BRITISH STANDARD

BS EN
1361 : 1997

Rubber hoses and hose assemblies for aviation fuel handling — Specification

The European Standard EN 1361 : 1997 has the status of a British Standard

ICS 49.100; 83.140.40

National foreword

This British Standard reproduces verbatim EN 1361 : 1997 and implements it as the UK national standard.

The UK participation in its preparation was entrusted by Technical Committee PRI/66, Rubber and plastics tubing, hoses and hose assemblies, to Subcommittee PRI/66/1, Industrial, chemical and petrochemical applications, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

It supersedes BS 3158 : 1985 which is withdrawn.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 16 an inside back cover and a back cover.

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Descriptors: Rubber hoses, hoses, fuel handling equipment, transfer, aviation fuels, specification, dimensions, equipment specifications, physical properties, tests, pressure, marking

English version

Rubber hoses and hose assemblies for aviation fuel handling — Specification

Tuyaux et flexibles en caoutchouc pour transfert de carburant aviation — Spécification

Gummischläuche und-schlauchleitungen für die Flugzeugbetankung — Anforderungen

This European Standard was approved by CEN on 1997-03-04. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 1361 : 1997 E

Foreword

This European Standard 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 October 1997, and conflicting national standards shall be withdrawn at the latest by October 1997.

This standard is based on BS 3158 but the following major changes have been incorporated:

– six hose types reduced to four, omitting type A (non electrically bonded) and type D (non electrically bonded but incorporating an antistatic cover compound), which are no longer in regular use and are considered to be obsolete;

– maximum allowable fuel soluble matter has been increased;

– minimum levels for adhesion between components have been increased;

– pressure ratings for all types have been standardized to the same requirements.

A flammability test proposed by Germany has been included as an informative annex (annex A) so that experience in use and values may be obtained prior to consideration for inclusion as a requirement.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

1 Scope

This European Standard specifies the dimensions, construction and requirements for four types of hoses and hose assemblies for use in all operations associated with the ground fuelling and defuelling of aircraft.

All four types of hose are designed for:

a) use with petroleum fuels, having an aromatic hydrocarbon content not exceeding 30 % by volume;

b) operation within the temperature range of −30 °C to +65 °C and are to be undamaged by climatic conditions of −40 °C to +70 °C when stored in static conditions.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 24671	*Rubber and plastics hose and hose assemblies — Methods of measurement of dimensions* (ISO 4671 : 1984)
EN 24672	*Rubber and plastics hoses — Sub-ambient temperature flexibility tests* (ISO 4672 : 1988)
EN 26246	*Determination of existent gum in fuels by jet evaporation* (ISO 6246 : 1995)
EN 27326	*Rubber and plastics hoses — Assessment of ozone resistance under static conditions* (ISO 7326 : 1991)
EN 28031	*Rubber and plastics hoses and hose assemblies — Determination of electrical resistance* (ISO 8031 : 1993)
EN 28033	*Rubber and plastics hose — Determination of adhesion between components* (ISO 8033 : 1991)
ISO 37	*Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*
ISO 188	*Rubber, vulcanized — Accelerated ageing or heat-resistance tests*
ISO 1402	*Rubber and plastics hoses and hose assemblies — Hydrostatic testing*
ISO 1817 : 1985	*Rubber, vulcanized — Determination of the effect of liquids*
ISO 4649	*Rubber — Determination of abrasion resistance using a rotating cylindrical drum device*
ISO/TR 8330	*Rubber and plastics — Glossary of terms used by the hose industry*

3 Definitions

For the purposes of this standard, the definitions given in ISO/TR 8330 apply.

4 Types and service reeling diameters

4.1 Types

Hoses shall be one of the following four types, each incorporating an antistatic cover compound:

a) type B, electrically conductive;

b) type C, non-electrically conductive but incorporating an antistatic cover compound;

c) type E, with enhanced defuelling capability (electrically conducting and incorporating a metallic wire helix reinforcement);

d) type F, with enhanced defuelling capability (non-electrically conducting and incorporating a non-metallic helix reinforcement with an antistatic cover).

