



BSI Standards Publication

Rubber and plastics hoses and hose assemblies — Hydrostatic testing

National foreword

This British Standard is the UK implementation of EN ISO 1402:2021. It is identical to ISO 1402:2021. It supersedes BS EN ISO 1402:2009, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/66, Rubber and plastics tubing, hoses and hose assemblies.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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- Essais hydrostatiques (ISO 1402:2021)

Gummi- und Kunststoffschläuche und
Schlauchleitungen - Hydrostatische
Prüfung (ISO 1402:2021)

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European foreword

This document (EN ISO 1402:2021) has been prepared by Technical Committee ISO/TC 45 "Rubber and rubber products" in collaboration with Technical Committee CEN/TC 218 "Rubber and plastics hoses and hose assemblies" the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2021, and conflicting national standards shall be withdrawn at the latest by November 2021.

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Contents

Page

Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 General	1
5 Apparatus	1
6 Test pieces	2
6.1 Hose assemblies.....	2
6.2 Hoses.....	2
6.3 Number of test pieces.....	2
7 Application of hydrostatic pressure	2
7.1 General.....	2
7.2 Procedure.....	2
8 Hydrostatic pressure tests	2
8.1 Proof pressure hold test.....	2
8.2 Measurement of deformation under pressure.....	3
8.2.1 General procedure.....	3
8.2.2 Change in length at the specified test pressure.....	3
8.2.3 Change in external diameter at the specified test pressure, measured at the approximate middle of the hose assembly.....	4
8.2.4 Twisting at the specified test pressure.....	5
8.2.5 Warping at the specified test pressure.....	5
8.3 Burst pressure test.....	5
8.4 Leakage test.....	6
8.4.1 Test pieces.....	6
8.4.2 Procedure.....	6
8.4.3 Criteria for failure.....	6
9 Test report	6
Bibliography	9

Foreword

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This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 218, *Rubber and plastics hoses and hose assemblies*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fifth edition cancels and replaces the fourth edition ([ISO 1402:2009](http://www.iso.org/iso/1402:2009)), which has been technically revised. The main changes compared to the previous edition are as follows:

- the tolerances of the pressure in [Figure 3](#), [7.2.2](#), [8.1](#) and [8.2](#) have been revised;
- the description of the failure mode in [8.3](#) has been revised.

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.

Rubber and plastics hoses and hose assemblies — Hydrostatic testing

1 Scope

This document specifies methods for the hydrostatic testing of rubber and plastics hoses and hose assemblies, including methods for the determination of dimensional stability.

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 7751](#), *Rubber and plastics hoses and hose assemblies — Ratios of proof and burst pressure to maximum working pressure*

[ISO 8330](#), *Rubber and plastics hoses and hose assemblies — Vocabulary*

[ISO 23529](#), *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO 8330](#) apply.

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

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

4 General

Unless otherwise specified, all tests shall be carried out at standard temperature in accordance with [ISO 23529](#).

5 Apparatus

5.1 Pressure source, capable of applying pressure at the rate specified in [7.2.2](#), up to the required test pressure.

5.2 Calibrated pressure gauge or pressure transducer with digital readout, chosen for each test so that the test pressure is between 15 % and 85 % of the full-scale reading.

In the interest of accuracy, calibrated pressure gauges or pressure transducers with digital readouts shall be checked at frequent intervals and the fitting of restrictors is recommended to minimize shock damage.

5.3 Dimensional equipment, sliding vernier callipers or micrometre, length measuring tape, circumferential measuring tape (π tape).

for evidence of leakage, cracking, abrupt distortions indicating irregularity in material or manufacture, or other signs of failure. The tolerance of the pressure is +10 % of the specified pressure.

Unless otherwise specified for the hose, the proof pressure shall be related to the maximum working pressure by the ratio given in [ISO 7751](#).

The test is not applicable to a curved hose.

NOTE This text uses the term “maximum working pressure” instead of the deprecated term “design working pressure”.

8.2 Measurement of deformation under pressure

8.2.1 General procedure

8.2.1.1 Setting up the test piece

When tests for determining change in length, change in outside diameter and twisting and/or warping are required, straighten the hose or hose assembly, lay it out horizontally for inspection and apply a hydrostatic pressure of 0,07 MPa (0,7 bar) approximately 5 min after completion of the proof pressure test. It is not necessary to apply 0,07 MPa (0,7 bar) when it is stable in keeping straightness without pressure. The supporting surface upon which the hose/hose assembly rests shall be flat and smooth enough to allow the hose/hose assembly to expand or contract without restriction. Alternatively, the hose/hose assembly may be supported on rollers or suspended vertically. When a section of hose is used as a test piece, it may also be placed in a test rig in a vertical position.

