BS EN 13483:2013

BSI Standards Publication

# Rubber and plastic hoses and hose assemblies with internal vapour recovery for measured fuel dispensing systems — Specification

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**National foreword**

This British Standard is the UK implementation of EN 13483:2013. It supersedes BS EN 13483:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/66, Rubber and plastics tubing, hoses and hose assemblies.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.



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**Compliance with a British Standard cannot confer immunity from legal obligations.**

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EUROPEAN STANDARD

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English Version

# Rubber and plastic hoses and hose assemblies with internal vapour recovery for measured fuel dispensing systems - Specification

Tuyaux et flexibles en caoutchouc et en plastique à récupération interne de vapeur pour systèmes de livraison mesurée de carburant - Spécification

Gummi- und Kunststoffschläuche und -schlauchleitungen mit innenliegender Gasrückführung für Zapfsäulen an Tankstellen - Anforderungen

This European Standard was approved by CEN on 25 April 2013.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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# Contents

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# Foreword

This document (EN 13483:2013) has been prepared by Technical Committee CEN/TC 218 “Rubber and plastics hoses and hose assemblies”, 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of an identical text or by endorsement, at the latest by December 2013, and conflicting national standards shall be withdrawn at the latest by December 2013.

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 document supersedes EN 13483:2005.

Compared with EN 13483:2005, the following fundamental changes have been made:

a) In Table 3 "Physical properties of compounds" the compound "Thermoplastic" has been added.

b) In Annex L the testing of the ozone resistance has been deleted.

c) The normative references have been updated.

**WARNING —** Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

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## 1 Scope

This European Standard specifies the requirements and test methods for verification for hose assemblies with vapour recovery for delivery systems on petrol filling stations.

The hose assemblies with vapour recovery for delivery systems on petrol filling stations need to be capable of withstanding anticipated mechanical, thermal and chemical stressing and be resistant to the combustible liquids used in these applications as well as their vapour and vapour air mixtures. It is imperative that the assemblies be constructed in such a way that actions during normal operation cannot give rise to dangerous electrostatic charges nor that there will be any reduction in the performance of the vapour recovery.

The assemblies are intended for use at ambient temperatures between –30 °C and +55 °C for normal temperature class and –40 °C and +55 °C for low temperature class at a working pressure ≤ 16 bar[1)].

Hoses can be constructed from rubber or thermoplastic elastomer (TPE) and this document specifies the requirements for three types of hoses in two grades and two classes of hose assemblies for measured fuel dispensing systems, including oxygenated fuels (≤ 15 % oxygenated compounds) with internal vapour recovery tubing or hose.

NOTE This European Standard is not applicable to multi chamber fuel dispensing hoses.

As part of the certification of a new dispenser, testing of fuel samples in accordance with EN 228 should be carried out at least eight weeks after the first use of the equipment to avoid unrepresentative sulphur content results.

## 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.

EN 26801, *Rubber or plastics hoses — Determination of volumetric expansion (ISO 6801)*

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

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

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)*

EN ISO 7326, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions (ISO 7326)*

EN ISO 8031:2009, *Rubber and plastics hoses and hose assemblies — Determination of electrical resistance and conductivity (ISO 8031:2009)*

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

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

EN ISO 10619-1, *Rubber or plastics hoses and tubing — Measurement of flexibility and stiffness — Part 1: Bending tests at ambient temperature (ISO 10691-1)*

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

1) 1 bar = 0,1 MPa

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

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 554, *Standard atmospheres for conditioning and/or testing — Specifications*

ISO 1817, *Rubber, vulcanized or thermoplastic —Determination of the effect of liquids*

ISO 4649:2010, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 8330:2008 and the following apply.

**3.1**
**hose assembly**
fuel hose complete with an internal vapour tubing or vapour hose and fitted with couplings

## 4 Classification

Hoses for this application shall be divided into three types:

— Type 1, textile reinforced;

— Type 2, textile and helical wire reinforced; or

— Type 3, fine wire reinforced.

Each type of hose shall be divided into two grades:

— Grade M: electrically bonded;

— Grade Ω: electrically conductive.

Each type of hose shall be divided into two temperature classes:

— normal temperature class with an ambient working temperature of −30 °C to +55 °C;

— low temperature class (LT) with an ambient working temperature of −40 °C to +55 °C.

## 5 Materials and construction

### 5.1 Fuel hose

The fuel hose shall consist of the following:

a) a smooth, fuel resistant lining of rubber or thermoplastic elastomer (TPE);

b) a suitable reinforcement, related to type;

c) a non-corrugated fuel and weather resistant rubber or TPE cover.

Hose assemblies shall be capable of conducting an electrical charge from coupling to coupling.

When this capability is provided by means of metallic bonding wires, not less than two (metallic) bonding wires shall be embedded in the hose and the metal used shall have a high resistance to fatigue and corrosion.

Hoses with metallic wires for electrical conductivity shall be designated ‘M‘ and those using conductive compounds shall be designated ‘Ω‘, the relevant mark being branded on the hose, (see Clause 12).

### 5.2 Vapour hose

The vapour hose shall consist of the following:

a) a smooth fuel and vapour resistant lining of rubber or TPE;

b) a textile and/or metallic reinforcement;

c) a non-corrugated fuel and vapour resistant rubber or TPE.

### 5.3 Vapour tubing

The vapour tubing shall consist of a smooth and vapour and fuel resistant thermoplastic.

