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Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing —

Part 4: Valves

Systèmes de canalisations en matières plastiques pour la distribution de combustibles gazeux — Systèmes de canalisations en polyamide non plastifié (PA-U) avec assemblages par soudage et assemblages mécaniques —

Partie 4: Robinets

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 7, *Valves and auxiliary equipment of plastics materials,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 155, *Plastics piping systems and ducting systems,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 16486-4:2016), which has been technically revised.

The main changes are as follows:

— the Scope highlights that this document is valid for On/Off valves;

— the Scope shows 16 bar[1)] as the regional CEN requirement for the limitation of the maximum operating pressure (MOP);

— in 7.3 and 7.4 the nominal diameter of spigot ends or electrofusion sockets has been expanded to d_n 400 mm;

— a new subclause, 5.2.4 Greases and lubricants, has been added;

— subclause 5.2 for non-unplasticized polyamide parts has been redrafted to bring it in line with EN 1555-4. A NOTE for regional requirements has been introduced;

— subclauses 6.3.1 General, 6.3.2 Valve body, 7.5 Dimensions of the operating device and 8.1 General have been redrafted;

— a new subclause, 6.3.3 Valve terminal ends, has been introduced for valve terminal ends;

— subclauses 6.3.4 Operating device and 6.3.5 Seals have been modified to bring them in line with EN 1555-4;

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

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— subclause 7.2 Measurement of dimensions has been modified to bring it in line with EN 1555-4 with the exception that PA-U conditioning does not allow the use of test pieces earlier than 48 h after their manufacture;

— subclause 8.4 Regional requirements has been added with reference to an extension of subclause B.1.1 for CEN;

— in Table 1, the number of test pieces has been added and new footnote [b] has been inserted relating to this addition;

— in Table 1, the condition period has been changed to 16 h;

— in Table 1, the test period has been changed to 1 000 h for hydrostatic strength (20 °C, 1 000 h);

— in Table 1, the pressure drop test been deleted, as this is covered in the new subclause 8.3.2;

— in Table 1, the operating torque for 125 mm < d_n ≤ 400 mm has been changed to 10 Nm < M ≤ 150;

— in Table 1, leaktightness after tensile load is added, including footnote [j] for limiting the diameter;

— a new subclause, 5.1.2 Fusion compatibility, substitutes the former subclause 6.4;

— a new Clause 11 Technical File has become an individual paragraph in line with EN 1555-4;

— subclause 12.1 General includes a NOTE for regional marking requirements on packaging, with reference to CEN/TS 12007-6, for CEN member countries, for example;

— Table 3 for minimum required marking of valves has been modified in line with EN 1555-4;

— former subclause 12.5 Packaging has become Clause 13 Delivery conditions, and has been modified and extended;

— Annex A has been updated in line with EN 1555-4;

— Annex B has been modified according longitudinal stress parameters in line with ISO 17885:2021, Table F.1;

— in Clause B.2 Test piece, the definition for the length of test piece has been redrafted;

— in Annex B, subclause B.4.4 has been added including a regional requirement.

A list of all parts in the ISO 16486 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document specifies the requirements for valves used in a piping system made from unplasticized polyamide (PA-U) that is intended to be used for the supply of gaseous fuels.

General requirements for unplasticized polyamide (PA-U) materials used for a piping system and its components, intended for the supply of gaseous fuels, are specified in ISO 16486-1.

Requirements and test methods for pipes are specified in ISO 16486-2 and for fittings in ISO 16486-3.

Characteristics for fitness for purpose of the system and generic fusion parameters are specified in ISO 16486-5.

Recommended practice for installation is given in ISO 16486-6, which will not be implemented as a European Standard under the Vienna Agreement.

NOTE Recommended practice for installation is also given in CEN/TS 12007-6[2], which has been prepared by Technical Committee CEN/TC 234, *Gas infrastructure*.

Assessment of conformity of the system is to form the subject of the future ISO/TS 16486-7:—[2)].

For CEN member countries, all components are to conform to the relevant EN standard(s). Alternative standards may be applied in cases where the suitable EN standard(s) do not exist.

The ISO 16486 series covers a range of maximum operating pressures and gives requirements concerning colours.

It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into consideration their particular requirements and any relevant national regulations and installation practices or codes.

2) Under preparation. Stage at the time of publication: ISO/WD TS 16486-7:2022.

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Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing —

Part 4:

Valves

1 Scope

This document specifies the characteristics of valves made from unplasticized polyamide (PA-U) in accordance with ISO 16486-1, intended to be buried and used for the supply of gaseous fuels.

It is applicable to isolating unidirectional and bi-directional valves with spigot ends or electrofusion sockets intended to be fused with PA-U pipes or fittings conforming to ISO 16486-2 and ISO 16486-3 respectively.

Valves made from material other than unplasticized polyamide designed for the supply of gaseous fuels conforming to the relevant standards are permitted to be used in PA-U piping systems according to the ISO 16486 series provided they have relevant PA-U connections for butt fusion or electrofusion ends (see ISO 16486-3). The component, i.e. the complete valve, is required to fulfil the requirements of this document.

This document also specifies the test parameters for the test methods it describes.

