BS EN 15889:2011

BSI Standards Publication

Fire-fighting hoses — Test methods

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee FSH/17/8, Hydrants, hoses and associated water delivery equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Tuyaux de lutte contre l'incendie - Méthodes d'essai

Feuerlöschschläuche - Prüfverfahren

This European Standard was approved by CEN on 4 June 2011.

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Foreword

This document (EN 15889:2011) has been prepared by Technical Committee CEN/TC 192 “Fire service equipment”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2012, and conflicting national standards shall be withdrawn at the latest by January 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This European Standard details hose and hose assembly test methods collated mainly from published EN fire hose standards. Although no technical changes have been introduced, some changes to the format of the test methods had to be made to enable them to be included in this European Standard.

The published EN fire-fighting hose standards will be revised to remove the test method annexes following the publication of this European Standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European standard specifies test methods for lay-flat fire-fighting hoses for fixed systems, semi-rigid fire-fighting hoses for both fixed systems and vehicles and fire-fighting suction hoses for vehicles.

These test methods are required for the standards for fire-fighting hose product standards developed by CEN/TC 192. Consequently, the applicable test methods are selected and the requirements and test values defined in the relevant fire-fighting hose product standards and normatively referenced in those standards.

This European Standard does not cover test methods for lay-flat fire-fighting hoses for vehicles for which no European standard exists.

NOTE Annex R (informative) lists the existing published ISO and EN hose test methods standards that are specified within fire-fighting hose standards.

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.

EN ISO 4671, *Rubber and plastics hose and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies (ISO 4671:2007)*

EN ISO 4672:1999, *Rubber and plastics hoses — Sub-ambient temperature flexibility tests (ISO 4672:1997)*

EN ISO 8033:2006, *Rubber and plastics hose — Determination of adhesion between components (ISO 8033:2006)*

EN ISO 8330:2008, *Rubber and plastics hoses and hose assemblies — Vocabulary (ISO 8330:2007)*

ISO 188:2007, *Rubber, vulcanized or thermoplastic -— Accelerated ageing and heat resistance tests*

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 following terms and definitions apply, together with those for working pressure, proof pressure and burst pressure as given in EN ISO 8330:2008.

3.1
lay-flat fire-fighting hose
hose with a soft wall which, when unpressurized internally, collapses to such an extent that the inner faces of the hose make contact and the hose takes up a flat cross-sectional appearance

3.2
hose coating
thin coating usually applied as a lacquer, which acts as a sealant through which the jacket fibres are likely to protrude through the coating

3.3
hose cover
cover which completely surrounds the jacket forming a separate component

3.4
jacket
circular woven seamless reinforcement

3.5
semi-rigid hose
hose which maintains its round cross-section even when unpressurized

3.6
suction hose
hard wall hose which is designed to resist external pressure

4 Test methods

The following fire hose test methods are detailed in the annexes:

— Annex A *Test for measurement of hose cover thickness (lay-flat fire-fighting hoses)*

— Annex B *Adhesion test (lay-flat fire-fighting hoses)*

— Annex C *Kink pressure test (lay-flat and semi-rigid fire-fighting hoses)*

— Annex D *Accelerated ageing test*

— Annex E *Surface abrasion resistance test (semi-rigid fire-fighting hoses)*

— Annex F *Point abrasion resistance test (semi-rigid fire-fighting hoses)*

— Annex G *Low temperature flexibility test (lay-flat fire-fighting hoses and semi-rigid fire-fighting hoses)*

— Annex H *Hot surface resistance test (semi- rigid and lay-flat fire-fighting hoses)*

— Annex I *Pressure loss test (semi-rigid fire-fighting hoses)*

— Annex J *Deformation under crushing test (semi-rigid fire-fighting hoses)*

— Annex K *Bending and crush resistance test (semi-rigid fire-fighting hoses)*

— Annex L *Test for fire-fighting hose assemblies*

— Annex M *Pressure impulse test (fire-fighting suction hoses)*

— Annex N *Reinforcement fracture resistance test (type B hoses only) (fire-fighting suction hoses)*

— Annex O *Test for flexibility at ambient temperature (fire-fighting suction hoses)*

— Annex P *Test for vacuum resistance with flexing (fire-fighting suction hoses)*

— Annex Q *Test for resistance to kinking (lay-flat fire-fighting hoses)*

— Annex R *Test methods from other EN and ISO standards*

NOTE The requirements for test methods are stated in the product fire hose standards.

Annex A
(normative)

Test for measurement of hose cover thickness (lay-flat fire-fighting hoses)

A.1 Test piece

Cut a ring sample from the hose and measure the distance between the top of the yarns and the surface of the cover at four equidistant points around the ring using the optical magnifier.

A.2 Apparatus

A.2.1 Optical magnifier, with a scale graduated in 0,01 mm divisions.

A.3 Procedure

Calculate the mean of the four measurements to obtain the cover thickness value. Where the cover is variable or ribbed, the measurements shall be made at the thinnest point.

A.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— cover thickness;

— date of the test.

Annex B
(normative)

Adhesion test (lay-flat fire-fighting hoses)

B.1 Test piece

Cut a ring (50 ± 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 at right angle to the hose axis (25 ± 0,5) mm apart, taking care not to cut through the yarns.

Separate a layer for a distance sufficient to enable the separated end to be held in the grips of the test machine (see Figure B.1).

Dimensions in millimetres

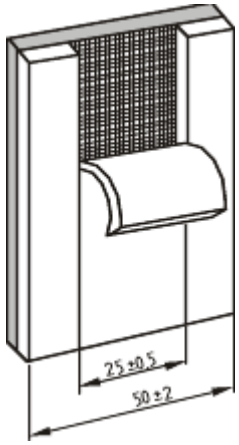


Figure B.1 — Test piece adhesion test

B.2 Apparatus

B.2.1 A tensile testing machine capable of carrying out the procedure in B.3.

B.3 Procedure

When tested in accordance with type 1 of EN ISO 8033:2006 the adhesion between lining and jacket shall be as specified in the relevant fire hose standard.

If an adhesion result is not possible because of tearing due to high adhesion, this shall be accepted as a pass. All adhesions shall be attempted and the results recorded.

B.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— adhesion value and any evidence of tearing;

— date of the test.

Annex C
(normative)

Kink pressure test (lay-flat and semi-rigid fire-fighting hoses)

C.1 Test piece

Cut a test piece of 2,0 m length from the hose.

C.2 Apparatus

C.2.1 Source of hydrostatic pressure, with water as the test medium, capable of maintaining the specified pressure.

C.3 Procedure

Connect the test piece to the pressure source and fill with water, expelling all air before securely clamping shut the free end of the hose. Maintain a pressure of 0,07 MPa in the test piece while bending it through 180° at a point approximately midway along its length. Tie the free end of the hose back on itself, as close as possible to the secure end, so as to form a sharp kink, ensuring that the tie does not prevent subsequent expansion of the diameter of the test piece.

Raise the pressure in the test piece to the specified pressure over a period of 60 s. Maintain the pressure for 60 s. Examine the test piece for any sign of leakage or damage prior to releasing the pressure.

C.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— any evidence of leakage or damage observed;

— date of the test.

Annex D
(normative)

Accelerated ageing test

D.1 Lay-flat fire-fighting hoses

D.1.1 Test piece

Cut four test pieces from the hose each of 1 m in length.

NOTE It is recommended that the test pieces should be taken from the same hose sample from which the test pieces for the burst pressure tests and adhesion tests were taken.

This will allow an exact comparison to the changes before and after the artificial ageing.

D.1.2 Apparatus

D.1.2.1 A temperature controlled oven as specified in ISO 188:2007.

