

# Rubber hoses and hose assemblies for steam — Test methods (ISO 4023:2009)

ICS 23.040.70

## National foreword

This British Standard is the UK implementation of EN ISO 4023:2009. It supersedes BS EN ISO 4023:1995 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/66/-/4, Rubber and plastics tubing, hoses and hose assemblies - Methods of test.

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

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2010

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ISBN 978 0 580 61718 8

### Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

**EN ISO 4023**

NORME EUROPÉENNE

EUROPÄISCHE NORM

November 2009

ICS 23.040.70

Supersedes EN ISO 4023:1995

English Version

## Rubber hoses and hose assemblies for steam - Test methods (ISO 4023:2009)

Tuyaux et flexibles en caoutchouc pour la vapeur -  
Méthodes d'essai (ISO 4023:2009)

Gummischläuche und -schlauchleitungen für Dampf -  
Prüfverfahren (ISO 4023:2009)

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## Foreword

This document (EN ISO 4023:2009) 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of an identical text or by endorsement, at the latest by May 2010, and conflicting national standards shall be withdrawn at the latest by May 2010.

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### Endorsement notice

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## Foreword

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ISO 4023 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

This fourth edition cancels and replaces the third edition (ISO 4023:1991), which has been technically revised.

The major technical change is the broadening of the scope to include hose assemblies. These have to be fitted with suitable end connections and couplings as, for a particular hose design, the type of end connection used can have a significant influence on the test results.

A procedure for dealing with any initial leakage between hose body and end fitting which sometimes occurs at the start of the test is also included.

# Rubber hoses and hose assemblies for steam — Test methods

**WARNING** — Persons using this International Standard should be familiar with normal laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate health and safety practices and to ensure compliance with any national regulatory conditions.

All necessary safety devices shall be provided to ensure safe working conditions for the operators.

## 1 Scope

This International Standard specifies test methods in which a rubber hose test piece or hose assembly is exposed to saturated steam, thus simulating service conditions.

Four methods are specified, namely:

- method A: vertical rack method;
- method B: horizontal rack method;
- method C: flexing test, vertical arrangement;
- method D: flexing test, horizontal arrangement.

## 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 6134, *Rubber hoses and hose assemblies for saturated steam — Specification*

## 3 Method A: Vertical rack method

### 3.1 Principle

A length of hose or hose assembly is held in a fixed vertical position and saturated steam is passed through it.

**NOTE** The temperature or pressure of the steam and the time of exposure are given in ISO 6134 for each particular hose type. The relevant hose product standard will normally state which, if any, physical properties are to be used to check for hose deterioration as well as the permitted changes in these properties. Properties commonly specified are bursting strength, tensile strength, elongation at break of the lining and/or cover and adhesion between layers. Visually assessed test criteria may also be specified, for example rupture of reinforcement, cracking of cover to a specified depth and pitting or blistering of the lining. Sometimes, the time of exposure until the hose fails may be specified as the test criterion.

For hose assemblies, the check is carried out as for hoses but, in addition, it is recorded in the test report whether there is any failure or leakage at the end-fitting-to-hose interface.

## 3.2 Apparatus

Refer to Figure 1. Two fixed horizontal steam manifolds having suitable connections for attaching test pieces are placed one above the other at such a distance that the test pieces will just fit between the connections in a vertical position without distortion. Dry saturated steam at the required pressure is supplied to the test pieces through the upper manifold, which is equipped with a pressure-regulating valve, a recording gauge and one or more suitable indicating gauges. The lower manifold is connected to a steam trap. Shut-off valves are provided at each opening in each manifold.

Should the apparatus be confined within an enclosure as a safety precaution, the enclosure shall be designed so that the ambient temperature measured 25 mm from the outer surface of the hose is not more than 11 °C above room temperature.

## 3.3 Test piece

### 3.3.1 Hoses

The test piece shall be a sample of hose, not less than 500 mm in length, and of a length sufficient to allow coupling removal after the steam test and recoupling the hose with an appropriate coupling for a burst test.

### 3.3.2 Hose assemblies

The test piece for the hose assembly shall be not less than 500 mm in length and shall be fitted with the recommended or specified end fittings.

## 3.4 Procedure

Mount the test piece in the apparatus and subject it to the internal steam conditions specified in ISO 6134 for the particular type of hose under test. After exposure for the time specified in ISO 6134 for the particular type of hose under test, release the pressure in the test piece, remove it from the apparatus, allow it to cool and hold it under atmospheric conditions for not less than 16 h and not more than 100 h.

