INTERNATIONAL STANDARD

**ISO 18225**

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# Plastics piping systems — Multilayer piping systems for outdoor gas installations — Specifications for systems

*Systèmes de canalisations en plastique — Tubes multicouches destinés à l'alimentation en gaz à l'extérieur des bâtiments — Spécifications pour les systèmes*



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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 18225 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastics pipes and fittings for the supply of gaseous fuels*.

This second edition cancels and replaces the first edition (ISO 18225:2007) which has been technically revised.

# Introduction

The test methods used in this International Standard have been developed by ISO TC 138/SC 5 as far as possible. However, not all the required methods were in the SC 5 standards development work programme at the time of publication of this International Standard, so they have been placed in its annexes. When those methods are developed for other International Standards, these annexes will be redundant.

For multilayer pipe construction — consisting of a layer of a reference standard material, an adhesive and a non-stress-designed layer — Procedure I and the relevant product standards are required to be followed for all aspects, excepting for those of delamination and — if applicable — oxygen permeation.

For example, layers can have the following purposes:

— the ability to withstand pressure;

— the ability to realize interlayer adhesion;

— the ability to block or greatly diminish incoming UV light and/or sunlight;

— the ability for mechanical protection;

— the ability to control longitudinal expansion;

— the ability to give the multilayer pipe a colour (inside or outside layer).

Moreover, some characteristics can be combined in one layer.

# Plastics piping systems — Multilayer piping systems for outdoor gas installations — Specifications for systems

## 1 Scope

This International Standard specifies general and performance requirements for multilayer pipe systems based on pipes made from thermoplastics and intended to be used for gas supply outdoors.

It gives requirements for the design of pipe systems consisting of multilayer pipes based on thermoplastics and for which at least 60 % of the wall thickness is of a polymeric material. The polymeric material used for stress design layers and all inner layers must be polyethylene (PE) and/or crosslinked polyethylene (PE-X), in accordance with Annex A. The outer layers of metal multilayer pipes must be of either PE or PE-X.

NOTE For the purposes of this International Standard, PE-RT is considered as PE, while PE-X and adhesive layers are considered as thermoplastics materials.

This International Standard is applicable to systems intended to be operated at temperatures ranging from –20 °C to 40 °C. It is applicable to pipes in these systems having a nominal diameter up to and including 630 mm, and to the supply of gaseous fuels of categories D (natural gas) and E (LPG vapour and natural gas or LPG vapour) (see ISO 13623).



## 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.



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

ISO 497, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers*

ISO 1167 (all parts),*Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure*

ISO 3126, *Plastics pipes — Measurement of dimensions*

ISO 4437, *Buried polyethylene (PE) pipes for the supply of gaseous fuels — Metric series — Specifications*

ISO 6447, *Rubber seals — Joint rings used for gas supply pipes and fittings — Specification for material*

ISO 8085-3, *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 3: Electrofusion fittings*

ISO 9080, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

ISO 9969, *Thermoplastics pipes — Determination of ring stiffness*

ISO 10146, *Crosslinked polyethylene (PE-X) pipes — Effect of time and temperature on the expected strength*

ISO 10838-1, *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels — Part 1: Metal fittings for pipes of nominal outside diameter less than or equal to 63 mm*

ISO 11922-1, *Thermoplastics pipes for the conveyance of fluids — Dimensions and tolerances — Part 1: Metric series*

ISO 12162, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient*

ISO 13968, *Plastics piping and ducting systems — Thermoplastics pipes — Determination of ring flexibility*

ISO 14531-1, *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 1: Pipes*

ISO 14531-2, *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 2: Fittings for heat-fusion jointing*

ISO 14531-3. *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 3: Fittings for mechanical jointing (including PE-X/metal transitions)*

ISO 16871, *Plastics piping and ducting systems — Plastics pipes and fittings — Method for exposure to direct (natural) weathering*

ISO 17454, *Plastics piping systems — Multilayer pipes — Test method for the adhesion of the different layers using a pulling rig*

ISO 17456:2006, *Plastics piping systems — Multilayer pipes — Determination of long-term strength*

ISO 24033, *Polyethylene of raised temperature resistance (PE-RT) pipes — Effect of time and temperature on the expected strength*



EN 573-3, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3: Chemical composition*



EN 12117, *Plastics piping systems — Fittings, valves and ancillaries — Determination of gaseous flow rate/pressure drop relationships*

## 3 Terms and definitions

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

### 3.1 Structural definitions

**3.1.1**
**multilayer pipe**
pipe comprised of several stress-designed layers

**3.1.2**
**multilayer M pipe**
multilayer pipe comprised of polymeric stress-designed layers and one embedded metallic layer, whose pipe wall thickness consists of at least 60 % of polymeric layers

**3.1.3**
**multilayer P pipe**
pipe comprised of more than one stress-designed polymeric layer

EXAMPLE PE/PE-X.