NOTE 1. Type C hoses are intended for general pressure application on all vehicles used for into-plane fuelling. It may also be used for vehicle/rail car loading and discharge where excessive vacuum does not occur.

NOTE 2. Type F hoses may be used for into-plane delivery applications on vehicles that are also used for defuelling at high flow rates, and where type C hoses are not suitable.

NOTE 3. Type E and type F hoses may also be used for vehicle/rail car loading and discharge, for trailer to fueller transfer, and for elevating platform supply (riser) to provide greater kink resistance. However, for 'riser' application, a 'heavy duty' type C hose or standard type C hose with an external wire spiral should be used when possible. This spiral should not be in electrical contact with the end couplings.

4.2 Service reeling diameter

Hoses shall be designed for operation on equipment fitted with hose reels of the diameters given in table 1.

NOTE. These hoses remain substantially circular in cross section when reeled on drums (see table 1) and should not be confused with hoses of the collapsible type that are intended to be reeled flat.

Table 1. Service reeling diameters

Nominal bore	**Minimum external diameter of reeling drum used in service** mm
19	225
25	300
32	375
38	450
50	550
63	600
75	600
76	600
100	900
101	900

5 Construction

The hose shall be mandrel built and vulcanized on the mandrel. Particulate type release agents shall not be used. The hose shall be uniform in quality and free from porosity, air holes, foreign inclusions and other defects.

The hose shall comprise:

– a lining of synthetic rubber resistant to petroleum fuel;

– a reinforcement of layers of woven, braided or spirally wound textile material;

– an outer cover of synthetic rubber, resistant to abrasion, outdoor exposure and petroleum fuel. The outer surface shall be uncorrugated and free from abrasive particles or ingredients which could scratch or mark aircraft surfaces.

NOTE. The cover may have a shallow cloth marked finish.

For type E and type F hoses only, an embedded helix reinforcement shall be included in the construction.

For type E hoses the wire reinforcement used shall be a hard steel and shall have a galvanized finish.

Construction relating to electrical properties are specified in clause **11**.

6 Physical properties

6.1 Rubber compounds

The physical properties of the rubber compounds used for the lining and cover shall comply with the values given in table 2, when tested by the methods listed in table 2.

Tests shall be carried out either on samples taken from the hose or from separately vulcanized sheets, except for cold embrittlement and abrasion resistance tests which shall be carried out on moulded test pieces.

6.2 Finished hose

The physical properties of the finished hose shall comply with the values given in table 3, when tested by the methods listed in table 3.

7 Pressure ratings

7.1 General

For all types of hoses the following shall apply:

– maximum working pressure	20 bar[1)];
– Proof pressure	40 bar;
– minimum bursting pressure	80 bar.

NOTE. It is essential that the maximum pressure, including surge pressure to which the hose is subjected in service, does not exceed the permissible maximum working pressure specified.

7.2 Variation in length at maximum working pressure

When tested in accordance with **K.1.1**, (see annex K), the maximum variation in length at maximum working pressure shall be 7 % of the original length for type B and type C hoses and 12 % of the original length for type E and type F hoses.

7.3 Proof pressure

When tested in accordance with **K.1.2**, (see annex K), the electrical continuity of type B and type E hoses shall comply with **11.1** and the electrical resistance of type C and type F hoses shall comply with **11.3**. The hose shall show no signs of leakage or other damage.

7.4 Minimum bursting pressure

When tested in accordance with **K.2**, (see annex K), the minimum bursting pressure shall not be less than 80 bar.

Table 2. Physical properties of rubber compounds

Property	Unit	Requirement		Method
		Lining	Cover	
Tensile strength, min.	MPa	7,0	7,0	ISO 37 (dumb-bell test pieces)
Elongation at break, min.	%	250	300	ISO 37 (dumb-bell test pieces)
Swelling in fuel, max.	%	50	75	**8.2** of ISO 1817 : 1984 (48 h at 40 °C in liquid B)
Fuel-soluble matter, max.	%	4,0	Not applicable	Annex B
Cold embrittlement	—	No cracking	No cracking	Annex C
Abrasion resistance	mm^3	Not applicable	140	Method A of ISO 4649
Ageing Tensile strength change, max.	%	±30	±30	ISO 188 (7 days at 70 °C)
Elongation at break change, max.	%	±30	±30	(Air-oven method)

[1)] 1 bar = 10^5 N/m^2 = 10^5 Pa.