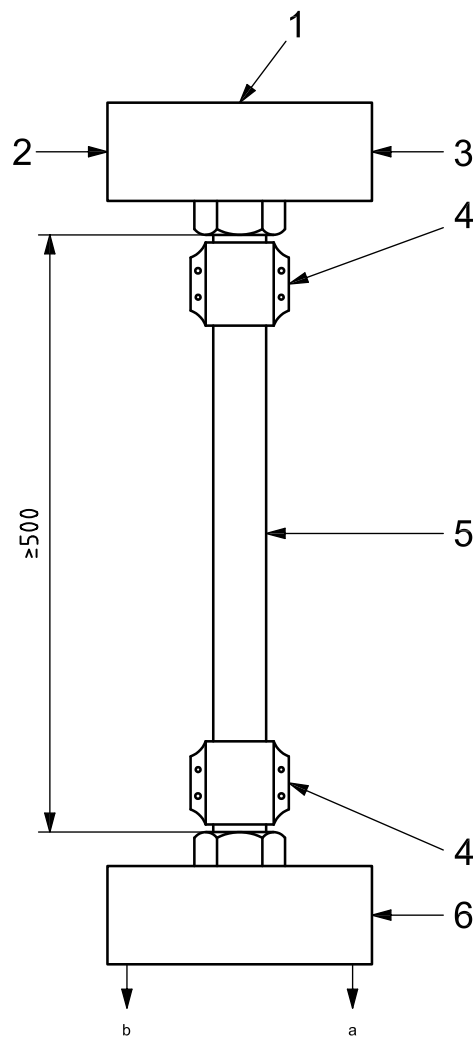
After this time, examine the test piece visually and carry out the physical determinations specified; at the same time, determine the same properties on a length of hose or a hose assembly which has not been exposed. In the case of hose assemblies, if a burst test is specified in the relevant product standard the complete hose assembly shall be removed from the apparatus to carry out the test.

If so specified, the exposure shall be continued until the hose or hose assembly fails, as indicated by the specified criteria, and the time to failure noted. These specified criteria will be stated in the relevant hose product standard.

Normally, at the start of the test, tightening of the hose end fittings to stop initial slight leakage between end fitting and hose body is allowed, unless the hose product standard explicitly forbids it. Once the end fittings have been tightened and leakage has been stopped as a result of this action, however, further tightening necessary to stop any subsequent leakage is not allowed and the hose assembly will be considered to have failed the test if such leakage takes place.



Dimensions in millimetres



**Key**

- 1 steam inlet manifold
- 2 recording and indicating gauges
- 3 pressure-regulating valve
- 4 suitable end fittings with couplings
- 5 steam hose or hose assembly under test
- 6 manifold
- a To open/close valve.
- b To steam trap.

**Figure 1 — Schematic diagram of arrangement for vertical steam rack test (method A)**

### 3.5 Test report

The test report shall include the following particulars:

- a) a full description of the hose or hose assembly (including end fittings) tested;
- b) a reference to this test method, i.e. ISO 4023:2009, method A;
- c) a reference to the relevant specification in which the test criteria are given or details of such criteria;
- d) details of the visual assessment of the test piece after testing;
- e) the results of the physical tests specified in the relevant specification;
- f) if testing was continued until the test piece failed, the time to failure;
- g) any other expression of results required by the relevant specification;
- h) any special observations.

## 4 Method B: Horizontal rack method

### 4.1 Principle

A length of hose or a hose assembly fitted with the recommended or specified end fittings is held in a horizontal position in such a manner that it sags, enabling condensate to collect in part of it.

NOTE 1 The temperature or pressure of the steam and the time of exposure are given in ISO 6134 for each particular hose type. The extent to which changes in appearance and physical properties as a result of exposure are permitted will normally be stated in the relevant hose specification (see also the note in 3.1).