In conjunction with ISO 16486-1, ISO 16486-2, ISO 16486-3 and ISO 16486-5, this document is applicable to PA-U valves and their joints and to joints with components of PA-U and other materials intended to be used under the following conditions:

a) a maximum operating pressure (MOP) of up to and including 18 bar[3)], or limited to 16 bar under regional CEN requirements, at a reference temperature of 20 °C for design purposes;

   NOTE 1 For the purpose of this document and the references to ISO 8233, MOP is considered to be nominal pressure.

b) an operating temperature of −20 °C to 40 °C;

   NOTE 2 For operating temperatures between 20 °C and 40 °C, derating coefficients are specified in ISO 16486-5.

This document covers valves for pipes with a nominal outside diameter, d_n, ≤ 400 mm.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 307, *Plastics — Polyamides — Determination of viscosity number*

3) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

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— IEC Electropedia: available at https://www.electropedia.org/

3.1 General

3.1.1
external leaktightness
leaktightness of the *valve body* (3.1.4) enveloping the space containing the gas, with respect to the atmosphere

3.1.2
internal leaktightness
leaktightness between the inlet and the outlet of the valve, with the valve in the closed position

3.1.3
leakage
emission of gas from a *valve body* (3.1.4) or any component of a valve

3.1.4
valve body
main part of a valve which contains the obturating device (closing element), the seat, the packing seals and the operating stop, as applicable and provides the terminal ends for connection to the PA-U pipe/fittings

3.1.5
operating device
part of a valve for connection with the operating key which allows the opening and the closing of the valve

3.2 Terms relating to design

3.2.1
full bore valve
valve with a flow section equal to or greater than 80 % of the section corresponding to the nominal inside diameter of the body end port[SOURCE: EN 736-3:2008, 3.3.1][4]

3.2.2
clearway valve
valve designed to have an unobstructed flow way, which allows for the passage of a theoretical sphere with a diameter that is not less than the nominal inside diameter of the body end port[SOURCE: EN 736-3:2008, 3.3.2][4]

3.2.3
reduced bore valve
valve with a flow section equal to or greater than 36 % of the section corresponding to the nominal inside diameter of the body end port and which does not correspond to the *full bore valve* (3.2.1) [SOURCE: EN 736-3:2008, 3.3.3][4]

4 Symbols and abbreviated terms

For the purpose of this document, the symbols and abbreviated terms given in ISO 16486-1 apply.

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5 Material

5.1 Compound for valve body

5.1.1 Compound

The compound from which the valve body with spigot or electrofusion socket is made shall be in accordance with ISO 16486-1.

The PA-U components of the valve shall be made from virgin material conforming to ISO 16486-1.

5.1.2 Fusion compatibility

Components made from PA-U 11 shall be heat fusion jointed only to components made from PA-U 11.

Components made from PA-U 12 shall be heat fusion jointed only to components made from PA-U 12.

Components made from PA-U are not fusion compatible with components made from other polymers.

5.2 Material for non-polyamide parts

5.2.1 General

All components shall conform to the relevant ISO International Standard(s). Alternative standards may be applied in cases where a suitable ISO International Standard does not exist.

In all cases, fitness for purpose of the components shall be demonstrated.

The materials and the constituent elements used in making the valve (including elastomers, greases and any metal parts used) shall be as resistant to the external and internal environments as the other elements of the piping system and shall have an expected lifetime under the following conditions at least equal to that of the PA-U pipes conforming to ISO 16486-2, with which they are intended to be used:

a) during storage,

b) under the effect of the fluids being conveyed, and

c) taking into account the service environment and operating conditions.

The requirements for the level of material performance of non-polyamide parts shall be at least as stringent as that of the PA-U compound for the piping system.

Other materials used in valves in contact with the PA-U pipe shall not adversely affect pipe performance or initiate stress cracking.

The valve manufacturer shall ensure that any transition joint between polyamide and non-polyamide parts and the valve body fulfil the requirements of ISO 16486-3.

5.2.2 Metal parts

All parts susceptible to corrosion shall be adequately protected, providing this is necessary for the durability and function of the system.

When dissimilar metallic materials are used which can be in contact with moisture, steps shall be taken to avoid the possibility of galvanic corrosion.

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5.2.3 Elastomers

Elastomeric materials used for the manufacture of seals shall be in accordance with ISO 16010. Other sealing materials are permitted if proven suitable for gas service.

As a regional requirement for CEN member countries, elastomeric seals shall conform to EN 682.

5.2.4 Greases and lubricants

Greases or lubricants shall not exude onto fusion areas and shall not affect the long-term performance of the valve materials.

5.2.5 Assembly

Ancillary components of valves shall be assembled according to the manufacturer's procedures and any component used in the assembly shall not prevent conformity of the valve to this document.

6 General characteristics

6.1 Appearance of the valve

When viewed without magnification, the internal and external surfaces of valves shall be smooth, clean and free from scoring, cavities or other surface defects to an extent that would prevent conformity to this document.

No component of the valve shall show any signs of damage, scratches, pitting, bubbles, blisters, inclusions, or cracks to an extent that would prevent conformity of the valves to this document.

6.2 Colour

The colour of the PA-U parts of valves shall be either black or yellow.