Table 3. Physical properties of finished hoses			
Property	**Unit**	**Requirement**	**Method of test**
Adhesion between components			Annex D
dry, min.	N/mm	3,0	
after contact with fuel, min.	N/mm	2,0	
Fuel contamination, R_e max.	mg/100 ml	10	Annex E
Ozone resistance	—	No cracking observed under ×2 magnification	EN 27326 (40 °C)
Flexibility	—	No permanent deformation or visible structural damage, no increase in electrical resistance, no impairment of electrical continuity and shall comply with the proof pressure requirement in **7.3** when measured at (20 ± 5) °C	Annex F (20 °C) Annex G (−30 °C)
Crush recovery (type F only)			Annex H
after 1 min	—	Regain 90 % of original diameter	
after 10 min	—	Regain 95 % of original diameter Shall comply with the proof pressure requirement in **7.3** at (20 ± 5) °C	
Cyclic kinking (type B and type C only)	—	No leakage at proof pressure; electrical resistance not increased; adhesion between lining and reinforcement not less than 2,0 N/mm	Annex J

8 Dimensions

8.1 Internal diameters

When measured in accordance with EN 24671 the internal diameters and tolerances shall comply with the values given in table 4.

Table 4. Nominal bore, internal diameters and tolerances		
Nominal bore	**Internal diameter** mm	**Tolerance** mm
19	19,0	±0,8
25	25,0	
32	32,0	
38	38,0	
50	50,0	
63	63,0	±1,2
75	75,0	
76	76,0	
100	100,0	±1,6
101	101,5	

8.2 Thickness

When measured in accordance with EN 24671 the thickness of the lining for hoses of all internal diameters shall not be less than 1,6 mm.

For hoses of nominal bore less than 50 the thickness of the cover shall not be less than 1,6 mm. For hoses of nominal bore 50 and above the thickness of the cover shall not be less than 2,0 mm.

8.3 Concentricity

When determined in accordance with EN 24671, the concentricity, based on a total indicator reading between the internal diameter and the outside surface of the cover, shall not exceed 1 mm.

8.4 Tolerance on length

The tolerance on the measured length of hose or hose assembly shall be ±1%.

8.5 Mass per unit length of hose

The maximum mass per unit length shall comply with the values given in table 5.

Table 5. Mass per unit length of hoses

Nominal bore	Type B and type C kg/m	Type E and type F kg/m
19	0,9	1,1
25	1,1	1,5
32	1,4	1,9
38	1,7	2,2
50	2,7	3,0
63	3,5	4,0
75	4,0	4,7
76	4,0	4,7
100	6,5	7,5
101	6,5	7,5

9 Resistance to vacuum

9.1 General

The hose length as supplied shall be tested at (20 ± 5) °C no earlier than 24 h after manufacture.

9.2 Type B and type C

Type B and type C hoses of all sizes shall withstand a vacuum equivalent to a pressure of 0,15 bar absolute for 10 min without suffering visible structural damage.

Hoses of nominal bore 19 to 63 inclusive shall also withstand a vacuum equivalent to a pressure of 0,85 bar absolute and when measured by a calliper gauge the loss of circularity shall not exceed 20 % of the internal diameter.

9.3 Type E and type F

Hoses of type E shall withstand a vacuum equivalent to a pressure of 0,15 bar absolute for 10 min and hoses of type F shall withstand a vacuum equivalent to a pressure of 0,35 bar absolute for 10 min.

When tested in accordance with annex L, for both types of hose the metal ball shall pass freely from end to end through the hose and the hose shall show no visible signs of structural damage.

10 Hose assemblies

10.1 Couplings

The dimensions of the couplings shall be compatible with the dimensions of the hose. The method of attachment of the couplings shall be such that the hose assembly complies with **10.2**.

10.2 Test for security of coupling attachment

Hose assemblies shall withstand, without leakage or movement of the coupling out of the hose, the tests described in annex M. There shall be no visible cuts or other damage to the hose lining.

