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**Rubber and plastics hoses —  
Determination of adhesion between  
components**

*Tuyaux en caoutchouc et en plastique — Détermination de  
l'adhérence entre éléments*

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ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
copyright@iso.org  
www.iso.org

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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](http://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](http://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 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](http://www.iso.org/iso/foreword.html).

The committee responsible for this document is ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

This fourth edition cancels and replaces the third edition (ISO 8033:2006), which has been technically revised with the following changes:

- [Figure 3](#), [6.3.8](#) and [Figure 7](#) have been technically revised.

# Rubber and plastics hoses — Determination of adhesion between components

## 1 Scope

This document specifies methods for the determination of the adhesion between lining and reinforcement, between cover and reinforcement, between reinforcement layers, between cover and outer lamination (thin layer of material outside the cover for protection) and between lining and inner lamination (thin layer of material inside the lining to reduce permeation of fluid into the lining). It covers all bore sizes and the following types of hose construction:

- woven textile fabric;
- braided textile fabric;
- knitted textile fabric;
- circular-woven textile fabric;
- textile spiral;
- textile cord;
- wire braid;
- wire spiral;
- hoses containing a supporting helix.

Adequate adhesion between the various components of a hose is essential if it is to perform satisfactorily in service.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5893, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification*

ISO 6133, *Rubber and plastics — Analysis of multi-peak traces obtained in determinations of tear strength and adhesion strength*

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:

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

## 4 Principle

Using test pieces of standard dimensions, the adhesion strength between lining and reinforcement, between cover and reinforcement, between reinforcement layers, between cover and outer lamination and between lining and inner lamination is measured under specified conditions.

## 5 Apparatus

### 5.1 General

A test machine having the following characteristics is required:

### 5.2 Test machine

The machine shall be power driven, equipped with a suitable dynamometer, capable of maintaining a substantially constant rate of traverse of the moving head during the test and fitted with an autographic recorder. It shall comply with the requirements for class 0,5 or 1 of ISO 5893.

An inertialess dynamometer shall be used.

### 5.3 Grips

The grips shall be capable of holding the test piece without slippage.

Self-tightening grips are recommended.

For strip test pieces, provision shall be made to maintain the strip in the appropriate plane of the grips during the test, for example, by attaching sufficient weights to the free end of the test piece or by fitting a supporting plate, coated with a low-friction material, such as polytetrafluoroethylene (PTFE), to the non-driven grip.

### 5.4 Mandrel

For testing ring test pieces (type 6 and type 8), a mandrel shall be provided that is a close sliding fit in the test piece. This mandrel shall be capable of being fitted into the driven head of the machine so that it will rotate freely during the test.

## 6 Test pieces

### 6.1 Types of test piece

#### 6.1.1 General

Eight types of test piece are specified to cover the range of hose constructions and bore sizes normally encountered (see [Figures 1](#) to [8](#)).

#### 6.1.2 Type 1

Strip, cut from the hose as a 25 mm ± 0,5 mm wide ring which is then cut transversely to form a strip.

#### 6.1.3 Type 2

Strip, 160 mm × half the hose circumference.

**6.1.4 Type 3**

Strip, cut from the hose as a 35 mm ± 2 mm wide ring which is then cut transversely to form a strip.

**6.1.5 Type 4**

Strip, 160 mm × half the hose circumference or 10 mm, whichever is smaller.

**6.1.6 Type 5**

Strip, 160 mm long × half the hose circumference.

**6.1.7 Type 6**

Ring, 35 mm ± 2 mm wide.

**6.1.8 Type 7**

Strip, cut along a reinforcing helix, 25 mm ± 0,5 mm wide or the maximum obtainable.

**6.1.9 Type 8**

Ring, 25 mm ± 0,5 mm wide.

**6.2 Test piece selection**

Unless specified in the particular product standard or otherwise agreed between the interested parties, the type of test piece shall be selected from [Table 1](#). Results obtained with different test pieces and/or hoses of the same construction but of different diameters are not comparable.

