BRITISH STANDARD

BS 5173 : Section 103.1 : 1992
ISO 8033 : 1991

Methods of test for

Rubber and plastics hoses and hose assemblies

Part 103. Physical tests

Section 103.1 Determination of adhesion between components

BSI STANDARDS

National foreword

This Section of BS 5173 has been prepared under the direction of the Plastics and Rubber Standards Policy Committee and is identical with ISO 8033 : 1991 *Rubber and plastics hose — Determination of adhesion between components*, published by the International Organization for Standardization (ISO). It supersedes BS 5173 : Section 103.1 : 1986, which is withdrawn.

Cross-references

International standard	Corresponding British Standard
	BS 903 *Methods of testing vulcanized rubber*
ISO 471 : 1983	Part A35 : 1985 *Temperatures, humidities and times for conditioning and testing of test pieces* (Identical)
ISO 6133 : 1981	Part A47 : 1982 *Analysis of multi-peak traces obtained in determinations of tear strength and adhesion strength* (Identical)

The Technical Committee has reviewed the provisions of ISO 1826 : 1981 and ISO 5893 : 1985, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. ISO 1826 is related to BS 903 : Part A5 : 1974 and BS 903 : Part A19 : 1986, and ISO 5893 is related to BS 5214 : Part 1 : 1975.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Contents

Rubber and plastics hose — Determination of adhesion between components

1 Scope

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

This International Standard specifies methods for the determination of the adhesion between lining and reinforcement, between cover and reinforcement and between reinforcement layers. It covers all bore sizes and the following types of hose construction:

— woven textile fabric

— braided yarns

— spiralled yarns

— knitted yarns

— circular woven yarns

— textile cord fabric

— braided wires

— spiralled wires

— hoses containing a supporting helix

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 471:1983, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

ISO 1826:1981, *Rubber, vulcanized — Time-interval between vulcanization and testing — Specification.*

ISO 5893:1985, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Description.*

ISO 6133:1981, *Rubber and plastics — Analysis of multi-peak traces obtained in determinations of tear strength and adhesion strength.*

3 Principle

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

4 Apparatus

A test machine having the following characteristics is required.

4.1 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 requirement for grade A of ISO 5893.

NOTE 1 An inertialess dynamometer should be used.

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

NOTE 2 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 the attachment of 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.

4.3 For testing a ring test piece, 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 (type 6).

5 Test pieces

5.1 Types of test piece

Seven types of test piece are specified to cover the range of hose construction for methods and bore size normally encountered.

5.1.1 Type 1

Ring, cut from the hose 25 mm ± 0,5 mm wide and cut transversely to form a strip.

5.1.2 Type 2

Strip, 160 mm × half the hose circumference.

5.1.3 Type 3

Ring, cut from the hose 35 mm ± 2 mm wide and cut transversely to form a strip.

5.1.4 Type 4

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

5.1.5 Type 5

Strip, 160 mm long × half the hose circumference.

5.1.6 Type 6

Ring, 35 mm ± 2 mm wide.

5.1.7 Type 7

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

5.2 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.

5.3 Test piece preparation

5.3.1 Type 1

Cut a ring 25 mm ± 0,5 mm wide from the hose at right angles to its longitudinal axis. Cut the ring transversely and open it out to form a strip (see figure 1).

NOTE 3 The test pieces should be prepared by a method that does not cause high temperatures due to the cutting blade. Where heat build-up might cause a deterioration of properties, type 2, 3, 5 or 6 test pieces should be used.

5.3.2 Type 2

Cut the test piece in half longitudinally. From one of the halves make two cuts parallel to the axis of the test piece 25 mm ± 0,5 mm, 10 mm ± 0,5 mm or 5 mm ± 0,2 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).

5.3.3 Type 3

Cut a ring 35 mm ± 2 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 mm ± 0,5 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).

5.3.4 Type 4

Cut the test piece in half longitudinally. Cut from one of the halves a strip 10 mm ± 0,5 mm wide, or of the maximum width obtainable if 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).

5.3.5 Type 5

Cut the test piece in half longitudinally. Using a twin bladed tool, cut a centrally located longitudinal strip 5 mm ± 0,2 mm wide through the lining and open up one end of the test piece to form a lip (see figure 5).