8.2.1.2 Reference marks

For long hoses or hose test pieces (see [6.2](#)), while maintaining the pressure, make three reference marks (A, B and C) on the outer surface, the middle mark (B) being made approximately midway along the length of the hose, and the outer marks (A and C) 250 mm (minimum) from B. Each mark shall consist of an arc on the circumference of the hose through which is drawn a straight line perpendicular to the arc, the three lines being co-linear (see [Figure 1](#)).

For hose assemblies, measure the distance between the contact faces of the end fittings, or place the reference marks on the hose surface near the end of the inserted part of the fitting.

8.2.1.3 Measurement of initial dimensions

At the initial state [no pressure or maintain pressure of 0,07 MPa (0,7 bar) for approximately 5 min], make the appropriate measurements (see [8.2.2](#), [8.2.3](#) and [8.2.4](#)) at the reference marks A and C with an accuracy of ± 1 mm using the measuring tape (see [5.3](#)) and record these. Also, measure the external diameter or circumference accurately.

8.2.2 Change in length at the specified test pressure

NOTE The test pressure is specified in the appropriate hose product specification and could be the maximum working pressure (see [8.1](#), NOTE), the proof pressure or any other pressure below the proof pressure at which the hose deformation characteristics are to be measured.

Raise the pressure to the test pressure specified in the hose product standard at the rate specified in [7.2.2](#) and maintain it for 5 min (or longer when specified in the hose product standard). At the end of this period, measure the length between the reference marks A and C or, in the case of hose assemblies, between the contact faces of the end fittings, with an accuracy of ± 1 mm, using the measuring tape (see [5.3](#)) and record these values. The tolerance of the pressure is +10 % of the specified pressure. Calculate the change in length, Δl , expressed as a percentage (%) of the original length, from [Formula \(1\)](#):

$$\Delta l = \frac{l_1 - l_0}{l_0} \times 100 \quad (1)$$

where

- l_0 is the distance between the reference marks A and C or the overall length (hose assemblies) measured at the initial state [no pressure or maintain pressure of 0,07 MPa (0,7 bar)], in metres (m);
- l_1 is the distance between reference marks A and C or the overall length (hose assemblies) measured at the specified test pressure, in metres (m).

The percentage change in length, Δl , will be positive (+) in the case of an increase in length and negative (-) in the case of a decrease in length.

For an illustration of the test procedure, see [Figure 3](#).

The complete test sequence (proof pressure — testing pressure — bursting pressure) only applies to “type tests”. For routine tests, the “measuring sequence” after the proof pressure is only applicable when the relevant hose product standard specifies this.

Measure the initial length and diameter/circumference and place reference marks for twist measurement between points A and B. Measure the increase in the length, diameter/circumference, twist and warping directly in front of point C.

8.2.3 Change in external diameter at the specified test pressure, measured at the approximate middle of the hose assembly

8.2.3.1 General

The external diameter should preferably be determined from measurements of circumference made with an accuracy of 1 mm using the circumferential measuring tape according to [ISO 4671](#). The measurements may, however, be made directly, using sliding vernier callipers having a minimum useful tip width of 5 mm.

8.2.3.2 Determination by measuring the change in external circumference

Using the circumferential measuring tape (see [5.3](#)), measure the circumference at each of the three reference marks (A, B and C) at the initial state [no pressure or maintain pressure of 0,07 MPa (0,7 bar)] (see [8.2.1.3](#)) and at the specified test pressure described in [8.2.2](#).

Calculate the change in diameter, ΔD , expressed as a percentage (%) of the original diameter, from [Formula \(2\)](#):

$$\Delta D = \frac{\Sigma C_1 - \Sigma C_0}{\Sigma C_0} \times 100 \quad (2)$$

where

- ΣC_0 is the sum of the circumferences at the three reference marks measured at the initial state;
- ΣC_1 is the sum of the circumferences at the three reference marks measured at the specified test pressure.