**3.1.4**
**layer**
homogeneous circumferential section of pipe wall that has chemical and/or mechanical and/or physical characteristics different from those of its immediate neighbours

**3.1.5**
**inner layer**
layer in contact with the conveyed fluid

**3.1.6**
**outer layer**
layer exposed to the outer environment

**3.1.7**
**embedded layer**
layer between the outer and inner layer

**3.1.8**
**stress-designed layer**
polymeric layer which is designed to be stress-bearing

## 3.2 Geometrical definitions

**3.2.1**
**nominal diameter**
$d_n$
specified diameter, in millimetres, assigned to a nominal size (DN/OD or DN/ID)

**3.2.2**
**outside diameter**
$d_e$
outside diameter measured through its cross-section at any point of a pipe, or the fitting end of a fitting, rounded to the next greater 0,1 mm



**3.2.3**
**mean outside diameter**
$d_{em}$
measured length of the outer circumference of the pipe divided by π, rounded up to the nearest 0,1 mm



NOTE The value for π is taken to be 3,142.

**3.2.4**
**inside diameter**
$d_i$
value of the measurement of the inside diameter through its cross-section at any point of a pipe, rounded to the next greater 0,1 mm

**3.2.5**
**mean inside diameter**
$d_{im}$
average value of a number of equally spaced measurements of inside diameter in the same cross-section of the pipe, rounded to the next greater 0,1 mm

**3.2.6**
**metal layer standard dimension ratio**
$SDR_m$
nominal outside diameter of the metal layer of the pipe divided by the nominal wall thickness of the metal layer (DN or $OD/e_{n,m}$)

**3.2.7**
**nominal wall thickness**
$e_n$
wall thickness corresponding to the minimum wall thickness at any point

**3.2.8**
**total wall thickness**
$e$
measured total wall thickness at any point around the circumference of the component, rounded up to the nearest 0,1 mm

**3.2.9**
**layer wall thickness**
$e_l$
measured wall thickness of the layer at any point around the circumference of the component, rounded up to the nearest 0,01 mm

**3.2.10**
**minimum layer wall thickness**
$e_{lmin}$
minimum value of the measured wall thickness of a layer at any point around the circumference of the component, rounded up to the nearest 0,01 mm

## 3.3 Definitions related to pressure

**3.3.1**
**design pressure**
$p_D$
highest pressure related to the circumstances for which the system has been designed and intended to be used



## 3.4 Materials definitions



**3.4.1**
**virgin material**
material in a form such as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no reprocessable or recyclable material has been added

**3.4.2**
**own reprocessable material**
material prepared from rejected unused pipes and fittings, including trimmings from the production of pipes and fittings that will be reprocessed in a manufacturer's plant after having been previously processed by the same manufacturer by a process such as moulding or extrusion and for which the complete formulation is known

**3.4.3**
**reference product standard**
International Standard or Draft International Standard prepared by ISO/TC 138/SC 4, applicable for non-multilayer pipes, to which this International Standard can refer for clauses related to the materials, components (e.g. fittings), and fitness for purpose of the system

## 3.5 Definitions related to material characteristics

**3.5.1**
**lower confidence limit of the predicted hydrostatic strength**
$\sigma_{LPL}$
quantity, with the dimensions of stress, expressed in megapascals (MPa), which represents the 97,5 % lower confidence limit of the predicted hydrostatic strength for a single value at a temperature, $T$, and time, $t$, and which is expressed as

$$\sigma_{LPL} = \sigma_{(T,t,0,975)}$$

**3.5.2**
**minimum required strength**
MRS
value of $\sigma_{LPL}$ at a temperature 20 °C and a time 50 years [$\sigma_{(20,\ 50years,\ 0,975)}$], rounded down to the next smaller value of the R10 series or of the R20 series conforming to ISO 3, ISO 497 and ISO 12162, depending on the value of $\sigma_{LPL}$

**3.5.3**
**lower confidence limit of the predicted hydrostatic pressure**
$P_{LPL}$
quantity with the dimension of pressure that represents the 97,5 % (one-sided) lower confidence limit of the predicted hydrostatic pressure at a temperature, $T$, and time, $t$

**3.5.4**
**minimum required pressure**
MRP
value of $P_{LPL}$ of a pipe at a temperature of 20 °C and a time 50 years, rounded to the nearest lower value of the R10 series conforming to ISO 3 and ISO 497

**3.5.5**
**design coefficient**
$C$
overall coefficient with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit

NOTE For gas systems, a minimum $C$ value of 2,0 is allocated by this International Standard for the calculation, see 4.2.3.



## 3.6 Terms related to service conditions



**3.6.1**
**gaseous fuel**
any fuel which is in the gaseous state at a temperature of 15 °C and a pressure of 1 bar

NOTE bar = 0,1 MPa = $10^5$ Pa; 1 MPa = 1 N/mm$^2$.

**3.6.2**
**category D gaseous fuel**
category of gaseous fuel, as defined in ISO 13623, corresponding to natural gas

**3.6.3**
**category E gaseous fuel**
category of gaseous fuel, as defined in ISO 13623, corresponding to LPG (liquefied petroleum gas) vapour

**3.6.4**
**maximum operating pressure**
**MOP**
maximum pressure at which a system can be operated continuously under normal conditions

# 4 Pipes

## 4.1 Material

### 4.1.1 General

All stress-designed and inner polymeric layers shall be reference materials in accordance with Annex A.