Table 1 — Test piece selection

Hose construction	Adhesion between	Hose nominal bore size, d (mm)		
		$d \leqslant 20$	$20 < d \leqslant 50$	$d > 50$
Textile woven fabric Textile braided Textile knitted Textile circular woven	Lining and reinforcement Reinforcement layers Cover and reinforcement	Type 4 Type 4 Type 4	Type 1 Type 1 Type 1	Type 1 Type 1 Type 1
Textile spiral Textile cord fabric	Lining and reinforcement Reinforcement layers Cover and reinforcement	Type 2 Type 2[1)] Type 2	Type 3 Type 2 or 3[1)] Type 3	Type 3 Type 3[1)] Type 3
Wire braid Wire spiral	Lining and reinforcement Reinforcement layers Cover and reinforcement	Type 5[2)] —[3)] Type 2 or 6	Type 5 —[3)] Type 2 or 6	Type 5 —[3)] Type 2 or 6
Hoses containing a supporting helix	Lining and reinforcement Reinforcement layers Cover and reinforcement	Type 7 Type 7 Type 7	Type 7 Type 7 Type 7	Type 7 Type 7 Type 7

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

2) Determination is impracticable below 12,5 mm bore size since insufficient test piece width is available.

3) 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.

5.3.6 Type 6

Cut a ring 35 mm ± 2 mm wide from the hose at right angles to its longitudinal axis. Make two circumferential cuts through the cover 25 mm ± 0,5 mm apart and located centrally on the specimen. 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).

5.3.7 Type 7

Obtain a strip from the hose wall by cutting along the reinforcing helix and trim to 160 mm long, 25 mm ± 0,5 mm wide or the maximum obtainable less than 25 mm (see figure 7).

NOTE 4 This is an optional test where helix reinforced hoses are made in long lengths. It does not apply to hoses made to individual lengths, with special ends, built-in fittings, etc. It is only applicable if the spacing between individual helices is greater than 10 mm.

5.4 Conditioning of test pieces

No tests shall be carried out within 24 h of manufacture. Test pieces shall be conditioned at standard temperature and humidity (see ISO 471) before testing for at least 16 h; this may be part of the 24 h after manufacture.

5.5 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 1826 shall be followed for time between sample manufacture and testing.

6 Procedure

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

6.2 Take the test piece from the conditioning atmosphere and measure the actual width of the test piece. Fix the separated ends of the test piece in the grips of the testing machine and 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.

6.3 The rate of travel of the power-driven grip shall be such as to provide a rate of ply separation of 50 mm/min ± 5 mm/min.

6.4 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.

7 Expression of results

The tracing 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.

8 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 reinforcement;

d) a reference to this International Standard;

e) the type(s) of test piece used;

f) if appropriate, the adhesion, expressed in kilonewtons per metre of width, between lining and reinforcement;

g) if appropriate, the adhesion, expressed in kilonewtons per metre of width, between layers of reinforcement, noting any difficulties [see footnote 1) to table 1];

h) if appropriate, the adhesion, expressed in kilonewtons per metre of width, between cover and reinforcement;

i) the date of test.