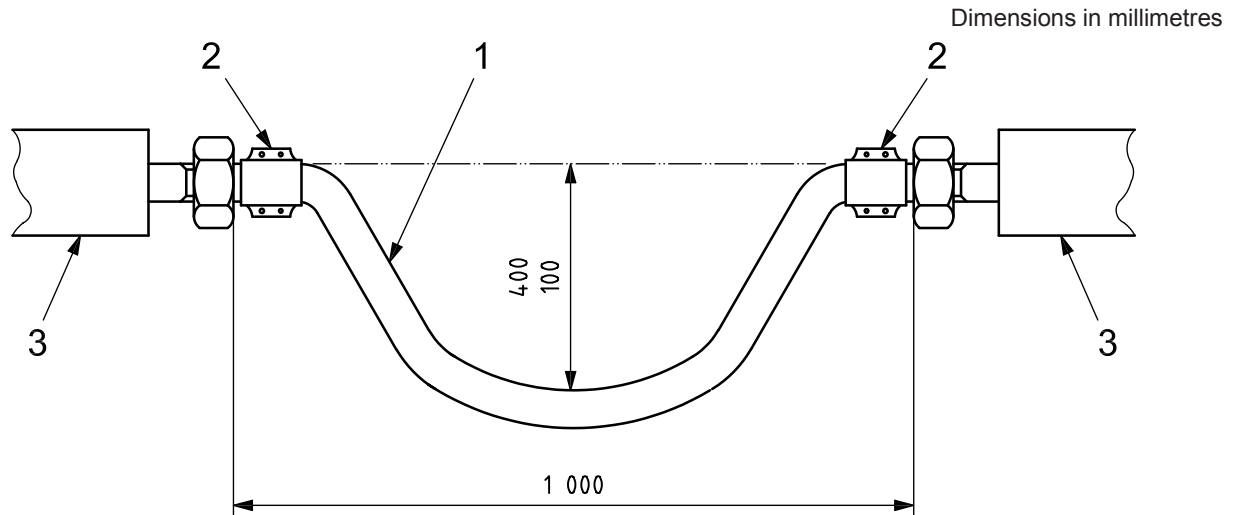
NOTE 2 This test is usually used to measure the tendency for the lining to blister or “chunk” out (“popcorning”), i.e. for portions of the lining to fracture and become detached.

For hose assemblies, the test is carried out as for hoses but, in addition, it is recorded in the test report whether there is any failure or leakage at the end-fitting-to-hose interface.

### 4.2 Apparatus

Refer to Figure 2. Two fixed horizontal steam manifolds having suitable connections for attaching test pieces are placed parallel to each other and in the same horizontal plane approximately 1 m from each other. Dry saturated steam at the required pressure is supplied to the test piece through one manifold, which is equipped with a pressure-regulating valve, a recording gauge and a suitable indicating gauge. The other manifold is connected to a steam trap. Shut-off valves are provided at each opening in each manifold.

Should the apparatus be confined within an enclosure as a safety precaution, the enclosure shall be so designed that the ambient temperature measured 25 mm from the outer surface of the hose is not greater than 11 °C above room temperature.



**Key**

- 1 hose or hose assembly under test
- 2 suitable end fittings with couplings
- 3 manifold

**Figure 2 — Schematic diagram of arrangement for horizontal steam rack test (method B)**

**4.3 Test piece**

The test piece shall be a sample of hose or a hose assembly fitted with the recommended or specified end fittings and of suitable length to conform to Figure 2.

**4.4 Procedure**

Mount the test piece in the apparatus so that there is a sag in the hose of 100 mm to 400 mm below the level of the hose at the manifolds. Subject the hose to the internal steam conditions specified in ISO 6134 for the particular type of hose under test. After 20 h, exhaust the hose within a time of 1 min or less and allow the hose to cool to room temperature for 4 h. Repeat this cycle for the length of time specified in ISO 6134 for the particular type of hose under test.

After exposure for the specified time, release the pressure in the test piece, remove it from the apparatus, allow it to cool and hold it under atmospheric conditions for not less than 16 h and not more than 100 h.

After this time, examine the test piece visually and carry out the physical determinations specified; at the same time, determine the same properties on a length of hose or a hose assembly which has not been exposed. In the case of hose assemblies, if a burst test is specified in the relevant product standard the complete hose assembly shall be removed from the apparatus to carry out the test.

If so specified, the exposure shall be continued until the hose (or hose assembly) fails, as indicated by the specified criteria, and the time to failure noted. These specified criteria will be stated in the relevant hose product standard.

