INTERNATIONAL STANDARD

ISO 18225

Second edition
2012-12-01

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

Reference number
ISO 18225:2012(E)

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Published in Switzerland

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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
σ_{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 σ_{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 σ_{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.

Materials intended for the stress-bearing layers shall conform to the material requirements of the reference product standard(s). See Annex A. The pipe manufacturer shall declare the reference material standard applicable to his product, as listed in Annex A.

4.1.2 Reprocessable materials

Clean, own-reprocessable material (except PE-X), of the same polymer type as products manufactured to the reference product standard, may be added to the virgin material of the same type.

4.1.3 Metallic materials

Aluminium materials used shall be in accordance with EN 573-3. Other metallic materials shall be in accordance with relevant standards.

4.2 General characteristics

4.2.1 General

When viewed without magnification, the internal and external surfaces of pipes shall be smooth, clean and free from scoring, cavities and other surface defects that would prevent conformance with this International Standard. The ends of the pipe shall be cut cleanly and square to the axis of the pipe.

The following information is required:

— outside diameter;

— wall thickness;

— thickness of the inner layer;

— thickness of the metal layer;

— thickness of the outer layer;

— and the tolerances.

Dimensions shall be measured in accordance with ISO 3126.

4.2.2 Multilayer pipe construction

The joint line of the metallic layer shall be continuously welded.

4.2.3 Minimum design coefficient and design pressure

The minimum design coefficient is 2, as used to calculate the design pressure, p_D, taking into account the maximum operating temperature.

Design stress or pressure is determined by dividing MRS or MRP by the design coefficient.

For the calculation of the design pressure of multilayer M pipes, the design coefficient of the polymeric stress-designed layer shall be used, with a minimum of 2.

For multilayer P pipes, the design coefficient of each layer shall be taken into account, with a minimum of 2.

4.3 Dimensions of pipes

4.3.1 General

The pipes are characterized by the nominal size related to the outside diameter (OD).

The values given by ISO 161-1 shall be used.

Pipe dimensions shall be selected taking into account the fitness for purpose (see Clause 6).

4.3.2 Dimensions

4.3.2.1 Measurements of dimensions

The dimensions of the pipes shall be measured in accordance with ISO 3126.

4.3.2.2 Mean outside diameter and out-of-roundness (ovality) and their tolerances

The mean outside diameter, $d_{e,m}$, and the out-of-roundness (ovality) and their tolerances shall be in accordance with Table 1.

Table 1 — Mean outside diameters and out-of-roundness

Dimensions in millimetres

Nominal outside diameter	$d_{em,min}$	$d_{em,max}$	Maximum of absolute out-of-roundness (ovality)	
d_n		Grade B	Grade K	Grade N
16	16,0	16,3	1,2	1,2
20	20,0	20,3	1,2	1,2
25	25,0	25,3	1,5	1,2
32	32,0	32,3	2,0	1,3
40	40,0	40,4	2,4	1,4
50	50,0	50,4	3,0	1,4
63	63,0	63,4	3,8	1,5
75	75,0	75,5	—	1,6
90	90,0	90,6	—	1,8
110	110,0	110,7	—	2,2
125	125,0	125,8	—	2,5
140	140,0	140,9	—	2,8
160	160,0	161,0	—	3,2
180	180,0	181,1	—	3,6
200	200,0	201,2	—	4,0
225	225,0	226,4	—	4,5
250	250,0	251,5	—	5,0
280	280,0	281,7	—	9,8
315	315,0	316,9	—	11,1
355	355,0	357,2	—	12,5
400	400,0	402,4	—	14,0
450	450,0	452,7	—	15,6
500	500,0	503,0	—	17,5
560	560,0	563,4	—	19,6
630	630,0	633,8	—	22,1
Measurement of out-of-roundness shall be made at the point of manufacture according to ISO 3126.				

For coiled pipe with $d_n \leq 63$ mm, grade K applies; for coiled pipe with $d_n \geq 75$ mm, the maximum out-of-roundness shall be specified according to ISO 11922-1.

If applicable, the maximum out-of-roundness of the pipes shall conform to the geometrical characteristics of the reference material standard.

4.3.2.3 Wall thickness and tolerances

The values of the wall thickness shall be specified by the manufacturer. For pipe dimensions in relation to fittings sizes, see Clause 5.

NOTE 1 Pipes are preferably sized such that they are compatible with standardized inserts.

NOTE 2 Layers will be measured by means of, for example, a microscope.