8.2.3.3 Direct measurement of change in external diameter

Using the sliding vernier callipers ([5.3](#)), measure two perpendicular diameters at each of the three reference marks at the initial state (no pressure or maintain pressure of 0,07 MPa (0,7 bar) (see [8.2.1.3](#)) and at the specified test pressure described in [8.2.2](#).

Calculate the change in diameter, ΔD , expressed as a percentage (%) of the original diameter, from [Formula \(3\)](#):

$$\Delta D = \frac{\Sigma D_1 - \Sigma D_0}{\Sigma D_0} \times 100 \quad (3)$$

where

- ΣD_0 is the sum of the six diameters measured at the reference marks at the initial state;
- ΣD_1 is the sum of the six diameters measured at the reference marks at the specified test pressure.

8.2.4 Twisting at the specified test pressure

If twisting of the hose develops under pressure, the original lines forming the reference marks will take up a helical pattern (see [Figure 2](#)).

With the hose at the specified test pressure described in [8.2.2](#), project a straight line along the length of the hose from reference mark A until it intersects, at C', the circular arc at reference point C. Alternatively, for short hose assemblies, the reference marks A and C may be placed on the end fittings or on the section of the hose covering the fitting tails.

Then measure the length, s , of the circular arc CC' to the nearest millimetre, using measuring tape ([5.3](#)).

Calculate T , the twisting per length, expressed in degrees per metre (°/m), from [Formula \(4\)](#):

$$T = \frac{s}{C_c \times l_0} \times 360 \quad (4)$$

where

- s is the length of the circular arc CC', in millimetres (mm);
- C_c is the circumference at reference mark C, in millimetres (mm), measured as described in [8.2.3.1](#);
- l_0 is the distance between A and C, in metres (m), as measured in [8.2.2](#).

8.2.5 Warping at the specified test pressure

Warping in hose tests is the deviation from a straight line drawn from fitting to fitting in a plane parallel to the surface on which the hose rests at the initial state [no pressure or maintain pressure of 0,07 MPa (0,7 bar)]. A tightly stretched cord may be used to establish the straight line from centre to centre of the fittings. The amount of warping at the specified test pressure is the maximum deviation of any portion of the hose from the straight line drawn from centre to centre of the fittings at the initial state. Express warping as the distance from this line to the centreline of the hose at the point of maximum deviation. Report the result to the nearest 5 mm.

8.3 Burst pressure test

Increase the pressure at a rate in accordance with [7.2.2](#) until the hose or hose assembly fails. Leakage at the end fitting, fitting blow-off, or ruptures within 25 mm from the terminal of fitting or a distance equal to external diameter of the hose, whichever is greater, is considered as failures in the performance of the assembly.

The position and mode of failure shall be recorded in the test report. If stated in the product standard, finish the test when the specified burst pressure is reached.

This test shall be considered a destructive test and the test piece shall be disposed of in accordance with local environmental guidelines.

For an illustration of the test procedure, see [Figure 3](#).

The complete test sequence (proof pressure — testing pressure — bursting pressure) only applies to “type tests”. For routine tests, the “measuring sequence” after the proof pressure is only applicable when the relevant hose product standard specifies this.

Measure the initial length and diameter/circumference and place reference marks for twist measurement between points A and B. Measure the increase in the length, diameter/circumference, twist and warping directly in front of point C.

8.4 Leakage test

8.4.1 Test pieces

The test pieces for the leakage test shall comprise unaged hose assemblies on which the end fittings have been attached for not more than 30 days and not less than 1 day.

8.4.2 Procedure

Subject the test assemblies to a specified hydrostatic pressure equal to 70 % of the specified minimum burst pressure. Maintain this specified test pressure for 5 min ± 0,5 min and then reduce it to zero. Re-apply the specified test pressure and maintain it for a further period of 5 min ± 0,5 min. This is considered to be a destructive test and the test assemblies shall be destroyed after test.