Normally, at the start of the test, tightening of the hose end fittings to stop initial slight leakage between end fitting and hose body is allowed, unless the hose product standard explicitly forbids it. Once the end fittings have been tightened and leakage has been stopped as a result of this action, however, further tightening necessary to stop any subsequent leakage is not allowed and the hose assembly will be considered to have failed the test if such leakage takes place.

## 4.5 Test report

The test report shall include the following particulars:

- a) a full description of the hose or hose assembly (including end fittings) tested;
- b) a reference to this test method, i.e. ISO 4023:2009, method B;
- c) a reference to the relevant specification in which the test criteria are given or details of such criteria;
- d) details of the visual assessment of the test piece after testing;
- e) the results of the physical tests specified in the relevant specification;
- f) if testing was continued until the test piece failed, the time to failure;
- g) any other expression of results required by the relevant specification;
- h) any special observations.

## 5 Method C: Flexing test, vertical arrangement

### 5.1 Principle

A length of hose or a hose assembly fitted with the recommended or specified end fittings is repeatedly flexed in a vertical configuration whilst saturated steam is passed through it.

This test is normally run for a specified number of hours, during which there shall be no failure. The hose may then be visually examined or tested for compliance with specified requirements.

NOTE The temperature or pressure of the steam and the time of exposure are given in ISO 6134 for each particular hose type. The extent to which changes in appearance and physical properties as a result of exposure are permitted will normally be stated in the relevant hose specification (see also the note in 3.1).

For hose assemblies, the check is carried out as for hoses but, in addition, it is recorded in the test report whether there is any failure or leakage at the end-fitting-to-hose interface.

### 5.2 Apparatus

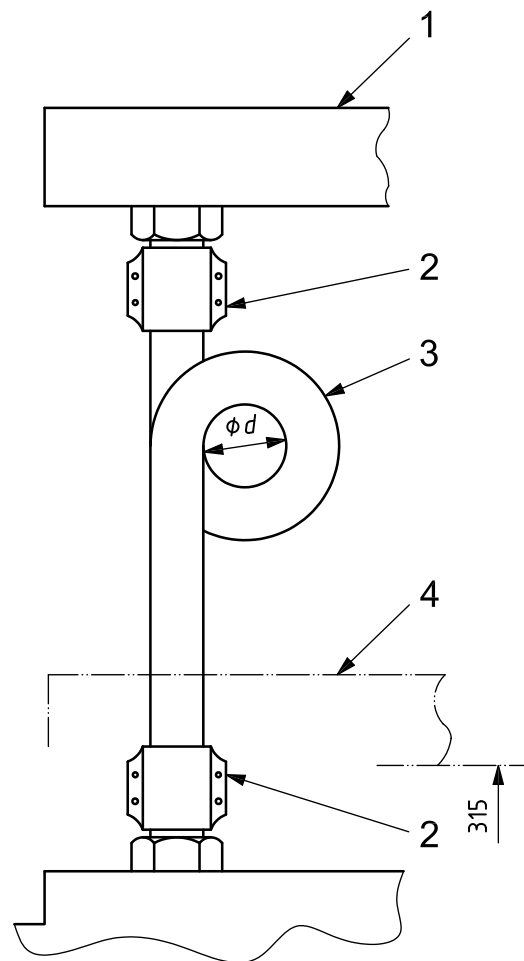
Refer to Figure 3. Two horizontal steam manifolds having suitable connections for attaching test pieces are spaced one above the other, mounted so that one of the manifolds is capable of moving vertically a distance of 315 mm during testing. Dry saturated steam at the required pressure is supplied to the specimens through the upper manifold, which is equipped with a pressure-regulating valve, a recording gauge and suitable indicating gauges. The lower manifold is connected to a steam trap. Shut-off valves are provided at each opening in each manifold.

Should the apparatus be confined within an enclosure as a safety precaution, the enclosure shall be so designed that the ambient temperature measured 25 mm from the outer surface of the hose is not greater than 11 °C above room temperature.

### 5.3 Test piece

The test piece shall be a piece of the hose sample or a hose assembly fitted with the recommended or specified end fittings, cut to such a length that it will form a loop of inside diameter ( $d$  in Figure 3) which is 10 times the hose inside diameter when disposed between the manifolds at their maximum distance apart.

Dimensions in millimetres



**Key**

- 1 stationary manifold
  - 2 suitable end fittings with couplings
  - 3 hose or hose assembly under test
  - 4 reciprocating manifold, vertical movement 315 mm
- d* 10 nominal inside hose diameters when lower manifold is in its lowest position (i.e. when the distance between the manifolds is at its maximum)

NOTE Manifolds may be constructed to hold more than one hose or hose assembly.

