INTERNATIONAL STANDARD

ISO 4642-2

Second edition
2015-12-01

Rubber and plastics hoses, non-collapsible, for fire-fighting service —

Part 2: Semi-rigid hoses (and hose assemblies) for pumps and vehicles

Tuyaux en caoutchouc et en plastique, non aplatissables, pour la lutte contre l'incendie —

Partie 2: Tuyaux (et flexibles) semi-rigides pour pompes et véhicules

Reference number
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Contents

Page

Foreword

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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).

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).

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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

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 second edition cancels and replaces the first edition (ISO 4642-2:2009), of which it constitutes a minor revision.

ISO 4642 consists of the following parts, under the general title *Rubber and plastics hoses, non-collapsible, for fire-fighting service*:

— *Part 1: Semi-rigid hoses for fixed systems*

— *Part 2: Semi-rigid hoses (and hose assemblies) for pumps and vehicles*

Introduction

This part of ISO 4642 is mainly concerned with fire service semi-rigid delivery hoses and incorporates those hoses used manually to control and extinguish fires.

Rubber and plastics hoses, non-collapsible, for fire-fighting service —

Part 2:
Semi-rigid hoses (and hose assemblies) for pumps and vehicles

1 Scope

This part of ISO 4642 specifies the requirements and test methods for semi-rigid reel hoses for use on fire-fighting vehicles and trailer pumps. The hoses are intended for use at a maximum working pressure of 1,5 MPa for normal pressure hoses (category I) and 4,0 MPa for high pressure hoses (category II). The hoses are further subdivided into types and classes (see Clause 4).

This part of ISO 4642 applies to delivery hoses for fire-fighting purposes intended for use at a minimum ambient temperature of −20 °C.

Hoses conforming to this part of ISO 4642 are intended to be used with fire hose couplings conforming to the relevant national standards couplings.

Requirements are also given for hose assemblies (see 6.12) where these are fitted by the hose manufacturer.

NOTE 1 Hoses for use at temperatures lower than −20 °C can be supplied by agreement between the manufacturer and purchaser.

NOTE 2 All pressures are expressed in megapascals where 1 MPa = 10 bar.

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 176:2005, *Plastics — Determination of loss of plasticizers — Activated carbon method*

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

ISO 1307, *Rubber and plastics hoses — Hose sizes, minimum and maximum inside diameters, and tolerances on cut-to-length hoses*

ISO 1402, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

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

ISO 7326:2006, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions*

ISO 8033:2006, *Rubber and plastics hoses — Determination of adhesion between components*

ISO 8330, *Rubber and plastics hoses and hose assemblies — Vocabulary*

ISO 10619-2:2011, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 2: Bending tests at sub-ambient temperatures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8330 and the following apply.

3.1
semi-rigid hose
hose that maintains its round cross-section even when unpressurized

4 Classification

4.1 General

All types and classes of hose shall be so flexible that they can be rolled and kept on a drum of minimum diameter 200 mm for 12 mm inside diameter, 19 mm inside diameter and 25 mm inside diameter hose and of minimum diameter 280 mm for 33 mm inside diameter hose.

Hoses shall be one of two categories distinguished by the maximum working pressure. Each hose shall be further divided into one of three types distinguished by its construction, and then into six classes distinguished by the materials used for lining and cover.

NOTE The hose can be coloured by agreement between the purchaser and the manufacturer.

4.2 Classification by types (hose construction)

4.2.1 Type A hoses shall consist of:

a) a seamless rubber or plastics lining;

b) a textile spiral or braided reinforcement;

c) a rubber or plastics cover.

4.2.2 Type B hoses shall consist of:

a) a seamless rubber or plastics lining;

b) a circular woven textile reinforcement with a rigid spiral helix;

c) an uncovered or rubber or plastics cover.

4.2.3 Type C hoses shall consist of:

a) a seamless rubber or plastics lining;

b) any suitable reinforcement;

c) a rubber or plastics cover.

NOTE While the construction of type A and type C hoses can be similar or even identical, the performance requirements differ for the following: burst and proof pressure, adhesion, hot surface resistance, crush resistance.

4.3 Classification by class (materials for lining and cover)

The hose types shall be further subdivided into six classes dependent on the materials used in their construction, in accordance with Table 1.

Table 1 — Classes and materials

Class	Lining material	Cover material
1	rubber	rubber
2	plastics	plastics
3	rubber	plastics
4	plastics	rubber
5	rubber	no cover
6	plastics	no cover

4.4 Classification by category

All hoses shall be divided into two categories dependent on the maximum working pressure, in accordance with Table 2.

Table 2 — Maximum working pressure, proof pressure and minimum burst pressure

Type of pressure MPa	Category I	Category II	
	Types A and B Classes 1 to 6	Types A and B Classes 1 to 6	Type C Classes 1 to 6
Maximum working pressure	1,5	4,0	4,0
Proof pressure	3,0	6,0	8,0
Minimum burst pressure	4,7	10,0	12,0

EXAMPLE A type C hose, constructed with a rubber lining and rubber cover and which has a maximum working pressure of 4,0 MPa, a proof pressure of 8,0 MPa and a minimum burst pressure of 12,0 MPa is classified as II/C/1.

5 Dimensions, tolerances and maximum mass

5.1 Inside diameter and maximum mass

The inside diameter of the hose and tolerances, when measured in accordance with ISO 4671, using any suitable method stated in ISO 4671:2007, Clause 4, shall conform to the requirements given in Table 3. The mass per metre length of the hose shall be in accordance with Table 3.