8.4.3 Criteria for failure

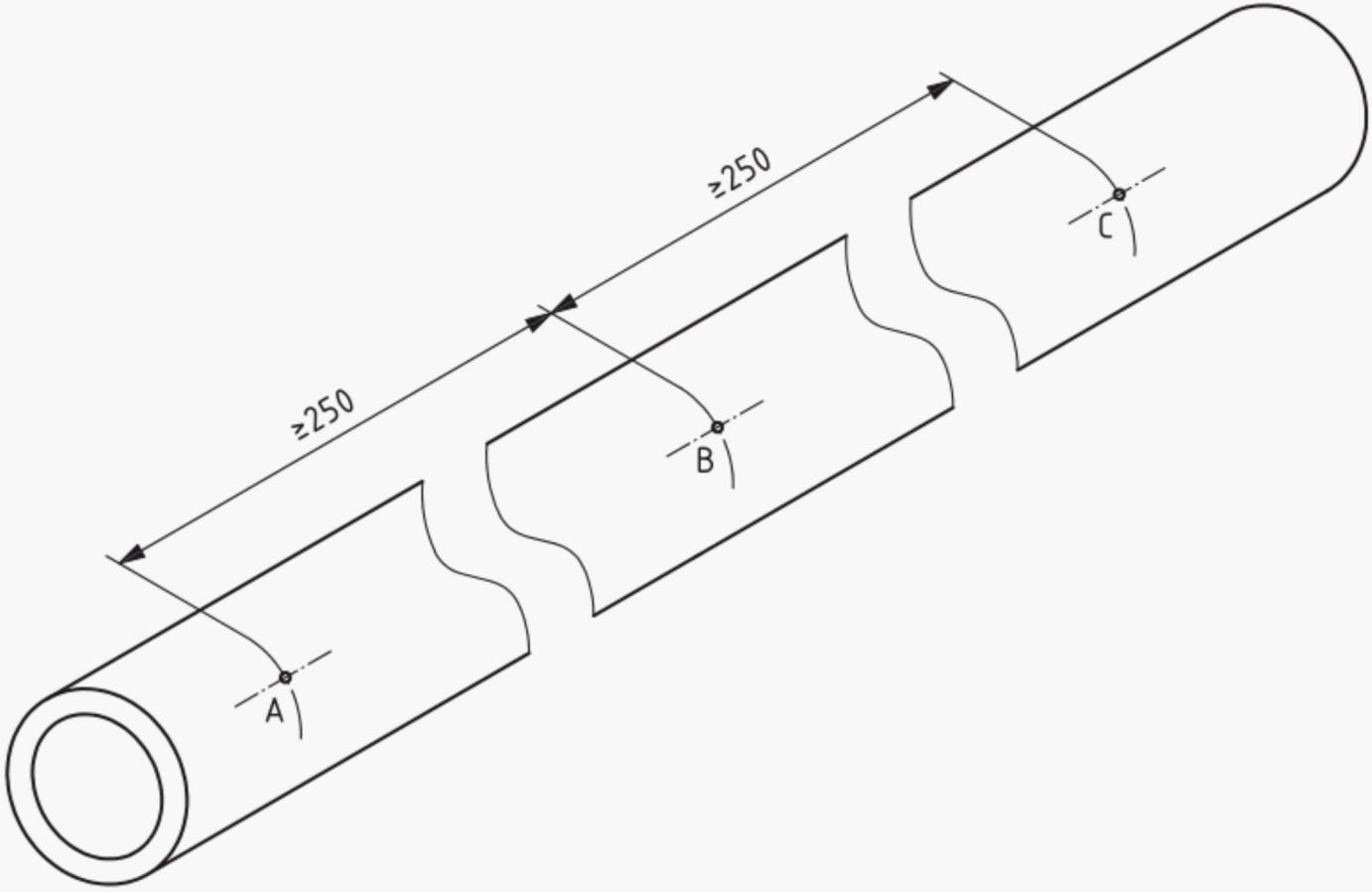
There shall be no leakage or evidence of failure. Leakage at the end fitting, fitting blow-off or rupture of the hose adjacent to the fitting shall be considered as failures in the performance of the assembly. Such failures do not necessarily demonstrate an inability of the hose to meet the specified requirements with an alternative fitting.