### 5.4 Vapour recovery fuel hose assembly

The vapour recovery fuel hose assembly shall consist of an outer fuel hose in accordance with 5.1 and an inner vapour recovery hose in accordance with 5.2 or vapour tubing in accordance with 5.3 with the fuel hose and vapour hose or tubing attached to an electrically bonded coupling system.

## 6 Pressure requirements

The pressure ratings of the fuel hose and the vapour tubing/hose shall comply with values given in Table 1.

**Table 1 — Pressure ratings**

| Property | Pressure ratings bar | |
|---|---|---|
| | Fuel hose | Vapour tubing/hose |
| Maximum working pressure | 16 | 0,2 abs./8 [a] |
| Proof test pressure | 24 | b |
| Minimum burst pressure | 48 | 18 |

[a] The vapour tubing/hose shall be designed for an absolute pressure of 0,2 bar (vacuum) with an external pressurisation of 8 bar.

[b] See Annex B.

## 7 Dimensions and tolerances

### 7.1 Diameters and bend radii

Diameters and bend radii shall conform to the values given in Table 2.

**Table 2 — Dimensions requirements**

Dimensions in millimetres

| Tubing/hose/assembly | Internal diameter max. | Outside diameter max. | Bend radius min. |
|---|---|---|---|
| Vapour tubing/hose | 8,4 | — | 75 |
| Fuel hose | — | 32,6 | 130 |
| Assembly | — | — | 130 |

### 7.2 Minimum thickness of lining and cover of the fuel hose

When measured in accordance with EN ISO 4671, the thickness of the lining shall be not less than 1,6 mm and the thickness of the cover shall be not less than 1,0 mm.

### 7.3 Concentricity

When determined in accordance with EN ISO 4671, the concentricity, based on a total indicator reading between the internal diameter and the outside diameter, shall not exceed 0,5 mm for the vapour tubing or hose, and shall not exceed 1,0 mm for the fuel hose.

### 7.4 Tolerance on cut lengths

For cut lengths, the tolerances on length shall be in accordance with EN ISO 1307. The length of a hose assembly shall be measured from sealing face to sealing face of the end fittings with a tolerance from the nominal length of ± 1 %.

## 8 Physical properties

### 8.1 Compounds

When tested in accordance with the methods in Table 3, the physical properties of the compounds used for the lining and cover shall conform to the values given in Table 3. Tests shall be performed either on samples taken from the hose or from moulded vulcanised sheets at a thickness of 2 mm or moulded test pieces vulcanised to the same cured state as the production hoses.

**Table 3 — Physical properties of compounds**

| Property | Unit | Requirement | | | Test piece[a] | Test method |
|---|---|---|---|---|---|---|
| | | Rubber | TPE | Thermo-plastic | | |
| Tensile strength, min.<br>Lining and cover of fuel hose and vapour tubing and hose | MPa | 9 | 12 | 12 | Test piece cut from hose or from test sheet | ISO 37<br>ISO 527-1 (Thermoplastic) |
| Elongation at break, min.<br>Lining and cover of fuel hose and vapour tubing and hose | % | 250 | 350 | 150 | | |
| Accelerated ageing<br>Tensile strength change,<br>Lining and cover fuel hose and vapour tubing and hose, max. | | 20 | 10 | 20 | | ISO 188<br>(air oven method)<br>14 days at<br>(70 ± 1) °C |
| Elongation at break change,<br>Lining and cover of fuel hose and vapour tubing and hose, max. | | –35 | –20 | -35 | | |
| Resistance to liquids<br>Swell of lining of fuel hose; tubing and cover of vapour hose max. | | 70 | | 70 | | ISO 1817<br>70 h at 40 °C in oxygenated fuel Type 3 |
| | | 25 | | 25 | | ISO 1817<br>70 h at 100 °C in oil N° 3 |
| Extracted matter<br>Lining of fuel hose; tubing and cover of vapour hose max.<br>Normal Temperature Class–30 °C<br>Low Temperature Class LT –40 °C | | +10<br>+15 | | 10<br>15 | | ISO 1817<br>70 h at 40 °C in oxygenated fuel Type 3<br>then dry 24 h at 100 °C |
| Swell of cover of fuel hose | | +100 | | 100 | | ISO 1817<br>70 h at 23 °C in liquid B |
| Low temperature class resistance,<br>-lining and cover of fuel hose and vapour tubing and hose,<br>at –30 °C (or at LT –40 °C if required) | — | No cracks under x 10 magnification | | | | Annex A |
| Abrasion, max.<br>-cover of fuel hose | $mm^3$ | 500 | | | Test piece from moulded test sheet of cover compound | ISO 4649:2010<br>Method A |

[a] It is necessary that the test report indicates the source of the test piece.

## 8.2 Finished hoses/tubing

When tested in accordance with the methods in Table 4, the physical properties of the finished hoses or tubing shall conform to the values given in Table 4.