Dimensions in millimetres

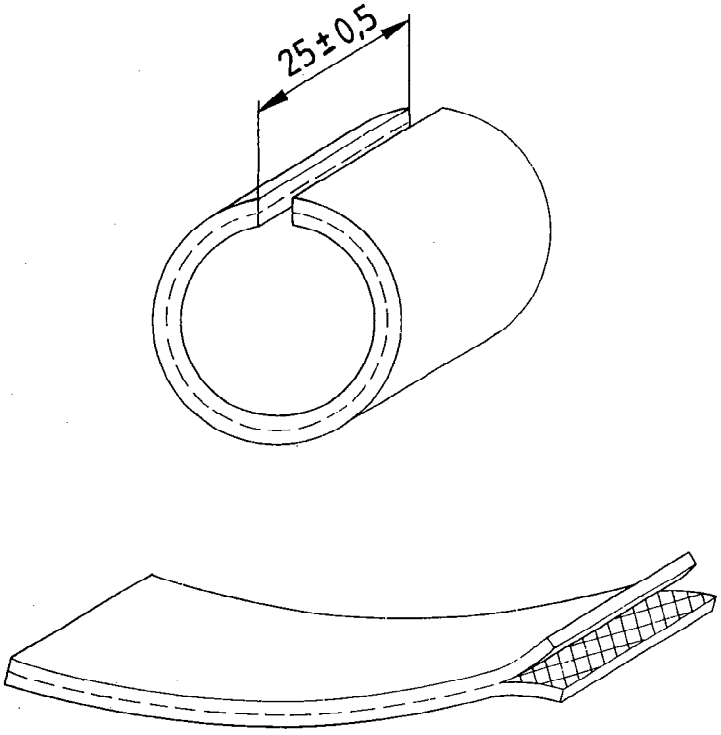

Figure 1 — Type 1 test piece

Dimensions in millimetres

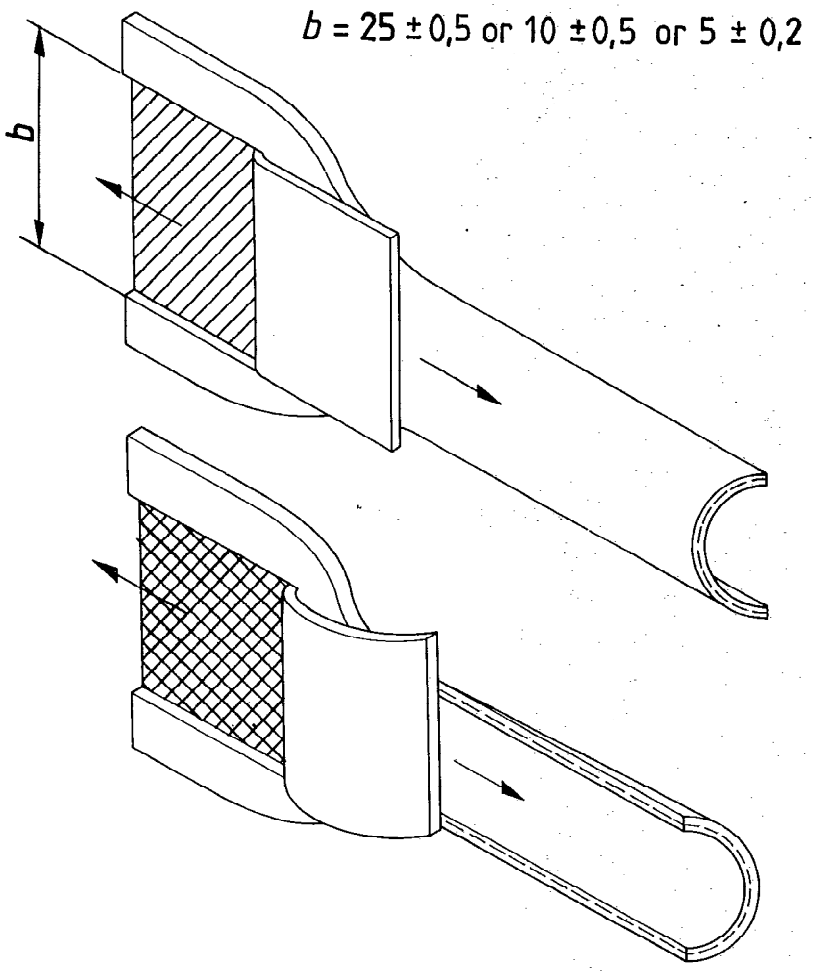

Figure 2 — Type 2 test piece

Dimensions in millimetres

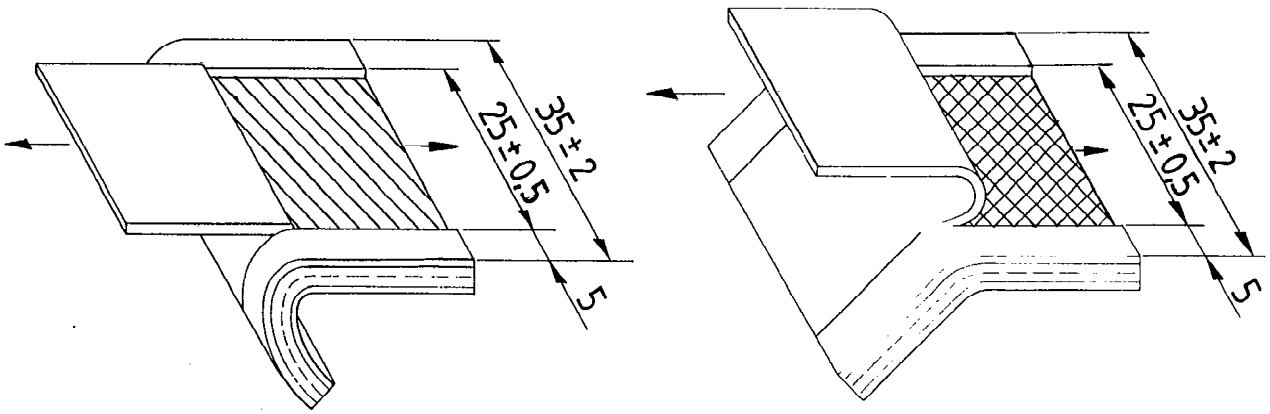

Figure 3 — Type 3 test piece

Dimensions in millimetres

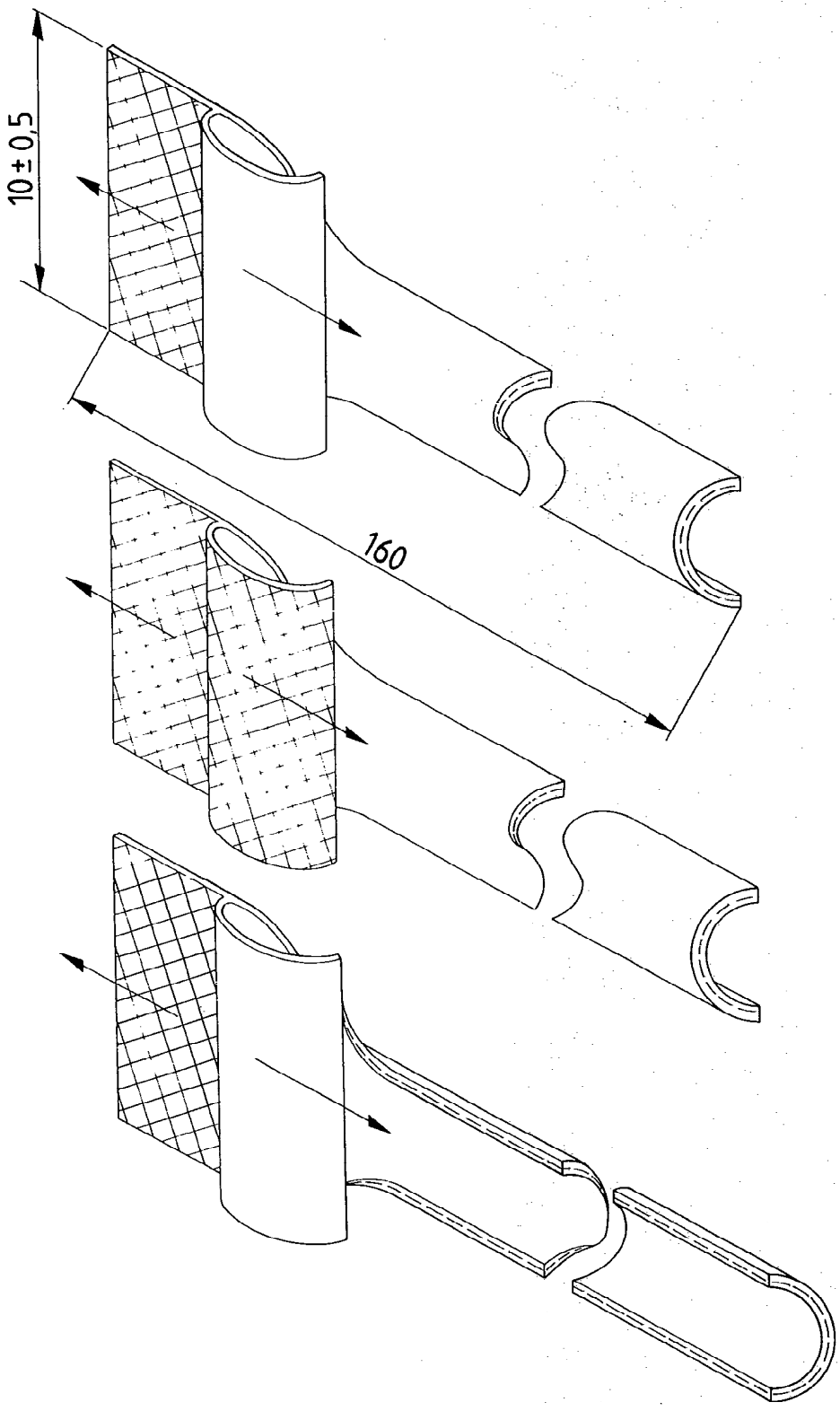

Figure 4 — Type 4 test piece

Dimensions in millimetres

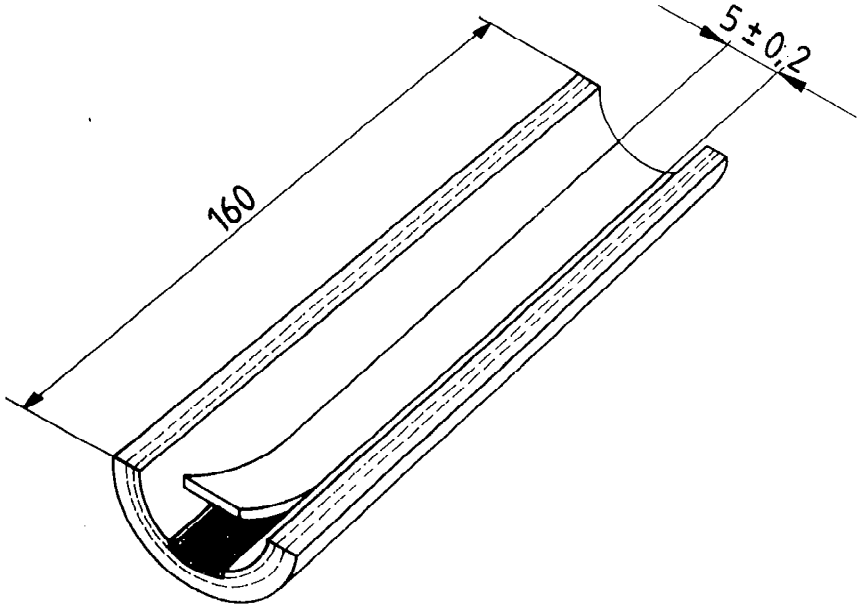

Figure 5 — Type 5 test piece

Dimensions in millimetres

