
**Rubber or plastics hoses and tubing —
Bending tests**

Tuyaux et tubes en caoutchouc ou en plastique — Essais de courbure

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Foreword

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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.

International Standard ISO 1746 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

This third edition cancels and replaces the second edition (ISO 1746:1983), which has been technically revised.

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Printed in Switzerland

Rubber or plastics hoses and tubing — Bending tests

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 safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

This International Standard specifies two methods for the determination of the behaviour of rubber or plastics hoses or tubing when bent to a specified radius.

Method A is suitable for hoses and tubing of internal diameter up to about 80 mm; the size of the apparatus for testing hoses and tubing of larger bore sizes becomes excessive. The method also provides a means of measuring the force required to reach a specified bend radius, and the test may be carried out at a specified internal pressure.

In method B, the bending characteristics, including the force required for bending, may be determined over a range of temperatures from -60°C to $+200^{\circ}\text{C}$. The nature of the apparatus, however, limits its applicability to hoses and tubing of small internal diameter, i.e. up to about 12,5 mm.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 471:1995, *Rubber — Temperatures, humidities and times for conditioning and testing*.

ISO 4671:—¹⁾, *Rubber and plastics hose and hose assemblies — Methods of measurement of dimensions*.

3 Method A

3.1 Apparatus

The apparatus consists 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 1).

¹⁾ To be published. (Revision of ISO 4671:1984)

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

3.2 Test pieces

3.2.1 Types and dimensions

The test pieces shall consist either of complete manufactured lengths of hose or of 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.

3.2.2 Number

Unless otherwise specified, two test pieces shall be tested.

3.3 Conditioning of test pieces

No tests 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. ISO 471 shall be followed for time between sample manufacture and testing.

Before testing, test pieces shall be conditioned for at least 16 h at a standard laboratory temperature and humidity (see ISO 471); this 16 h period may be part of the 24 h interval after manufacture.

3.4 Test procedure

3.4.1 If required, apply the specified test pressure as given in the relevant product specification.

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

3.4.3 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 $1,6C + 2D$ or 200 mm, whichever is the longer, where C is twice the minimum bend radius specified in the appropriate specification, so that the marked distances are exactly opposed. This will ensure a sufficient length for the bend test and adequate support of the hose.

3.4.4 Separate guides A and B to a distance slightly less than $1,6C + 2D$. 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 $C + 2D$ (see figure 1).

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

3.4.6 Measure and determine the minimum outside dimension T in the curved portion of the hose (see figure 3).

4 Method B

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.

4.1.2 **Pair of twin channel-shaped holders**, fitted with end stops for the hose test pieces (see figure 4).

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

4.2 Test pieces

4.2.1 Types and dimensions

The test shall be carried out on two pieces, of equal length, of the hose or tubing under test. The length of the test pieces depends on the dimensions of the test piece holders and shall be $2G + 0,5\pi C$, where G is the length of the test piece holders (see figure 4) and C is twice the minimum bend radius specified in the appropriate specification. In no case shall the 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

Unless otherwise specified, three sets of tests shall be carried out.

4.3 Conditioning of 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. ISO 471 shall be followed for time between sample manufacture and testing.

Before testing, 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 test temperature (see 4.4).

4.4 Test temperature

ISO 1746:1998

The test temperature will be specified in the appropriate hose specification.

4.5 Test procedure

4.5.1 Measure the outside diameter D at the mid-point of the test pieces in the unstressed condition by means of a suitable measuring instrument as specified in ISO 4671.

4.5.2 Install the test pieces 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.

4.5.3 Start the machine and determine the force required to reach the specified bend radius.

4.5.4 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.

4.5.5 Measure the outside dimension T at any point in the curved portion of the hose.

NOTE — It is advantageous if the machine can be pre-set to stop when twice the specified bend radius C has been reached.

5 Expression of results

For both method A and method B, calculate the value of T/D using the mean values obtained. 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 of this International Standard;
- 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 at which the test was carried out;
- f) observation on any abrupt change(s) in 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 force required to reach the specified bending radius, if appropriate;
- j) the date of the test.