**Table 4 — Physical properties of tubing and hoses**

| Property | Unit | Requirement | Test piece | Test method |
|---|---|---|---|---|
| **Vapour tubing/hoses** | | | | |
| Pressure test | – | Free ball passage, no leakage | Short length cut from hose/tubing | Annex B |
| Change in length due to swelling max. | % | 4 | Annex C | Annex C |
| Pressure loss max. | bar | 0,030 | 4 m of hose/tubing | Annex D, D.1 |
| Burst pressure min. | | 18 | Short length cut from hose/tubing | EN ISO 1402 |
| Adhesion (hose only)<br>Un-aged<br>Aged | N/mm | <br>2,4<br>1,8 | Short length cut from hose | Annex E |
| Low temperature class flexibility max. | _ | No cracks or breaks Maximum bending force 170 N | Annex F | Annex F |
| **Fuel Hoses** | | | | |
| Proof pressure at 24 bar | – | No leakage or other signs of weakness nor abrupt twisting | Full length of hose | EN ISO 1402<br>Proof test pressure |
| Burst pressure, min. | bar | 48 | Short length cut from hose | EN ISO 1402<br>Burst pressure |
| Volumetric expansion, max.<br><br>Type 1 and Type 2<br>Type 3 | % | <br><br>2<br>1 | At least 1 m cut from hose | EN 26801<br>Test pressure 3 bar |
| Adhesion between components on<br>Un-aged hose, min.<br><br>Aged hose, min. | kN/m | <br><br>2,4<br>1,8 | Short length cut from hose | Annex E |
| Ambient temperature bending | – | $\frac{T}{D} \geq 0{,}8$ | | EN ISO 10619-1<br>Nominal diameter<br>$C$ = 10 × nominal bore |
| Low temperature class flexibility | | No cracks or breaks Maximum bending force 180 N | Annex F | Annex F |
| Change in length at proof pressure | % | 0 to +5 | Full length of hose | EN ISO 1402 |
| Change in length due to swelling max. | | 4 | Short length cut from hose | Annex C |
| Ozone resistance of cover | – | No cracks under × 2 magnification | | EN ISO 7326<br>168 h at 40 °C, 50 pphm,<br>relative humidity (55 ± 10) %,<br>and elongation 20 % |
| Fuel permeation of hose max.<br>Normal temperature class<br><br>Low temperature class | ml/(m·day) | <br>12<br><br>18 | 2 m test piece cut from hose | Annex G |

**Table 4** *(continued)*

| Property | Unit | Requirement | Test piece | Test method |
|---|---|---|---|---|
| Electrical resistance max.<br>Grade Ω | Ω | $1 \times 10^{6}$ | Equivalent to the length of hose assembly | EN ISO 8031:2009 4.5, 4.6, 4.7 |
| Grade M | | $1 \times 10^{2}$ | | EN ISO 8031:2009 4.8 |
| Flammability | – | a) Burning with a naked flame to cease within 20 s of removal of the burner;<br>b) no further glowing visible 2 min after removal of the burner;<br>c) hose shall show no sign of leakage | Length of assembly to suit test rig | Annex H |

## 8.3 Hose assembly

When tested in accordance with the methods in Table 5, the physical properties of the hose assembly shall conform to the values given in Table 5.

**Table 5 — Physical properties of hose assembly**

| Property | Unit | Requirement | Test piece | Test method |
|---|---|---|---|---|
| Electrical resistance max.<br>Grade M | Ω/ assembly | $1 \times 10^{2}$ | Full length of hose assembly | EN ISO 8031:2009 4.8 |
| Grade Ω | | $1 \times 10^{6}$ | | EN ISO 8031:2009 4.5, 4.6, 4.7 |
| Leak test | – | No leakage | | Annex I |
| Flex test | | No defects after 18000 cycles<br>No leakage after 50000 cycles<br>max. electrical resistance | | Annex J |
| Pull-off test | | No movement of end fitting after removal of force. | Short length of hose assembly | Annex K |
| Difference between the change in length due to swelling of the fuel hose and the vapour tubing/hose, max. | % | 1,5 | Full length of hose assembly | Annex C |
| Pressure loss max. | bar | 0,75 | | Annex D, D.2 |

# 9 End fittings

The end fittings used for this application for both fuel and vapour hoses shall be compatible with the specification shown in Figure 1.

In addition, the following requirements shall be fulfilled:

— end fittings for fuel and vapour hoses shall be designed for the pressure ratings in accordance with Table 1;

— end fittings shall be designed so that, where used for their intended purpose, they do not adversely affect in-service reliability of the hose due to sharp edges or burrs;

— end fittings shall have a parallel thread;

— end fittings with thread sealing (e.g. with Polytetrafluorethylene (PTFE)-band) are not permitted;