Table 3 — Inside diameter, tolerances on inside diameter and maximum mass per unit length

Inside diameter mm	Tolerances for inside diameter mm		Mass per unit length kg/m	
	Types A and C	Type B	Types A and C max.	Type B max.
12	0 to +0,6	—	0,30	—
19	0 to +0,9	0 to +1,5	0,75	0,25
25	0 to +1,2	0 to +1,5	0,90	0,35
33	0 to +1,6	0 to +2,0	1,00	0,50

5.2 Length and tolerances on length

The total length of hose supplied shall be in accordance with the purchaser's requirements and shall be stated in metres. Tolerance on length shall be in accordance with ISO 1307.

5.3 Concentricity

When tested in accordance with ISO 4671:2007, 8.3 (Method 2), the variation from concentricity measured between inside and outside diameters shall not exceed the following values:

Types A and C 1,5 mm

Type B 0,4 mm

6 Performance requirements of finished hose

6.1 Hydrostatic requirements

6.1.1 Deformation under maximum working pressure

The dimensional stability of the hose, when tested in accordance with ISO 1402, shall conform to the requirements given in Table 4. The length of the test piece shall be 1 m.

For category I hoses, the initial test pressure shall be 0,07 MPa and the final test pressure shall be 1,5 MPa. For category II hoses, the initial test pressure shall be 0,07 MPa and the final test pressure shall be 4,0 MPa.

The twist shall be no greater than 30° m^{-1} for types A and C. For type B, the twist may be greater than 30° m^{-1} but in this case it shall only be in a direction which closes the coupling and shall be stated in the test report.

Table 4 — Change in length and external diameter

	Tolerances for types A, B and C %
Change in length	0 to +7,5
Change in external diameter	0 to +7,5

NOTE Hose with a lower maximum change in length can be agreed between the purchaser and manufacturer.

6.1.2 Deformation under proof pressure

A proof pressure hold test shall be carried out on three hose lengths each of 1 m in accordance with ISO 1402. The proof pressure shall be as given in Table 2 and, on examination during the test, the test pieces shall not show any evidence of leakage, cracking, abrupt distortion or other signs of failure.

6.1.3 Minimum burst pressure

A burst pressure test shall be carried out in accordance with ISO 1402 on the three test pieces used for the deformation under proof pressure test, until the hose bursts.

None of the test pieces shall burst at a pressure less than that given in Table 2.

6.1.4 Kink pressure

When tested in accordance with Annex A, the test piece shall neither burst nor show any visible signs of defect before or after pressurizing at 1,5 MPa for category I hoses and at 4,0 MPa for category II hoses.

6.2 Adhesion

When tested in accordance with Annex H the adhesion between all components shall be not less than 1,5 kN/m for type A hoses, 1,0 kN/m for type B hoses and 2,0 kN/m for type C hoses.

6.3 Accelerated ageing

When tested in accordance with Annex B, the three test pieces subjected to the burst pressure test shall conform to the requirements of 6.1.3. The mean of the burst pressure test results shall not decrease by more than 25 % from the initial mean burst value determined from the results obtained in 6.1.3.

The resultant adhesion of the fourth test piece shall be in accordance with the requirements of 6.2.

NOTE There is no limitation on the increase in the values of these properties.

6.4 Abrasion resistance

6.4.1 General

Abrasion tests are specific to different hose constructions and/or materials. Two procedures with different values are therefore specified here to avoid unfair discrimination. In addition, it is important to note that the requirements, revolutions as given in Table 5 and double strokes as given in Table 6, cannot be correlated.

6.4.2 Abrasion resistance of class 5 and class 6 hoses

When tested in accordance with Annex C and using the number of revolutions given in Table 5, at least four of the five test pieces shall not burst on being subjected to the normal working pressure given in Table 2.

Table 5 — Abrasion resistance of uncovered hose (classes 5 and 6)

Inside diameter mm	Number of revolutions
12, 19, 25 and 33	300

6.4.3 Abrasion resistance of classes 1, 2, 3 and 4 hoses

When tested in accordance with Annex D, the average number of double strokes completed before burst shall be not less than that given in Table 6.

Table 6 — Abrasion resistance of covered hose (classes 1, 2, 3 and 4)

Inside diameter mm	Minimum number of double strokes before burst
12, 19, 25 and 33	300

6.5 Low temperature flexibility

The test shall be carried out in accordance with ISO 10619-2:2011, Clause 5 (Method B) using a mandrel of outside diameter equal to 12 × 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 Table 2.

6.6 Hot surface resistance

When tested in accordance with Annex E at a test temperature of (300 ± 10) °C for types A and B and of (400 ± 10) °C for type C, in none of the four tests shall the test piece show signs of leakage within 60 s of the application of the filament rod or on removal of this filament rod after the specified period.

6.7 Ozone resistance

After carrying out an ozone resistance test in accordance with ISO 7326:2006, 8.1 (Method 1) for all inside diameter sizes and types, the hose lining and cover shall not show any signs of cracking. The lining shall be examined by slitting the hose wall.

6.8 Bending and crush resistance

When tested in accordance with Annex F at a temperature of (23 ± 2) °C, the ratio *T*:*D* shall not exceed 1,20.

6.9 UV resistance (xenon arc lamp)

NOTE A test for resistance to UV and requirements based on ISO 30013 will be added at next revision of this part of ISO 4642, when more experience has been acquired.