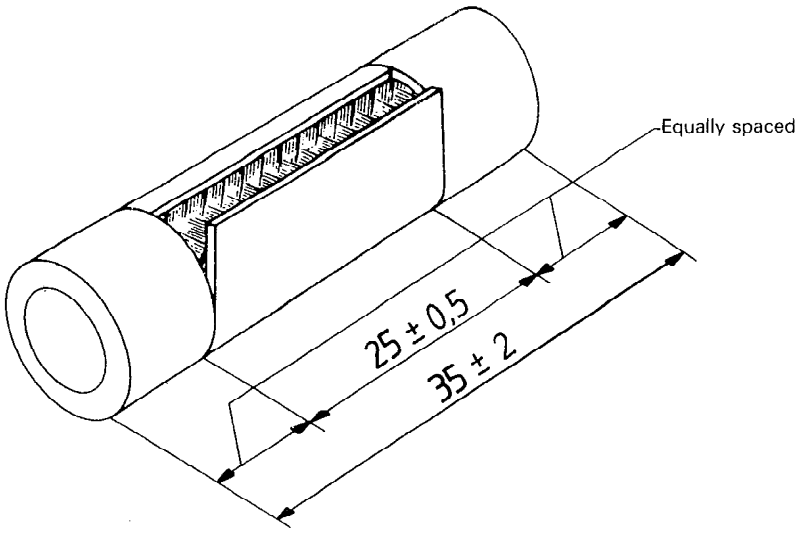

Figure 6 — Type 6 test piece

Dimensions in millimetres

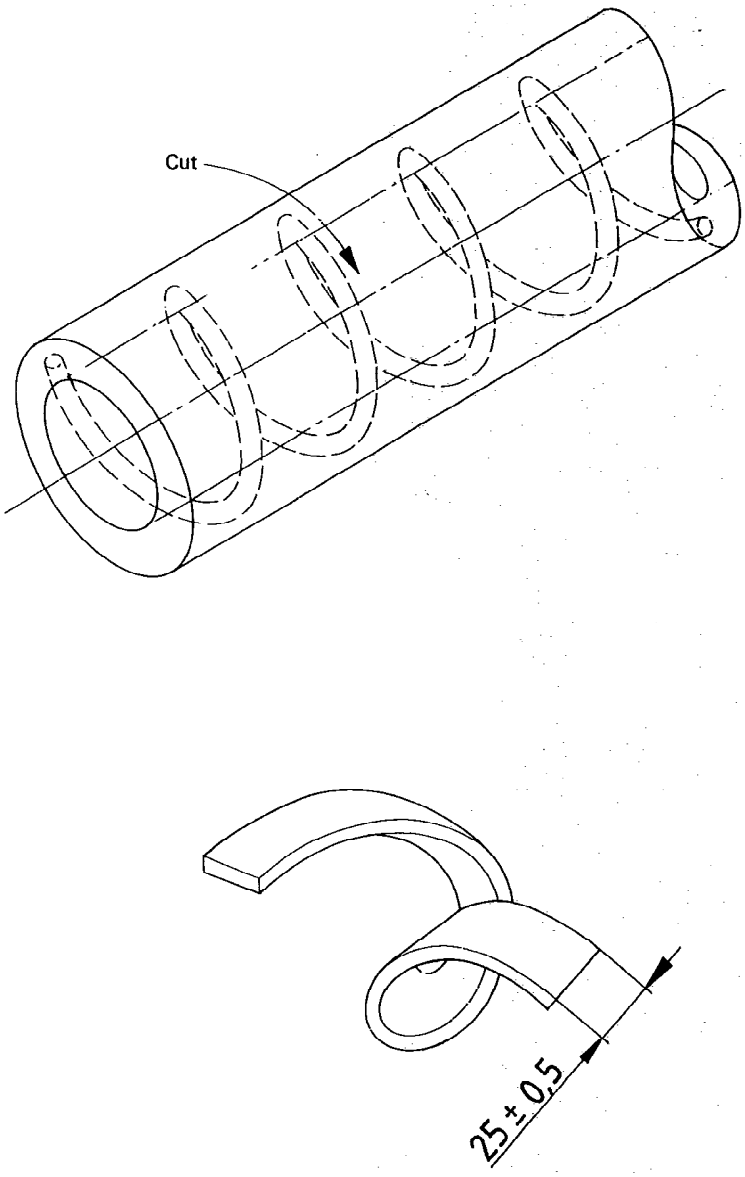

Figure 7 — Type 7 test piece for hoses containing a supporting helix

List of references

See national foreword.

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Plastics and Rubber Standards Policy Committee (PRM/-) to Technical Committee PRM/66, upon which the following bodies were represented:

Association of Metropolitan Authorities
British Coal Corporation
British Compressed Gases Association
British Rubber Manufacturers' Association Ltd.
Chief and Assistant Chief Fire Officers' Association
Energy Industries Council
Fire Extinguishing Trades Association
Home Office
Institution of Fire Engineers
Liquefied Petroleum Gas Industry Technical Association (UK)
London Fire and Civil Defence Authority
Ministry of Defence
Society of Motor Manufacturers and Traders Ltd.

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Fluid Power Association
British Gas plc

This British Standard, having been prepared under the direction of the Plastics and Rubber Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on
15 June 1992

First published September 1986
Second edition June 1992

The following BSI references relate to the work on this standard:
Committee reference PRM/66
Draft for comment 92/37936 DC

ISBN 0 580 20868 0

9206—5—0.55k—B

Amendments issued since publication

Amd. No.	Date	
7563	19-8-93	D. Hicks.

BSI, 2 Park Street, London W1A 2BS BSI, Linford Wood, Milton Keynes MK14 6LE