6.3 Design

6.3.1 General

The valve shall be designed to provide the fluid flow passageway and the body ends.

The pressure resistance of the valve shall be specified by the manufacturer according to the design SDR and material classification.

6.3.2 Valve body

The valve body shall be such that it cannot be dismantled.

An operating stop system shall be provided at the fully open and closed positions.

6.3.3 Valve terminal ends

PA-U spigot ends or electrofusion sockets shall conform with the requirements as reported in ISO 16486-3.

6.3.4 Operating device

The operating device shall be integral with or connected to the stem in such a way that disconnection is impossible without special equipment.

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The valve shall close by turning the operating device clockwise. For a quarter-turn valve, the position of the obturator shall be clearly indicated on the top side of the operating device.

It is recommended that the position of the obturator should be marked on the access point for a quarter-turn valve.

Stops shall be provided at the fully open and closed positions.

6.3.5 Seals

The seals shall be so mounted as to be resistant to normally occurring mechanical loads, see 5.2.3. Creep and cold flow effects shall be taken into account. Any mechanism that puts a loading on the seals shall be permanently locked. Line pressure shall not be used as the sole means of seal activation.

7 Geometrical characteristics

7.1 General

Each valve shall be characterized by its dimensions and associated end connections.

In order to prevent stress concentrations, it is recommended that any change in the wall thickness of the valve body is gradual.

7.2 Measurement of dimensions

The dimensions of the fittings shall be measured in accordance with ISO 3126, and rounded to the next 0,1 mm. In case of dispute, the measurement of dimensions shall be made not less than 48 h after manufacture.

Additionally, for spigot end valves provided with temporary supports, dimensional measurement shall be performed at least 1 h after removal of the supports.

Indirect measurement at the stage of production is allowed at shorter time periods providing evidence is shown of correlation.

7.3 Dimensions of spigot ends for valves

The dimensions of spigot ends shall conform to ISO 16486-3:2020, Table 4, up to and including d_n 400 mm.

7.4 Dimensions of valves with electrofusion sockets

The dimensions of electrofusion sockets shall conform to ISO 16486-3:2020 Table 1, up to and including d_n 400 mm.

7.5 Dimensions of the operating device

For a quarter-turn valve, the dimension of the operating devices shall be designed so it can be operated with a $50 \pm^{0,5}_{0}$ mm square socket, (40 ± 2) mm depth.

NOTE For a multi-turn operated valve, attention is drawn to the requirements specified in ISO 5210.

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8 Mechanical characteristics of assembled valves and regional requirements

8.1 General

All tests shall be carried out on valves assembled with pipe from the same SDR conforming to ISO 16486-2, in accordance with the technical instructions of the manufacturer and taking into account the extreme conditions of utilisation described in ISO 16486-5.

NOTE The properties of an assembled valve depend on the properties of the pipes and the valve and on the conditions of their installation (i.e. geometry, temperature, type, method of conditioning, assembly and fusion procedures).

8.2 Conditioning

Unless otherwise specified in the applicable test method, the test pieces shall be conditioned for at least 16 h at 23 °C and 50 % relative humidity in accordance with ISO 291 before testing in accordance with Table 1.

The test pieces shall not be tested within the period of 48 h after their manufacture.

8.3 Requirements

8.3.1 Generals

When tested in accordance with the test methods as specified in Table 1 using the indicated parameters, the valves shall have mechanical characteristics conforming to the requirements given in Table 1.

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Table 1 — Mechanical characteristics of valves

Characteristic	Requirements	Test parameters		Test method
		Parameter	Value	
Hydrostatic strength (20 °C, 1 000 h)[g]	No failure during the test period of any test piece	Conditioning time[a]	16 h	ISO 1167-1 ISO 1167-4
		Number of test pieces[b]	3	
		Type of test	Water-in-water	
		Test temperature	20 °C	
		Test period	1 000 h	
		Circumferential (hoop) stress[i] PA-U 11 and PA-U 12 160[c] PA-U 11 and PA-U 12 180[c]	19,0 MPa 20,0 MPa	
Hydrostatic strength (80 °C, 165 h)[g]	No failure during the test period of any test piece [c]	Conditioning time[a]	16h	ISO 1167-1 ISO 1167-4
		Number of test pieces[b]	3	
		Type of test	Water-in-water	
		Test temperature	80 °C	
		Test period	165 h	
		Circumferential (hoop) stress[i] PA-U 11 and PA-U 12 160[c] PA-U 11 and PA-U 12 180[c]	10,0 MPa 11,5 MPa	
Leaktightness of seat(s) and packing	No leakage during the test period	Test temperature	23 °C[f]	Annex A
		Test fluid	Air or nitrogen	
		Number of test pieces[b]	1	
		Test pressure	25 mbar	
		Duration of the test	1 h	
Leaktightness of seat(s) and packing	No leakage during the test period	Test temperature	23 °C[f]	Annex A
		Test fluid	Air or nitrogen	
		Number of test pieces [b]	1	
		Test pressure	1,5 * MOP	
		Duration of the test	30 s	
WARNING — Safety precautions need to be taken when testing with air or nitrogen up to 1,5 MOP. For testing with air or nitrogen, a pressure of a maximum of 6 bar should be used. For MOP > 4 bar, testing with water should be considered, and the test conditions shall be agreed between the manufacturer and end user.				
Operating torque[d]	Torque range: For $d_n \leq 63$ mm: 5 Nm < $M \leq$ 35 Nm For 63 mm < $d_n \leq$ 125 mm: 10 Nm < $M \leq$ 70 Nm For 125 mm < $d_n \leq$ 400 mm: 10 Nm < M ≤ 150 Nm	Test temperatures	+23 °C[f] and −20 °C and +40 °C	ISO 8233
		Number of test pieces[b]	1	

[a] The valves shall not be pressurized within 24 h after fusion.