9 Test report

The test report shall include the following particulars for each test undertaken:

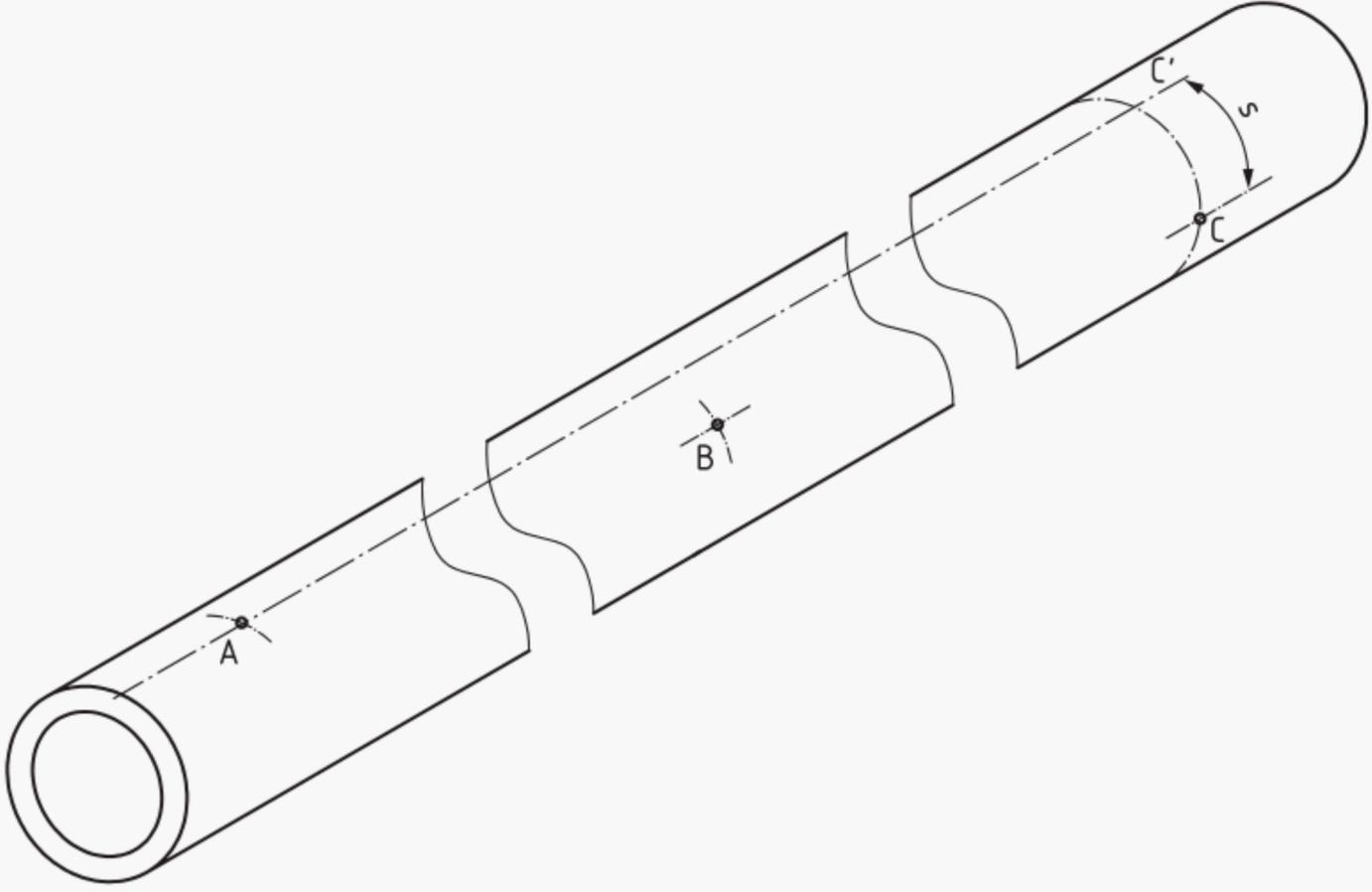
- a) a full description of the hose and, where applicable, the hose assembly tested;
- b) a reference to this document with year of publication, i.e. ISO 1402:2021;
- c) the method used;
- d) the number of test pieces tested and the length of each test piece;
- e) the test pressure and rate of pressure increase;
- f) the test medium (if other than water);
- g) the results obtained for each test piece;
- h) if the test piece fails, the position and mode of failure;
- i) any unusual features noted during the test;
- j) the date of the test.