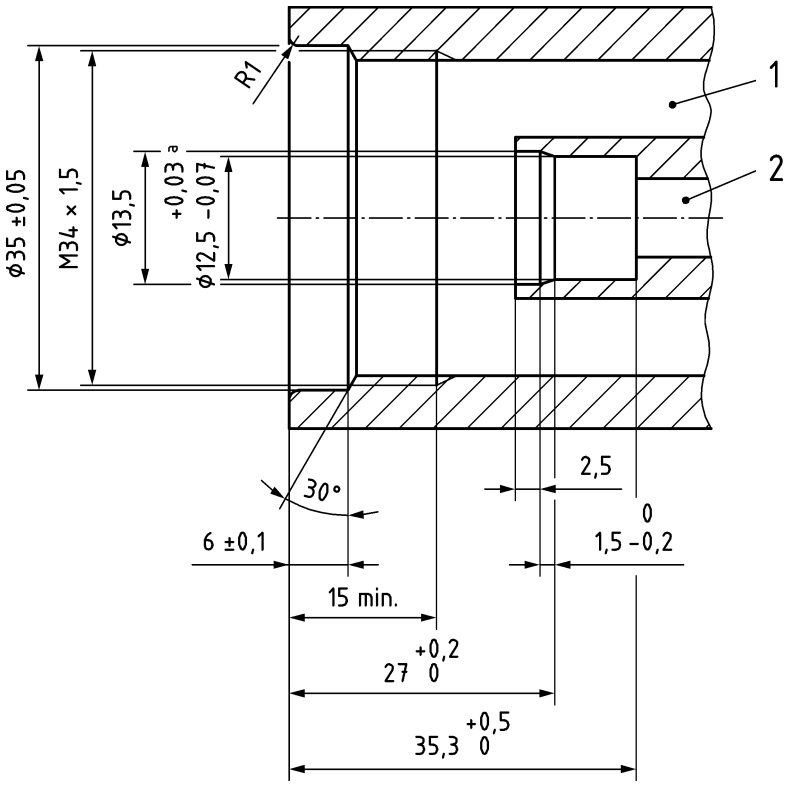
— the vapour-hose-fitting shall incorporate a suitable seal;

— the materials of the thread-bearing parts shall be manufactured from a corrosion-resistant metallic material; control screw threads shall not be made from aluminium;

— surfaces that come into contact with the conductive layers of the fuel hose shall be metallically conductive; anodised surfaces and surfaces with insulating layer are not permitted; end fitting components that are in contact with the lining or the cover of the fuel hose shall have secure, electrically conductive, metallic contact when assembled.

There are two types of end fittings that may be used, reusable and non-reusable. The use of non-reusable fittings is mandatory in the U.K.

Dimensions in millimetres




**Key**

1 fuel path
2 vapour path

**Figure 1 — Dimensions of connections**

## 10 Type tests

Type tests shall be performed to supply evidence that all the material, construction and test requirements of this document have been met by the method of manufacture and hose design.

Type tests shall be performed a minimum of every five years or whenever a change of manufacture or material occurs.

# 11 Frequency of testing

The minimum frequency of type tests and routine tests shall be in accordance with Annex L.

The frequency of test for production acceptance tests should be in accordance with Annex M.

# 12 Marking

## 12.1 Hoses

The hoses shall be marked clearly and indelibly, at not more than 2 m intervals. Marking shall include, at least, the following information:

**Fuel hose**

(a) manufacturer's name and/or trade mark, e.g. - xxx;
(b) number and date of this document, EN 13483:2013;
(c) type of hose (1, 2 or 3)

(d) grade of hose, i.e. M or Ω

(e) temperature class e.g. LT (low temperature class) [2)]

(f) nominal bore e.g. 19

(g) maximum working pressure in bar, e.g. 16;

(h) quarter and year of manufacture, e.g. 3Q12.

EXAMPLE: xxx/EN 13483:2013/1/M/LT/19/16/3Q12

**vapour tubing/hose**

(a) the manufacturer's name and/or trade mark, e.g. - xxx;
(b) number and date of this document, EN 13483:2013;
(c) quarter and year of manufacture, e.g. 3Q12.

EXAMPLE: xxx - EN 13483:2013 - 3Q12

## 12.2 End fittings

The fittings shall be marked with the manufacturer’s trademark and depending on their purpose with the wording “reusable" (alternatively “R“) or "non-reusable” (alternatively “NR”) respectively.

## 12.3 Hose assemblies

The information detailed in 12.1 shall appear in full at least once on each hose assembly. The fitting shall be marked with the name or the trademark of the assembler and the date of the assembling, e.g. 3Q11. In case of re-assembly, the fitting shall be marked with the name or trademark of the re-assembler and date of the re-assembling, e.g. 3Q12.

2) For hoses for normal temperature class, no special marking is required.

# Annex A
(normative)

# Test method for determination of low temperature class resistance at –30 ºC (for normal temperature class) and –40 °C (for low temperature class)

## A.1 Test piece

A dumb-bell of Type 2 in accordance with ISO 37.

## A.2 Apparatus

**A.2.1 Two moving plates** able to reciprocate between (50 ± 1) mm and (25 ± 1) mm apart.

**A.2.2 A cabinet maintained at (–30 ± 2) °C or (at LT –40 ± 2) °C**, in which the plates can be moved.

## A.3 Test method

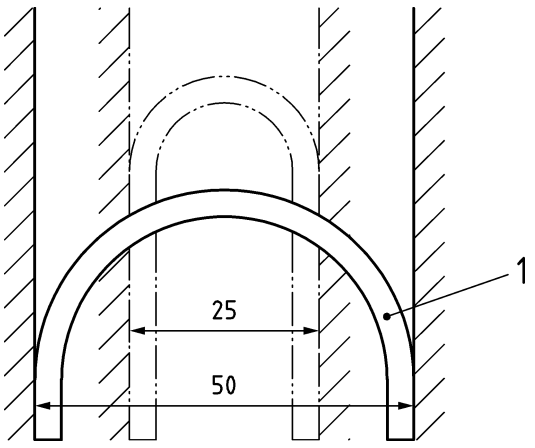
The test piece shall be placed between the plates in accordance with Figure A.1, separated at (50 ± 1) mm and at the test temperature.

After 30 min, the plates shall be pressed to (25 ± 1) mm apart during 5 s. Hold for 5 s and then release to (50 ± 1) mm within 5 s.