[b] The numbers of test pieces given indicate the numbers required to establish a value for the characteristic described in the table. The numbers of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. For guidance, see ISO/TS 16486-7.

[c] For material classification and designation, see ISO 16486-1:2020,

[d] The maximum operating torque recorded at the 3 testing temperatures shall be within the torque range given in this table according to ISO 8233 (i.e. opening and closing torque).

[e] The other four tests shall be carried out on the valve in the order stated, and as soon as possible after 24 h from the completion of the internal pressure test,

[f] For the purpose of factory production control, the test temperature is 23^{+8}_{-5} °C and the preconditioning of opening and closing the valve is not required.

[g] The valves shall be in open or partially open position.

[h] The test shall be performed by locking the obturator.

[i] The test pressure shall be calculated using the design SDR of the valve.

[j] The regional CEN requirement according to B.4.4 is not applicable to diameters > 110 mm unless requested by the end user.

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

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Table 1 *(continued)*

Characteristic	Requirements	Test parameters		Test method
		Parameter	Value	
Stop resistance	a) no failure at stops in closing and opening position, Followed by: -	Test temperature	−20 °C and +40 °C	ISO 8233
		Number of test pieces[b]	1	
		Torque	150 Nm or two times the value of the maximum measured operating torque whichever the greater	
		Duration	30 s	
	b) no leakage at seat and packing	Test temperature	23 °C	Annex A
		Test fluid	Air or nitrogen	
		Number of test pieces	1	
		Test pressure	1,5 MOP	
		Duration	30 s	
Actuation mechanism resistance[h]	For $d_n \leq 63$ mm: 1,5 * measured torque or 1,2 * 35 Nm (whichever is higher) For 63 mm < $d_n \leq 125$ mm: 1,5 * measured torque or 1,2 * 70 Nm (whichever is higher) For 125 mm < $d_n \leq 400$ mm: 1,5 * measured torque or 1,2 * 150 Nm (whichever is higher)	Test pressure	6 bar	ISO 8233
		Test temperature	23 °C	
		Number of test pieces[b]	1	
Resistance to bending between supports	No leakage and maximum value for operating torque (see examination of operating torque)	Load applied for: 63 mm < $d_n \leq 125$ mm 125 mm < $d_n \leq 400$ mm	 3,0 kN 6,0 kN	EN 12100
		Number of test pieces[b]	1	
Thermal cycling resistance $d_n > 63$ mm	No leakage and maximum value for operating torque (see examination of operating torque)	Number of test pieces[b]	1	EN 12119
Leaktightness under bending with thermal cycling $d_n \leq 63$ mm	No leakage	Number of cycles	50	EN 1704
		Temperature of cycling	−20 °C to +40 °C	
		Number of test pieces[b]	2	
Leaktightness after tensile load	No leakage, maximum value for operating torque (see examination of operating torque)[j]	Test temperature	23 °C	Annex B
		Test pressure	25 mbar	
		Test fluid	Air or nitrogen	
		Number of test pieces[b]	1	

[a] The valves shall not be pressurized within 24 h after fusion.

[b] The numbers of test pieces given indicate the numbers required to establish a value for the characteristic described in the table. The numbers of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. For guidance, see ISO/TS 16486-7.

[c] For material classification and designation, see ISO 16486-1:2020,

[d] The maximum operating torque recorded at the 3 testing temperatures shall be within the torque range given in this table according to ISO 8233 (i.e. opening and closing torque).

[e] The other four tests shall be carried out on the valve in the order stated, and as soon as possible after 24 h from the completion of the internal pressure test,

[f] For the purpose of factory production control, the test temperature is $23 \pm \frac{8}{5}$ °C and the preconditioning of opening and closing the valve is not required.

[g] The valves shall be in open or partially open position.

[h] The test shall be performed by locking the obturator.

[i] The test pressure shall be calculated using the design SDR of the valve.

[j] The regional CEN requirement according to B.4.4 is not applicable to diameters > 110 mm unless requested by the end user.