**Figure 3 — Schematic diagram of arrangement for vertical flexing test (method C)**

**5.4 Procedure**

Mount the test piece between the upper and lower manifolds in such a way that a loop is formed with an inside diameter 10 times the hose inside diameter when the manifolds are at their maximum distance from each other. Apply steam continuously at the pressure specified in ISO 6134 for the particular type of hose under test for the time specified for the particular type of hose under test. During this period of exposure, move one of the manifolds up and down on a 315 mm stroke to flex the test piece at a rate of 0,1 Hz. If necessary, the upper part of the loop may be supported by means of a suspension wire or cord.

After exposure for the specified time, release the pressure in the test piece, remove it from the apparatus, allow it to cool and hold it under atmospheric conditions for not less than 16 h and not more than 100 h.

After this time, examine the test piece visually and carry out the physical determinations specified; at the same time, determine the same properties on a length of hose or a hose assembly which has not been exposed. In the case of hose assemblies, if a burst test is specified in the relevant product standard the complete hose assembly shall be removed from the apparatus to carry out the test.

If so specified, the exposure shall be continued until the hose or hose assembly fails, as indicated by the specified criteria, and the time to failure noted. These specified criteria will be stated in the relevant hose product standard.

Normally, at the start of the test, tightening of the hose end fittings to stop initial slight leakage between end fitting and hose body is allowed, unless the hose product standard explicitly forbids it. Once the end fittings have been tightened and leakage has been stopped as a result of this action, however, further tightening necessary to stop any subsequent leakage is not allowed and the hose assembly will be considered to have failed the test if such leakage takes place.

## 5.5 Test report

The test report shall include the following particulars:

- a) a full description of the hose or hose assembly (including end fittings) tested;
- b) a reference to this test method, i.e. ISO 4023:2009, method C.
- c) a reference to the relevant specification in which the test criteria are given or details of such criteria;
- d) details of the visual assessment of the test piece after testing;
- e) the results of the physical tests specified in the relevant specification;
- f) if testing was continued until the test piece failed, the time to failure;
- g) any other expression of results required by the relevant specification;
- h) any special observations.

## 6 Method D: Flexing test, horizontal arrangement

### 6.1 Principle

A length of hose or a hose assembly in a horizontal configuration is used to convey saturated steam while being subjected to flexing during a predetermined cycle. The maximum bore size of hose which can be tested is 50 mm.

The hose or hose assembly is subjected to flexing, alternating with resting in a horizontal position, in accordance with a timed cycle. The position is selected to evaluate the service performance of a hose in experimental conditions closely simulating regular industrial service conditions. Such a position causes three bends in reverse directions:

- first bend, in the area of the supply fitting;
- second bend, at the bottom part of the loop;
- third bend, in the area of the outlet fitting.

The reverse bends check the performance of the whole construction of the hose. Due to both the horizontal position and the bottom bend, condensed water will also occasionally be present, as it would be in regular industrial service conditions.

The test equipment allows the hose to be subjected to the bending permitted by its construction. From measurements of the bend radii specified during the test, it is possible to evaluate the flexibility retained or the gradual degradation of the hose during the test.

**NOTE** The temperature or pressure of the steam and the time of exposure are given in ISO 6134 for each particular hose type. The extent to which changes in appearance and physical properties as a result of exposure are permitted will normally be stated in the relevant hose specification (see also the note in 3.1).

For hose assemblies, the check is carried out as for hoses but, in addition, it is recorded in the test report whether there is any failure or leakage at the end-fitting-to-hose interface.

## 6.2 Apparatus

Refer to Figure 4. The apparatus is designed so that it is possible to install one or several hoses using one steam supply line. The equipment may be used only for hoses not larger than 50 mm in diameter.

One end is stationary; the other end has an automatically timed reciprocating horizontal movement. The adjustable travel makes it possible to adjust the minimum bending radius at the start of the test as required.

During the test, the steam supply is kept constant and the supply circuit, properly drained, is controlled through a pressure recorder.

## 6.3 Test piece

The test piece shall be a hose or a hose assembly fitted with the recommended or specified end fittings, 2 m in length for all bore sizes.