This cycle shall be repeated a further nine times, i.e. for a period of approximately 5 h.

Any appearance of cracking shall be reported.

Dimensions in millimetres




**Key**

1 dumb bell test piece

**Figure A.1 — Arrangement for low temperature class resistance test**

# Annex B
(normative)

# Test method for pressure requirements of vapour recovery hoses and tubes

## B.1 Principle

Testing of the vapour tubing/hose for dimensional stability with maximum external pressure and internal vacuum at the same time.

## B.2 Test method

The vapour tubing/hose shall be subjected to external pressure of 0,8 MPa (8 bar) in a visual testing chamber (e.g. a transparent pipe). At the same time, the tubing/hose shall be charged with a vacuum of 0,08 MPa (0,02 MPa absolute) (0,8 bar) (0,2 bar absolute) on the inside. After reaching the required pressures, a ball of 75 % of actual internal diameter shall have free passage from one end of the tubing/hose to the other.

# Annex C
(normative)

# Test method for determination of change in length due to swelling

## C.1 Principle

The increase in length of an un-aged fuel hose and vapour tubing/hose due to swelling in test fuel shall be no greater than 4 %.

NOTE If the change in length of the vapour tubing/hose is greater than that of the fuel hose the former will not be torn off the coupling.

## C.2 Test method

New hoses that have not yet been in contact with fuel shall be assembled with tightly sealing fittings at both ends. The length of hose between the fittings shall be at least 1 200 mm. The cover of the hose shall be marked with lines at a distance of 1 000 mm apart. The fuel hose shall be filled with test fuel Liquid 1 in accordance with ISO 1817 and conditioned in a freely suspended state for 48 h at room temperature. The vapour tubing/hose shall be conditioned at room temperature, immersed in test fuel 1 in accordance with ISO 1817.

After the immersion period, the distance between the two marks shall be re-measured, and the difference shall be expressed as a percentage of the original length.

# Annex D
(normative)

# Test method for determination of pressure loss

## D.1 Vapour tubing/hose

The vapour inlet of a vapour recovery tubing/hose (total length 4 m) shall be connected to a flow meter and the vapour outlet of the tubing/hose to a manometer capable of measuring a depression.

Air with a flow rate of 45 l/min shall be sucked through the flow meter by a vacuum pump or other means installed downstream of the manometer.

The depression indicated by the manometer is the pressure loss.

## D.2 Fuel hose

The fuel inlet of a hose assembly (fuel and vapour tube/hose, total length 4 m) shall be connected to a manometer. Upstream from the manometer a flow meter shall be installed.

Water with a flow rate of 40 l/min shall be pumped through the fuel passage of the hose assembly by a pump or other means installed upstream of the flow meter.

The depression indicated by the manometer is the pressure loss.

# Annex E
(normative)

# Method for determination of adhesion between components

## E.1 Dry adhesion

The hose shall be subjected to the adhesion test in accordance with EN ISO 8033 and the minimum value in N/mm for adhesion shall be determined:

a) between lining and reinforcement;

b) between reinforcement and cover;

c) between reinforcement layers.

## E.2 Adhesion after contact with fuel

A sample shall be cut from the hose that is to be tested approximately 300 mm in length and sealed at one end. The hose shall be filled with liquid B in accordance with ISO 1817 and the top lightly capped. The sample shall be conditioned at (20 ± 5) °C for $\left(168_{0}^{+2}\right)\mathrm{h}$. The sample shall be emptied and the minimum adhesion between components listed in E.1 shall be determined.

# Annex F
(normative)

# Test method for the determination of low temperature flexibility

## F.1 Test piece

The test hose length shall be (250 ± 2) mm for vapour hoses and (265 ± 2) mm for fuel hoses.

## F.2 Apparatus

The test arrangement shall be in accordance with Figure F.1. The diameter of the mandrel and the lever shall be the same as the bore diameter of the hose.

Plug the mandrel and the lever into the hose at the depth specified in Figure F.1.