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

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Table 1 *(continued)*

Characteristic	Requirements	Test parameters		Test method
		Parameter	Value	
Stop resistance	a) no failure at stops in closing and opening position, Followed by: -	Test temperature	−20 °C and +40 °C	ISO 8233
		Number of test pieces[b]	1	
		Torque	150 Nm or two times the value of the maximum measured operating torque whichever the greater	
		Duration	30 s	
	b) no leakage at seat and packing	Test temperature	23 °C	Annex A
		Test fluid	Air or nitrogen	
		Number of test pieces	1	
		Test pressure	1,5 MOP	
		Duration	30 s	
Actuation mechanism resistance[h]	For $d_n \leq 63$ mm: 1,5 * measured torque or 1,2 * 35 Nm (whichever is higher) For 63 mm < $d_n \leq 125$ mm: 1,5 * measured torque or 1,2 * 70 Nm (whichever is higher) For 125 mm < $d_n \leq 400$ mm: 1,5 * measured torque or 1,2 * 150 Nm (whichever is higher)	Test pressure	6 bar	ISO 8233
		Test temperature	23 °C	
		Number of test pieces[b]	1	
Resistance to bending between supports	No leakage and maximum value for operating torque (see examination of operating torque)	Load applied for: 63 mm < $d_n \leq 125$ mm 125 mm < $d_n \leq 400$ mm	 3,0 kN 6,0 kN	EN 12100
		Number of test pieces[b]	1	
Thermal cycling resistance $d_n > 63$ mm	No leakage and maximum value for operating torque (see examination of operating torque)	Number of test pieces[b]	1	EN 12119
Leaktightness under bending with thermal cycling $d_n \leq 63$ mm	No leakage	Number of cycles	50	EN 1704
		Temperature of cycling	−20 °C to +40 °C	
		Number of test pieces[b]	2	
Leaktightness after tensile load	No leakage, maximum value for operating torque (see examination of operating torque)[j]	Test temperature	23 °C	Annex B
		Test pressure	25 mbar	
		Test fluid	Air or nitrogen	
		Number of test pieces[b]	1	

[a] The valves shall not be pressurized within 24 h after fusion.

[b] The numbers of test pieces given indicate the numbers required to establish a value for the characteristic described in the table. The numbers of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. For guidance, see ISO/TS 16486-7.

[c] For material classification and designation, see ISO 16486-1:2020,

[d] The maximum operating torque recorded at the 3 testing temperatures shall be within the torque range given in this table according to ISO 8233 (i.e. opening and closing torque).

[e] The other four tests shall be carried out on the valve in the order stated, and as soon as possible after 24 h from the completion of the internal pressure test,

[f] For the purpose of factory production control, the test temperature is $23 \pm \frac{8}{5}$ °C and the preconditioning of opening and closing the valve is not required.

[g] The valves shall be in open or partially open position.

[h] The test shall be performed by locking the obturator.

[i] The test pressure shall be calculated using the design SDR of the valve.

[j] The regional CEN requirement according to B.4.4 is not applicable to diameters > 110 mm unless requested by the end user.

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

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Table 1 *(continued)*

Characteristic	Requirements	Test parameters		Test method
		Parameter	Value	
4) Operating torque[d]	Torque range: For $d_n \leq 63$ mm: 5 Nm < M ≤ 35 Nm For 63 mm < $d_n \leq 125$ mm: 10 Nm < M ≤ 70 Nm For 125 mm < $d_n \leq 400$ mm: 10 Nm < M ≤ 150 Nm	Test temperatures	+23 °C[f] and −20 °C and +40 °C	ISO 8233
		Number of test pieces[b]	1	
5) Impact loading resistance	No leakage and maximum value for operating torque (see examination of operating torque)	Position of sample	Vertical, see Figure 1	EN 1705
		Drop height	2 m	
		Mass of the striker	2,5 kg	
		Type of the striker	d90 conforming to ISO 3127	
		Test temperature	−20 °C	
		Number of test pieces[b]	1	

[a] The valves shall not be pressurized within 24 h after fusion.

[b] The numbers of test pieces given indicate the numbers required to establish a value for the characteristic described in the table. The numbers of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. For guidance, see ISO/TS 16486-7.

[c] For material classification and designation, see ISO 16486-1:2020,

[d] The maximum operating torque recorded at the 3 testing temperatures shall be within the torque range given in this table according to ISO 8233 (i.e. opening and closing torque).

[e] The other four tests shall be carried out on the valve in the order stated, and as soon as possible after 24 h from the completion of the internal pressure test,

[f] For the purpose of factory production control, the test temperature is 23 $^{+8}_{-5}$ °C and the preconditioning of opening and closing the valve is not required.

[g] The valves shall be in open or partially open position.

[h] The test shall be performed by locking the obturator.

[i] The test pressure shall be calculated using the design SDR of the valve.

[j] The regional CEN requirement according to B.4.4 is not applicable to diameters > 110 mm unless requested by the end user.