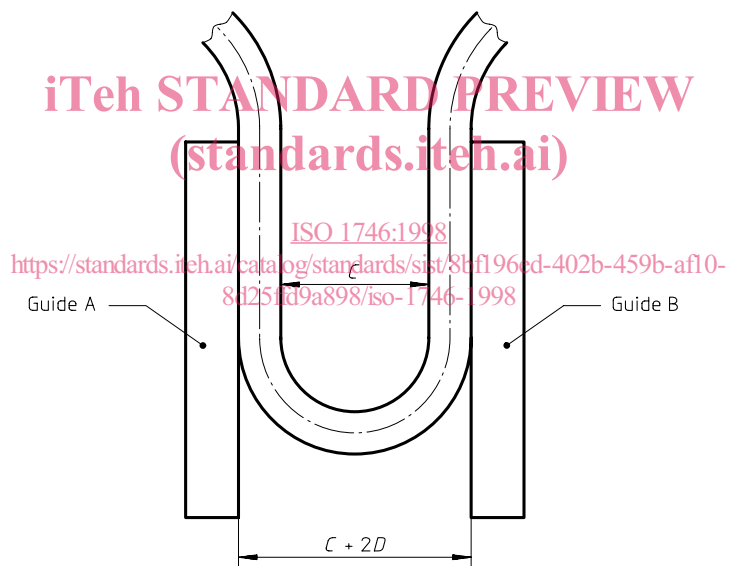


Figure 1 — Schematic arrangement for method A

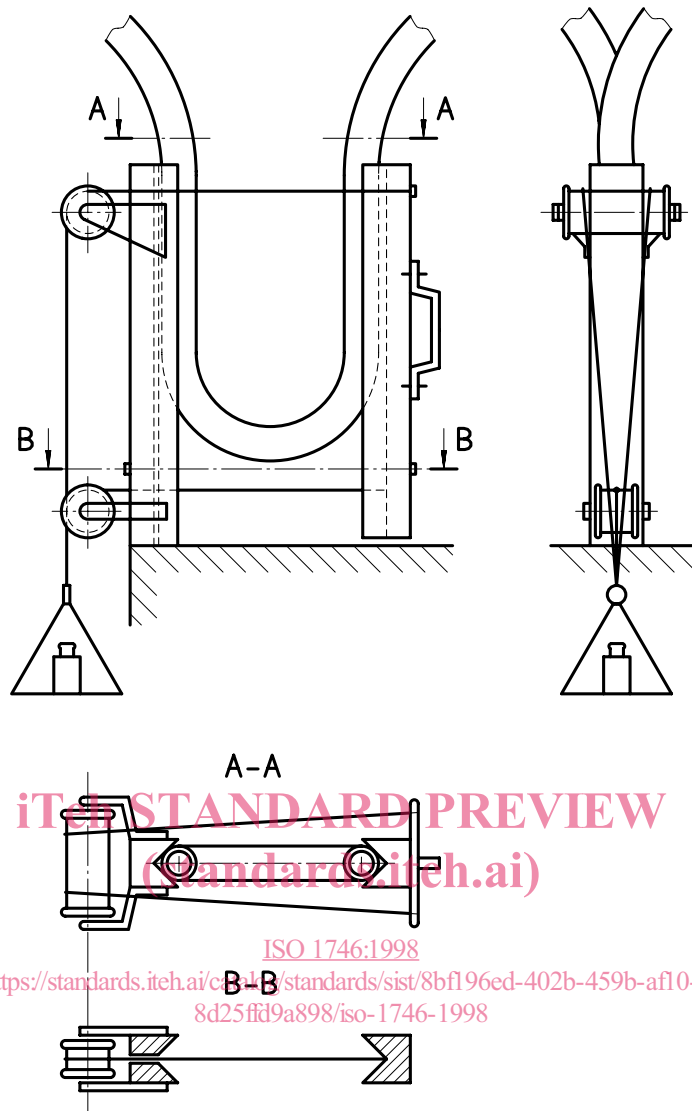


Figure 2 — Method A — Arrangement for measuring bending force

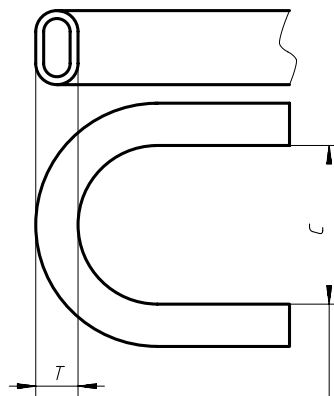