4.4 Mechanical properties

4.4.1 Long-term hydrostatic strength

4.4.1.1 General

The long-term hydrostatic strength of the multilayer pipes shall be measured or calculated, as applicable. Consequently two procedures for determining the long-term hydrostatic strength of multilayer pipes are defined:

— Procedure I: calculation method;

— Procedure II: testing of pipe construction.

For design purposes, the value of the long-term hydrostatic strength of the multilayer pipes at a time 50 years and at a temperature of 20 °C shall be determined to obtain MRS or MRP.

Evaluation shall permit the calculation of the long-term hydrostatic strength at a time of 50 years at 40 °C in accordance with the scope of this International Standard and taking into account the relevant extrapolation time factors given in ISO 9080.

4.4.1.2 Procedure I (calculation method)

The long-term hydrostatic strength, σ_{LTHS}, shall be calculated using the reference lines (see Table A.1) or from data determined in accordance with ISO 9080 for each individual pressure-bearing polymer layer in accordance with ISO 17456. The addition rule related to each pressure-bearing layer assumes complete interlayer adhesion.

For validation of this calculation, a pressure test shall be carried out at an elevated temperature of at least 80 °C for 3 000 h on a pipe of each diameter group (see Table 2). This test shall be carried out at the calculated test pressure according to ISO 17456.

NOTE Procedure I can only be used for multilayer P pipes.

4.4.1.3 Procedure II (testing method)

4.4.1.3.1 General

Evaluate at least one diameter (the pipe with the lowest strength) of every similar construction type in accordance with ISO 9080 for each group of dimensions as defined in Table 2.

Table 2 — Dimension groups

	Dimension group		
	1	2	3
Nominal outside diameter, d_n mm	≤ 63	> 63 and < 250	≥ 250

4.4.1.3.2 Pressure strength of all diameters

All diameters of similar construction type, excluding the diameter tested in accordance with 4.4.1.3.1, shall undergo a confirmation testing of 3 000 h at a temperature of at least 80 °C, or in accordance with the reference material standard and at a pressure level of 95 % of LPL.

4.4.1.4 Calculation of the control points

4.4.1.4.1 Procedure I — P-pipes

Control points for each diameter for 22 h, 165 h and 1 000 h shall be calculated at a temperature of at least 80 °C, using ISO 17456:2006, Annex A.

4.4.1.4.2 Procedure II — P-pipes and M-pipes

Control points for each diameter for 22 h, 165 h and 1 000 h shall be calculated at a temperature of at least 80 °C, using the 95 % value of the P_{LPL} line of the fully tested diameter.

4.4.2 Resistance to RCP

Any pipe product used for the transport of gaseous fuels shall be resistant to *rapid crack propagation* (RCP) in the intended service conditions. Multilayer pipe constructions shall comply with the following.

a) The pipe shall have an RCP critical pressure ≥ 1,5 × MOP. The test shall be carried out on a pipe with a wall thickness equal to the maximum wall thickness of the production range.

b) RCP shall be tested if pipes are intended to be used under the following conditions:

   1) in distribution systems with an MOP > 0, 1 bar and d_n ≥ 250 mm;

   2) in distribution systems with an MOP > 4 bar and d_n ≥ 90 mm;

   3) for RCP relating to PE and PE-X, according to ISO 4437 and ISO 14531-1, for test methods in accordance with ISO 13477 (S4 test) or ISO 13478 (Full Scale Test) and the conditions under which they are performed.

For severe service conditions (e.g. sub-zero temperatures) RCP testing is also recommended to establish the critical pressure at service temperature.

4.4.3 Strength of the weld line of M pipe

The strength of the weld line is covered by the control points for the resistance-to-inner-water-pressure test carried out according to ISO 17456.

4.4.4 Resistance to slow crack growth of the outer layer (cone test) for M pipes

When tested according to ISO 13480, the crack growth rate of the material of the outer layer shall be less than 10 mm/day.

Testing shall be carried out on pipe produced from material used for the outer layer.

4.4.5 Structural performance

4.4.5.1 Multilayer M pipes

The test pieces shall be tested in accordance with Table 3. When tested using the test method and parameters specified therein, the pipe shall have mechanical characteristics conforming to the requirements of Table 3.

Table 3 — Structural performance of M pipes

Characteristic	Requirement	Test parameters	Test method
Delamination	Adhesion force ≥ 1,5 N/mm	In accordance with ISO 17454	ISO 17454

4.4.5.2 Multilayer P pipes

When tested in accordance with the test methods specified in Table 4 using the indicated parameters, the pipe shall have structural performance conforming to the requirements given in Table 4.