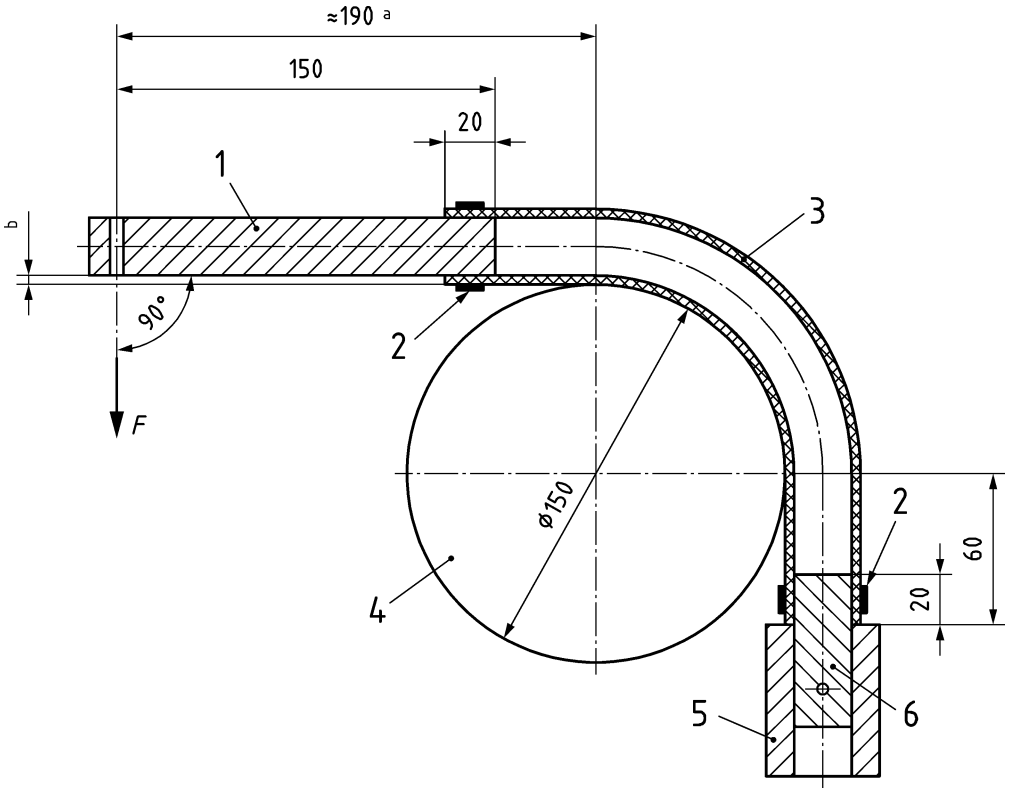
## F.3 Test method

The un-aged hose and the test apparatus shall be conditioned at a temperature of (−30 ± 2) °C for a period of 24 h prior to the testing. A suitable measuring instrument (spring balance, ring dynamometer) shall be fixed to the end of the lever to determine force F.

The hose shall be bent, at (−30 ± 2) °C, through 90° around the bending device, against any curvature that can arise during manufacturing, by means of the tensile force on the measuring instrument, for between 2 s and 4 s.

The maximum force F applied shall be recorded.

Dimensions in millimetres




**Key**

a length, depending on hose outer diameter
b parallel
1 lever
2 clamp
3 hose
4 bending device, ∅ = 150 mm
5 holding device for mandrel
6 mandrel

**Figure F.1 — Test arrangement for low temperature class flexibility test**

# Annex G
(normative)

# Test method for the determination of rate of fuel permeation

## G.1 Test piece

Two meter sample of hose.

## G.2 Apparatus

**G.2.1 Graduated pipette** with minimum capacity of 100 ml.

## G.3 Test method

A 2 m sample of fuel hose, closed at one end, shall be fitted with a graduated pipette with a minimum capacity of 100 ml and shall be filled without bubbles with test fuel liquid C in accordance with ISO 1817. The sample shall be conditioned for a period of 48 h (for swelling) suspended vertically at standard atmosphere 23/50 in accordance with ISO 554. The fuel hose shall be drained and refilled with fresh test fuel liquid C in accordance with ISO 1817 up to a gauge mark. This value shall be recorded.

The amount of fuel diffusing through the fuel hose after a period of (72 ± 2) h at standard atmosphere 23/50 and without adding fuel in the meantime shall be determined, by noting the reduction in volume in the pipette.

The amount evaporated through the pipette opening during the test period shall be determined by performing a blank test under the same conditions. This loss of volume shall be deducted from that recorded for the test sample.

The rate of permeation shall be determined as:

$$X = \text{corrected loss of test fuel ml}/(2\ \text{m} \times 3\ \text{d})$$

where

$X$ permeation per length and time in ml/m per day.

# Annex H
(normative)

# Test method for flammability

## H.1 Test piece

Hose assembly with both ends capped.

## H.2 Apparatus

### H.2.1 Bunsen burner

### H.2.2 Stop watch

### H.2.3 Suitable clamps to hold test assembly

## H.3 Test method

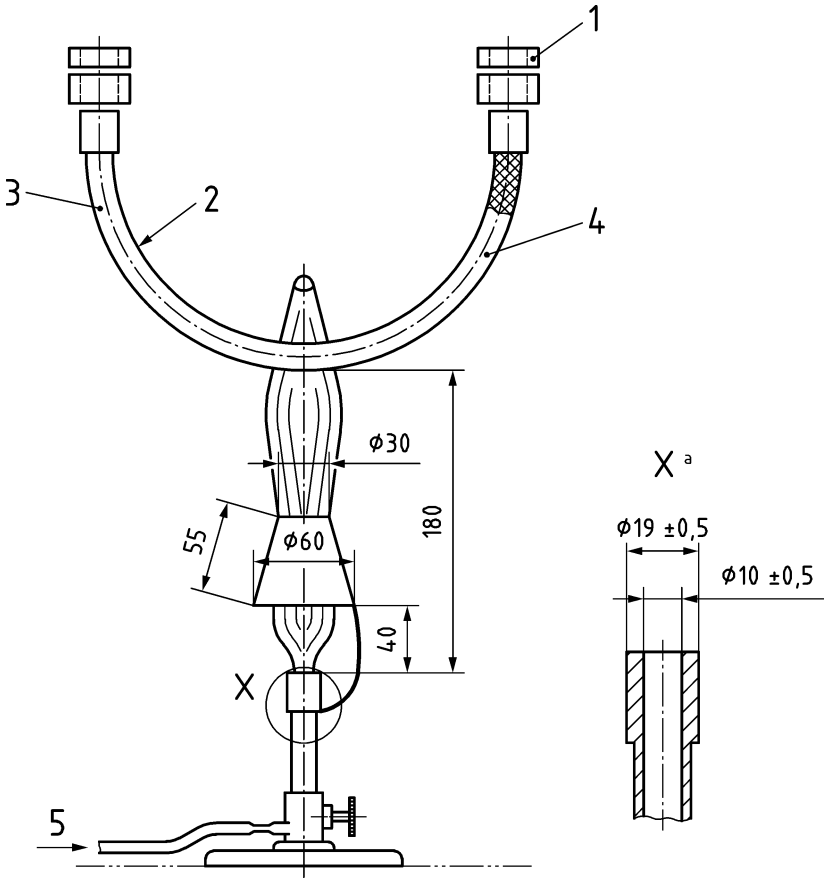
The hose test piece shall be bent into a U-shape of radius in accordance with Figure H.1. The test piece shall be filled with liquid F in accordance with ISO 1817. The test piece shall be exposed to a naked flame from a Bunsen burner of 10 mm pipe diameter for a period of 3 min, with the airflow to the burner shut off. The distance between the burner and test piece shall be in accordance with Figure H.1. The hose sample shall be deemed to be non-flammable if;