D.1.3 Procedure

Bend three of the test pieces through 180° at a point approximately midway along their length and tie in this flaked position.

Loosely coil the remaining test piece.

Age all four test pieces in air for 14 days at a temperature of (70 ± 1) °C in a temperature controlled oven as specified in ISO 188:2007.

After ageing, straighten out the three flaked test pieces and subject them to the burst pressure test as specified.

Subject the remaining test piece to the adhesion test as specified in relevant fire hose standard.

The three test pieces subjected to the burst pressure test shall conform to the requirements of relevant fire hose standard.

The resultant adhesion of the fourth test piece shall be in accordance with the requirements in relevant fire hose standard.

D.1.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— burst test value;

— adhesion value and any evidence of tearing;

— date of the test.

D.2 Semi-rigid hoses

D.2.1 Test piece

Cut four test pieces from the hose, each of 1 m length.

NOTE It is recommended that the test pieces should be taken from the hose adjacent to the original burst and adhesion test pieces.

D.2.2 Apparatus

D.2.2.1 A temperature controlled oven as specified in ISO 188:2007.

D.2.3 Procedure

Age the test pieces in air for 7 days at a temperature of (70 ± 1) °C in a temperature controlled oven as specified in ISO 188:2007.

After ageing, subject three of the test pieces to the burst pressure test as given in the relevant fire hose standard.

Subject the remaining test piece to the adhesion test as given in the relevant fire hose standard.

The three test pieces subjected to the burst pressure test shall conform to the requirements of the relevant fire hose standard.

The resultant adhesion of the fourth test piece shall be in accordance with the requirements in the relevant fire hose standard.

D.2.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— burst test value;

— adhesion value and any evidence of tearing;

— date of the test.

Annex E
(normative)

Surface abrasion resistance test (semi-rigid fire-fighting hoses)

E.1 Test pieces

Cut five test pieces of hose, each 0,35 m in length.

E.2 Apparatus

E.2.1 Test machine (see Figure E.1) for abrading the surface of a pressurized rotatable test piece with a laterally moveable abrading strip which is continually renewed.

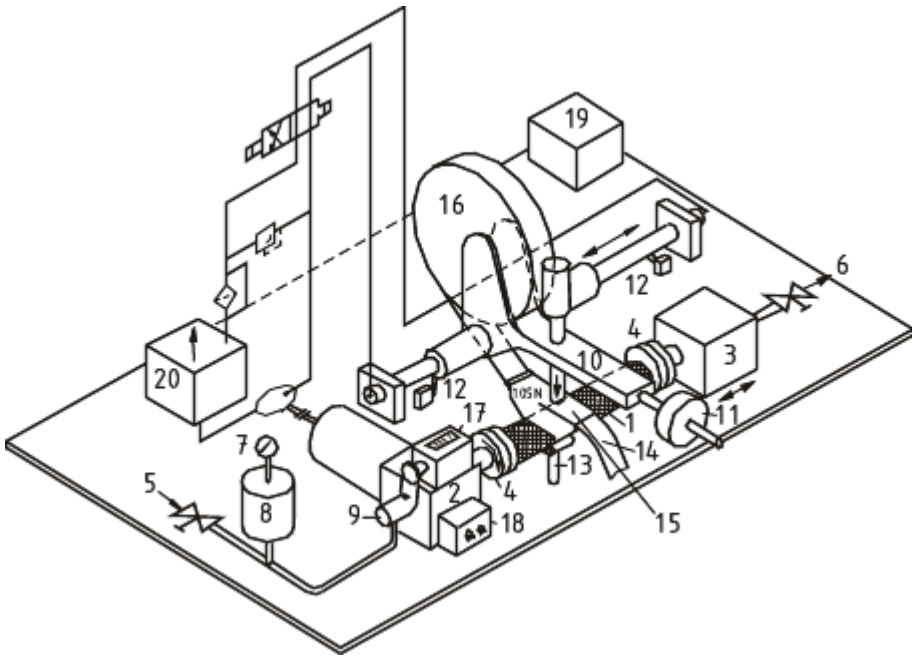
The driven rotating coupling is fixed in the axial direction whereas the other coupling can be moved axially in a guide.

The abrasion arm is in the form of a rocker pivoted to swivel upwards, and the weight of the arm is such that a force of 105 N acts on the test piece when it is set horizontally. This abrasion arm reciprocates along the hose axis at a rate of between 18 mm/s to 20 mm/s over a distance of 80 mm with the direction of travel being changed automatically. The pause time at the reversal points shall not exceed 0,1 s in each case.

The abrasion arm carries the abrading strip which moves 4 mm along the hose length for each double stroke, and the test piece is supported midway along its length by plain rollers.

E.2.2 Air pressure vessel with a capacity of at least 2 l fitted to the test machine to retain the pressure in the event of a loss of water.

E.2.3 Abrasive material consisting of a roll of corundum twill abrasive cloth measuring 50 mm wide and approximately 50 m long. The abrasive used for this abrasive material shall be synthetic 15, good quality fused aluminium oxide (Al2O3) with a minimum Al_2O_3 content with mass fraction of 70 %. It shall have a grain size of 60P as specified in the Grain Size Standard (43-1984 rev 1993) of the Federation of European Producers of Abrasive Products (FEPA).



Key

1	test piece	11	weight
2	driven bearing	12	direction change switch
3	axial movable bearing	13	hose support rolls
4	coupling	14	abrasive cloth
5	water inlet	15	feeding device
6	water outlet	16	abrasive roll
7	pressure gauge	17	rotation counter
8	air chamber	18	on-off switch
9	swivel	19	electrical appliance
10	abrasion arm	20	hydraulic appliance

Figure E.1 — Surface abrasion test machine

E.3 Procedure

Position the test piece in the machine and connect to the pressure source. Fill it with water at (20 ± 3) °C expelling all air.

When a pressure of 0,5 MPa has been achieved, check that the abrading arm and test piece are horizontal and rotate the test piece at (27 ± 1) r/min. in a clockwise direction when viewed from the side of the water inlet as indicated in Figure E.1.

After the specified number of revolutions as stated in the product standard, submit the test piece to the normal working pressure as given in the product standard.

Repeat the procedure with the remaining four test pieces.

E.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— abrasion results including the number of revolutions and any failures;

— date of the test.

Annex F
(normative)

Point abrasion resistance test (semi-rigid fire-fighting hoses)

F.1 Test pieces

Cut five test pieces of hose, each 1 m in length.

Since the abrasion resistance shall be determined at five equidistant positions around the hose, each test piece shall be marked at one of the five positions, ready for abrasion testing, using the centre of one face as a reference point.

F.2 Apparatus

F.2.1 Test machine (see Figure F.1), for abrading the upper surface of the test piece with a reciprocating movement.

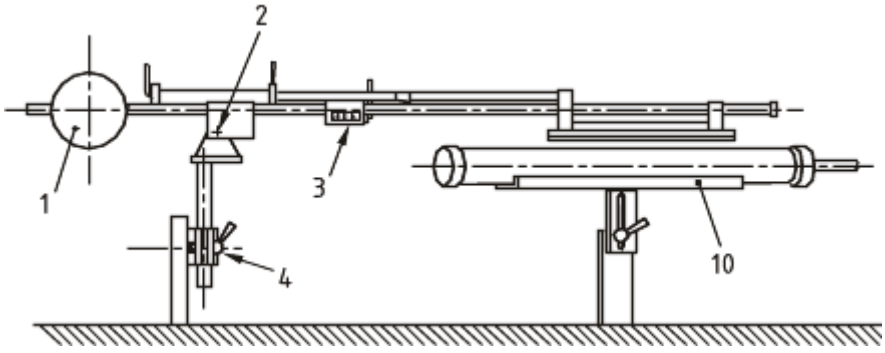
The abrading strip is mounted in a carrier and set at an angle of 45° to the horizontal axis of the test piece and at an angle of 20° to the direction of the reciprocating action of the test machine.

