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Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness —

Part 1: Bending tests at ambient temperature

Tuyaux et tubes en caoutchouc et en plastique — Mesurage de la flexibilité et de la rigidité —
Partie 1: Essais de courbure à température ambiante

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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 on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

This second edition cancels and replaces the first edition (ISO 10619-1:2011), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— the unit used in the formula to calculate the flexural stiffness in 8.4 and 8.5 has been changed.

A list of all parts in the ISO 10619- series can be found on the ISO website.

Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness —

Part 1: Bending tests at ambient temperature

WARNING — Persons using this document should be familiar with normal laboratory practice. This document 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 safety and health practices.

1 Scope

This document specifies three methods for measuring the flexibility of rubber and plastics hoses and tubing (methods A1, B and C1), where the deformation of the hose or tubing is measured, and two methods for measuring the stiffness (methods A2 and C2) by measuring the force required to bend rubber or plastics hoses or tubing to a specific radius at ambient temperature.

Methods A1 and A2 are suitable for rubber and plastics hoses and tubing with inside diameter of up to and including 80 mm.

Method A1 allows the measurement of the flexibility of the hose or tubing by measuring the reduction in outside diameter when the hose is compressed between two plates.

Method A2 provides a means of measuring the force required to reach a specific bend radius when the hose or tubing is compressed, as between two plates. The test can be carried out at a specified internal pressure.

Method B is suitable for rubber and plastics hoses and tubing with inside diameter of up to and including 100 mm, and provides a means of assessing the behaviour of the hose and tubing when bent around a mandrel. The final mandrel diameter used can be taken as the minimum bend radius of the hose or tubing. As this value is determined by the reduction of the outside diameter, it can be used as a measure of the flexibility of the hose or tubing. The hose or tubing being tested can be unpressurized, pressurized or under vacuum and, if required, with the curvature or against the curvature of the hose or tubing, if such curvature is present.

Methods C1 and C2 are suitable for rubber and plastics hoses and tubing with inside diameter of 100 mm and greater.

Method C1 provides a means of determining the flexibility of the hose and tubing at the minimum bend radius.

Method C2 provides a method of measuring the stiffness of the hose and tubing at the minimum bend radius.

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 4671, *Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies*

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 and the following apply.

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

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

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
bending
shaping or forcing something straight into a curve or angle at a specified temperature

3.2
flexibility
ease of *bending* (3.1) a hose without it being damaged by kinking, collapse, breaking or cracking

Note 1 to entry: A hose can be bent around a mandrel, for example.

3.3
stiffness
resistance of a hose to *bending* (3.1)

3.4
hose deformation
ovality obtained when a hose is compressed or *bent* (3.1) around a mandrel

Note 1 to entry: This may be measured by the reduction in the outside or inside diameter.

3.5
flexural stiffness
measure of the resistance of a hose to *bending* (3.1)

3.6
dynamometer
force measuring device

4 Method A1

4.1 Apparatus

The apparatus shall consist of two guides, A and B, guide A being fixed in a plane and guide B being movable in that plane, parallel to and in line with, guide A [see Figure 1a)].

If it is desired to measure the force to attain the specified radius of curvature, this may be done, for example, by means of pulleys and weights. Care shall be taken to minimize the effects of frictional resistance (see Figure 2).

4.2 Hose test pieces

4.2.1 Types and dimensions

The hose test pieces shall consist either of complete manufactured lengths of hose or suitable test lengths. If the manufactured length is shorter than the length required for the test, hose test pieces of adequate length shall be specially manufactured.

4.2.2 Number

Unless otherwise specified, two hose test pieces shall be tested.

4.3 Conditioning of hose test pieces

No test shall be carried out within 24 h of manufacture.

For evaluations which are intended to be comparable, the test shall, as far as possible, be carried out after the same time interval following manufacture. ISO 23529 shall be followed for the time between sample manufacture and testing.

Before testing, hose test pieces shall be conditioned for at least 16 h at a standard laboratory temperature and humidity. This 16 h period may be part of the 24h interval after manufacture.

4.4 Test temperatures

The test shall be conducted at a standard laboratory temperature and humidity in accordance with ISO 23529.

4.5 Test procedure

4.5.1 If required, apply the specific test pressure or vacuum as given in the relevant product specification.

4.5.2 Measure and determine the average outside diameter, *D*, of the hose by means of a suitable measuring instrument as specified in ISO 4671.

4.5.3 Draw two parallel and diametrically opposed lines along the length of the hose. If the hose has natural curvature, one of the lines shall be on the outside of the curve. On each of these lines, mark a distance of 1,6 C + 2 D or 200 mm, whichever is longer, where C is twice the minimum bend radius specified in the appropriate specification, so that the marked distances are exactly opposed. This ensures a sufficient length for the bend test and adequate support of the hose.