Hose couplings that are approved by the hose manufacturer and which are installed prior to despatch of hose assemblies, shall remain attached to the hose under an internal pressure of 80 bar for at least 5 min. Minor leakage and/or distortion is permitted at this pressure.

10.3 Written confirmation

Where the manufacturer's authorized distributor fits the coupling, the distributor shall have written confirmation from his hose manufacturer clearly indicating that the distributor has available the necessary equipment, facilities and expertise to assemble and test hose assemblies.

11 Electrical properties

11.1 General

During and after subjection to the hydrostatic tests described in annex K, electrical continuity of each hose shall be maintained from end to end and electrical continuity of each hose assembly shall be maintained from one coupling to the other. The hose shall show no breakdown in electrical continuity of type B and type E (see **11.2**) or increase in electrical resistance above the specified limits of type C and type F (see **11.3**).

11.2 Type B and type E (electrically conductive)

No fewer than two low resistance electrical conducting wires shall be provided between, or incorporated in, the reinforcement plies and arranged in such a manner that electrical continuity is maintained along the length of the hose in service. Each conducting wire shall have not less than nine strands. The metal used shall have high resistance to fatigue.

When attaching couplings to type B and type E hoses, the protruding length of conducting wire shall be folded into the hose bore, positioned between lining and fitting tail and extended along approximately half the length of the fitting tail. If the hose is supplied without couplings, conducting wires shall protrude approximately 150 mm at each end of the hose.

NOTE. A suitable method of confirming electrical continuity is by the use of a 4,5 V battery and a 3,5 V, 0,3 A test bulb. A dimly lighted bulb is sufficient to indicate satisfactory continuity.

11.3 Type C and type F (non-electrically conductive incorporating an antistatic cover compound)

When tested in accordance with EN 28031, the electrical resistance shall be between the following limits:

(1×10^3) W/m to (1×10^6) Ω/m

NOTE 1. For these hoses, it is necessary to create a connection between the cover and the coupling.

NOTE 2. The conditioning parameters should be agreed between the manufacturer and the purchaser.

12 Frequency of testing

Minimum frequencies of testing shall be as given in annex N.

13 Marking

13.1 Hoses

The hose shall be legibly and durably marked, at intervals of not more than 1 m on the outer cover, with the following information:

a) manufacturer's name or identification, e.g. XXXX;

b) manufacturer's product identification, e.g. No 123;

c) number of this European Standard, EN 1361;

d) type, e.g. C;

e) nominal bore, e.g. 63;

f) maximum working pressure, in bar, e.g. 20;

g) quarter and year of manufacture, e.g. 2Q96;

h) unique batch/serial number.

EXAMPLE : XXXX/No 123/EN1361/ C/63/20/2Q96/0001

13.2 Hose assemblies

The couplings shall be permanently marked with the following information:

a) name or identification of the assembler;

b) a serial number corresponding to a hydrostatic test certificate. This serial number shall be recorded on test inspection document by the hose assembly manufacturer, at time of factory testing.

NOTE. It is recommended that hoses be supplied to the end user complete with couplings, i.e. as a hose assembly.

14 Test inspection document

When requested, a test inspection document shall be provided with each length of hose or hose assembly, containing the following, as appropriate:

a) hose manufacturer's name;

b) coupling manufacturer's name;

c) assembler's name;

d) hose type;

e) length and nominal bore of the hose or assembly;

f) serial or reference number of hose;

g) serial or reference number of assembly;

h) quarter and year of hose manufacture;

i) month and year of assembly manufacture;

j) hydrostatic test pressure;

k) date of test(s).

15 Cleanliness

The hose bore shall be cleaned, flushed and dried to remove excess substances used in manufacture.

NOTE. A recommended practice for flushing and handling hoses is given in annex P.

16 Protection for despatch and storage

To protect the couplings and to prevent damage to the lining, corrosion-resistant protective end caps shall be fitted to all hoses and hose assemblies at the manufacturer's works after testing is completed.

Annex A (informative)

Flammability test

Warning. This test is potentially hazardous and shall be carried out by qualified personnel under controlled conditions.