The reciprocating movement shall have a frequency of 50 to 60 double strokes per minute and the length of a single stroke shall be 230 mm.

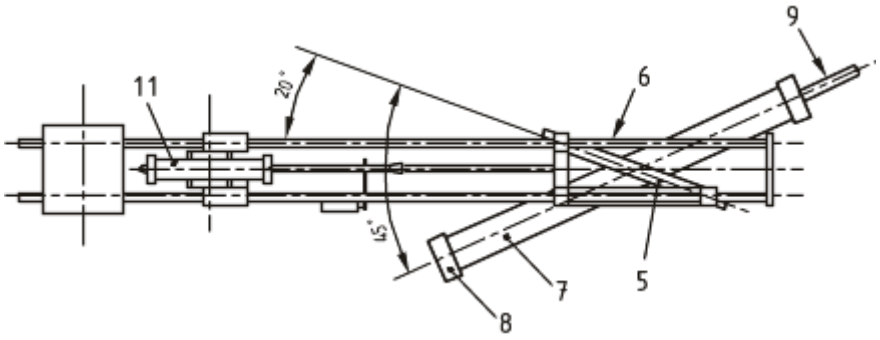
The machine shall exert a downward force of 15,5 N on the test piece.

NOTE The apparatus should be contained in a box with a shatter resistant transparent cover and it is recommended that it should be made from a rust resistant material.

F.2.2 Air nozzle, fitted to the test machine and producing a continuous jet of air to remove debris from the plane of abrasion.



a) Side view



b) View from above

Key

1	counter balance	7	test piece
2	pivot	8	blank end
3	stoke counter	9	water inlet
4	levelling clamp	10	hose support platform
5	abrading strip carrier	11	pneumatic cylinder
6	carrier slide bars		

Figure F.1 — Typical apparatus for the point abrasion test

F.2.3 Abrasive material, consisting of an abrasive cloth strip measuring 25 mm × 300 mm.

The abrasive used for this abrasive cloth shall be good quality fused aluminium oxide (Al_2O_3) free from extraneous materials and with a minimum Al_2O_3 content with a mass fraction of 93 %. It shall have a grain size of 50P as specified in the Grain Size Standard (43-1984 rev 1993) of the Federation of European Producers of Abrasive Products (FEPA). The cloth shall be of good quality cotton having a minimum warp way breaking strength of 1,392 N and a minimum weft way breaking strength of 431 N.

The abrasive strip shall be renewed for each test.

F.3 Procedure

Position the test piece in a holder to prevent twisting and then connect it to the pressure source and fill with water, expelling all the air. When a pressure of 0,7 MPa has been achieved, check that the hose and abrading arm are horizontal. Start the machine and abrade the test piece until it bursts. Record the number of double strokes at burst.

Repeat the test with the remaining four test pieces.

F.4 Test report

The test report shall include the following information:

— a full description of the hose tested;

— a reference to this test method;

— the five abrasion results, in number of double strokes to burst, with their mean;

— the date of the test.

Annex G
(normative)

Low temperature flexibility test (lay-flat fire-fighting hoses and semi-rigid fire-fighting hoses)

G.1 Lay-flat fire-fighting hoses

G.1.1 Test piece

Cut two test pieces from each hose tested. For hoses with an inside diameter of 25 mm the test piece shall measure 80 mm × 40 mm. For all other inside diameter sizes, the test pieces taken from the hose shall measure 100 mm × 40 mm. The test pieces shall be cut circumferentially.

NOTE The test piece need not be conditioned.

G.1.2 Apparatus

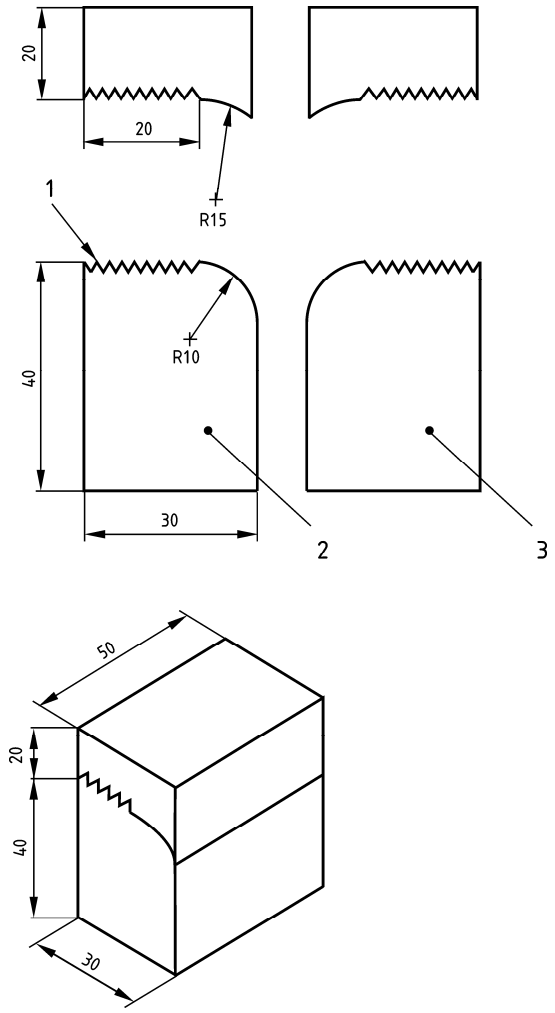
G.1.2.1 Two clamping jaws, with dimensions shown in Figure G.1 to retain the test piece in position.

One of the clamping jaws is fixed, whereas the other is moveable. The space between the jaws in the closed position (see Figure G.2) shall be three times the total hose thickness including ribs where applicable. A typical apparatus is given in Figure G.3.

The space between the jaws in the open position when the test piece is straightened out shall be 50 mm plus the longitudinal increase of the hose which results from the tensile force of 250 N exerted by the moveable jaw. The moveable jaw shall reciprocate with a speed of 10 mm/s. A typical apparatus is given in Figure G.3.

G.1.2.2 Freezer, capable of maintaining temperatures of (-20 ± 2) °C and (-30 ± 2) °C.

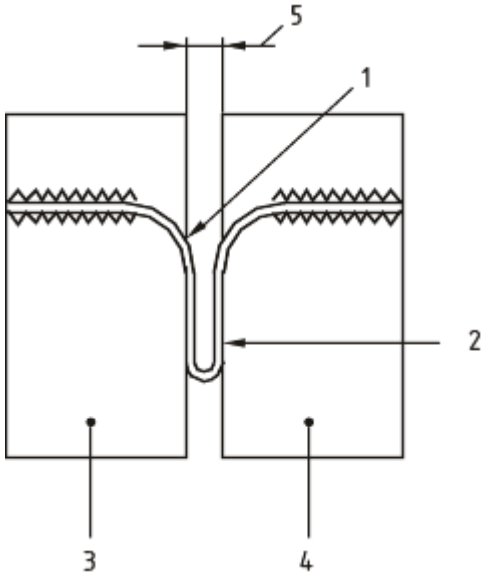
Dimensions in millimetres



Key

1 grooves
2 fixed jaw
3 movable jaw
R raduis

Figure G.1 — Clamping jaws

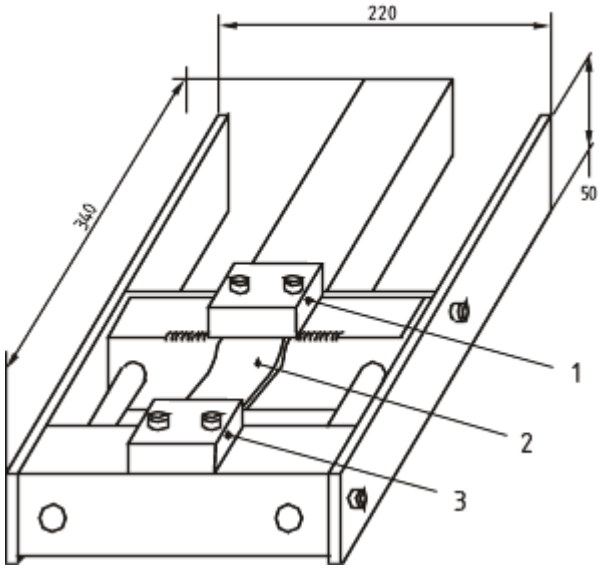


Key

1 hose lining inwards
2 hose test piece
3 fixed jaw
4 movable jaw
5 dimension 3 × hose thickness (including ribs if present)