6.10 Loss in mass on heating

When tested in accordance with ISO 176:2005, 6.2 (Method B), the lining and cover materials shall not show a loss in mass greater than 4 %.

6.11 Deformation under crushing (type C only)

When tested in accordance with Annex G, the test piece shall allow the free passage of a ball of the diameter specified in Table 7.

Table 7 — 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

6.12 Hose assemblies

In some circumstances it is not the manufacturer who supplies the hose complete with couplings attached. In this case, the purchaser should be aware that this is outside the scope of this part of ISO 4642 and should ensure by other means that the security of the hose assembly has been tested.

Where the hose couplings are fitted by the hose manufacturer, the security of the hose assembly shall be tested in accordance with Annex I, by the manufacturer, before delivery to the purchaser. There shall be no sign of leakage or movement of the hose from the coupling.

The hose manufacturer should fit hose couplings that conform to any relevant national standards or legal requirements of the country of use.

7 Frequency of testing

Type testing and routine testing and the minimum frequency of such tests shall be as specified in Annex J.

Type tests are those tests carried out in order to obtain product approval.

Routine tests are those carried out on each length of hose or hose assembly.

Production tests are those tests, specified in Annex K, which should preferably be carried out to control the quality of manufacture. The frequencies specified in Annex J are given as a guide only.

8 Type tests

Type testing is carried out in order to confirm that all the materials, construction and test requirements of this part of ISO 4642 have been met by the method of manufacture and hose design.

Type testing shall be repeated at a minimum of every five years or whenever there is a change in the method of manufacture of materials.

9 Test report

A test report shall be supplied if requested by the customer.

10 Recommendation for packaging and storage

Details of packaging and storage are given in ISO 8331.

11 Marking

Each length of hose shall be legibly and permanently marked with the following minimum information, at least twice per length, at both ends, for type B hoses and along the whole length at minimum intervals of 2 m for type A and type C hoses:

a) manufacturer's name or trademark;

b) number of this part of ISO 4642, i.e. ISO 4642-2;

c) hose category;

d) type, class;

e) inside diameter in millimetres;

f) maximum working pressure in MPa (bar);

g) quarter and year of manufacture;

h) test temperature if lower than −20 °C (see 6.5);

i) approval number and certifying body or its reference, where applicable.

EXAMPLE Man-ISO 4642-2-I-A-2–19- (15 bar) - 2Q/2015

Annex A
(normative)

Kink pressure test

A.1 Principle

This tests the hose for leakage or damage in a kinked test piece held under pressure.

A.2 Test piece

The test piece shall be a hose assembly, 2,0 m in length.

A.3 Apparatus

A.3.1 Source of hydrostatic pressure, with water as the test medium, capable of maintaining a pressure of 1,5 MPa for category I hose and of 4,0 MPa for category II hose.

A.4 Procedure

Connect the test piece to the pressure source and fill with water, expelling all air before securely clamping 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 that given in 6.1.4 over a period of 60 s. Maintain the pressure for 1 min. Examine the test piece for any sign of leakage or damage prior to releasing the pressure.

A.5 Test report

The test report shall include the following information:

a) a full description of the hose tested;

b) a reference to this part of ISO 4642, i.e. ISO 4642-2;

c) any evidence of leakage or damage observed;

d) the date of the test.

Annex B
(normative)

Accelerated ageing test

B.1 Test pieces

Four test pieces, each of 1 m length, shall be tested.

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

B.2 Apparatus

A temperature-controlled oven, as specified in ISO 188.

B.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.

After ageing, subject three of the test pieces to the burst pressure test as given in 6.1.3.

Subject the remaining test piece to the adhesion test as given in 6.2.

B.4 Test Report

The test report shall include the following information:

a) a full description of the hose tested;

a) a reference to this part of ISO 4642, i.e. ISO 4642-2;

b) the burst test value;

c) the adhesion value and any evidence of tearing;

d) the date of the test.

Annex C
(normative)

Surface abrasion resistance test

C.1 Test pieces

Five test pieces of hose, each 0,35 m in length, shall be tested.

C.2 Apparatus

C.2.1 Test machine, for abrading the surface of a pressurized rotatable test piece with a laterally moveable abrading strip which is continually renewed. See Figure C.1.

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^{-1} to 20 mm s^{-1} 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.

C.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 loss of water.

C.2.3 Abrasive material, consisting of a roll of corundum twill emery 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 (Al_2O_3) with a minimum Al_2O_3 content of 70 % by mass. It shall have a grain size of 60P (see Reference [4]).