Table 4 — Structural performance of P pipes

Characteristic	Requirement	Test parameters		Test method
Integrity of the structure after deflection	≥ 80 % of the initial stiffness value	Deflection position of test piece	30 % of d_{em} when applicable, at 0°, 45° and 90° from the upper plate	ISO 13968

For the determination of the integrity of the structure after deflection of multilayer P pipes, the following procedure shall be applied.

a) Determine the initial ring stiffness of the pipe according to ISO 9969.

b) Carry out the ring flexibility test according to ISO 13968.

c) After a 1 h period for recovery, determine again the ring stiffness of the pipe according to ISO 9969. The ring stiffness of the multilayer P pipes shall be at least 80 % of the initial ring stiffness.

4.5 Physical properties

4.5.1 General

The applicable physical characteristics of each stress-designed and inner layer shall be checked in accordance with the corresponding clause of the reference product standard.

4.5.2 Additional requirements

Additional requirements for pipes and layers other than those referred to in 4.5.1 are given in Table 5.

Table 5 — Physical properties

Characteristic	Requirements	Test parameters		Test method
		Parameter	Value	
Resistance to gas constituents [M and P pipes]	No delamination	Conditioning under pressure	1 500h/23 °C, 0,4 P_D	Annex B
[M pipes]	No delamination	Delamination test	1,5 N/mm	ISO 17454
Oxidation induction time for outer layer (OIT)	≥ 20 min	Temperature	200 °C [a]	ISO 11357-6
Resistance to weathering (for non-black compounds only) [M pipes][b]	No visible cracks at a bending strain of 3 %	Energy	≥ 3,5 GJ/m2	Annex C ISO 16871

[a] The test may be carried out at 210 °C provided that there is clear correlation with the results at 200 °C. In case of dispute, the reference temperature shall be 200 °C.

[b] Resistance to weathering for P pipes is covered by the reference product standards.

5 Fittings

5.1 Fittings reference standards

Fittings shall comply with the performance requirements of the following standards:

— mechanical fittings, ISO 10838-1;

— electrofusion fittings, ISO 8085-3;

— PE-X electrofusion fittings, ISO 14531-2;

— mechanical fittings for PE-X, ISO 14531-3.

5.2 Materials

The materials from which the fitting components are made shall be such that the level of performance of these components is at least equal to that specified for the multilayer pipe connected to the fitting. ISO 10838-1 shall be used as a reference for fitting materials. Materials in contact with the multilayer pipe shall not prevent the pipe from conforming to this specification.

5.3 Dimensions

The values of the nominal inside diameter and the value of the nominal wall thickness and tolerances shall be provided by the supplier.

The tolerances on these values shall also be supplied.

5.4 Elastomeric seals

Elastomeric seals shall comply with ISO 6447.

6 Fitness for purpose of the system

The clauses related to the fitness of purpose of the relevant reference product standards shall be fulfilled for the respective kinds of pipe.

Fitness for purpose is described in the following International Standards:

— mechanical fittings, ISO 10838-1;

— electrofusion fittings, ISO 8085-3;

— PE-X electrofusion fittings, ISO 14531-2;

— mechanical fittings for PE-X, ISO 14531-3.

During installation of the fittings on the pipe, the metal layer and, in particular, the welded metal seam shall not be torn.

Tools and aids used for installation of the fittings shall not damage the pipe or fittings.

7 Marking and documentation

7.1 Legibility

Marking details shall be legible without magnification.

Legibility shall be maintained during storage, handling, installation and use.

7.2 Damage

Marking shall not initiate cracks or other types of failure in the product.

7.3 Minimum marking requirements

Marking details shall be in a colour that differs from that of the external pipe surface.

The marking frequency shall be at intervals not greater than 1 m.

Coils shall be sequentially marked with the length in metres which will indicate the length remaining on the coil. The marking shall include the information specified in Table 6.

Table 6 — Minimum information for marking

Information	Marking or symbol
Manufacturer or trademark	Name or symbol
Internal fluid	Gas
Design pressure	In accordance with national regulations
Dimensions	$d_n \times e_n$
Material and designation: layer construction and type of material required; description from outside to inside	e.g. PE-X-Al-PEX or PE80-PEX
Production period	Date, code (manufacturer's own reference)
Reference to this International Standard	ISO 18225

7.3.1 Additional instructions

The manufacturer shall provide clear assembly instructions containing at least the following information:

— instructions that pipe and fitting(s) belong together and are not interchangeable with other products;

— statement as to whether a coupler is fit for repeated assembly;

— if the manufacturer allows the use of a standard bending tool, a statement in the manufacturer's instructions that damage of the external coating shall be avoided if bending the pipe;

— information on gaseous flow rate/pressure drop relationship according to EN 12117;

— minimum bending radius;

— bending tools to be used;

— if a calibration tool is necessary to insert a stiffener, the manufacturer's instructions shall be given.