Figure G.2 — Test piece mounted between clamping jaws

Dimensions in millimetres



Key

1 movable jaw

2 test piece

3 fixed jaw

Figure G.3 — Typical low temperature test apparatus

Procedure

Place the test piece and apparatus in the freezer (G.1.2.2) and carry out the test at the temperature specified.

Clamp the test piece in position in the jaws with the hose lining (and/or cover of class 3 or 4 hoses) as shown in Figure G.2 and in such a way that the free straight length between the jaws amounts to approximately 50 mm.

Immediately move the jaws to the closed position and leave for 10 min. Then cause the moveable jaw to carry out one test cycle at a speed of 10 mm/s and a force of 250 N.

One test cycle shall take 60 s according to the following:

— time to open jaws 5 s;

— open position 10 s;

— time to close jaws 5 s;

— closed position 40 s.

After 15 cycles examine the test piece for cracking or detachment of the cover or lining from the jacket.

G.1.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— whether cracks or delamination were observed;

— temperature at which the test was carried out;

— date of the test.

G.2 Semi-rigid fire-fighting hoses

G.2.1 General

The test shall be carried out in accordance with Clause 4 Method B of EN ISO 4672:1999 using a mandrel of outside diameter equal to 12 times the inside diameter of the hose. After bending the hose round the mandrel through 180° for (10 ± 2) s at a temperature of (-20 ± 2) °C or lower if requested, it shall not show any signs of breaking or cracking and shall meet the proof pressure requirement given in the product standard.

G.2.2 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— whether cracks were observed;

— temperature at which the test was carried out;

— pass or failed the pressure test;

— date of the test.

Annex H
(normative)
Hot surface resistance test (semi-rigid and lay-flat fire-fighting hoses)

H.1 Test piece

The test piece shall be a sample of hose of length approximately 0,5 m.

Mark the test piece in 4 places at approximately 90° intervals circumferentially. In the case of lay-flat fire-fighting hose the marked positions shall be such that 2 of the marks are coincident with the flat edges of the hose.

NOTE This sampling procedure is designed to eliminate eccentric covers.

H.2 Apparatus

H.2.1 Filament rod, consisting of an electrically heated spiral resistance wire with a resistance of approximately 80 Ω wound around a ceramic tube of an approximant diameter of 21 mm, enclosed in a tube of quartz glass containing a mass fraction of at least 95 % of SiO_2 (silicon dioxide) and fitted with a brass sleeve (see Figure H.3). [1)]

An example of the design is given in Figure H.1.

H.2.2 Temperature controller and recorder, capable of restoring the set temperature within 15 s of commencement of the test and maintaining the set temperature within the specified limits.

H.2.3 Thermocouple, type J or K, (i.e. not twisted together), jacketed type diameter of 1,5 mm.

H.2.4 Loading weight, designed to press the filament rod (H.2.1) against the vertically mounted test piece with a force (*F*) equivalent to 4 N (see Figure H.2).

H.2.5 Cabinet or small enclosure, to eliminate local air movement in the vicinity of the test piece and filament rod.

1) A suitable filament rod can be obtained from Thermal Quartz-Schmelze GmbH, Postfach 130309, D-65201 Wiesbaden-Schierstein, Germany (immersion heater, article no. 7801). This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Dimensions in millimetres

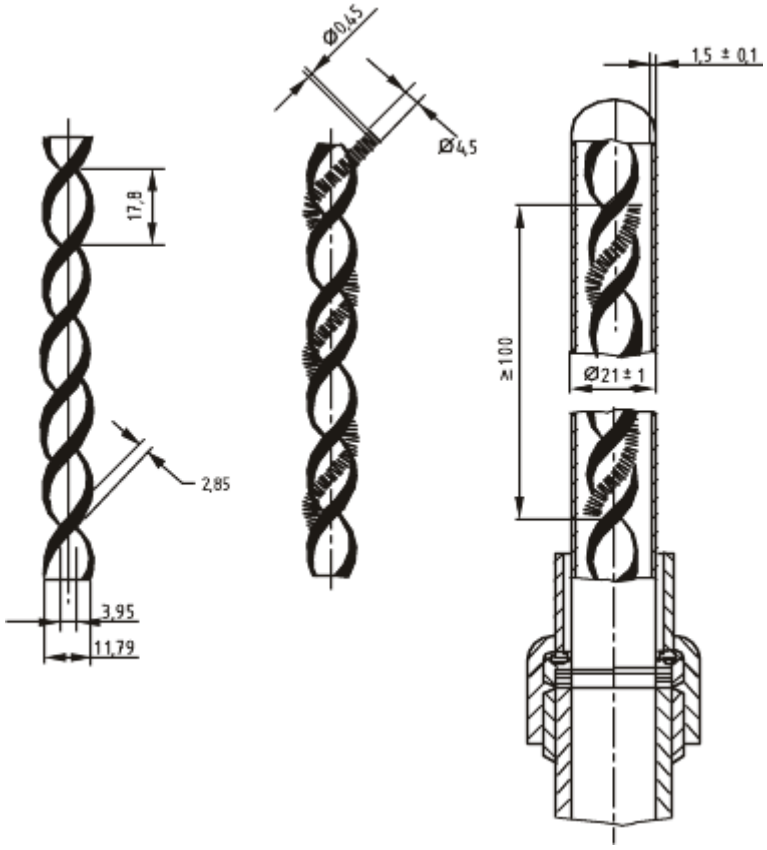
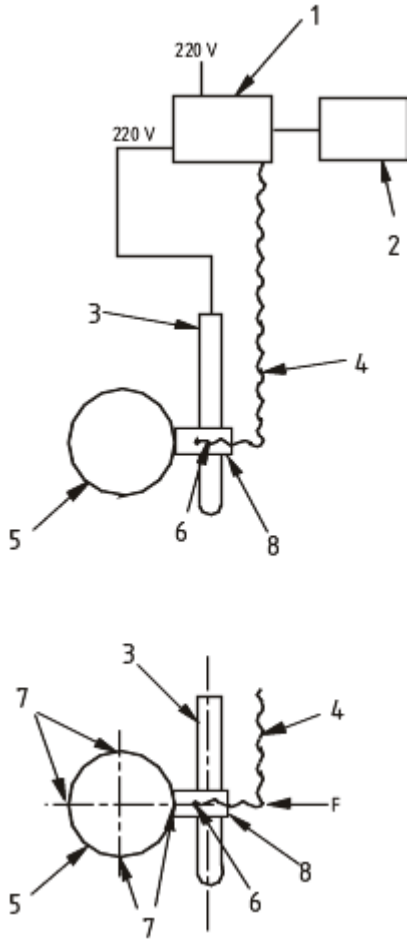