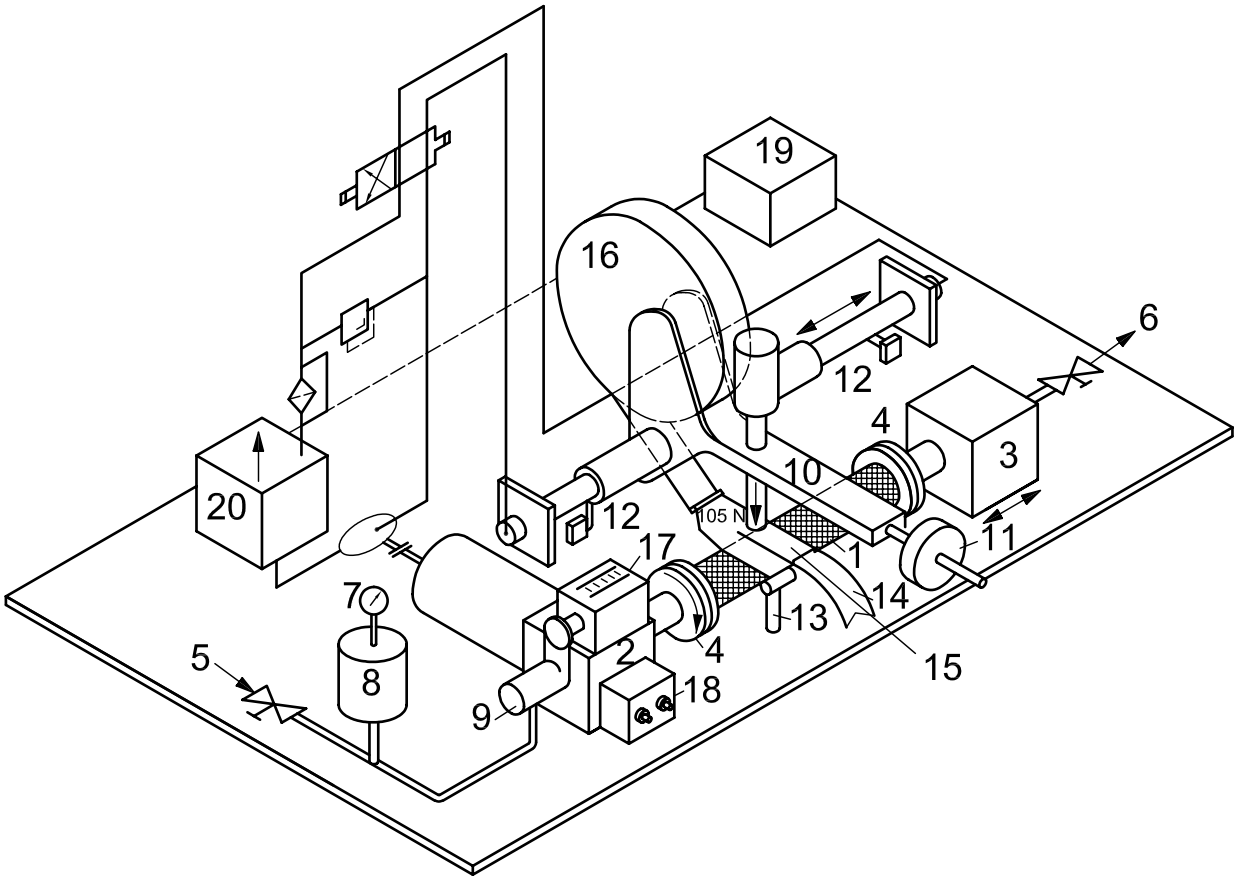
C.3 Procedure

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) rev/min (approximately 0,45 s^{-1}) in a clockwise direction when viewed from the side of the water inlet as indicated in Figure C.1.

After the specified number of revolutions (see Table 5) submit the test piece to the maximum working pressure as given in Table 2.

Repeat the procedure with the remaining four test pieces.



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 service
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 C.1 — Surface abrasion test machine

C.4 Test report

The test report shall include the following information:

a) a full description of the hose tested;

b) a reference to this part of ISO 4642, i.e. ISO 4642-2;

c) the abrasion results including the number of revolutions and any failures;

d) the date of the test.

Annex D
(normative)

Point abrasion resistance test

D.1 Test pieces

Five test pieces of hose, each 1 m in length, shall be tested. 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.

D.2 Apparatus

D.2.1 Test machine, for abrading the upper surface of the test piece with a reciprocating movement as shown in Figure D.1. 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.

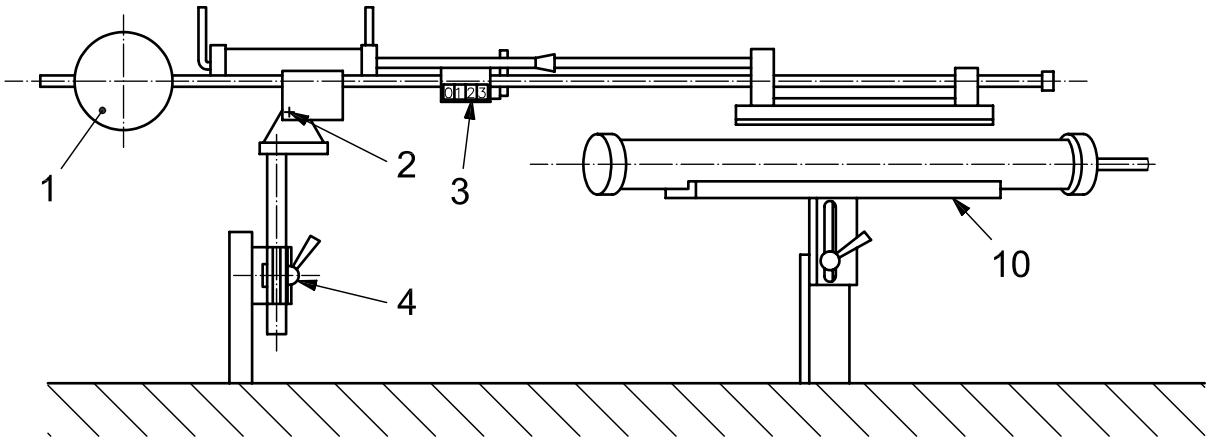
The machine shall exert a downward force of 15,5 N on the test piece.