**Table 1 — Test piece selection**

Hose construction	Adhesion between	Hose nominal bore size, <i>d</i>		
		mm		
		<i>d</i> ≤ 20	20 < <i>d</i> ≤ 50	50 < <i>d</i>
Woven textile fabric	Lining and reinforcement	Type 4 or 8	Type 1 or 8	Type 1 or 8
Braided textile fabric	Reinforcement layers	Type 4 or 8	Type 1 or 8	Type 1 or 8
Knitted textile fabric	Cover and reinforcement	Type 4 or 8	Type 1 or 8	Type 1 or 8
Circular-woven textile fabric				
Textile spiral	Lining and reinforcement	Type 2, 6 or 8	Type 3, 6 or 8	Type 3, 6 or 8
Textile cord	Reinforcement layers	Type 2 <sup>a</sup> , 6 or 8	Type 2, 3 <sup>a</sup> , 6 or 8	Type 3 <sup>a</sup> , 6 or 8
	Cover and reinforcement	Type 2, 6 or 8	Type 3, 6 or 8	Type 3, 6 or 8

<sup>a</sup> If the determination of adhesion is affected by difficulty in obtaining a cleanly separating interface because of fraying of the yarns, indicate this in the test report.

<sup>b</sup> Determination is impracticable below 12,5 mm bore size since insufficient test piece width is available.

<sup>c</sup> Determination is impracticable since the wire braid or spiral layers tend to disintegrate and the result is in any case significantly affected by the forces required to bend the wires.

Table 1 (continued)

Hose construction	Adhesion between	Hose nominal bore size, $d$		
		mm		
		$d \leq 20$	$20 < d \leq 50$	$50 < d$
Wire braid	Lining and reinforcement	Type 5 <sup>b</sup>	Type 5	Type 5
Wire spiral	Reinforcement layers	— <sup>c</sup>	— <sup>c</sup>	— <sup>c</sup>
	Cover and reinforcement	Type 2, 6 or 8	Type 2, 6 or 8	Type 2, 6 or 8
Hoses containing a supporting helix	Lining and reinforcement	Type 7	Type 7	Type 7
	Reinforcement layers	Type 7	Type 7	Type 7
	Cover and reinforcement	Type 7	Type 7	Type 7
All constructions	Lining and inner lamination	Type 2, 4, 5 or 8	Type 2, 4, 5 or 8	Type 2, 4, 5 or 8
	Cover and outer lamination	Type 2, 4, 5 or 8	Type 2, 4, 5 or 8	Type 2, 4, 5 or 8

<sup>a</sup> If the determination of adhesion is affected by difficulty in obtaining a cleanly separating interface because of fraying of the yarns, indicate this in the test report.

<sup>b</sup> Determination is impracticable below 12,5 mm bore size since insufficient test piece width is available.

<sup>c</sup> Determination is impracticable since the wire braid or spiral layers tend to disintegrate and the result is in any case significantly affected by the forces required to bend the wires.

## 6.3 Test piece preparation

### 6.3.1 General

Test pieces shall be prepared by a method that does not produce high temperatures due to the action of the cutting blade.

The thickness of test pieces shall be adjusted by buffing so that the separated faces are positioned as close as possible to the axis of traction of the grips.

Test pieces that contain foreign matter or have blisters or flaws shall not be used for tests.

### 6.3.2 Type 1

Cut a ring  $25 \text{ mm} \pm 0,5 \text{ mm}$  wide from the hose at right angles to its longitudinal axis. Cut the ring transversely and open it out to form a strip.

Separate a layer for a distance sufficient to enable the separated ends to be held in the grips of the test machine (see [Figure 1](#)).

Where heat build-up might cause deterioration of properties, use test pieces of type 2, 3, 5 or 6.

### 6.3.3 Type 2

Cut a suitable length of hose in half longitudinally. From one of the halves, make two cuts parallel to the axis of the test piece  $25 \text{ mm} \pm 0,5 \text{ mm}$ ,  $10 \text{ mm} \pm 0,5 \text{ mm}$  or  $5 \text{ mm} \pm 0,2 \text{ mm}$  apart, depending on the width available, taking care not to cut through the yarns.

Separate a layer for a distance sufficient to enable the separated ends to be held in the grips of the test machine (see [Figure 2](#)).