Figure HH.1 — Example of suitable filament rod design

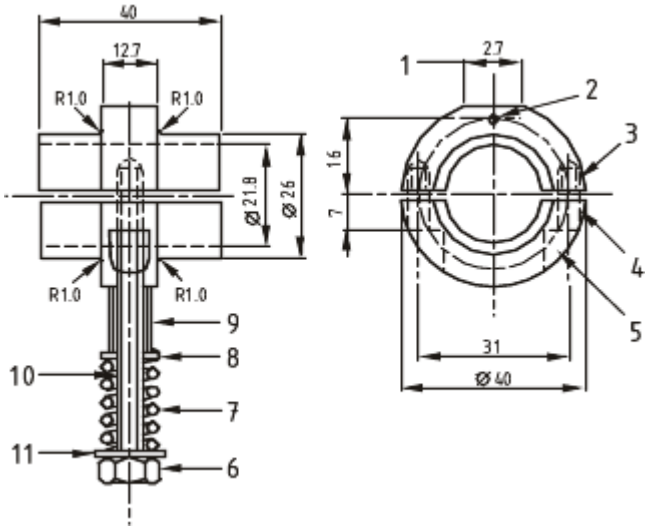


Key

1	temperature controller	5	hose
2	recorder or computer	6	point of measuring
3	filament rod	7	testing areas
4	thermocouple type J or K	8	metal sleeve

Figure HH.2 — Point of contact of filament rod with hose (seen from above)

Dimensions in millimetres



a) Side view **b) Top view**

Key

1 flat
2 hole ∅ 1,6 × 10
3 tap M5 × 6
4 drill ∅ 5,5
5 mill ∅ 9
6 M5 nut
7 compression spring
8 collar
9 tube spacer
10 5 mm threaded bar
11 M5 washer

Figure HH.3 — Detail of brass metal sleeve

Procedure

Couple the test piece in a vertical position, fill it with water at a test temperature of (15 ± 5) °C, expelling all air and subject it to a pressure of 0,7 MPa.

At ambient temperature, adjust the test piece and the sleeve on the filament rod such that the flat side of the sleeve is in contact with one of the marks on the test piece.

Swing the filament rod away from the test piece, switch on the temperature controller and adjust to the test temperature as specified in the fire hose standard. Maintain and record the test temperature throughout the tests.

Press the filament rod against the mark on the test piece with a force of 4 N.

For semi-rigid fire-fighting hose after 60 s, remove the rod and examine the test piece for leaks.

If a leak occurs in less than the specified time period, stop the test and record the time to failure.

If no leak occurs, repeat the test at the further 3 marked test positions after ensuring that the sleeve contact area is clean.

H.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— all test results, whether there was any leaks, failures, exposure of reinforcement in semi-rigid hose; and burst test value;

— temperature at which the test was carried out;

— date of the test.

Annex I
(normative)

Pressure loss test (semi-rigid fire-fighting hoses)

I.1 Test piece

The test pieces shall comprise two lengths of hose, one of (1 ± 0,1) m with couplings attached, and the other (20 ± 0,2) m with couplings attached. Couplings shall be recognised by national standards.

I.2 Apparatus

I.2.1 Controllable water supply, at a flow rate [2)] given in fire hose standard and with an inlet pressure of 0,6 MPa.

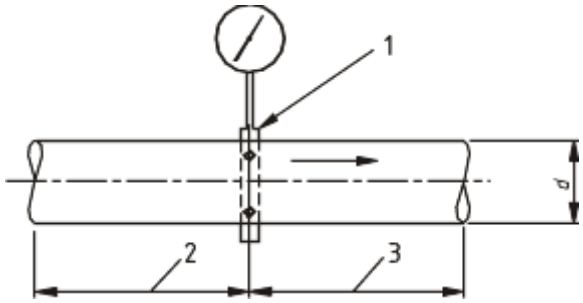
I.2.2 Pressure gauge.

I.2.3 Two differential pressure gauges.

I.2.4 Control valve, enabling a distinct quantity of water (l/min) to be pumped through the test piece.

I.2.5 Pressure measuring adaptor, positioned before and after the test piece, and similar to that illustrated in Figure I.1, used to obtain differential pressure measurements.

It is therefore necessary to have three compatible sleeves with the same diameter for each of the inside diameters of hoses to be tested.



Key

1 ring shaped chamber with 4 holes at 90° circumferential distance

2 at least three times the diameter of the hose

3 three times the diameter of the hose

d inside diameter of the hose $^{+10}_{0}$ %

Figure I.1 — Typical pressure measuring adaptor (see Figure I.2)

[2)] When testing larger diameter hoses (greater than 76 mm) it is possible to reduce the flow of water depending upon the available water supply. Thus if, for example, the flow rate is divided by x (where $x < 1,7$) the measured pressure loss is multiplied by x^2 to give the equivalent pressure loss as specified in the relevant fire hose standard. However, to retain the original degree of accuracy it is recommended that a longer length of hose than 20 m is used.

I.3 Procedure

Lay out the hose test pieces, without bends, in a horizontal position.

Connect the hose test pieces in tandem to the pressure measuring sleeves (I.2.5) as shown in Figure I.2 and to the controllable water supply (I.2.1).

Obtain the required water flow, as given in relevant hose standard, with an inlet pressure of 0,6 MPa. Measure the actual length of the test piece exposed to the water flow (m1 for the actual length of the 1 m test piece and m20 for the 20 m test piece). Determine the pressure loss between the sleeves using the differential pressure gauges (I.2.3).

Calculate the pressure loss per metre of hose for the two hose test pieces as follows:

Pressure loss kPa/m = (P20 – P1) divided by (m20 – m1)

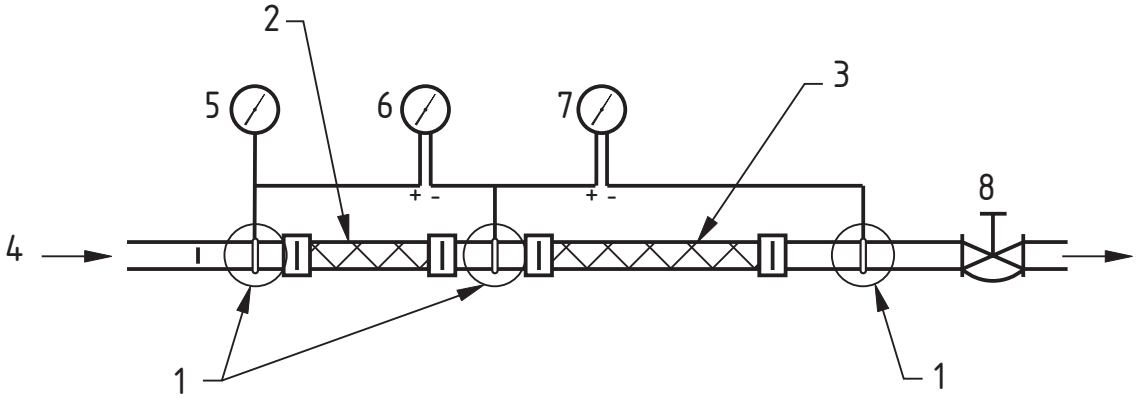
where

P20 is the pressure loss of the 20 m hose length, in kilopascals;

P1 is the pressure loss of the 1 m hose length, in kilopascals;

m20 is the actual length of the 20 m hose length exposed to the water flow, in metres;

m1 is the actual length of the 1 m hose length exposed to the water flow, in metres.