4.5.4 Separate guides A and B to a distance slightly less than 1,6 C + 2 D. Place the hose between the guides so that the ends of the marked distances are parallel to the ends of the guides and remain in this position while the guides are closed to a distance of C + 2 D (see Figure 1).

4.5.5 Check that the hose on each side is supported to a length of not less than D.

4.5.6 Measure and determine the minimum outside dimension, T, in the curved position of the hose [see Figure 1b)].

4.6 Expression of results

Calculate the value of T/D using the mean values obtained. Compare the result with the permitted deformation given in the appropriate hose specification.

4.7 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 10619-1:2017;

b) the method used;

c) a full description of the hose or tubing tested and a reference to the hose specification in accordance with which the hose was tested;

d) the test temperature;

e) the internal pressure or vacuum at which the test was carried out (if applicable);

f) observation on any abrupt change(s) in the hose section or irregularity in curvature caused by kinking;

g) the value of D,T and T/D;

h) whether T/D was within the permitted deformation;

i) the date of the test.

5 Method A2

5.1 Apparatus

The apparatus shall consist of two guides, A and B, guide A being fixed in a plane and guide B being movable in that plane, parallel to and in line with, guide A, and attached to a series of pulleys and weights, as shown in Figure 2. Care shall be taken to minimize the effects of frictional resistance.

5.2 Hose test pieces

5.2.1 Types and dimensions

The hose test pieces shall consist either of complete manufactured lengths of hose or suitable test lengths. If the manufactured length is shorter than the length required for the test, test pieces of adequate length shall be specially manufactured.

5.2.2 Number

Unless otherwise specified, two hose test pieces shall be tested.

5.3 Conditioning of hose test pieces

No test shall be carried out within 24 h of manufacture.

For evaluations which are intended to be comparable, the test shall, as far as possible, be carried out after the same time interval following manufacture. ISO 23529 shall be followed for the time between sample manufacture and testing.

Before testing, hose test pieces shall be conditioned for at least 16 h at a standard laboratory temperature and humidity. This 16 h period may be part of the 24 h interval after manufacture.

5.4 Test temperatures

The test shall be conducted at a standard laboratory temperature and humidity in accordance with ISO 23529.

5.5 Test procedure

5.5.1 If required, apply the specific test pressure or vacuum as given in the relevant product specification.

5.5.2 Draw two parallel and diametrically opposed lines along the length of the hose test piece. If the hose has natural curvature, one of the lines shall be on the outside of the curve. On each of these lines, mark a distance of 1,6 C + 2 D or 200 mm, whichever is longer, where C is twice the minimum bend radius specified in the appropriate specification, so that the marked distances are exactly opposed. This ensures a sufficient length for the bend test and adequate support of the hose.

5.5.3 Separate guides A and B to a distance slightly less than 1,6 C + 2 D. Place the hose between the guides so that the ends of the marked distances are parallel to the ends of the guides and remain in this position while the guides are closed to a distance of C + 2 D by adding weights until the minimum outside dimension, T, in the curved position of the hose, has been achieved (see Figure 1).

5.5.4 Check that the hose on each side is supported to a length of not less than D.

5.5.5 Measure and determine the minimum outside dimension, T, in the curved position of the hose and note the total weight added, in kilograms, to reach this position [see Figure 1a)].

5.6 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 10619-1:2017;

b) the method used;

c) a full description of the hose or tubing tested and a reference to the hose specification in accordance with which the hose was tested;

d) the test temperature;

e) the internal pressure or vacuum at which the test was carried out, if applicable;

f) the value of T and the force (i.e. the total mass added, in kilograms) required to reach the specific bend radius;

g) the date of the test.

6 Method B

6.1 Apparatus

The apparatus shall consist of a mandrel, having an outside diameter equal to twice the minimum bend radius specified for the hose, or a former, with an arc of at least 180°, as shown in Figure 3. If the minimum bend radius is not specified, the mandrel or former shall have an outside diameter of equal to 12 times the nominal bore of the hose. Additional mandrels whose outside diameters are less that the diameter of the original mandrel chosen should be available.

6.2 Hose test piece

The hose test piece shall be cut from the hose under test and shall have a length adequate to provide a grip at each end in addition to a section which can be bent around the periphery of the mandrel. In addition, if the hose is being tested under pressure or vacuum the sample should be long enough to allow the attachment of suitable end fittings.

6.3 Test temperatures

The test shall be conducted at a standard laboratory temperature and humidity (see ISO 23529).