### 6.3.4 Type 3

Cut a ring  $35 \text{ mm} \pm 2 \text{ mm}$  wide from the hose at right angles to its longitudinal axis. Cut the ring transversely and open it to form a strip.

Make two parallel cuts on the strip  $25 \text{ mm} \pm 0,5 \text{ mm}$  apart, taking care not to cut through the yarns.

Separate a layer for a distance sufficient to enable the separated ends to be held in the grips of the test machine (see [Figure 3](#)).

#### 6.3.5 Type 4

Cut a suitable length of hose in half longitudinally. From one of the halves, cut a strip  $10 \text{ mm} \pm 0,5 \text{ mm}$  wide, or of the maximum width obtainable if the width is less than 10 mm.

Separate a layer for a distance sufficient to enable the separated ends to be held in the grips of the test machine (see [Figure 4](#)).

#### 6.3.6 Type 5

Cut a suitable length of hose in half longitudinally. Using a twin-bladed tool, cut from one of the halves a centrally located longitudinal strip  $5 \text{ mm} \pm 0,2 \text{ mm}$  wide through the lining and open up one end of the test piece to form a lip.

Separate a layer for a distance sufficient to enable the separated ends to be held in the grips of the test machine (see [Figure 5](#)).

#### 6.3.7 Type 6

Cut a ring  $35 \text{ mm} \pm 2 \text{ mm}$  wide from the hose at right angles to its longitudinal axis. Make two circumferential cuts through the cover  $25 \text{ mm} \pm 0,5 \text{ mm}$  apart and located centrally on the test piece. Make a transverse cut across the 25 mm width through the cover and open up on one side of the cut to form a lip (see [Figure 6](#)).

NOTE When cutting ring-shaped test pieces from a hose, it is advisable to insert a wooden cylinder, or similar device, into the hose before cutting out the test piece.

#### 6.3.8 Type 7

Obtain a strip from the hose wall by cutting along the reinforcing helix through the complete thickness of the hose wall and trim to 160 mm long and  $25 \text{ mm} \pm 0,5 \text{ mm}$  wide or the maximum width obtainable if the width is less than 25 mm.

Separate a layer for a distance sufficient to enable the separated ends to be held in the grips of the test machine (see [Figure 7](#)).

This is an optional test for helix-reinforced hoses made in long lengths. It does not apply to hoses made to individual lengths, with special ends, built-in fittings, etc. If the spacing between adjacent coils of the helix is less than 10 mm, leaving an appropriate length (i.e. more than 160 mm or 25 mm) without applying reinforcing helix on one end of the hose is recommended during manufacturing, so that this end has the same process and state with the hose body which applied helix. Cut this part off and prepare the test piece according to type 4 or type 8.

#### 6.3.9 Type 8

Cut a ring-shaped test piece  $25 \text{ mm} \pm 0,5 \text{ mm}$  wide from the hose at right angles to its longitudinal axis. Make a transverse cut across the 25 mm width through the cover and open up on one side of the cut to form a lip (see [Figure 8](#)).

NOTE When cutting ring-shaped test pieces from a hose, it is advisable to insert a wooden cylinder, or similar device, into the hose before cutting out the test piece.

## 6.4 Conditioning of test pieces

No tests shall be carried out within 24 h of manufacture. Before testing, test pieces shall be conditioned at standard temperature and humidity (see ISO 23529) for at least 16 h; this may be part of the 24 h after manufacture.

## 6.5 Time interval between vulcanization and testing

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

## 7 Procedure

### 7.1 Preparation

A separate test piece shall be used for each interface to be tested.

### 7.2 Insertion of test pieces

Take a test piece from the conditioning atmosphere and measure the actual width of the test piece. For types 1, 2, 3, 4, 5 and 7, fix the separated ends of the test piece in the grips of the test machine. For types 6 and 8, place the test piece on the mandrel (5.4) and the separated ends in the grips. Adjust so that the tension is distributed uniformly and that no twisting of the test piece occurs during the test. Place the test piece in the grips so that the angle of separation is approximately 180° for strip or 90° for ring test pieces.

It is important to ensure that the pulling force acts in the plane of separation.