Key

1 ring shaped chamber with 4 holes at 90° circumferential distance (see Figure I.1)

2 (1 ± 0,1) m test piece

3 (20 ± 0,2) m test piece

4 water flow

5 pressure gauge

6 differential pressure gauge

7 differential pressure gauge

8 control valve

Figure I.2 — Hose test pieces in tandem

I.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— pressure loss per metre length, in kilopascals per metre;

— date of the test.

Annex J
(normative)

Deformation under crushing test (semi-rigid fire-fighting hoses)

J.1 Test piece

Prepare the test piece which shall be a length of hose of at least 128 mm. No test shall be carried out within 24 h of manufacture.

Before testing, condition the test pieces for at least 16 h at a standard laboratory temperature and humidity according to ISO 23529.

NOTE This 16 h period may be part of the 24 h interval after manufacture.

J.2 Apparatus

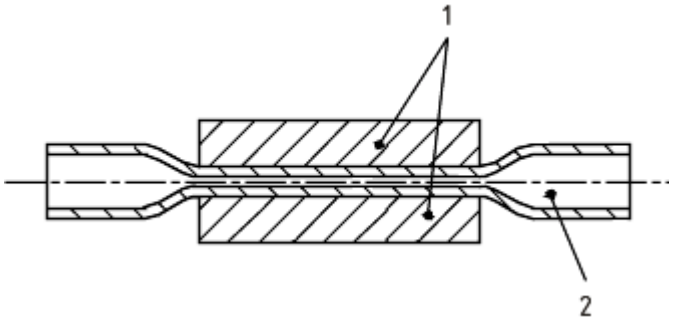
J.2.1 Compression testing machine, capable of a rate of traverse of (50 ± 5) mm/min, and with a load capacity adequate for the level of crushing force.

J.2.2 Two square metal plates, 80 mm × 80 mm, of sufficient thickness to be capable of withstanding the applied forces without deformation, and with rounded edges to avoid cutting of the hose during the test.

J.2.3 Balls, of diameters as given in Table J.1.

J.3 Procedure

After conditioning place the test piece between the two parallel plates (J.2.2) mounted in the test machine (J.2.1) so that the central section of the test piece is crushed (see Figure J.1).



Key

1 test piece

2 metal plates

Figure J.1 — Side-section of hose subjected to crushing test

Table JJ.1 — Deformation under crushing

Inside diameter mm	Crush dimension, outside diameter mm	Minimum force N	Ball diameter mm
12	6	500	10
19	9,5	500	16
25	12,5	500	21
33	16	500	27

Apply the crushing force as given in Table J.1 at a rate of (50 ± 5) mm/min until the mean distance between the faces of the plates is the specified crush dimension (see Table J.1) for the hose under test. Measure the force applied and maintain the deformation for (60 ± 2) s.

Release the force and remove the test piece from the machine. After (60 ± 2) s insert a ball of the diameter specified in Table J.1 into one end of the test piece and note whether or not it passes freely through the test piece.

J.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— test result (pass/fail of ball);

— date of the test.

Annex K
(normative)

Bending and crush resistance test (semi-rigid fire-fighting hoses)

K.1 Test piece

Prepare the test piece which shall be a length of hose not less than 1 m. A minimum of two test pieces shall be tested.

K.2 Apparatus

K.2.1 A rigid drum of diameter 200 mm for up to 32 mm inside diameter hoses and a rigid drum of diameter 280 mm for 33 mm inside diameter hose.

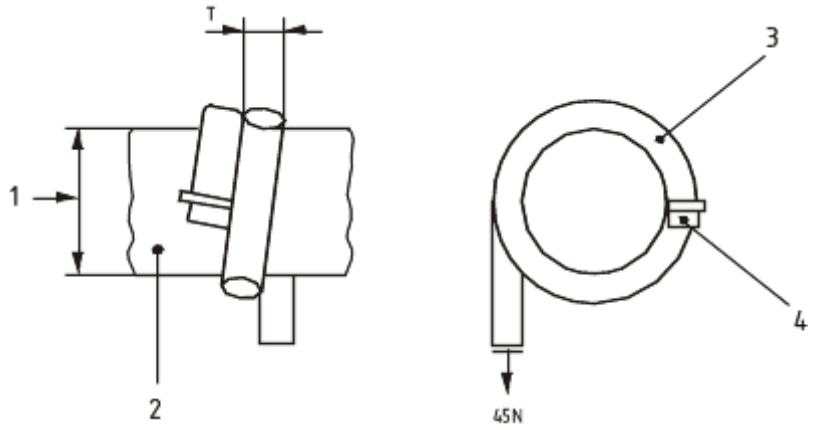
K.3 Procedure

Determine, in accordance with EN ISO 4671, the average outside diameter, D, in millimetres, of the hose using a suitable measuring instrument.

Clamp one end of the test piece onto the appropriate sized rigid drum (K.2) and wind 1,5 turns round the drum (see Figures K.1 a) and K.1 b)). The hose shall not show any visible signs of kinking.

Load the free end of the test piece with a force of 45 N. After 5 min, with the hose still wound round the drum, measure the outside diameter of the major axis of the hose along the part of the test piece that is touching the drum to determine the greatest outer dimension (T).

Calculate the ratio, T/D.



a) Side view **b) Face view**

Key

1 diameter of the drum

2 drum

3 test piece

4 clamp

Figure K.1 — Test apparatus

K.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— report any kinking;

— mean value of the test result, ratio T/D;

— date of the test.

Annex L
(normative)

Test for fire-fighting hose assemblies

L.1 Test piece

The assembled hose, complete with couplings, shall be used as the test piece.

L.2 Apparatus

A pump with the capacity of reaching the specified proof pressure.

L.3 Procedure

Raise the pressure to the specified proof pressure and maintain for 1 min, examining during this time for any coupling movement or leaks.

Release the pressure and allow the assembly to relax for 1 min, then raise the pressure again to the specified proof pressure, maintain for a further 1 min and examine carefully for coupling movement or leaks.

Release the pressure and re-examine.

NOTE A statistically based sampling plan may be used to provide evidence that hoses in a given batch conform to this requirement.

L.4 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— whether any coupling movement or leakage was observed;

— date of the test.

Annex M
(normative)

Pressure impulse test (fire-fighting suction hoses)

M.1 Test pieces

Prepare a minimum of three test pieces of hose with end fittings. The clear distance between fittings shall be at least five times the inside diameter of the hose.

M.2 Apparatus

Circuit capable of applying an internal hydraulic pressure which can be released at a predetermined level, delayed by a fixed period of time and the impulse cycle then repeated. The impulse cycle shall conform to the pressure/time requirements of Figure M.1.a suitable circuit is shown in Figure M.2.

M.3 Test fluid

The test fluid shall be water which may be suitably dyed.

M.4 Conditioning

No test shall be carried out within 24 h of manufacture of the hose. Test pieces shall be conditioned at (23 ± 2) °C for at least 3 h before testing.

NOTE The 3 h of conditioning can be included in the 24 h period following manufacture.

M.5 Procedure

Connect the test piece in a straight condition to the apparatus and ensure that the temperature of both the test fluid and the ambient condition is (23 ± 2) °C. Expel all air from the test piece and apply 10 000 impulse cycles.

The maximum pressure of the test cycle (see Figure N.1) shall be 0,18 MPa.

NOTE Due to the length of this test, a short interruption is permitted. The test can be resumed from the point of interruption, but this should be stated in the test report.