A hose test piece, bent into a U-shape or formed by U-shaped metal connectors, is filled with fuel oil EL and exposed to a naked flame from a bunsen burner of 10 mm pipe diameter for a period of 3 min, with the air flow shut off (see figure A.1).

The hose sample is hardly inflammable if it ceases to burn with a naked flame once the bunsen burner is removed, and if, 2 min after removing the bunsen burner, there are no further sparks. The hose test piece shall be impervious to fluids after this time.

The test may be carried out on a reference nominal bore, preferably 25.

Annex B (normative)

Method for determination of fuel-soluble matter

B.1 Procedure

Take a sample from the lining of the hose and remove any extraneous fibres. Cut the sample into pieces approximately 3 mm square and extract ($5 \pm 0{,}01$) g of the comminuted sample with 100 ml of liquid B, as specified in ISO 1817, in a glass flask for 96 h at (40 ± 1) °C. Take suitable precautions to prevent loss by evaporation.

While still hot, filter the contents into a pre-weighed hemispherical glass dish of suitable size. Wash both the residue in the flask and the filter with a further known quantity of the solvent mixture.

Evaporate the contents of the dish on a boiling water bath and heat the residue in a ventilated air oven for 2 h at (150 ± 3) °C.

NOTE. Precautions to avoid overheating during preparation of the test sample are essential as any degradation of the polymer due to overheating is not estimable and could give a falsely high result.

B.2 Expression of results

Calculate the mass of residual fuel-soluble matter as a percentage of the original mass of the test portion.

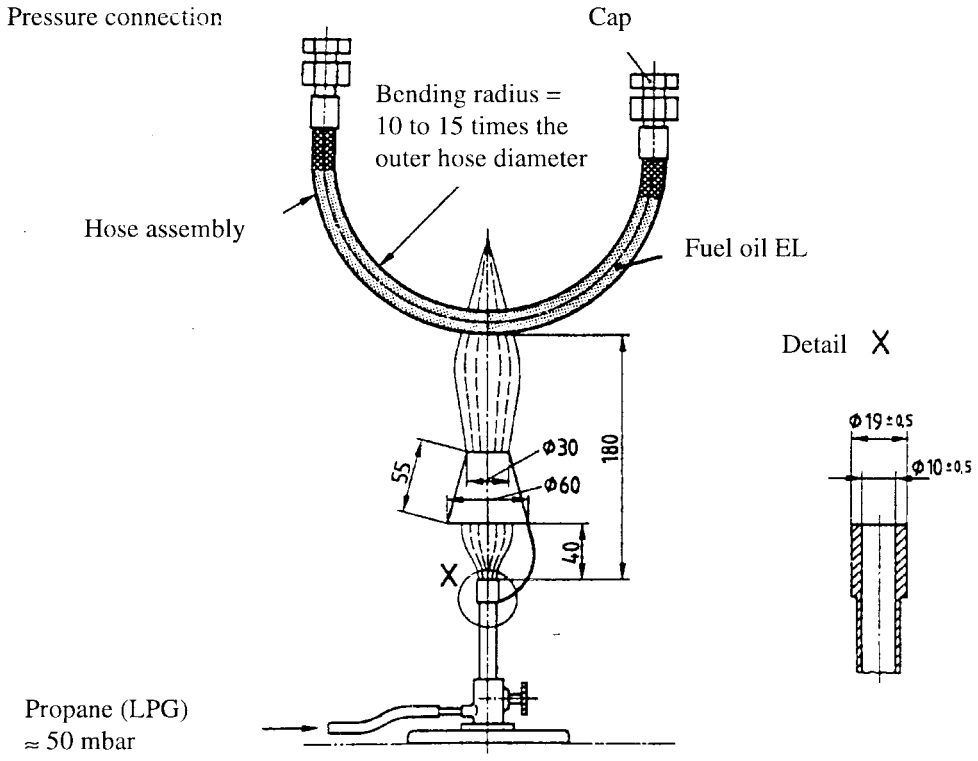

Figure A.1 Arrangement for flammability test

Annex C (normative)
Method of test for cold embrittlement

C.1 Apparatus

The apparatus is shown in figure C.1.