Figure 3 — Measurement of coefficient of deformation

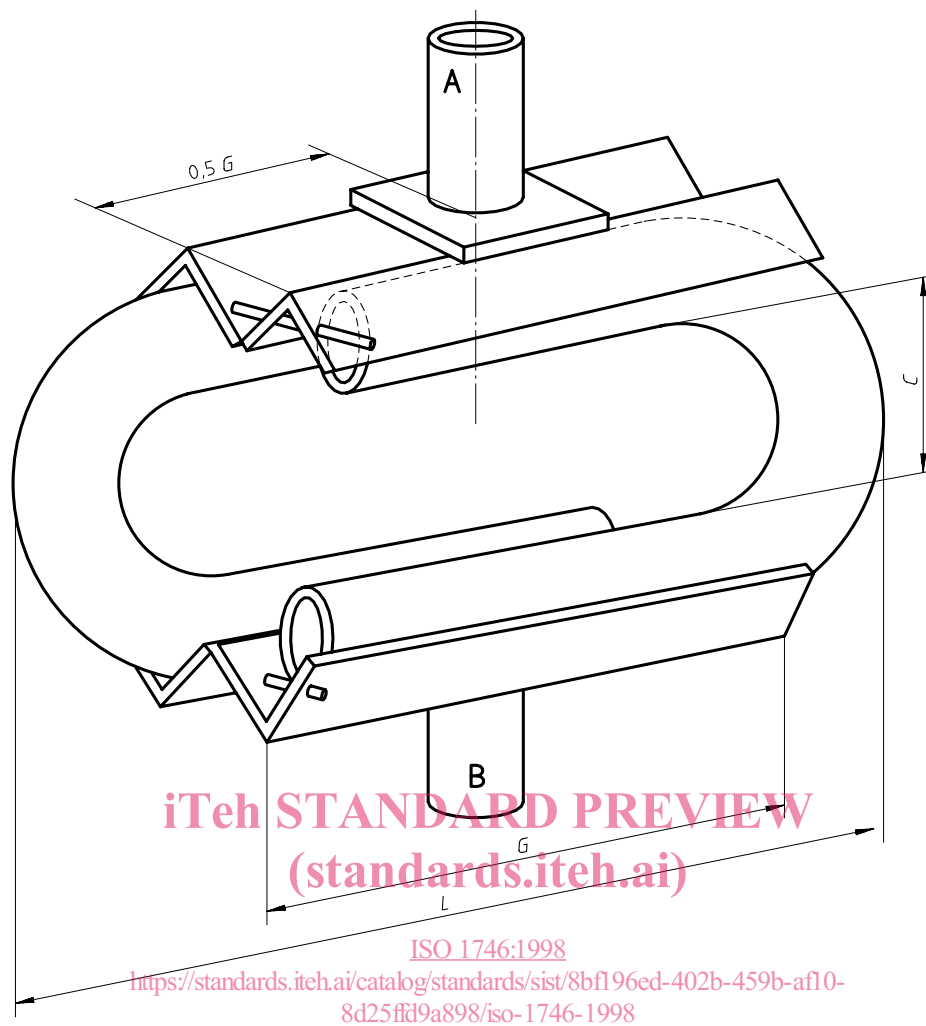


Figure 4 — Schematic arrangement for method B

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