M.6 Test report

The test report shall include the following information:

— full description of the hose tested;

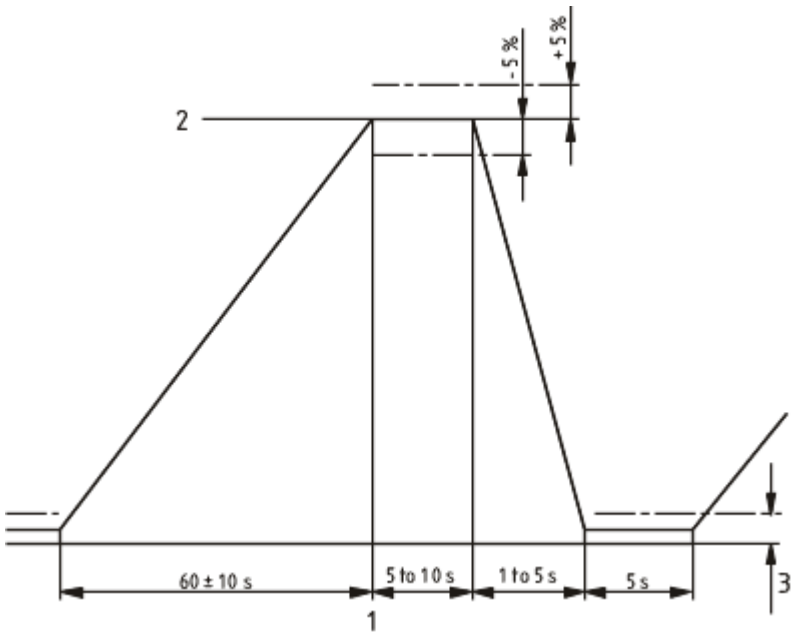
— reference to this test method;

— numbers of cycles to failure of less than 10 000;

— position and mode of failure for each test piece;

— test fluid and dye used, if applicable;

— date of the test.



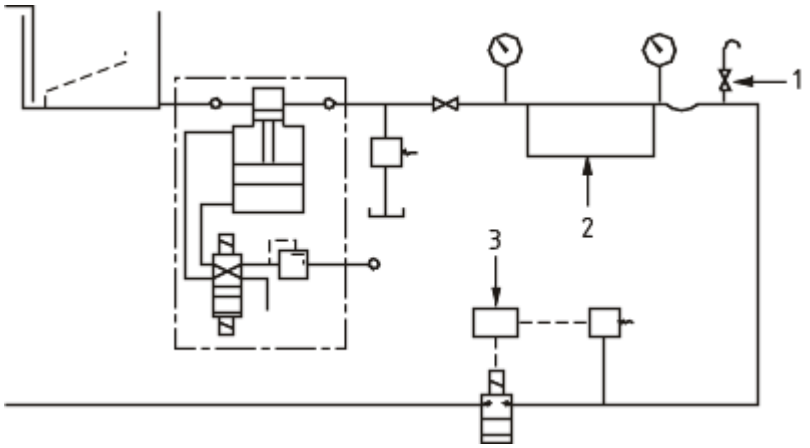
Key

1 time

2 test pressure

3 5 % test pressure

Figure M.1 — Pressure impulse cycle



Key

1 air bleed valve

2 test piece

3 timer

Figure M.2 — Suitable impulse test circuit

Annex N
(normative)

Reinforcement fracture resistance test (type B hoses only) (fire-fighting suction hoses)

N.1 Test pieces

Prepare each test piece which shall contain three helices of reinforcement and shall be split with a clean cut along its length. Three test pieces shall be tested.

N.2 Apparatus

Lengths of hardwood or rectangular metal sections with a square cross-section conforming to the appropriate value given in Table N.1.

N.3 Conditioning

No test shall be carried out within 24 h of manufacture. Test pieces shall be conditioned at (23 ± 2) °C for at least 3 h before testing.

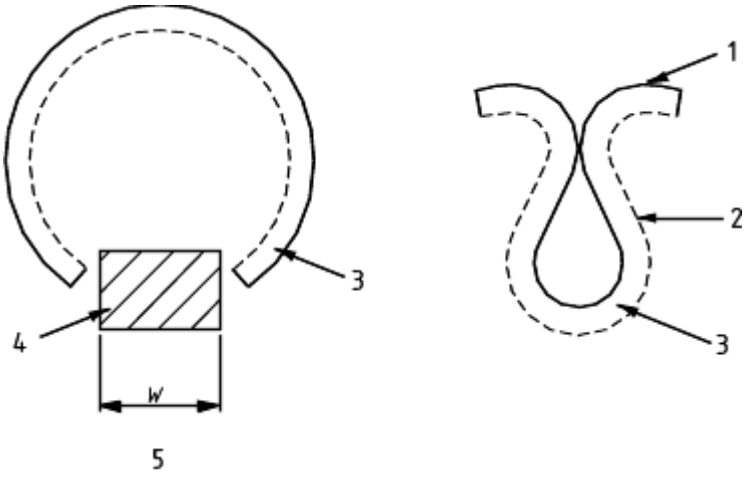
NOTE The 3 h of conditioning can be included in the 24 h period following manufacture.

N.4 Procedure

Open up the test piece and place it lengthways on a block extension appropriate to its inside diameter (see Table N.1 as indicated in Figure N.1 a)). Leave in this condition for either 336 h (for a batch test) or 4 months (for a type test), as appropriate. Carry out the test at a temperature of (23 ± 2) °C. Reverse bend the test piece bringing the cut sides together until the outside surfaces touch and examine for cracking of the helix (see Figure N.1 b)).

Table N.1 — Block extension dimensions for reinforcement fracture resistance test

Inside diameter of hose mm	Block width mm
45	29
50	31
52	31
65	34
70	36
75	37
76	37
90	41
100	44
102	44
110	47
125	49
140	51
150	53



N.1 a) **N.1 b)**

Key

1 outer surface

2 inner surface

3 test piece

4 test block

5 block width

Figure N.1 — Reinforcement fracture test

N.5 Test report

The test report shall include the following information:

— full description of the hose tested;

— reference to this test method;

— state either no failure or the position and nature of failure for each test piece, as applicable;

— date of the test.

Annex O
(normative)

Test for flexibility at ambient temperature (fire-fighting suction hoses)

O.1 Test piece

The test piece shall be a length of hose and suitable couplings, giving an overall hose assembly length of (2 500 ± 25) mm.

O.2 Apparatus

O.2.1 Vertical slings, to suspend the test piece at least 600 mm below a beam.

O.2.2 Straight edge, at least the length of the test piece.

O.2.3 Weight or force, capable of applying 450 N.

O.2.4 Rule or steel measuring tape.

O.3 Procedure

At a test temperature of (23 ± 2) °C, suspend the test piece with the slings around the couplings. Position the test piece so that when at rest it forms an arc, with the slings vertical throughout the test (see Figure P.1). In the case of hoses of inside diameter equal to or greater than 125 mm, add an appropriate weight to the middle of the test piece to apply a vertical downward force of 450 N, readjusting the slings as necessary.

NOTE No additional weight is added to hoses of smaller inside diameter.

Place a straight edge across the top of the couplings as a datum and measure the deflection at the vertical distance between the datum and the upper surface of the hose at the centre of the arc.

O.4 Test report

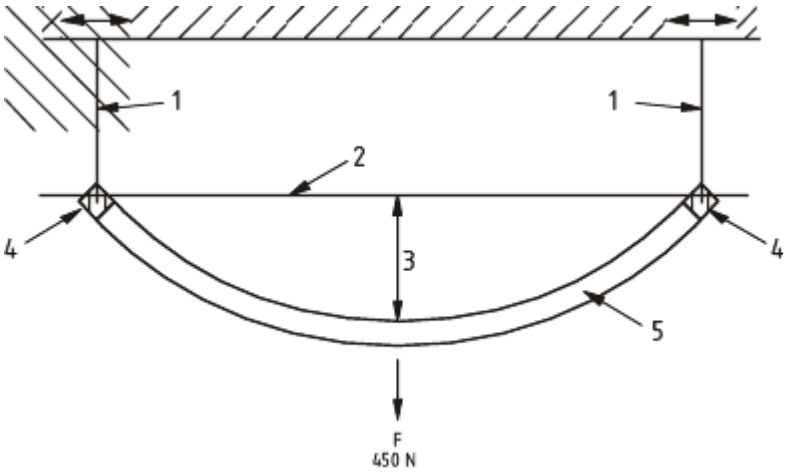
The test report shall include the following information:

— full description of the hose assembly;

— date of manufacture of the hose;

— amount of deflection and length of the assembly;

— date of the test.