C.2 Procedure

Fix the test piece, 150 mm × 25 mm × 2 mm, in two grips so that it lies in one plane with 127 mm exposed between the grips and then reduce the distance between the grips by 1 mm.

If the test piece is taken from a piece of hose it shall be free of any adhering reinforcement fabric.

Place the clamped test piece in a Dewar vessel containing a coolant so that the test piece is completely immersed. Maintain the temperature at (-40 ± 1) °C for 30 min and then reduce the distance between the grips by 25 mm in 20 s by moving one grip directly towards the other in the same plane.

Examine the test piece for cracks.

NOTE. A temperature of −40 °C may be attained by using methanol or ethanol with crushed dry ice (solid carbon dioxide) and maintained by carefully adding further pieces of dry ice.

Annex D (normative)
Method for determination of adhesion between components

D.1 Dry adhesion

Samples of hoses for type E and type F shall be cut parallel with the helix.

Subject the hose to the adhesion test described in EN 28033 and determine the minimum value (in Newtons per millimetre) for adhesion:

a) between lining and reinforcement;

b) between reinforcement and cover;

c) between reinforcement layers.

D.2 Adhesion after contact with fuel

Cut a sample of the hose to be tested approximately 300 mm in length and seal one end.

Fill the hose with liquid B as described in ISO 1817 and lightly cap the top.

Condition the sample at (20 ± 5) °C for (168 + 2/0) h.

Determine the minimum adhesion between components as stated in **D.1**.

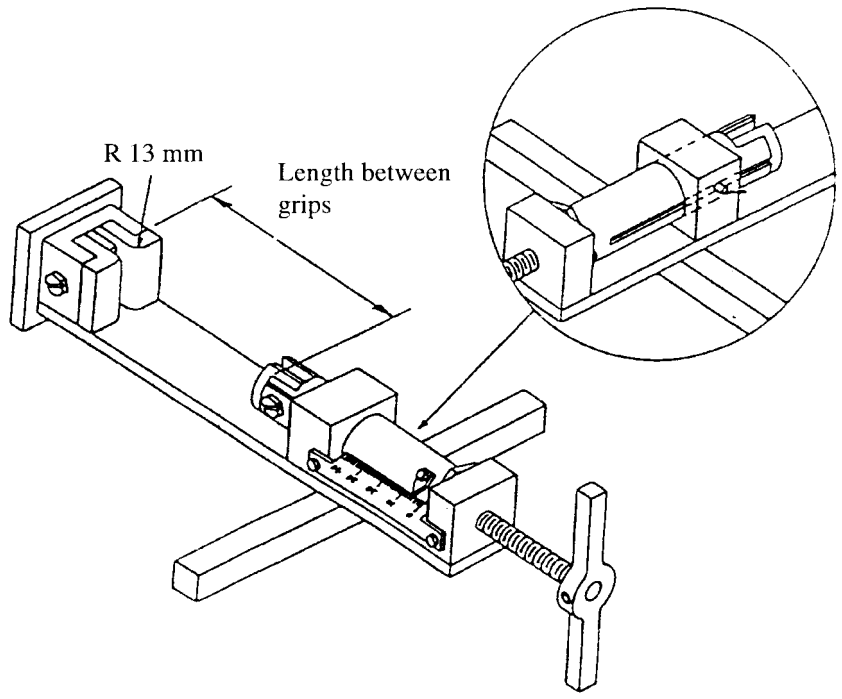

Figure C.1 Apparatus for cold embrittlement test

Annex E (normative)

Method for determination of resistance to fuel contamination

E.1 Principle

The fuel contamination is judged by determination of the substances which are dissolved from the hose by a simulator liquid after a certain pretreatment. The result is given in terms of a hose with a nominal bore of 76.

E.2 Procedure

Take a suitable hose length, not less than 300 mm, and stopper one end with a glass plug. Fill the hose with liquid B, specified in ISO 1817, and allow to stand at room temperature for 3 days. Remove the liquid and visually examine it.

For a further 4 days, at daily intervals, refill the hose with liquid B, allow to stand at room temperature, remove the liquid and visually examine it.