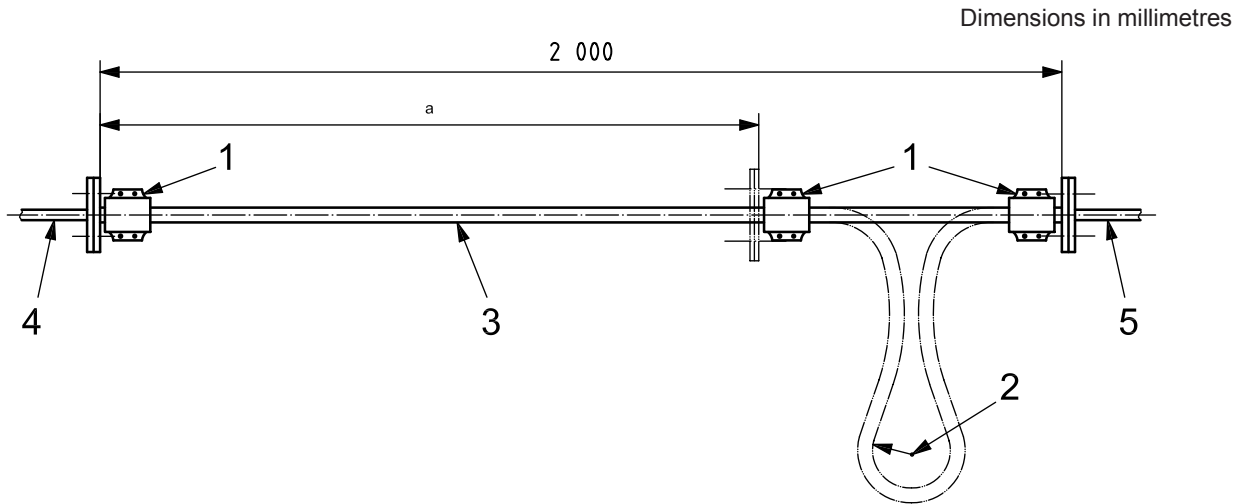
## 6.4 Procedure

Mount the test piece in the apparatus and adjust the horizontal movement so that the test piece is bent to its minimum bend radius.

The length of the exposure cycle shall be 4 h unless otherwise specified in the hose specification, made up as follows:

- static horizontal position      3 h 15 min;
- flexing at 0,33 Hz                0 h 45 min.

Measure the minimum bend radius of the original test piece and check the value once per cycle during the test.



**Key**

- 1 suitable end fittings with couplings (flanged or other connections)
- 2 minimum bend radius of the hose or hose assembly
- 3 hose or hose assembly under test
- 4 reciprocating end
- 5 stationary end
- <sup>a</sup> Movement arranged so that the test piece is bent to its minimum bend radius.

**Figure 4 — Schematic diagram of arrangement for horizontal flexing test (method D)**

After exposure for the time specified in ISO 6134 for the particular type of hose under test, release the pressure in the test piece, remove it from the apparatus, allow it to cool and hold it under atmospheric conditions for not less than 16 h and not more than 100 h.

After this time, examine the test piece visually and carry out any physical determinations specified; at the same time, determine the same properties on a length of hose or a hose assembly which has not been exposed. In the case of hose assemblies, if a burst test is specified in the relevant product standard the complete hose assembly shall be removed from the apparatus to carry out the test.

If so specified, the exposure shall be continued until the hose fails, as indicated by the specified criteria, and the time to failure noted. These specified criteria will be stated in the relevant hose product standard.

Normally, at the start of the test, tightening of the hose end fittings to stop initial slight leakage between end fitting and hose body is allowed, unless the hose product standard explicitly forbids it. Once the end fittings have been tightened and leakage has been stopped as a result of this action, however, further tightening necessary to stop any subsequent leakage is not allowed and the hose assembly will be considered to have failed the test if such leakage takes place.



## 6.5 Test report

The test report shall include the following particulars:

- a) a full description of the hose or hose assembly (including end fittings) tested;
- b) a reference to this test method, i.e. ISO 4023:2009, method D;
- c) a reference to the relevant specification in which the test criteria are given or details of such criteria;
- d) details of the visual assessment of the test piece after testing;
- e) the results of the physical tests specified in the relevant specification;
- f) if testing was continued until the test piece failed, the time to failure;
- g) any other expression of results required by the relevant specification;
- h) any special observations.

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