F = 450 N

Key

1 suspension sling
2 straight edge
3 deflection
4 hose couplings
5 test piece

Figure O.1 — Apparatus for flexibility test

Annex P
(normative)

Test for vacuum resistance with flexing (fire-fighting suction hoses)

P.1 Test piece

The test piece shall be a length of hose and suitable couplings, giving an overall hose assembly length of (2 500 ± 25) mm.

P.2 Apparatus

Flat table, with one edge rounded to 25 mm radius.

Weight or force, equivalent to the mass of two test pieces.

Vacuum source.

P.3 Procedure

Weigh the test piece. Anchor one coupling to the table (P.2) so that half the length of the test piece is hanging over the rounded edge of the table and the other half is lying horizontally. Attach the weight (P.2) or an equivalent force to the other coupling. At a temperature of (23 ± 2) °C, apply a vacuum of 0,097 MPa below atmospheric pressure, i.e. 0,004 MPa absolute for 5 min. Return the pressure to atmospheric, lay the test piece on a flat surface and examine for evidence of distortion or damage.

P.4 Test report

The test report shall include the following information:

— full description of the hose assembly;

— date of manufacture of the hose;

— weight/force attached to the hose assembly;

— observations on the hose at the end of the test;

— date of the test.

Annex Q
(normative)

Test for resistance to kinking (lay-flat fire-fighting hoses)

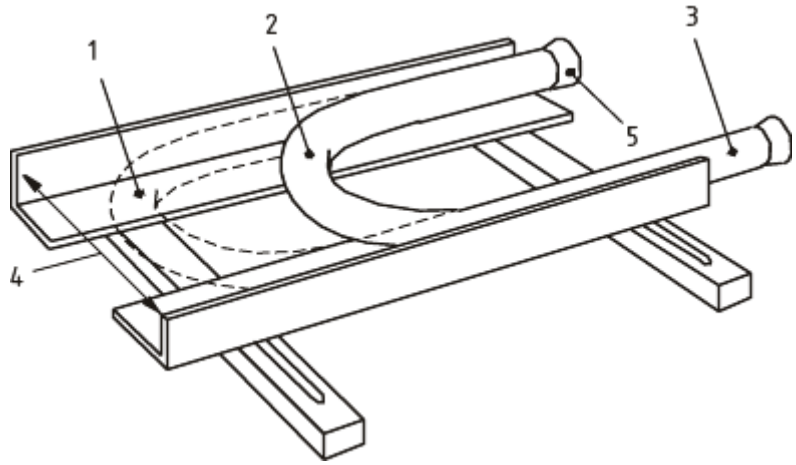
Q.1 Test piece

The test piece shall be a hose assembly with a minimum length of 15 m.

Q.2 Apparatus

Q.2.1 Device, consisting of two planks of wood or metal sheet which restrict the outward movement of the pressurized hose.

One of the sides is fixed whereas the other can be moved and held at a given distance from the other.(See Figure Q.1 for a typical device.)



Key
1 original position of hose
2 test position of hose
3 hose pulled when pressurized
4 distance between planks of wood is 22× inside diameter of hose
5 couplings

Figure Q.1 — Typical apparatus for resistance to kinking test

Q.3 Procedure

Position an unpressurized length of hose in the device (Q.2) in a curved position with the distance between the restricting boards 22 times the inside diameter of the hose. Fill the hose with water, expelling the air, pressurize to 1,0 MPa and lightly mark it at the point of contact with each of the restricting boards.

NOTE This delineates the curved portion of the hose which may contain incipient kink points.

Pull the hose to align the original curved portion alongside a restricting board.

Finally check to determine whether visible kinks are obvious in the new curvature section of the hose.

Q.4 Test report

The test report shall contain the following information:

— full description of the hose tested;

— reference to this European Standard;

— whether kinks were observed or not;

— date of the test.

Annex R
(informative)

Test methods from other EN and ISO standards

The following test methods are additionally specified in fire hose standards and are included under this annex for information.

Inside diameter	EN ISO 4671, *Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies (ISO 4671:2007)*
Flexibility	EN ISO 4672, *Rubber and plastics hoses — Sub-ambient temperature flexibility tests (ISO 4672:1997)*
Ozone	EN ISO 7326, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions (ISO 7326:2006)*
Hose sizes and	EN ISO 1307, *Rubber and plastics hoses — Hose sizes, minimum and maximum inside diameters, and tolerances on cut-to-length hoses (ISO 1307:2006)*
Hydrostatic	EN ISO 1402, *Rubber and plastics hoses and hose assemblies— Hydrostatic testing (ISO 1402:2009)*
Working pressure	
Proof pressure	
Burst pressure	
Bending	EN ISO 1746, Rubber and plastics hoses and tubing — Bending tests (ISO 1746:1998, including technical corrigendum 1:1999)
Suction	EN ISO 7233, *Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum (ISO 7233:2006)*
UV	EN ISO 11758 *Rubber and plastics hoses - Exposure to a xenon arc lamp - Determination of changes in colour and appearance (ISO 11758:1995)*
Adhesion	EN ISO 8033, *Rubber and plastics hoses — Determination of adhesion between components (ISO 8033:2006)*
Ageing	ISO 188, *Rubber vulcanised or thermoplastic — Accelerated ageing and heat resistance tests*
Loss of plasticiser	EN ISO 176, *Plastics — Determination of loss of plasticizer — Activated carbon method (ISO 176:2005)*

Bibliography

[1] EN 671-1, *Fixed fire-fighting systems — Hose systems — Part 1:Hose reels with semi-rigid hose*

[2] EN 671-2, *Fixed fire-fighting systems — Hose systems — Part 2: Hose systems with lay-flat hose*

[3] EN 671-3, *Fixed fire-fighting systems — Hose systems — Part 3: Maintenance of hose reels with semi-rigid hose and hose systems with lay-flat hose*

[4] EN 694, *Fire-fighting hoses — Semi-rigid hoses for fixed systems*

[5] EN 1947, *Fire-fighting hoses — Semi-rigid delivery hoses and hose assemblies for pumps and vehicles*

[6] EN 14540, *Fire-fighting hoses — Non-percolating lay-flat hoses for fixed systems*

[7] EN ISO 176, *Plastics — Determination of loss of plasticizer — Activated carbon method (ISO 176:2005)*

[8] EN ISO 1307, *Rubber and plastics hoses — Hose sizes, minimum and maximum inside diameters, and tolerances on cut-to-length hoses (ISO 1307:2006)*

[9] EN ISO 1402, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing (ISO 1402:2009)*

[10] EN ISO 1746, Rubber and plastics hoses and tubing — Bending tests (ISO 1746:1998, including technical corrigendum 1:1999)

[11] EN ISO 7233, *Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum (ISO 7233:2006)*

[12] EN ISO 7326, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions (ISO 7326:2006)*

[13] EN ISO 11758, *Rubber and plastics hoses - Exposure to a xenon arc lamp - Determination of changes in colour and appearance (ISO 11758:1995)*

[14] EN ISO 14557, *Fire-fighting hoses — Rubber and plastics suction hoses and hose assemblies (ISO 14557:2002)*

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