ISO 3606 and ISO 4422 for the dimensions.

For preinsulated pipelines laid above ground, the PVC pipe used as a casing shall be resistant to ultraviolet radiation.

2.3.1.4 Steel pipes

Steel pipes shall comply with ISO 6892 for the material and ISO 559 for the dimensions.

Table 4

Casing	Characteristic	Specified value	Test method
High density polyethylene (PE-HD)	Density	$\geqslant$ 940 kg/m³	ISO 1183
	Yield stress	$\geqslant$ 19 MPa	1)
	Percentage elongation after fracture	$\geqslant$ 350 %	1)
Poly(vinyl chloride) (PVC)	Density	$\geqslant$ 1 350 kg/m³	ISO 1183
	Percentage elongation after fracture	50 % to 150 %	ISO/R 527
	Tensile strength	$\geqslant$ 47 MPa	ISO/R 527
Steel	Tensile strength	$\geqslant$ 320 MPa	ISO 6892
	Percentage elongation after fracture	$\geqslant$ 15 %	ISO 6892
Steel casing (spirally wound)	Tensile strength	$\geqslant$ 320 MPa	ISO 6892
	Percentage elongation after fracture	$\geqslant$ 15 %	ISO 6892

1) Will form the subject of a future International Standard.

Internal and external coatings of steel casings shall be in conformity with national standards or the catalogues of preinsulated pipes manufacturers.

2.3.1.5 Spirally wound steel casings

Spirally wound steel casings shall comply with ISO 6892 for the material and with national standards or manufacturers' catalogues for the dimensions.

Internal and external coatings of spirally wound steel casings shall be in conformity with national standards or the catalogues of preinsulated pipes manufacturers.

2.3.2 Sheaths

2.3.2.1 Dense polyurethane

Dense polyurethane sheaths shall have a minimum thickness of 0,5 mm and the material shall comply with the specifications given in table 5.

Table 5

Characteristic	Specified value	Test method
Density	$\geqslant$ 1 350 kg/m^3	ISO 1183
Percentage elongation after fracture	$\geqslant$ 25 %	ISO/R 527
Penetration resistance	$\geqslant$ 25 MPa	Annex A

For preinsulated pipelines laid above ground, the polyurethane sheath shall be resistant to ultraviolet radiation.

2.3.2.2 Polyethylene adhesive tape

The sheath shall be factory produced by hot application of an adhesive-backed polyethylene tape in at least two counterwound and overlapping layers so that no seams align. The tape shall be made of high-density polyethylene (PE-HD), the adhesive sealant being a synthetic polymer or a modified rubber mastic.

An alternative method of fabrication is by continuous winding of a thin PE-HD tape at a temperature ensuring fusion welding of two overlapping layers.

The sheath thickness shall be at least 1,25 mm.

The polyethylene tape sheath shall meet the requirements given in table 6.

Table 6

Characteristic	Specified value	Test method
Density	$\geqslant$ 940 kg/m^3	ISO 1183
Percentage elongation after fracture	$\geqslant$ 350 %	1)
Penetration resistance	$\geqslant$ 25 MPa	Annex A

1) Will form the subject of a future International Standard.

For preinsulated pipelines laid above ground, the polyethylene tape shall be resistant to ultraviolet radiation.

2.4 Joints of conveying pipes and fittings

Pipes are equipped with push-in joints, fittings with push-in joints or flanged joints, in conformity with specifications given in national standards or in manufacturers' catalogues.

2.4.1 Hot water pipelines

Push-in joints shall allow the sliding movements due to variations in the length of the pipes caused by temperature changes and shall maintain their tightness quality under the mechanical actions they are subjected to.

The spigot end of pipes and fittings shall receive a coating designed to permit the sliding movements of the joint and to be compatible with the thermal and mechanical stresses.

Gaskets for push-in joints and for flanged joints shall be made of a rubber compatible with the liquid to be conveyed and shall comply with the specifications of ISO 9631. They shall be suitable for operating at the temperatures and pressures given in clause 1.1.

Push-in joints shall meet the specifications of the performance tests specified in annex B.

2.4.2 Cold-weather insulation pipelines

For cold-weather insulation pipelines, the sliding movements due to temperature changes are negligible; push-in joints do not have to comply with the requirements of 2.4.1.

Flanged joints shall be compatible with the specified pressure and temperature.

Gaskets for push-in joints and for flanged joints shall be made of a rubber compatible with the liquid to be conveyed and shall comply with the specifications of ISO 4633. They shall be suitable for operating at the specified temperatures and pressures.

2.5 Junctions between preinsulated pipes and fittings

Preinsulated pipelines may have continuous or discontinuous thermal insulation at pipe junctions, which shall be described in manufacturers' catalogues and shall meet the requirements of the performance test specified in annex C.

When the thermal insulation is continuous over the joints, the junctions shall ensure the continuity of the external protection provided by casing or sheaths. If the thermal insulation is discontinuous over the joints, the end pieces of each pipe and fitting shall be proof against water ingress.