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

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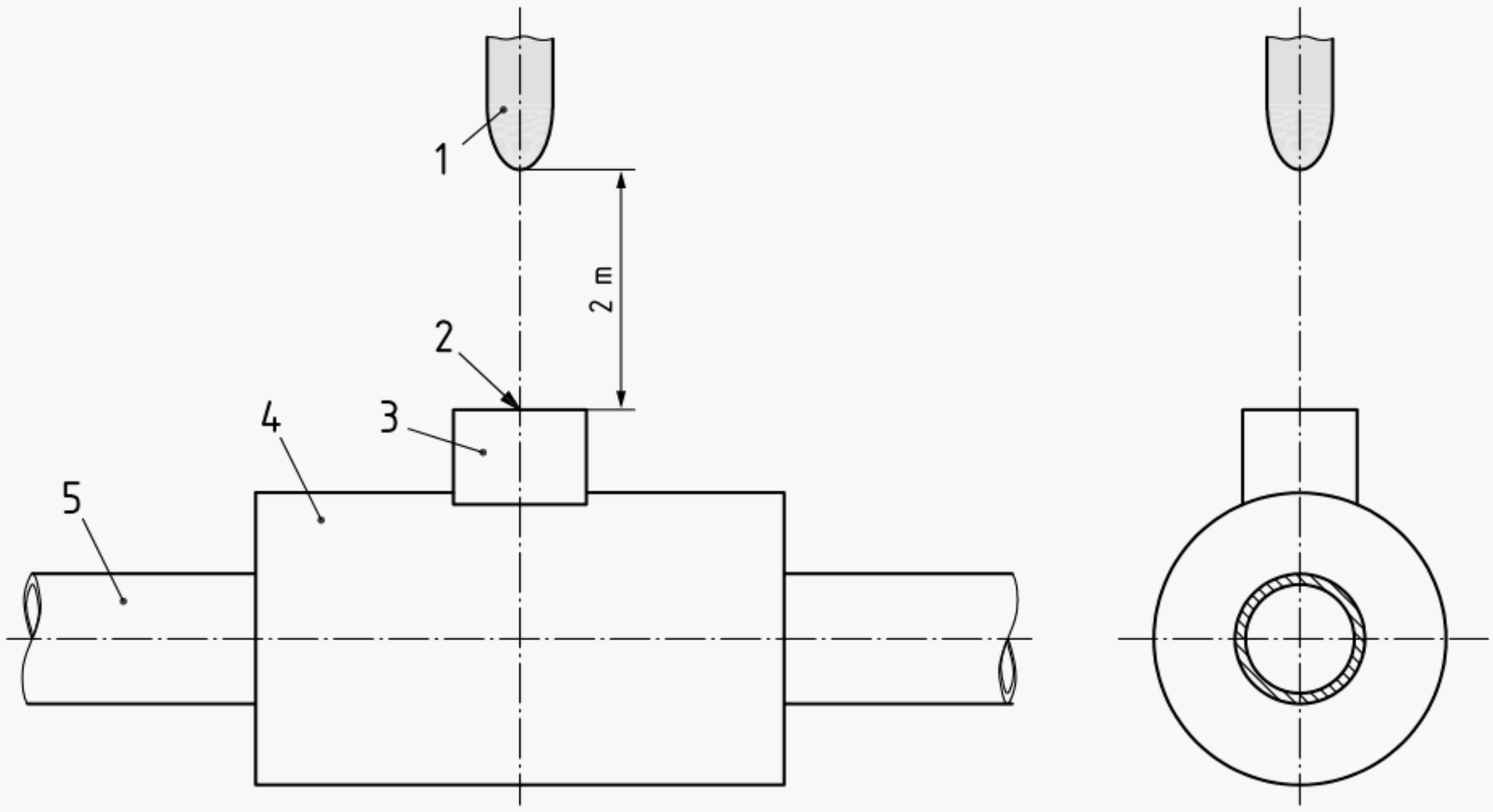

Key

1 striker
2 impact point
3 operating device
4 valve body
5 valve outlet

Figure 1 — Position of the test piece for the impact loading test

8.3.2 Air flow rate

The manufacturer shall indicate in the technical documentation the value of the air flow rate for reduced bore valves. This value is determined according to ISO 17778 at pressure drop for $d_n \leq 63$ mm of 0,5 mbar and $d_n > 63$ mm of 0,1 mbar[4)] on 1 test piece.

8.4 Regional requirement

For CEN member countries, ISO 16486-6 is not CEN harmonized, but substituted by CEN/TS 12007-6[2] where the MOP is limited to up to and including 16 bar for the whole piping system with all components. CEN/TS 12007-6[2] makes reference to several functional standards of CEN/TC 234, *Gas infrastructure*. More detailed information about regional requirements for CEN member countries is given in ISO 16486-6:2012, Annex F.

The leaktightness test method according to Annex B is modified for CEN member countries by an extension of B.1.1 and by B.4.4.

4) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

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9 Physical characteristics

9.1 Conditioning

Unless otherwise specified in the applicable test method, the test pieces shall be conditioned for at least 16 h at 23 °C and 50 % relative humidity in accordance with ISO 291 before testing in accordance with Table 2.

The test pieces shall not be tested within the period of 48 h after their manufacture.

9.2 Requirement

The test pieces shall be tested in accordance with Table 2. When tested using the test method and parameters specified therein, the valves shall have physical characteristics conforming to the requirements of Table 2.

Table 2 — Physical characteristics

Characteristic	Requirement	Test parameters		Test method(s)
		Parameter	Value	
Viscosity number	≥ 180 ml/g	Solvent	*m*-Cresol	ISO 307
Melt volume-flow rate (MVR)[a,b]	As recommended by the material supplier	Temperature	235 °C	ISO 1133-2
		Load	10 kg	

[a] The water content of the sample shall be <0,1 %. This is because PA-U resin is sensitive to hydrolysis. Therefore, the test sample shall be dried prior to testing at 80 °C in a dry air or vacuum dryer for 3 h, or as recommended by the PA-U resin producer. The MVR report shall include the water content of the sample prior testing with the used methodology for its determination.

