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

**Part 3:
Bending tests at high and low
temperatures**

*Tuyaux et tubes en caoutchouc et en plastique — Mesurage de la
flexibilité et de la rigidité —*

Partie 3: Essais de courbure à des températures basses et élevées



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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 10619-3 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

ISO 10619 consists of the following parts, under the general title *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness*:

- *Part 1: Bending tests at ambient temperature*
- *Part 2: Bending tests at sub-ambient temperatures*
- *Part 3: Bending tests at high and low temperatures*

Introduction

This method was originally included in ISO 1746¹⁾. This part of ISO 10619 allows for samples to be tested at sub-ambient temperatures and at elevated temperatures of up to 200 °C.

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1) Withdrawn.

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

Part 3: Bending tests at high and low temperatures

WARNING — Persons using this part of ISO 10619 should be familiar with normal laboratory practice. This part of ISO 10619 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 and to ensure compliance with any national regulatory conditions.

1 Scope

This part of ISO 10619 specifies a method for the determination of the bending characteristics of rubber and plastics hoses and tubing, including the force required for bending, over a range of temperatures from $-60\text{ }^{\circ}\text{C}$ to $+200\text{ }^{\circ}\text{C}$. The nature of the apparatus, however, limits its applicability to rubber and plastics hoses and tubing of small internal diameter, i.e. up to 12,5 mm.

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 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.

3.1

bending

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

3.2

flexibility

ease of bending a hose without it being damaged by kinking, collapse, breaking or cracking

NOTE A hose can be bent around a mandrel, for example.

3.3

stiffness

resistance of a hose to bending

4 Method

4.1 Apparatus

4.1.1 Compression testing machine, with a rate of travel of the moving jaw of 100 mm/min, preferably provided with a chart recorder. A scale, graduated in millimetre divisions, may be attached to the moving jaw to enable the bend diameter to be measured or, preferably, this may be determined from a graphical record or other measuring device.

4.1.2 Pair of twin channel-shaped holders, fitted with end stops for the hose test pieces (see Figure 1).

4.1.3 Thermostatically controlled environmental chamber, which can be fitted to the testing machine with the provision for access to enable the external diameter of the hose to be measured.

4.2 Hose test pieces

4.2.1 Types and dimensions

The test shall be carried out on two hose pieces (one set), of equal length, of the hose or tubing under test. The length of the hose test pieces depends on the dimensions of the hose test piece holders and shall be $2G + 0,5\pi(C+D)$, where G is the length of the hose test piece holders (see Figure 1) and C is twice the minimum bend radius specified in the appropriate specification. In no case shall the hose test pieces come into contact with the walls of the chamber and the length, L , shall always be less than the length of the enclosure.

4.2.2 Number of hose test pieces

Unless otherwise specified, three sets of tests shall be carried out (one set being two hose test pieces).

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 after manufacture. The time between sample manufacture and testing shall be in conformity with ISO 23529.

Before testing, the hose test pieces shall be conditioned in the straight condition or conforming to their natural curvature for 5 h in the environmental chamber (4.1.3) at the specified temperature (see 4.4).

4.4 Test temperature

The test temperature is specified in the appropriate hose specification.

4.5 Test procedure

4.5.1 Where testing is being done on samples conditioned to sub-ambient temperatures, the following test should be completed within 8 s to 12 s. Testing on samples conditioned at higher temperatures should be completed within 5 s and the test equipment should be conditioned to the same temperature as the test piece.

4.5.2 Measure the outside diameter, D , three times at the midpoint of the test pieces in the unstressed condition by means of a suitable measuring instrument as specified in ISO 4671. A total of three readings per set for each test piece shall be taken and the average of these should be used for the value of D_i .

4.5.3 Install the test piece between the holders with a large bend radius and the ends of the test pieces against the end stops. The curvature shall follow the natural curvature, if any.

4.5.4 Start the machine. Apply force between A and B (Figure 1) and determine the force required to reach twice the specified bend radius.

4.5.5 Divide the force value obtained by direct reading or from a graphical record by two to obtain the bending force for a single test piece.

4.5.6 Measure the outside dimension, T (see Figure 1) at the smallest diameter in the curved part of the hose. Six readings should be taken and the average of these should be used for the value of T_i .

5 Expression of results

Calculate the value T_i/D_i using the mean values obtained.

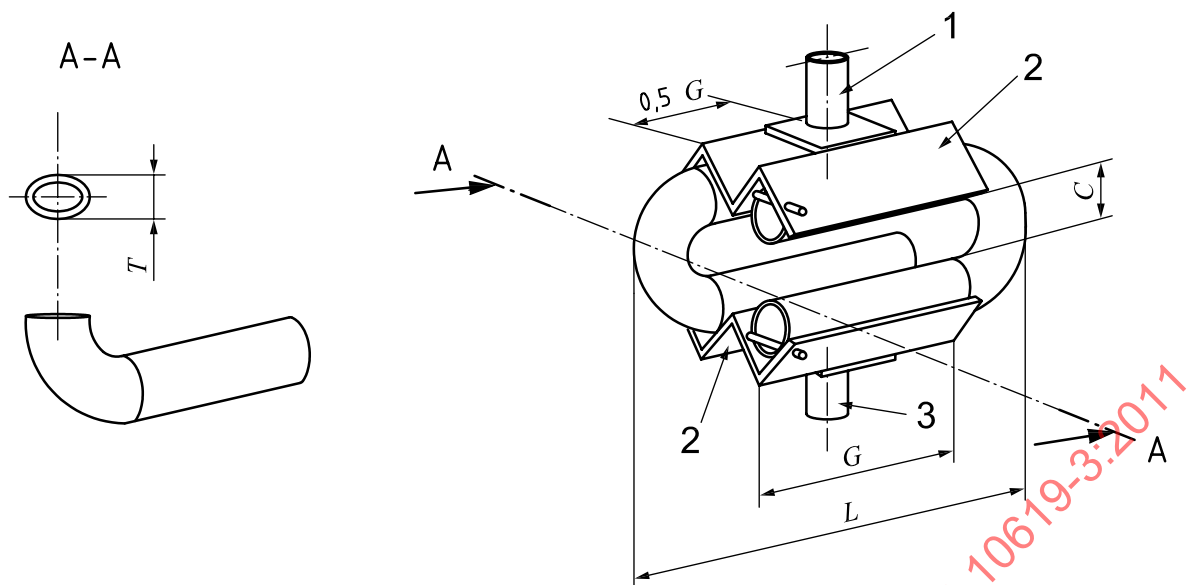
Where T_i is the outside diameter measured (see Figure 1) when the hose sample has been bent to its minimum bend radius and D_i is the outside diameter of the hose measured at the midpoint of the sample in the unstressed state.

Compare the result with the permitted deformation given in the appropriate hose specification.

6 Test report

The test report shall include the following information:

- a) a reference to this part of ISO 10619, i.e. ISO 10619-3:2011;
- b) details of 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) observation on any abrupt change(s) in hose section or irregularity in curvature caused by kinking;
- f) the value of D_i , T_i and T_i/D_i ;
- g) whether or not T_i/D_i was within the permitted deformation;
- h) the force required to reach the specified bend radius, if appropriate;
- i) the date of the test.



Key

- 1 part A
- 2 twin channel-shaped holders for hose sample
- 3 part B
- C twice the minimum bend radius
- G length of test piece holders
- $0,5 G$ half the length of the test piece holders
- L length of hose sample installed in the apparatus where L is less than the length of the heating or cooling chamber
- T smallest diameter on the curvature of the hose

Figure 1 — Schematic arrangement for test