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

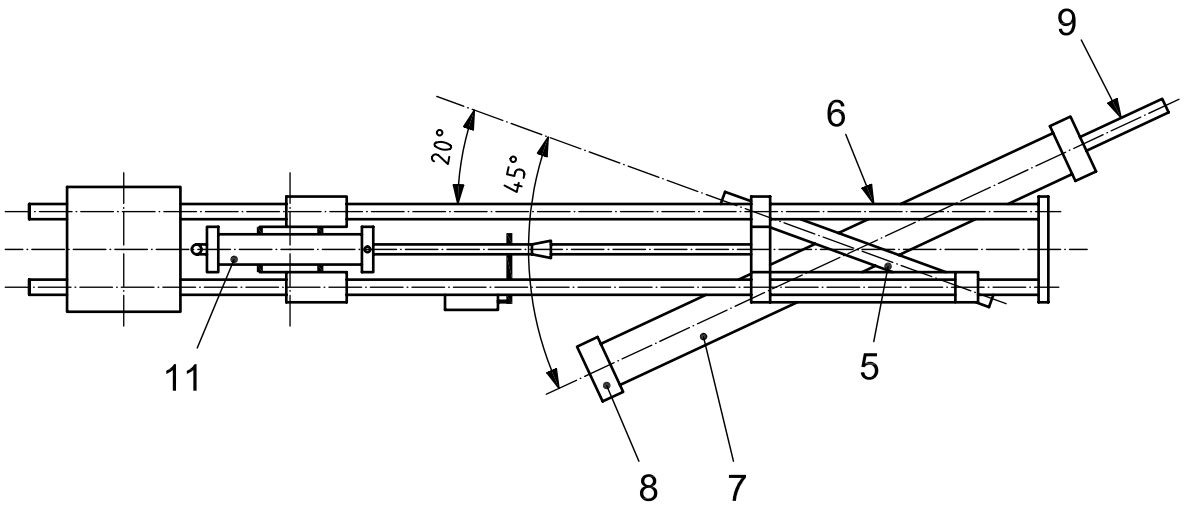
D.2.2 Air nozzle, fitted to the test machine and producing a continuous jet of air to remove debris from the plane of abrasion.

D.2.3 Abrasive cloth, measuring 25 mm × 300 mm should be used as the abrading medium. 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 of 93 % by mass. It shall have a grain size of 50P (see Reference [4]). 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.



a) Side view



b) View from above

Key

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

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

D.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.

D.4 Test report

The test report shall include the following information:

a) a full description of the hose tested;

b) a reference to this part of ISO 4642, i.e. ISO 4642-2;

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

d) the date of the test.

Annex E
(normative)

Hot surface resistance test

E.1 Test piece

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

Mark the test piece in four places at approximately 90° intervals, circumferentially. In the case of layflat hose, the marked positions shall be such that two of the marks are coincident with the flat edges of the hose.

NOTE This sampling procedure is designed to eliminate eccentric covers.

E.2 Apparatus

E.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 diameter 21 mm and 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 E.3)[1)]. An example of the design is given in Figure E.1.

E.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.

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

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

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

1) The filament rod can be obtained from Saint-Gobain Quarz GmbH, Hüttenstraße 10, 65201 Wiesbaden, Deutschland (laboratory immersion heater). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

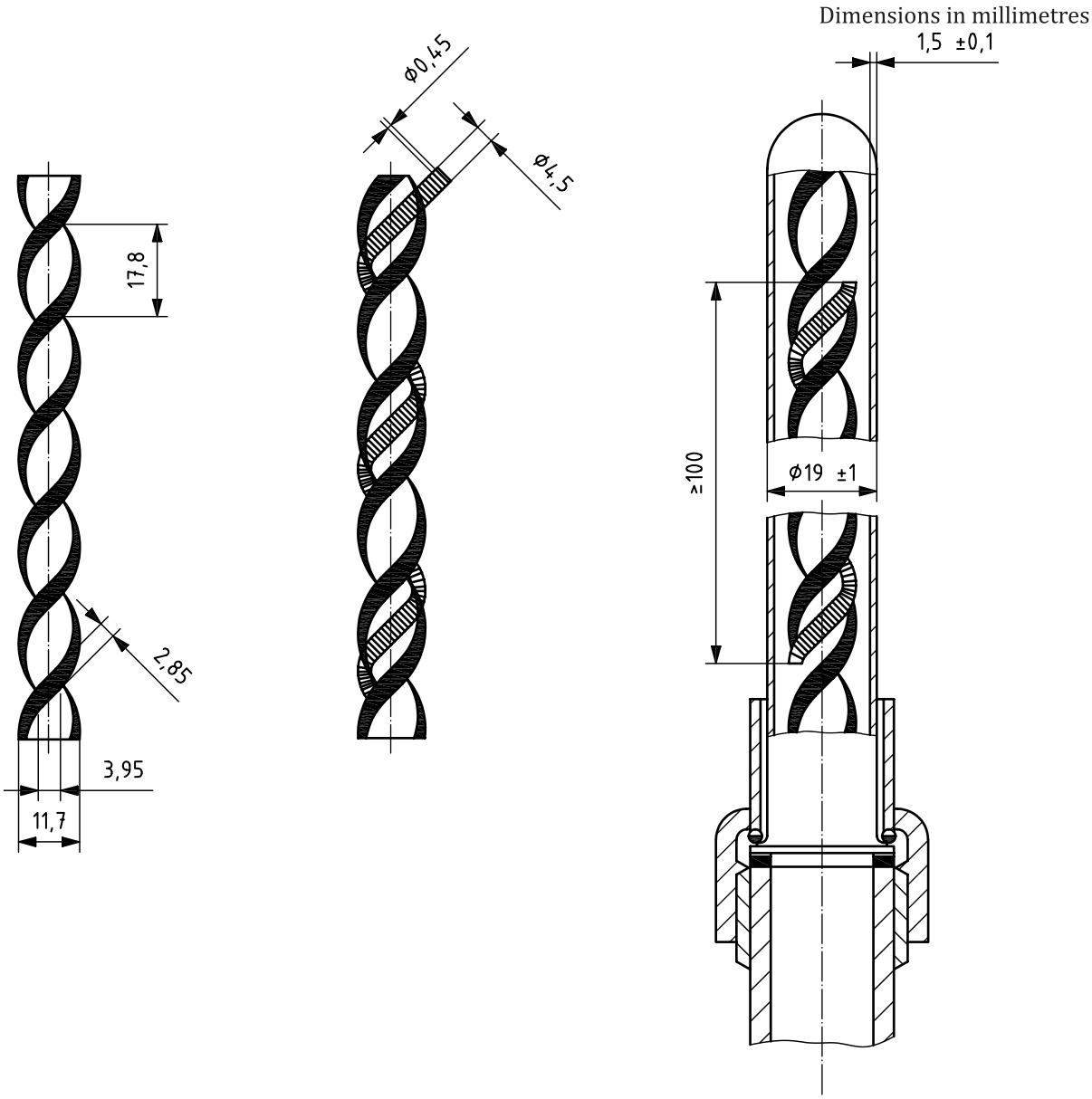
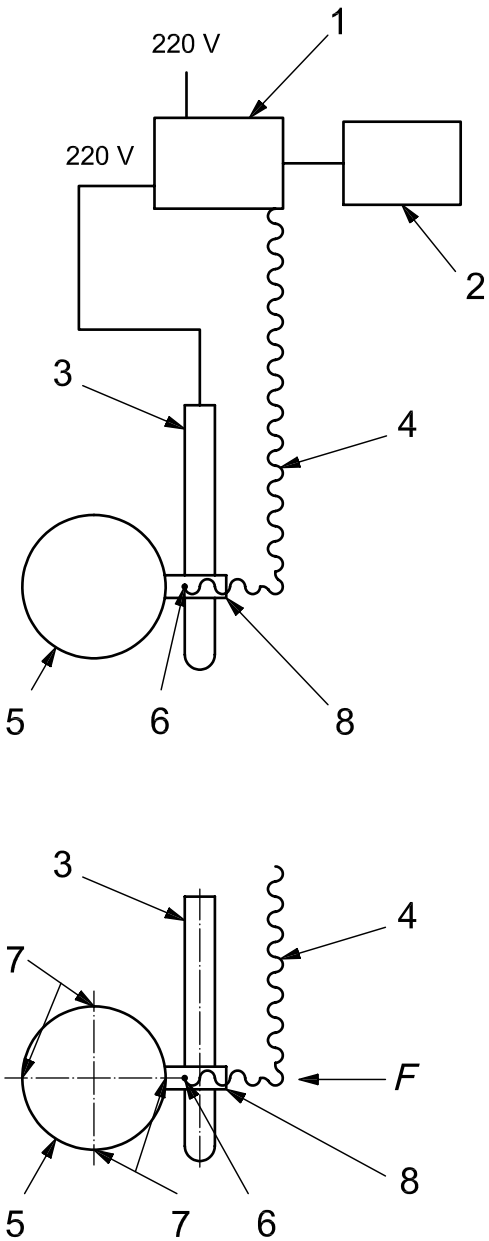


Figure E.1 — Example of suitable filament rod design

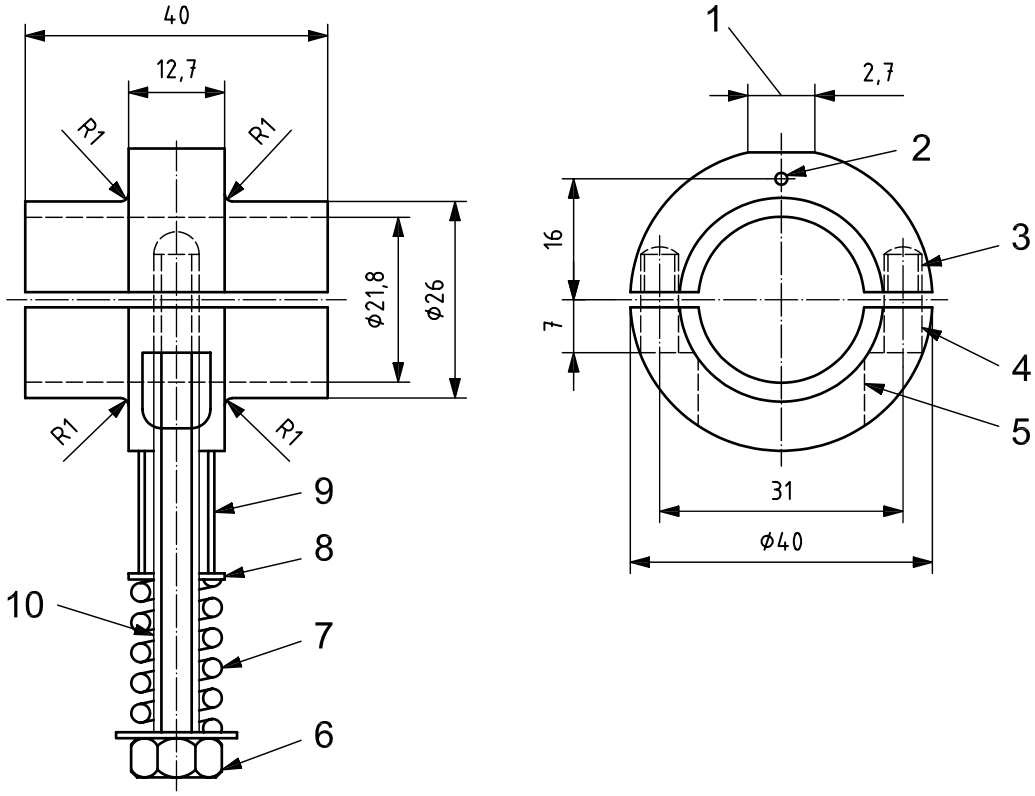


Key

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	contact point
		F	force

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

Dimensions in millimetres



Key

1	flat	6	M5 nut
2	hole Ø1,6 × 10	7	compression spring
3	tap M5 × 6	8	M5 washer
4	drill Ø5,5	9	tube spacer
5	mill Ø9	10	threaded bar, 5 mm

Figure E.3 — Detail of brass metal sleeve

E.3 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 (see 6.6). 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 layflat hose, after 120 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 three marked test positions after ensuring that the sleeve contact area is clean.

Subject the test piece to the burst test as specified in the fire hose standard.

E.4 Test report

The test report shall include the following information:

a) a full description of the hose tested;

b) a reference to this part of ISO 4642, i.e. ISO 4642-2;

c) all test results, whether there were any leaks, failures or exposure of the reinforcement and the burst value;

d) the temperature at which the test was carried out;

e) the date of the test.

Annex F
(normative)

Bending and crush resistance test

F.1 Test piece

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

F.2 Apparatus

A rigid drum of diameter 200 mm for 19 mm inside diameter and 25 mm inside diameter hoses and of diameter 280 mm for 33 mm inside diameter hose.

F.3 Procedure

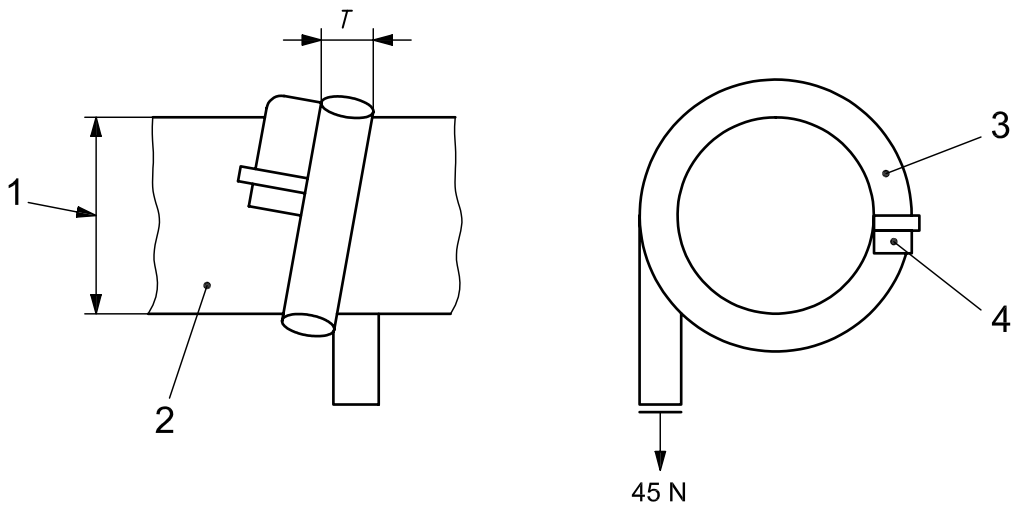
Determine, in accordance with ISO 4671, the average outside diameter of the hose, *D*, in millimetres, using a suitable measuring instrument.

Clamp one end of the test piece on to the appropriate rigid drum and wind 1,5 turns round the drum (see Figure F.1). 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 determine the greatest outer dimension, *T*, in millimetres, of the part of the test piece which is touching the drum.

Measure the outside diameter of the major axis of the hose while the hose is still wound round the drum.

Calculate the ratio *T*:*D*.



Key

1 diameter of the drum
2 drum
3 clamp
4 test piece

Figure F.1 — Bending and crush resistance test

F.4 Test report

The test report shall include the following information:

a) a full description of the hose tested;

b) a reference to this part of ISO 4642, i.e. ISO 4642-2;

c) the mean value of the test result, ratio *T*:*D*;

d) the date of the test.

Annex G
(normative)

Deformation under crushing test

G.1 Test piece

The test piece 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 (see ISO 4671).

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

G.2 Apparatus

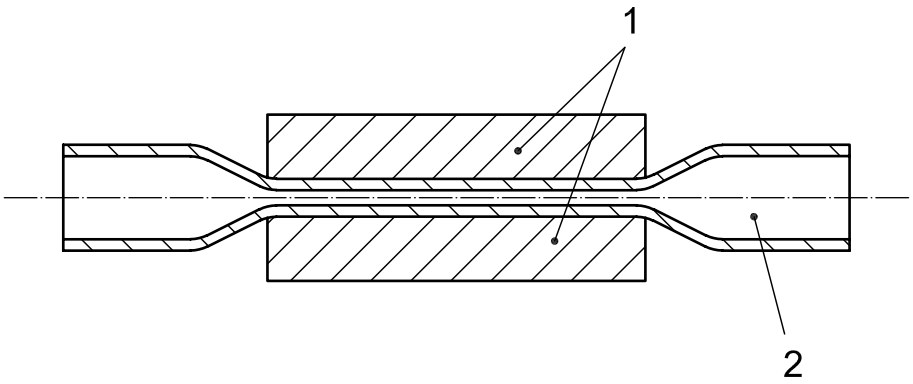
G.2.1 Compression testing machine, capable of a rate of traverse of (50 ± 5) mm/min, and with a load capacity adequate for the level of crushing force.

G.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.

G.2.3 Balls, of diameters as given in Table 7.

G.3 Procedure

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



Key

1 parallel plates

2 test piece

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

Apply the crushing force as given in Table 7 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 7) 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 7 into one end of the test piece and note whether or not it passes freely through the test piece.

G.4 Test report

The test report shall include the following information:

a) a full description of the hose tested;

b) a reference to this part of ISO 4642, i.e. ISO 4642-2;

c) the test result (pass/fail);

d) the date of the test.

Annex H
(normative)

Adhesion test (lay-flat fire-fighting hoses)

H.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 H.1).

Dimensions in millimetres

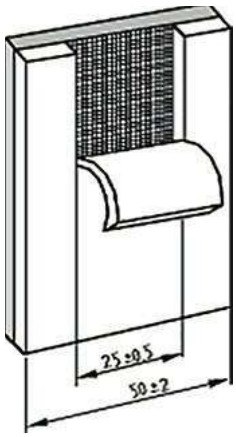


Figure H.1 — Test piece adhesion test

H.2 Apparatus

H.2.1 A tensile testing machine, capable of carrying out the procedure described in H.3.

H.3 Procedure

When tested in accordance with type 1 of 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.

H.4 Test report

The test report shall include the following information:

a) a full description of the hose tested;

b) a reference to this part of ISO 4642, i.e. ISO 4642-2;

c) the adhesion value and any evidence of tearing;

d) the date of the test.

Annex I
(normative)

Test for fire-fighting hose assemblies

I.1 Test piece

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

I.2 Apparatus

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

I.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 can be used to provide evidence that hoses in a given batch conform to this requirement.

I.4 Test report

The test report shall include the following information:

a) a full description of the hose tested;

b) a reference to this part of ISO 4642, i.e. ISO 4642-2;

c) whether any coupling movement or leakage was observed;

d) the date of the test.

Annex J
(normative)

Type test and routine test

Type approval tests are those tests carried out to determine that the hose design and methods of manufacture meet the full requirements of this part of ISO 4642. They should be repeated whenever the hose construction or the materials are modified, or every three years, whichever occurs first.

Table J.1 gives the minimum frequencies for the tests specified in this part of ISO 4642.

Table J.1 — Recommended minimum frequencies of testing

Dimension/property under test (with reference to relevant subclause)	**Type test**	**Routine test**
Inside diameter (5.1)	×	×
Concentricity of hose cover wall (5.3)	×	×
Tolerance on length (5.2)	×	×
Maximum mass (5.1)	×	—
Change in length at maximum working pressure (6.1.1)	×	—
Change in external diameter at maximum working pressure (6.1.1)	×	—
Twist at maximum working pressure (6.1.1)	×	—
Deformation under proof pressure (6.1.2)	×	×
Minimum burst pressure (6.1.3)	×	—
Kink pressure (6.1.4)	×	—
Adhesion (6.2)	×	—
Accelerated ageing (6.3)	×	—
Low temperature flexibility (6.5)	×	—
Bending and crush resistance (6.8)	×	—
Ozone resistance (6.7)	×	—
Hot surface resistance (6.6)	×	—
Abrasion resistance (6.4)	×	—
Deformation under crushing (6.11)	×	—
Loss in mass on heating (6.10)	×	—
Hose assembly (where applicable) (6.12)	×	×
NOTE See Note in J.3.		

Annex K
(informative)

Production tests

Production tests are those tests to be carried out on a hose or sample of hose from each batch manufactured. A batch is defined as either maximum 10 000 m for hose or 6 000 m for lining and/or cover plastic compound.

Table K.1 gives the recommended tests for production testing.

Table K.1

Dimension/property under test (with reference to relevant subclause)	**Batch test**
Inside diameter (5.1)	×
Concentricity of hose cover wall (5.3)	×
Tolerance on length (5.2)	×
Maximum mass (5.1)	×
Change in length at maximum working pressure (6.1.1)	×
Change in external diameter at maximum working pressure (6.1.1)	×
Twist at maximum working pressure (6.1.1)	×
Deformation under proof pressure (6.1.2)	×
Minimum burst pressure (6.1.3)	×
Kink pressure (6.1.4)	×
Adhesion (6.2)	×
Accelerated ageing (6.3)	—
Low temperature flexibility (6.5)	—
Bending and crush resistance (6.8)	—
Ozone resistance (6.7)	—
Hot surface resistance (6.6)	—
Abrasion resistance (6.4)	—
Deformation under crushing (6.11)	—
Loss in mass on heating (6.10)	—
Hose assembly (where applicable) (6.12)	×
NOTE See Note in I.3.	

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