[b] The Melt Volume-flow Rate (MVR) can be measured by the fitting manufacturer for internal QC, as an alternative for the viscosity number, e.g. to test deviations prior to and after working with the material. In practice, the MVR is extremely sensitive to any influence of water content, even if the water content is extremely low (see ISO 1133-2:2011, Table B.1, example for PA 6). For PA-U only MVR results from one test device should be compared.

10 Performance requirements

When valves conforming to this document are assembled to each other or to components conforming to other parts of the ISO 16486 series, the joints shall conform to the requirements given in ISO 16486-5.

11 Technical File

The manufacturer of the valves shall ensure the availability of a technical description (generally confidential) containing all relevant data necessary to prove the conformity of the valves to this document. The file shall include all results of type-testing. It shall also include all data necessary to implement a traceability system where required.

The characteristics of the fluid flow shall be such that the manufacturer will declare the valve as:

a) full bore valve;

b) clearway valve;

c) reduced bore valve;

The technical descriptions of the manufacturer shall include the following information:

a) dimensional characteristics, by working drawings;

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b) assembly instructions;

c) service conditions (e.g. valve temperature limits);

d) for valves with electrofusion sockets, the fusion instructions (power requirements or fusion parameters with limits);

e) air flow rate value.

12 Marking

12.1 General

12.1.1 Unless otherwise stated in Table 3, the marking elements shall be printed or formed directly on the valve in such a way that after storage, weathering, handling and installation, legibility is maintained during use of the valve.

NOTE 1 The manufacturer is not responsible for marking being illegible due to actions caused during installation and use such as painting, scratching, covering of the components, use of detergents, etc. on the components unless agreed or specified by the manufacturer.

NOTE 2 Marking requirements on the packaging can be found in ISO 16486-6; regional marking requirements on the packaging can be found, for example, in CEN/TS 12007-6[2] for CEN member countries.

12.1.2 Marking shall not initiate cracks or other types of defects which adversely influence the performance of the valve.

12.1.3 If printing is used, the colour of the printed information shall differ from the basic colour of the valve.

12.1.4 The size of the marking shall be such that it is legible without magnification.

12.1.5 There shall be no marking over the minimum spigot length of the valve.

12.2 Minimum required marking of valves

The minimum required marking shall conform to Table 3.

Table 3 — Minimum required marking on valve

Aspects	Marking
Number of the System Standard[a]	ISO 16486 or EN ISO 16486[b]
Manufacturer's name or trademark	Name or symbol
Nominal outside diameter(s) of pipe, d_n	e.g. 110
Material and designation	e.g. PA-U 12 160[c]
Design application series	e.g. SDR 11

[a] This information may be printed on a label associated with the valve or on an individual bag.

[b] EN ISO 16486 shall only be used, if the valve is conforming to regional CEN requirements.

[c] For material classification and designation, see ISO 16486-1:2020, 5.4.

[d] For providing traceability, the following details shall be given:

— the production period, year, month and/or week, in figures or in code;

— a name or code for the production site if the manufacturer is producing in different sites.

NOTE Traceability data can be coded and found in ISO 12176-4 and ISO 12176-5.

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Table 3 *(continued)*

Aspects	Marking
Manufacturer´s information[d]	
Intended use[a]	Gas
Flow direction (only for unidirectional valve)	Arrow

[a] This information may be printed on a label associated with the valve or on an individual bag.

[b] EN ISO 16486 shall only be used, if the valve is conforming to regional CEN requirements.

[c] For material classification and designation, see ISO 16486-1:2020, 5.4.

[d] For providing traceability, the following details shall be given:

— the production period, year, month and/or week, in figures or in code;

— a name or code for the production site if the manufacturer is producing in different sites.

NOTE Traceability data can be coded and found in ISO 12176-4 and ISO 12176-5.

12.3 Additional marking

Valves conforming to this document, which are third-party certified by a certification body, may be marked accordingly.

13 Delivery Conditions

The valves shall be packaged in bulk or individually protected where necessary in order to prevent deterioration and contamination. Whenever possible, they shall be placed in individual bags, in cardboard boxes or cartons.

It is recommended that spigot ends should be protected by external caps.

The cartons and/or individual bags shall bear at least one label with the manufacturer's name, type and dimensions of the valve, number of units in the box, and any special storage conditions and storage time limits.

It is recommended that valves should be stored in their original packing, until ready for use.

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Annex A
(normative)

Determination of the leaktightness of seat(s) and packing

A.1 General

This annex specifies the test method to verify the leaktightness of the seat and packing (see 8.3) of a valve/valve body made from PA-U.

A.2 Test pieces

The test piece shall be a complete valve with the open ends closed off by, for example, covers, plugs, flexible seals or end connectors.

The setting time of moulded or fusion-jointed components, specified by the manufacturer shall be completed before commencing conditioning.

A.3 Test procedure

A.3.1 Conditioning

Condition the test piece in accordance with this document (see 8.2).