### 7.3 Test speed

The rate of travel of the power-driven grip shall be such as to provide a rate of ply separation of 50 mm/min  $\pm$  5 mm/min (for test pieces of types 1 to 7) or 25 mm/min  $\pm$  2,5 mm/min (for type 8 test pieces).

### 7.4 Measurement

Start the machine and record the force, in newtons, over a length of separation of at least 100 mm or the maximum distance possible if the test piece is less than 100 mm long.

If separation occurs at any other point, for example, inside either component under test, note this failure and report the force at which it occurs.

## 8 Expression of results

The trace obtained from the graphical recorder shows the variations in the force at which the plies or layers have separated.

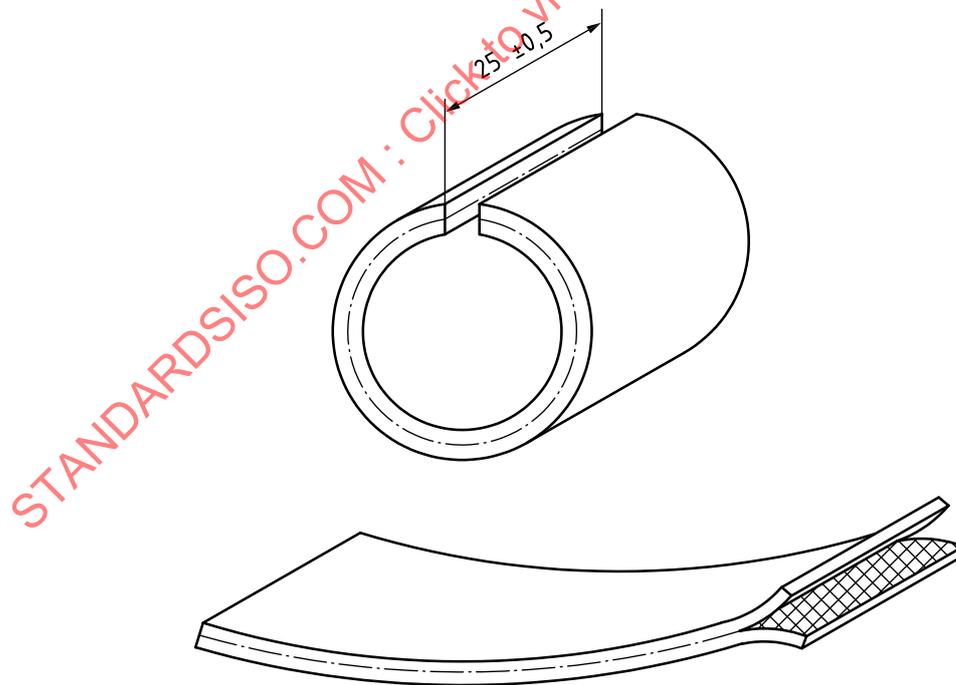
Determine the median peak force from the trace using the appropriate method specified in ISO 6133. Divide the median peak force by the effective width of the test piece and express the adhesion strength in kilonewtons per metre.

## 9 Test report

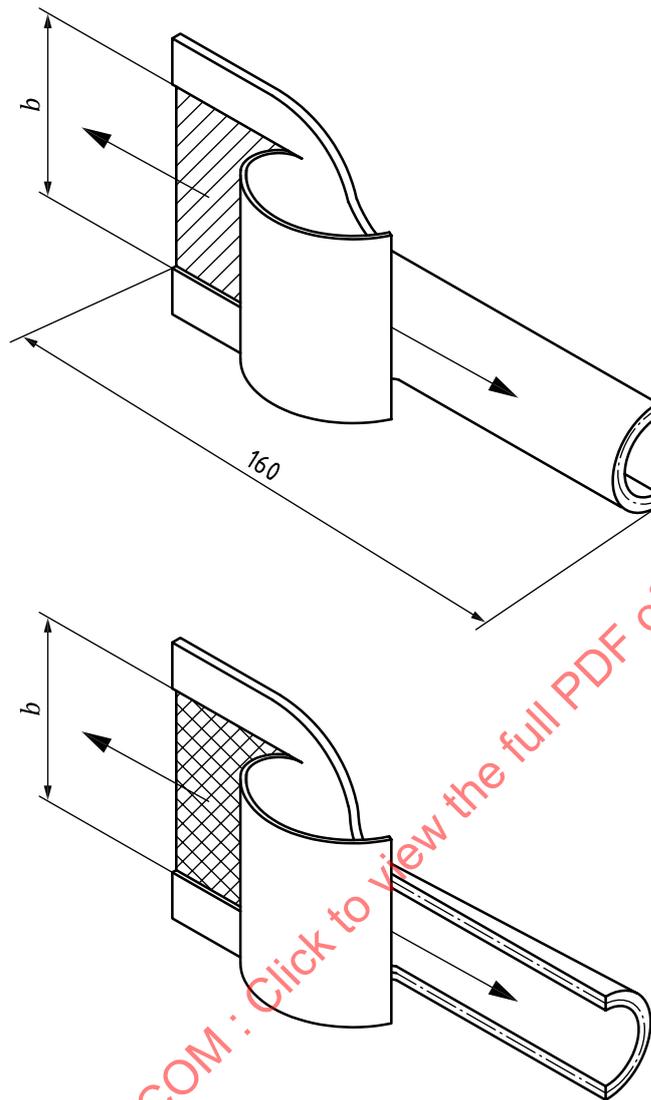
The test report shall contain the following information:

- a) the hose type and nominal bore;
- b) the date of manufacture and batch number or reference, as applicable;
- c) the method of manufacture and details of the reinforcement;
- d) a reference to this document, i.e. ISO 8033:2016;
- e) the type(s) of test piece used;
- f) the test speed;
- g) if appropriate, the adhesion strength, expressed in kilonewtons per metre of width, between lining and reinforcement;
- h) if appropriate, the adhesion strength, expressed in kilonewtons per metre of width, between layers of reinforcement, noting any difficulties (see [Table 1](#), footnote "a");
- i) if appropriate, the adhesion strength, expressed in kilonewtons per metre of width, between cover and reinforcement;
- j) if appropriate, the adhesion strength, expressed in kilonewtons per metre of width, between cover and outer lamination and between lining and inner lamination;
- k) the date of test.

Dimensions in millimetres



**Figure 1 — Type 1 test piece**



$b$  25 mm  $\pm$  0,5 mm or 10 mm  $\pm$  0,5 mm or 5 mm  $\pm$  0,2 mm

Figure 2 — Type 2 test piece

Dimensions in millimetres

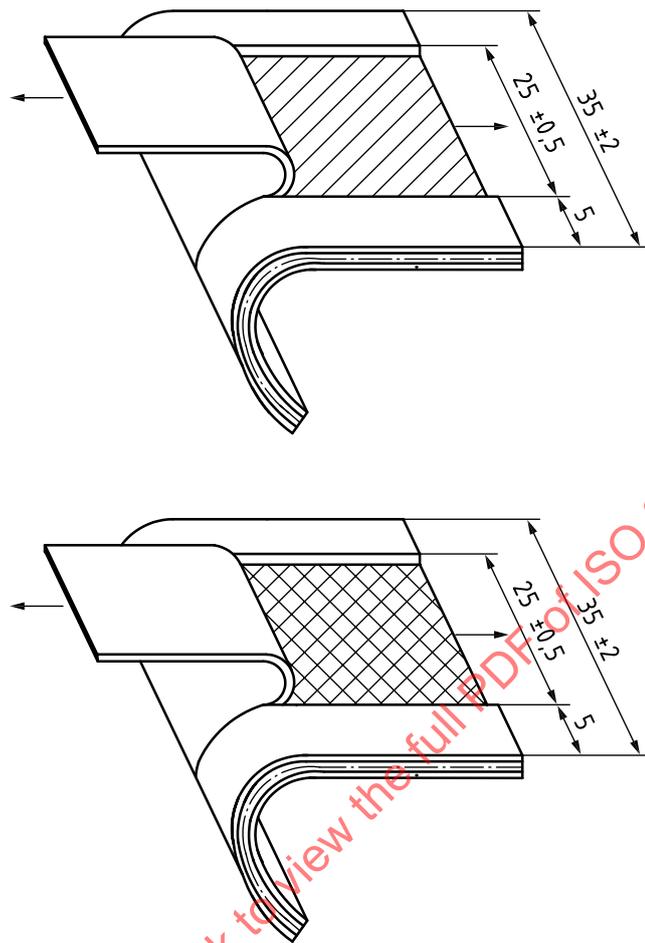


Figure 3 — Type 3 test piece

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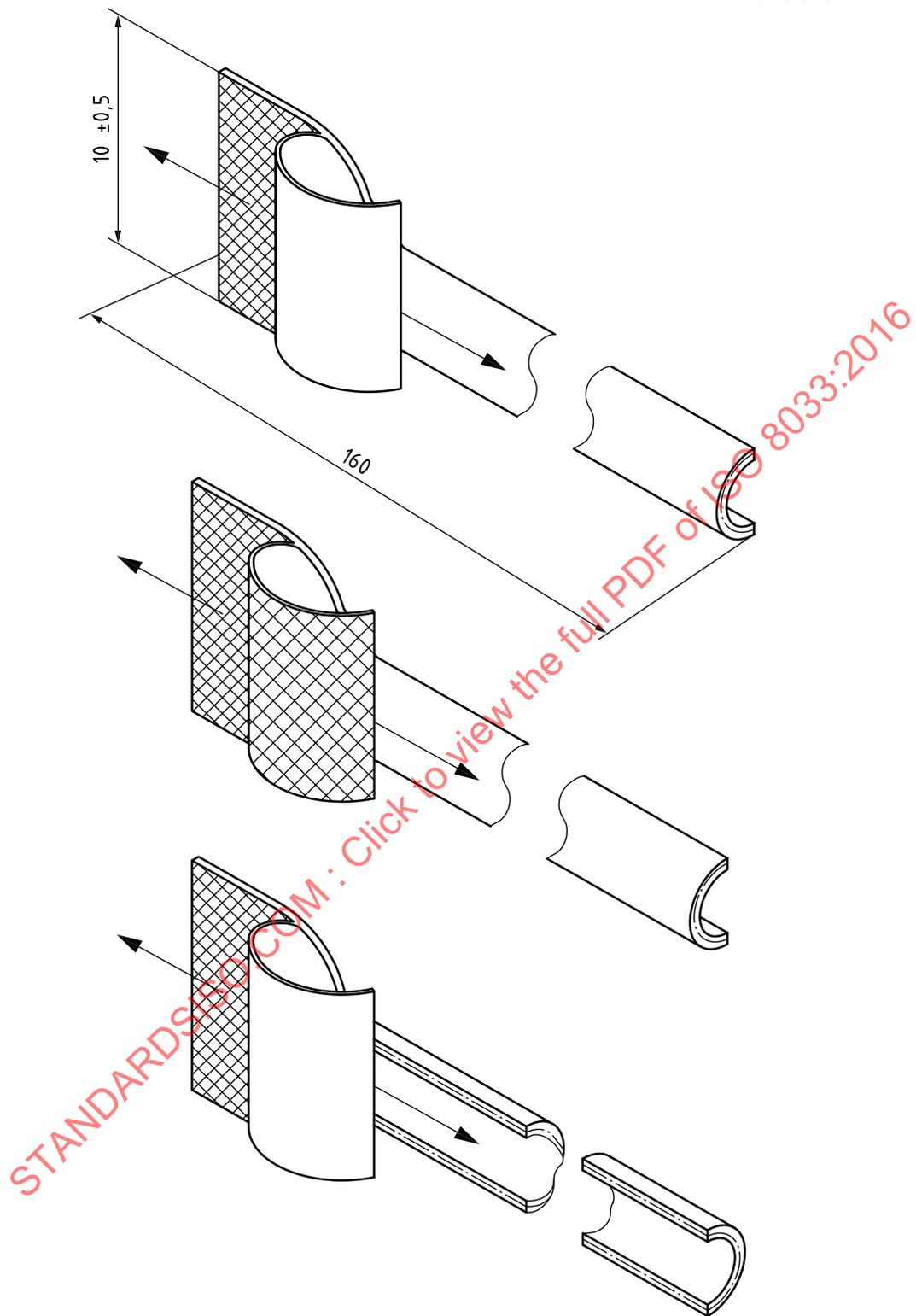


Figure 4 — Type 4 test piece