Annex A
(normative)

List of reference product standards

At the time of publication of this International Standard, the reference product standards either published or under preparation are those listed in Table A.1.

The list is applicable only to materials used in stress-designed layers and inner layers.

Table A.1 — Reference product standards

Reference material	Reference material standard
PE	ISO 4437
PE-X	ISO 14531-1 (ISO 10146 for reference lines)
PE-RT	ISO 4437 (ISO 24033 for reference lines)

Annex B
(normative)

Testing resistance to gas constituents

B.1 Principle

Samples of pipe/fitting assemblies are filled with a liquid containing 50 % n-decane and 50 % 1-2-3 trimethylbenzene under pressure for a specified period. After this conditioning period, a peeling test is to be carried out on the pipe in order to determine the grade of delamination.

B.2 Sample

Prepare a sample according to ISO 1167. The test sample will preferably be made of pipe from dimension group 1. The end caps shall be mounted so that the condensate has free access to the pipe ends.

B.3 Procedure

The test procedure is as follows.

a) Prepare a synthetic condensate comprised of a mixture of a mass fraction of 50 % n-decane (99 %) and a mass fraction of 50 % 1-3-5-trimethylbenzene.

b) Condition the pipe by filling it with condensate and allowing it to stand in air for 1 500 h at (23 ± 2) °C with a pressure of 0,4 P_D.

c) Test samples shall be taken from the tested pipe at a distance of 0,1D from the end caps.

d) Test in accordance with ISO 17454.

e) Check the sample visually for leakage and for delamination of the layers.

B.4 Report

The following information shall be included in the test report:

— number, type and nominal dimension of the sample;

— test temperature;

— duration of the test;

— any observation made during and after the test;

— any unforeseen event able to influence the test results.

Annex C
(normative)

Testing resistance to weathering of outer layer of M-pipes

C.1 Principle

Pipe samples are exposed to an energy of 3,5 GJ/m^2 according to ISO 16871. After this weathering, the test piece is bent to produce a required axial strain in the outside layer. The layer is observed visually for cracks.

C.2 Apparatus

C.2.1 Weathering rig

C.2.2 Bending template

C.3 Procedure

After weathering, deform the test piece by bending with bending template at (23 ± 2) °C for a duration ranging from a minimum of 3 s to a maximum of 10 s (for complete deformation).

Table C.1 — Parameters

Total pipe length l_1	Bending length l_2	Bending radius R
$10d_e$	$7{,}5d_e$	$16d_e$
d_e outside diameter of pipe		

The required strain of 3 % is equivalent to a bending radius of $16d_e$.

EXAMPLE Relationship of bending radius and strain: for a pipe with an outside diameter of 32 mm, the required bending template radius is calculated as follows:

$$R = 16 \times d_e = 16 \times 32 \text{ mm} = 512 \text{ mm}$$

Strain of the outer fibre in relation to the neutral axis of the pipe:

$$\varepsilon = (R + d_e)/(R + d_e/2) - 1 = (17 \times d_e/16{,}5 \times d_e) - 1 = 0{,}0303 = 3{,}0\ \%$$

C.4 Report

The following information shall be included in the test report:

— number, type and nominal dimension of the sample;

— presence of cracks;

— duration of the test;

— any observation made during and after the test;

— any unforeseen event able to influence the test results.

Bibliography

[1] ISO 3, *Preferred numbers — Series of preferred numbers*

[2] ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

[3] ISO 3503, *Assembled joints between fittings and polyethylene (PE) pressure pipes — Test of leakproofness under internal pressure when subjected to bending*

[4] ISO 6957, *Copper alloys — Ammonia test for stress corrosion resistance*

[5] ISO 10147, *Pipes and fittings made of crosslinked polyethylene (PE-X) — Estimation of the degree of crosslinking by determination of the gel content*

[6] ISO 10508, *Plastics piping systems for hot and cold water systems — Guidance for classification and design*

[7] ISO/TS 10839, *Polyethylene pipes and fittings for the supply of gaseous fuels — Code of practice for design, handling and installation*

[8] ISO 11357-6, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)*

[9] ISO 13480, *Polyethylene pipes — Resistance to slow crack growth — Cone test method*

[10] ISO 13623, *Petroleum and natural gas industries — Pipeline transportation systems*

[11] ISO/TR 18124, *Plastics piping systems — Multilayer M (metal) pipes — Test method for strength of the weld line in the metal layer and bonding between layers by use of a cone*

ICS 75.200, 23.040.45, 23.040.20

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