A.3.2 Internal leaktightness test (fully closed valve test)

Conduct the following procedure, where, in case of bi-directional valves, both sides of the valves shall be tested.

a) Connect one end of the test piece to the pressure line and the other end(s) to a device capable of detecting leakage.

b) Fill the closed test piece with air or nitrogen at the specified temperature.

c) Close the valve.

d) Raise the pressure progressively and smoothly in such a way that the test pressure specified in this document is attained within 30 s.

e) Maintain the pressure and temperature for the length of time specified in this document.

f) Observe and record any signs of leakage.

g) Depressurize the test piece.

Valves with independent double seating (such as two-piece obturator or double-seated valves) can be tested by applying pressure between the seats and having each side of the closed valve checked for leakage.

A.3.3 External Leaktightness test (half open valve)

Conduct the following procedure.

a) Put the valve in half open position.

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b) Connect one end of the test specimen piece to the pressure supply and close the other end.

c) Fill the test specimen piece with air or nitrogen at the specified temperature.

d) Raise the pressure progressively and smoothly in such a way that the test pressure specified in this document is attained within 30 s.

e) Maintain the pressure and temperature for the length of time specified in this document.

f) Observe and records any signs of external leakage.

g) Depressurize the test piece.

A.4 Test report

The test report shall include at least the following information:

a) full identification of the valve under test;

b) reference to this method of test, including the year of publication (i.e. ISO 16486-4:2022, Annex A);

c) test pressure(s), applied to the test piece;

d) test duration;

e) results of internal and external leaktightness testing;

f) any conditions or incidents not detailed by this test method and which might have affected the results;

g) any unusual features observed;

h) date of test.

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Annex B
(normative)

Test method for leaktightness and ease of operation after tensile loading

B.1 Apparatus

B.1.1 Tensile test machine, capable of applying to a test piece, and maintaining for a specified period, t, a tensile force corresponding to a specified longitudinal tensile stress, σ_x, in the walls of pipes joined to the valve, and then if relevant producing a specified rate of extension.

As a regional requirement for CEN member countries, the tensile testing machine shall be sufficiently powerful to allow tests to be carried out up to the yield point of the pipe.

B.1.2 Grips or couplings, to enable the tensile test machine (B.1.1) to apply the appropriate force, directly or via intermediate fittings.

B.1.3 Pressurizing equipment, to enable a specified internal pressure, p, to be applied via suitable connections to the test piece while it is subject to the tensile force.

B.2 Test piece

The test piece shall comprise the valve under test assembled in accordance with 8.1 between two PA pipes, each of the nominal outside diameter, d_n, and the SDR series with which the valve is designed to be used, and each pipe having a length of either $2d_n$ or 250 mm, whichever is the shorter.

B.3 Test conditions

The valves shall be tested using the following conditions:

a) nominal longitudinal tensile stress, σ_x, in the connected pipe wall shall be 19 MPa for PA-U 160 or 20 MPa for PA-U 180;

b) internal pressure, p, shall be 25 mbar[5)] maintained for the specified duration of the test;

c) tensile force shall be calculated using the nominal pipe dimensions;

d) time period, t, for which the tensile force is maintained steady shall be 1 h;

e) rate of extension between the grips shall be (25 ± 1) mm/min.

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

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B.4 Procedure

B.4.1 The valve shall be tested by closing the obturator in the normal manner while maintaining an ambient test temperature of (23 ± 2) °C.

Apply the specified internal pressure, *p*, for the internal leaktightness assessment before tensile testing. In case of bi-directional valves, apply pressure to both sides. Ensure that all relevant parts of the valve are subject to the pressure.

B.4.2 After completion of the leaktightness test, mount the test piece in the tensile testing machine. Apply an increasing force smoothly until the applicable longitudinal stress, σ_x, is induced in the walls of the pipes in the test assembly.

B.4.3 Maintain the force for the specified test period, *t*, then close the pressure inlet and check the leaktightness for 30 s.

B.4.4 As a regional requirement for CEN member countries, the specified rate of extension shall be applied until the valve spigot end or pipe yields (see Table 1, footnote j).

NOTE Yield is defined as a visible necking and elongation or a decrease of the load during the tensile test.

B.4.5 Remove the tensile load and, without any intervening operation of the valve, submit the valve to torque testing according to ISO 8233 and leaktightness testing of the seat and packing according to Annex A.

Yielded pipe test pieces can be removed in order to perform the torque and leaktightness tests.

B.5 Test report

The test report shall include at least the following information:

a) reference to this document, including the year of publication (i.e. ISO 16486-4:2022);

b) details necessary for complete identification of the valve under test;

c) dimensions of the pipes used in the test piece;

d) longitudinal tensile stress, σ_x;

e) tensile force applied to the test piece;

f) internal pressure, *p*, applied to the test piece;

g) period, *t*, for which the tensile force was maintained;

h) results of torque testing in accordance with ISO 8233;

i) results of testing of leaktightness of seat and packing, in accordance with Annex A of this document;

j) any factor that could have affected the results, such as incident or operating detail not specified in Annex B of this document;

k) any unusual features observed;

l) date of testing.

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[7] ISO 12176-5, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 5: Two-dimensional data coding of components and data exchange format for PE piping systems*

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