— it ceases to burn with a naked flame within 20 s of removal of the burner, and

— there is no further glowing visible 2 min after removing the burner flame.

On completion of the test, the hose test piece shall show no sign of leakage with the test fluids.

Dimensions in millimetres




**Key**

1 cap
2 bending radius = 10 to 15 times of outside diameter
3 hose assembly
4 liquid F in accordance with ISO 1817
5 propane (LPG) ≈ 50 mbar
[a] cross section of detail

**Figure H.1 — Arrangement for flammability test**

# Annex I
(normative)

# Test method for the determination of leakage (leak test)

Each hose assembly shall be subjected to an air pressure of 3,5 bar. The ends of the hose assembly, which includes the fittings and 100 mm of the hose, shall be immersed in a container of water at ambient temperature for a minimum period of 30 s.

Observe any leakage (bubbles) at the interface of the hose and fitting.

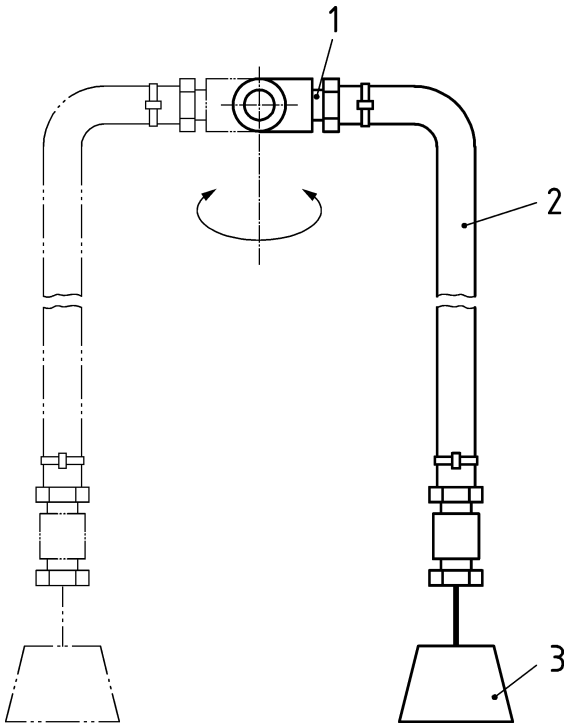
# Annex J
(normative)

# Test method for fatigue strength under reversed bending stresses (flex test)

## J.1 Apparatus and test piece

### J.1.1 Testing rig in accordance with Figure J.1.

If found necessary, the dead weight may be guided to prevent swinging. The length of the hose assembly shall be approximately 1 m.




**Key**

1 centre of rotation of coupling
2 hose Assembly, pressurised
3 dead weight

**Figure J.1 — Testing rig**

## J.2 Test method

The test specimen shall be fitted to the testing rig in accordance with Figure J.1. A dead weight having a mass of 5 kg shall be attached to the free end of the assembly. A pressure of 2 bar using fuel liquid C in accordance with ISO 1817 shall be applied. The testing rig shall be moved to and fro at room temperature, thereby the hose shall be flexed through 180° relative to the coupling. One complete cycle is two rotations through 180°. The minimum flexing rate shall be two complete cycles per minute. The number of cycles to be carried out shall be in accordance with Table 5.

## J.3 Test observations and report

The test report shall, in addition to the number of cycles achieved, include the following information:

a) temperature of the test medium before and after the test, if that temperature deviates from the room temperature;

b) any leakage between the hose and the end fittings;

c) any visible defects, such as any splitting of the hose cover, any bubbling of the cover, any separation of the cover or of the reinforcing plies, or any damage to the lining;

d) any loosening of the hose from the end fittings;

e) any deviation from the maximum permissible electrical resistance specified in Table 5 when tested in accordance with the relevant method as specified in EN ISO 8031.

# Annex K
(normative)

# End-fitting pull-off test

## K.1 Test piece

The test sample shall be a hose assembly of a length to fit the test equipment, prepared under the same manufacturing conditions and by the same manufacturing processes as used for actual assemblies. The test samples shall be prepared at the beginning and end of a batch of assemblies and, in addition, when the 100$^{th}$ assembly is made if the batch is larger than 100 units. This test frequency of 100 units only applies for non-reusable fittings.