Dimensions in millimetres



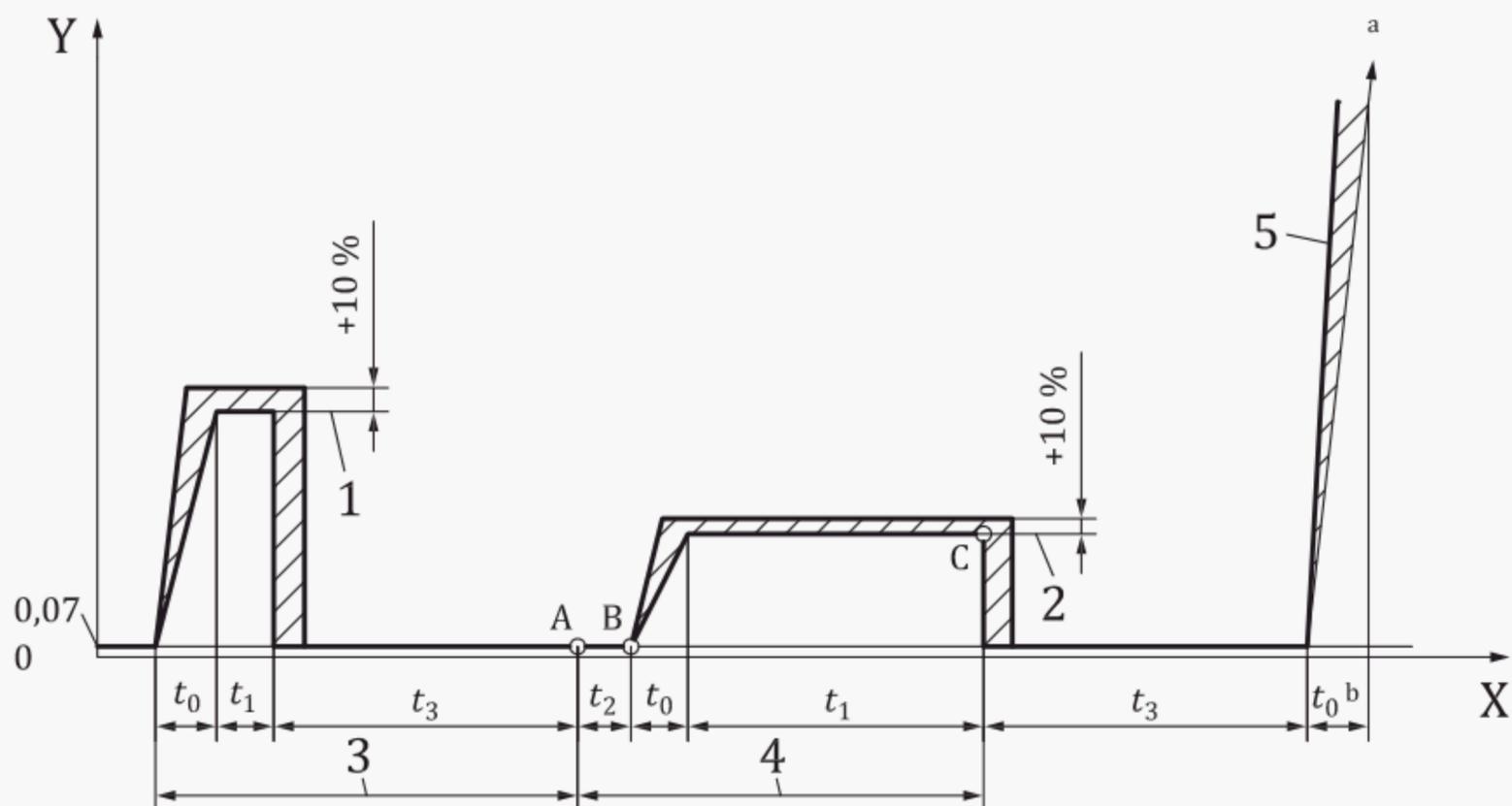
NOTE This also applies to hose assemblies (end fittings are not shown in this figure).

Figure 1 — Measurement of dimensional stability



NOTE This also applies to hose assemblies (end fittings are not shown in this figure).

Figure 2 — Measurement of amount of twisting



Key

- X time, t
- Y pressure, p (in MPa or bar)
- 1 proof pressure
- 2 testing pressure
- 3 detecting of leakage and defects
- 4 measuring
- 5 bursting pressure
- t_0 specified pressure increasing time
- t_1 specified pressure holding time
- t_2 initial dimensions (length and diameter) at reference pressure [0 or 0,07 MPa (0,7 bar)] measuring time
- t_3 specified waiting time between different pressures
- a To burst.
- b Bursting.

Figure 3 — Example of a hydrostatic test sequence as specified in this document

Bibliography

- [1] [ISO 4671](#), *Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies*

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BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK