
**Intravascular catheters — Sterile and
single-use catheters —**

**Part 4:
Balloon dilatation catheters**

*Cathéters intravasculaires — Cathéters stériles et non réutilisables —
Partie 4: Cathéters de dilatation à ballonnets*



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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.

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 document 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).

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This document was prepared by Technical Committee ISO/TC 84, *Devices for administration of medicinal products and catheters*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 205, *Non-active medical devices*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 10555-4:2013), which has been technically revised.

The main changes are as follows:

- added a definition for balloon rated burst pressure (RBP) (see [3.2](#));
- added a definition (see [3.3](#)), requirement (see [4.4.5](#)), and created test method (see [Annex E](#)) for crossing profile;
- added guidance on endpoint of deflation period (see [Annex C](#));
- defined effective length of the balloon (see [3.4](#));
- expanded radio-detectability to include detectability by x-ray or by other means (see [4.2](#));
- within designation of nominal size, added the minimum inner diameter of the introducer, guide catheter, sheath, etc. that can be used with the catheter (see [4.3](#));
- added requirement (see [4.4.6](#)) and test method (see [Annex F](#)) for balloon removal without damage after inflation and deflation;
- added annex for rationale of changes and guidance (see [Annex G](#)).

A list of all parts in the ISO 10555 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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Intravascular catheters — Sterile and single-use catheters —

Part 4: Balloon dilatation catheters

1 Scope

This document specifies requirements for balloon dilatation catheters supplied sterile and intended for single use.

This document does not specify requirements for vascular stents (see ISO 25539-2).

NOTE Guidance on the selection of balloon materials is given in [Annex C](#).

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 10555-1:2023, *Intravascular catheters — Sterile and single-use catheters — Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10555-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 balloon dilatation catheter

intravascular catheter fitted with a balloon, which is introduced into an artery or vein to dilate a part or parts of the vascular system

3.2 balloon rated burst pressure RBP

pressure at which the balloon bursts or leaks with an appropriate safety margin

3.3 crossing profile

maximum outer diameter found between the proximal end of the uninflated balloon and the distal tip of the catheter

3.4 effective length of the balloon

length of the balloon intended to treat the lesion

4 Requirements

4.1 General

Unless otherwise specified in this document, balloon dilatation catheters shall conform with the requirements in ISO 10555-1.

4.2 Detectability of the balloon position

The balloon position shall be detectable by X-ray or by other means (ultra-sound, MRI, etc.).

Detectability shall be demonstrated by an appropriate test method, e.g. the test method specified in ASTM F640-20 or DIN 13273-7.

4.3 Designation of nominal size

The nominal size of the catheter shall be designated by the following:

- a) diameter(s) expressed in millimetres (rounded to the nearest 0,1 mm or 0,01 mm) of the inflated balloon(s) or, for multidiameter balloon(s), the diameter of each portion at nominal pressure;
- b) effective length of the balloon at nominal pressure(s);
- c) diameter of the largest guidewire that can be used with the catheter, if applicable;
- d) minimum inner diameter of the introducer, guide catheter, sheath, etc. that can be used with the catheter.

NOTE For stent delivery systems, refer to ISO 25539-2.

4.4 Physical requirements

4.4.1 Balloon rated burst pressure (RBP)

Determine the RBP when tested in accordance with [Annex A](#).

Longitudinal burst is the desirable balloon burst mode, though other modes are acceptable with appropriate justification.

4.4.2 Balloon fatigue; freedom from leakage and damage on inflation

Evaluate the ability of the balloon to withstand 10 repeated inflation cycles to the RBP. When tested as described in [Annex B](#), there shall be no leakage or evidence of damage, such as herniation or bursting of the catheter. In cases where 10 repeated inflation cycles are not clinically relevant, the clinically relevant number of cycles including a safety margin can be used when supported by risk assessment. If a number of cycles other than 10 is applied, the test method given in [Annex B](#) shall be used but in a revised version adapted to the alternative number of cycles.

4.4.3 Balloon deflation time

Determine the time required to deflate the balloon from the RBP as described in [Annex C](#).

4.4.4 Balloon diameter to inflation pressure (balloon compliance)

Determine the relationship between the balloon diameter and the balloon inflation pressure as described in [Annex D](#).

4.4.5 Crossing profile

Determine the crossing profile as described in [Annex E](#).

NOTE The largest diameter over the effective length of the catheter, including the proximal balloon bond, is evaluated when measuring the outside diameter (see ISO 10555-1).

4.4.6 Balloon removal

Demonstrate that the balloon can be removed without damage after inflation and deflation in accordance with the procedure described in [Annex F](#).

4.5 Information to be supplied with the catheter

Information supplied with the catheter shall fulfil the requirements of ISO 10555-1:2023, 6.3 and shall also include the following information:

- a) nominal size of the catheter, as designated in [4.3](#);
- b) position(s) of detectable marker(s);
- c) RBP of the balloon, expressed in kPa;
- d) balloon inflation pressure, expressed in kPa, required to achieve the nominal balloon diameter(s);
- e) guidewire, guide catheter or sheath or introducer compatibility and size recommendations appropriate to the intended clinical use.

Units of measurement systems other than those specified in this document should additionally be given if clinically relevant.

NOTE The crossing profile, expressed in mm, can be given.

Annex A (normative)

Test for rated burst pressure (RBP)

A.1 Principle

The catheter is connected via its hub or proximal end to a pressure generating device which is filled with fluid for inflation. Pressure is applied at a rate that allows accurate detection of burst pressure until catheter balloon leaks or bursts. The burst pressure is recorded, and the RBP of the balloon is determined.

A.2 Apparatus

A.2.1 Recommended guidewire or equivalent.

A.2.2 Water bath, controlled at $(37 \pm 2) ^\circ\text{C}$.

A.2.3 Leak detection mechanism, e.g. dye in test fluid, pressure drop monitor, flow rate monitor.

A.2.4 Timing mechanism, with specified accuracy of at least ± 1 s.

A.2.5 Pressure generating device, fitted with a means of measuring pressure with an accuracy of ± 5 % of the reported value while maintaining the inflation pressure and fitted with a male 6 % (Luer) taper for leak proof connection to the catheter.

A.3 Reagent

Fluid for inflation, e.g. room temperature water or other justified clinically relevant media.

A.4 Test procedure

A.4.1 Fill the pressure generating device ([A.2.5](#)) with fluid for inflation ([A.3](#)).

A.4.2 The following steps of [A.4.2](#) may be completed in any order.

A.4.2.1 Replace the air in the balloon catheter with fluid for inflation by applying vacuum and allowing the fluid for inflation to return in place of the air. A small amount of air remaining, indicative of normal use, is acceptable.

A.4.2.2 If the instructions for use specify that a guidewire should be used during balloon inflation, insert the appropriate guidewire ([A.2.1](#)) in the device.

A.4.2.3 Connect the pressure generating device to the catheter under test and immerse at least the balloon portion(s) in the water bath ([A.2.2](#)) at $(37 \pm 2) ^\circ\text{C}$.

A.4.3 Allow the immersed portion of the catheter to equilibrate for a minimum of 2 min.

A.4.4 Inflate the balloon using a pre-determined pressure profile versus time that will allow accurate detection of burst pressure until the catheter bursts or fails. Record the burst pressure, burst mode and location of the burst.

A.4.5 Calculate the RBP.

A.5 Test report

The test report shall include at least the following information:

- a) identity of the catheter (e.g. description, lot number, reference part number, etc.);
- b) a reference to this document (including its year of publication) and annex;
- c) for variable data analysis, the maximum, minimum, mean and standard deviation of the burst pressure, expressed in kPa;
- d) RBP, expressed in kPa;
- e) all observed burst modes (e.g. longitudinal burst, bond leak etc.) and locations and whether fragments were produced;
- f) any deviations from the procedure;
- g) the date of test.

Annex B (normative)

Balloon fatigue test for freedom from leakage and damage on inflation

B.1 Principle

The catheter is connected via its hub or proximal end to a pressure generating device which is inflated and deflated multiple times to simulate use in vivo. Pressure is inflated to the RBP and held for a minimum of 30 s. While the catheter is in the inflated state, examine the balloon catheter for leakage, burst or herniation.

B.2 Apparatus

B.2.1 Recommended guidewire or equivalent.

B.2.2 Water bath, controlled at $(37 \pm 2) ^\circ\text{C}$.

B.2.3 Leak detection mechanism, e.g. dye in test fluid, pressure drop monitor, flow rate monitor.

B.2.4 Timing mechanism, with specified accuracy of at least ± 1 s.

B.2.5 Pressure generating device, fitted with a means of measuring pressure with an accuracy of ± 5 % of the reported value while maintaining the inflation pressure and fitted with a male 6 % (Luer) taper for a leak proof connection to the catheter.

B.3 Reagent

Fluid for inflation, e.g. room temperature water or other justified clinically relevant media.

B.4 Test procedure

B.4.1 Fill the pressure generating device ([B.2.5](#)) with fluid for inflation ([B.3](#)).

B.4.2 The following steps of [B.4.2](#) may be completed in any order.

B.4.2.1 Replace the air in the balloon catheter with fluid for inflation by applying vacuum and allowing the fluid for inflation to return in place of the air. A small amount of air remaining, indicative of normal use, is acceptable.

B.4.2.2 If the instructions for use specify that a guidewire should be used during balloon inflation, insert the appropriate guidewire ([B.2.1](#)) in the device.

B.4.2.3 Connect the pressure generating device to the catheter under test and immerse at least the balloon portion(s) in the water bath ([B.2.2](#)) at $(37 \pm 2) ^\circ\text{C}$.

B.4.3 Allow the immersed portion of the catheter to equilibrate for a minimum of 2 min.

B.4.4 Inflate the balloon to RBP holding the inflation pressure for a minimum of 30 s before deflating. Then deflate the balloon(s). Repeat this step eight more times to a total of 9 cycles of inflations and deflations. Observe for leaks.

B.4.5 Inflate the balloon(s) one more time to the RBP and remove the catheter from the water bath, maintaining the balloon(s) in the inflated state for a minimum of 30 s.

B.4.6 During the last cycle to RBP, examine the whole catheter for leaks, bursts, herniations and the direction of any balloon bursts. If bursts occurred, examine whether fragments were produced.

B.5 Test report

The test report shall include at least the following information:

- a) identity of the catheters (e.g. description, lot number, reference part number, etc.);
- b) a reference to this document (including its year of publication) and annex;
- c) RBP used, expressed in kPa;
- d) whether leakage occurred from the catheter including the balloon(s);
- e) all observed burst modes (e.g. longitudinal burst, bond leak, herniation, etc.) and locations and whether fragments were produced, if burst occurred;
- f) any deviations from the procedure;
- g) the date of test.

Annex C (normative)

Test for balloon deflation time

C.1 Principle

The catheter is connected via its hub or proximal end to a pressure generating device. Pressure is applied until the pressure reaches RBP. The balloon is deflated in accordance with the instructions for use. Determine the time required to deflate the balloon from the RBP. When testing hydratable catheters, both the pre- and post-hydration states shall be considered; a worst-case scenario shall be documented at a minimum.

C.2 Apparatus

C.2.1 Recommended guidewire or equivalent.

C.2.2 Water bath, controlled at $(37 \pm 2) ^\circ\text{C}$.

C.2.3 Timing mechanism, with a specified accuracy of at least ± 1 s.

C.2.4 Pressure generating device, fitted with a means of measuring pressure with an accuracy of ± 5 % of the reported value while maintaining the inflation pressure and fitted with a male 6 % (Luer) taper for leak proof connection to the catheter.

C.3 Reagent

Fluid for inflation, e.g. room temperature water, contrast media, or other justified clinically relevant media.

C.4 Test procedure

C.4.1 Fill the pressure generating device ([C.2.4](#)) with fluid for inflation ([C.3](#)).

C.4.2 The following steps of [C.4.2](#) may be completed in any order.

C.4.2.1 Replace the air in the balloon catheter with fluid for inflation by applying vacuum and allowing the fluid for inflation to return in place of the air. A small amount of air remaining, indicative of normal use, is acceptable.

C.4.2.2 If the instructions for use specify that a guidewire should be used during balloon inflation, insert the appropriate guidewire ([C.2.1](#)) in the device.

C.4.2.3 Connect the pressure generating device to the catheter under test and immerse at least the balloon portion(s) in the water bath ([C.2.2](#)) at $(37 \pm 2) ^\circ\text{C}$.

C.4.3 Allow the immersed portion of the catheter to equilibrate for a minimum of 2 min.

C.4.4 Inflate the balloon to the RBP in accordance with the instructions for use, simulating clinical use.

C.4.5 Deflate the balloon in accordance with the instructions for use and measure (C.2.3) the balloon deflation period until:

- a) an 80 % reduction in volume is reached; or
- b) the entire balloon is fully collapsed.

The chosen deflation end point shall be justified.

NOTE Due to the numerous designs and volumes of balloon catheters, the end point for sufficient deflation during clinical use differs. Therefore, two deflation end points have been identified to be applicable for the variety of designs.

C.5 Test report

The test report shall include at least the following information:

- a) identity of the catheters (e.g. description, lot number, reference part number, etc.);
- b) a reference to this document (including its year of publication) and annex;
- c) balloon deflation times, expressed in seconds, with the chosen acceptance criteria (C.4.5. a) or b));
- d) identity of fluid for inflation;
- e) any unusual features observed, e.g. any bursts or leaks;
- f) for variable data analysis, the maximum, minimum, mean and standard deviation of the balloon deflation times, expressed in seconds;
- g) any deviations from the procedure;
- h) the date of test;
- i) the chosen deflation end point.

Annex D (normative)

Test for balloon diameter to inflation pressure (balloon compliance)

D.1 Principle

The catheter is connected via its hub or proximal end to a pressure generating device which is filled with fluid for inflation. Pressure is applied incrementally, allowing the system to stabilize between intervals, and the diameter is measured at each pressure increment up to the RBP. This determines the relationship between the balloon diameter and the inflation pressure.

D.2 Apparatus

D.2.1 Recommended guidewire or equivalent.

D.2.2 Water bath, controlled at $(37 \pm 2) ^\circ\text{C}$.

D.2.3 Pressure generating device, fitted with a means of measuring pressure with an accuracy of $\pm 5\%$ of the reported value while maintaining the inflation pressure and fitted with a male 6 % (Luer) taper for leak proof connection to the catheter.

D.2.4 Equipment for measuring balloon diameter with an appropriate accuracy (e.g. micrometre, optical profile projector, laser-micrometre), capable of measuring to 10 % of the specified tolerance or 1 % of the measured value. If a tolerance is specified, the lesser value of the respective percentages shall be used.

D.3 Reagents

Fluid for inflation, e.g. room temperature water or other justified clinically relevant media.

D.4 Test procedure

D.4.1 Fill the pressure generating device ([D.2.3](#)) with fluid for inflation ([D.3](#)).

D.4.2 The following steps of [D.4.2](#) may be completed in any order.

D.4.2.1 Replace the air in the balloon catheter with fluid for inflation by applying vacuum and allowing the fluid for inflation to return in place of the air. A small amount of air remaining, indicative of normal use, is acceptable.

D.4.2.2 If the instructions for use specify that a guidewire should be used during balloon inflation, insert the appropriate guidewire ([D.2.1](#)) in the device.

D.4.2.3 Connect the pressure generating device to the catheter under test and immerse at least the balloon portion(s) in the water bath ([D.2.2](#)) at $(37 \pm 2) ^\circ\text{C}$.

D.4.3 Allow the immersed portion of the catheter to equilibrate for a minimum of 2 min.

D.4.4 Inflate the balloon incrementally; pressures should be chosen to determine the balloon diameter at appropriate intervals (e.g. 100 kPa) over the indicated range of pressures.