## K.2 Apparatus

Test rig capable of producing and holding a tensile force of 2 000 N for at least 30 s with a jaw speed of (75 $\pm$ 5) mm/min.

## K.3 Test method

The test sample shall be mounted in a test rig and a tensile force of 2 000 N shall be applied at the extremities of the assembly and held for 30 s. The force shall be built up by moving apart the jaws of the test rig at a rate of (75 $\pm$ 5) mm/min.

Each test assembly shall be discarded on completion of the test.

If a sample fails this test, the preceding 100 hose assemblies shall be deemed as not conforming to this document and subject to further investigation.

# Annex L
(normative)

# Test frequency for type tests and routine tests

The minimum frequency of test for type tests and routine tests shall be as specified in Table L.1.

**Table L.1 — Test frequency of type tests and routine tests**

| Property | Type test | Routine test |
|---|---|---|
| **Compound** | | |
| Tensile strength and elongation at break, lining and cover | X | N.A. |
| Accelerated ageing | X | N.A. |
| Swelling in fuel, lining and cover | X | N.A. |
| Extracted matter from lining fuel hose | X | N.A. |
| Low temperature class resistance | X | N.A. |
| Abrasion of the cover | X | N.A. |
| **Fuel hose** | | |
| Adhesion between components | X | N.A. |
| Ambient temperature bending | X | N.A. |
| Low temperature class flexibility | X | N.A. |
| Measurement of outer diameter | X | X |
| Measurement of thickness (lining and cover) | X | X |
| Proof pressure | X | X |
| Change in length (at proof pressure) | X | N.A. |
| Burst pressure | X | N.A. |
| Ozone resistance of cover | X | N.A. |
| Electrical resistance | X | X |
| Flammability | X | N.A. |
| Fuel permeation | X | N.A. |

**Table L.1** *(continued)*

| Property | Type test | Routine test |
|---|---|---|
| Volumetric expansion | X | N.A. |
| **Fuel hose** | | |
| Bend radius | X | N.A. |
| Change in length due to swelling | X | N.A. |
| **Vapour hose/tubing** | | |
| Pressure test | X | N.A. |
| Change in length due to swelling | X | N.A. |
| Pressure loss test | X | N.A. |
| Burst pressure | X | N.A. |
| Adhesion between components (only hoses) | X | N.A. |
| Low temperature class flexibility | X | N.A. |
| Measurement of internal diameter | X | X |
| Bend radius | X | N.A. |
| **Hose assembly** | | |
| Proof pressure | X | N.A. |
| Leak test | X | X |
| Electrical resistance | X | X |
| Pull-off test | X | See Annex K |
| Flex test | X | N.A. |
| Difference in change in length due to swelling | X | N.A. |
| Pressure loss test | X | N.A. |
| X = test to be performed<br>N.A. = not applicable | | |

# Annex M
(informative)

# Test frequency for production acceptance tests

The frequency of test for production acceptance tests should be as specified in Table M.1. It should be noted that this is only a recommendation. These tests are carried out per batch or 10 batches as indicated in Table M.1. A batch is defined as either 5 000 m of hose or 2 000 kg of lining and/or cover compound or 1 000 hose assemblies.

**Table M.1 —Test frequency for production acceptance tests**

| Property | Production acceptance tests | |
|---|---|---|
| | Per batch | Per 10 batches |
| **Compound** | | |
| Tensile strength and elongation at break, lining and cover | X | X |
| Accelerated ageing | N.A. | X |
| Swelling in fuel, lining and cover | N.A. | X |
| Extracted matter from lining fuel hose | N.A. | X |
| Low temperature class resistance | N.A. | X |
| Abrasion of the cover | N.A. | X |
| **Fuel hose** | | |
| Adhesion between components | X | X |
| Ambient temperature bending | N.A. | X |
| Low temperature class flexibility | N.A. | X |
| Measurement of outer diameter | X | X |
| Measurement of thickness (lining and cover) | X | X |
| Proof pressure | X | X |
| Change in length (at proof pressure) | N.A. | X |
| Burst pressure | N.A. | X |
| Ozone resistance of cover | N.A. | X |
| Electrical resistance | X | X |

**Table M.1** *(continued)*

| Property | Production acceptance tests | |
|---|---|---|
| | **Per batch** | **Per 10 batches** |
| Flammability | N.A. | X |
| **Fuel hose** | | |
| Fuel permeation | N.A. | X |
| Volumetric expansion | N.A. | X |
| Bend radius | N.A. | N.A. |
| Change in length due to swelling | N.A. | X |
| **Vapour hose/tubing** | | |
| Pressure test | N.A. | N.A. |
| Change in length due to swelling | N.A. | X |
| Pressure loss test | N.A. | N.A. |
| Burst pressure | N.A. | X |
| Adhesion between components (only hoses) | X | X |
| Low temperature class flexibility | N.A. | N.A. |
| Measurement of internal diameter | X | X |
| Bend radius | N.A. | N.A. |
| **Hose assembly** | | |
| Leak test | X | X |
| Electrical resistance | X | X |
| Pull-off test | N.A. | N.A. |
| Flex test | N.A. | N.A. |
| Difference in change in length due to swelling | N.A. | N.A. |
| Pressure loss test | N.A. | N.A. |
| X = test to be performed<br>N.A. = not applicable | | |

# Bibliography

[1] EN 228, *Automotive fuels — Unleaded petrol — Requirements and test methods*

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