D.4.5 Measure the diameter of the balloon at appropriate pressure interval(s) at appropriate location(s) along the length of the balloon; these measurements shall be taken as soon as practical after stabilization.

D.4.6 Continue incremental inflations until the balloon reaches RBP.

The entire test should be completed rapidly to minimize the effects of viscoelastic behaviour and to better simulate the inflation method used clinically.

D.5 Test report

The test report shall include at least the following information:

- a) identity of the catheters (e.g. description, lot number, reference part number, etc.);
- b) a reference to this document (including its year of publication) and annex;
- c) balloon diameter, expressed in millimetres, and the associated pressure, expressed in kPa;
- d) for variable data analysis, the maximum, minimum, mean and standard deviation of the balloon diameter, expressed in millimetres at each associated pressure, expressed in kPa;
- e) any deviations from the procedure;
- f) the date of test.

Annex E (normative)

Determination of crossing profile

E.1 Principle

The purpose of this test is to determine the maximum crossing profile. This test provides information that can be useful for introducer sizing and treatment planning.

E.2 Apparatus

E.2.1 Recommended guidewire or equivalent.

E.2.2 Equipment for measuring balloon diameter, with a resolution of at least 0,025 mm (e.g. thickness gauge, digital indicator, laser micrometre, ring gauge). Due to variations in balloon materials and balloon fold characteristics, use of contacting measurement devices can be more appropriate than non-contacting measurement devices. A rationale should be provided to support the type of measurement device used.

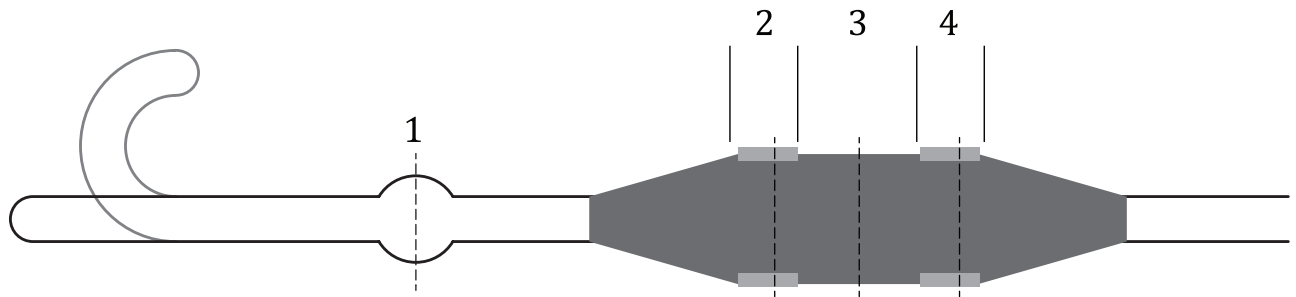
E.3 Test procedure

E.3.1 Remove protective sleeves covering the balloon portion of the catheter, if present.

E.3.2 Insert an appropriately sized guidewire through the catheter guidewire lumen such that it completely spans the region under the balloon and associated connections.

E.3.3 If using a one axis measuring tool, measure the crossing profile at the proximal, middle, and distal balloon regions (see [Figure E.1](#)), rotating the test sample 90° for two measurements at each location. Additional regions should be measured based upon unique balloon features. If using a ring gauge, measure from the distal tip to the proximal end of the balloon.

If there are any balloon junctions distal to the balloon region that would affect clinical use of the device, those junctions shall be measured as well to ensure that all needed dimensional information is available.

**Key**

- 1 junction
- 2 distal
- 3 middle
- 4 proximal

Figure E.1 — Balloon regions**E.4 Test report**

The test report shall include at least the following information:

- a) identity of the catheters (e.g. description, lot number, reference part number, etc.);
- b) a reference to this document (including its year of publication) and annex;
- c) maximum balloon profile at each location measured, expressed in millimetres;
- d) for variable data analysis, the maximum, minimum, mean and standard deviation of the balloon profile, expressed in millimetres, of all tested samples;
- e) any deviations from the procedure;
- f) the date of test.