Refill the hose with liquid B and allow to stand for 3 days at (20 ± 5) °C. Remove the liquid and determine the residue on evaporation of the test sample in accordance with EN 26246.

Determine also the residue on evaporation of the blank (liquid B) sample in accordance with EN 26246.

Report the value R, which is the increase in residue on evaporation of test sample against that of the blank sample as milligrams of residue per 100 ml of test liquid.

E.3 Expression of results

When testing hoses having nominal bore other than 76 adjust the values obtained to give the final result in terms of the 76 nominal bore.

Calculate R_e from the equation:

$$R_c = \frac{RB}{76}$$

where

R_e is the 76 equivalent increase in residue (in milligrams per one hundred millimetres);

R is the measured increase in residue (in milligrams per one hundred millimetres);

B is the nominal bore of the hose.

NOTE. Application of the formula is to compensate for the fact that the hose surface area/liquid volume ratio is different and allowance for this factor has to be made.

Annex F (normative)

Method of test for flexibility at 20 °C

Coil an empty hose at (20 ± 5) °C around a test drum of external diameter given in table F.1. Uncoil and check for visible structural damage and permanent deformation.

For type B and type E hoses check the electrical continuity is maintained (see **11.2**) and for type C and type F hoses measure the electrical resistance (see **11.3**).

Table F.1 External diameter of test drum for flexibility test at 20 °C

Nominal bore	External diameter of test drum mm
19	180
25	230
32	280
38	360
50	430
63	460
75	460
76	460
100	690
101	690

Annex G (normative)

Method of test for flexibility at −30 °C

Use Method B of EN 24672 with the following additions:

a) test temperature: (−30 ± 2) °C;

b) diameter of test drum 10 times the nominal bore of hose;

c) hoses of nominal bore 19 to 63 inclusive bent through 180 ° and hoses of nominal bore 75 to 101 inclusive bent through 90 °;

NOTE. 100 or 101 nominal bore hoses may be tested outside the cold chamber but it is essential that they are tested within 30 s of removal from the cold chamber.

d) hose examined at ambient temperature and then pressure tested to 40 bar (see **7.1**) in accordance with ISO 1402;

e) test piece filled with aviation kerosene and allowed to soak for 24 h at ambient temperature before being placed in the cold chamber for 24 h;

f) test carried out on the filled sample;

g) for hoses type B and type E check the electrical continuity (see **11.2**) and for hoses type C and type F measure the electrical resistance (see **11.3**);

NOTE. The torque value, measured as described in annex Q, should be recorded for information.

Annex H (normative)

Method of test for crush recovery

NOTE. This test applies to type F hoses only which may be subjected to crushing force in service.

H.1 Apparatus

H.1.1 *Apparatus 1*

H.1.1.1 *Compression testing machine*, capable of a rate of traverse of (50 ± 5) mm/min with a capacity adequate for the level of crushing force that may be specified.

H.1.1.2 *Two metal plates*, each 80 mm wide and capable of withstanding the applied forces without deformation. The edges of the plates are rounded (approximately 1,5 mm radius) to avoid cutting the hose during the test.

H.1.2 ***Apparatus 2***

H.1.2.1 *Tensile testing machine*, with a rate of traverse of (50 ± 5) mm/min with a capacity adequate for the level of crushing force that may be specified.

H.1.2.2 *Compression cage.*

H.1.2.3 *Two metal plates*, as described in **H.1.1.2**.

H.2 Test piece

Sample of hose of minimum length 500 mm.

H.3 Conditioning of test pieces

No test shall be carried out within 24 h of manufacture of the hose. Test pieces shall be conditioned at a temperature of (20 ± 5) °C, for at least 3 h before testing; this may be part of the 24 h after manufacture.

H.4 Procedure

Measure the outside diameter of the test piece in accordance with the method described in EN 24671.

Place the test piece between the two parallel plates (see **H.1.1.2**) mounted in the testing machine (see **H.1.1.1** or **H.1.2.1**) so that the central 80 mm of the test piece will be crushed.

Compress the hose so that the outside diameter is reduced by 50 % and retain it in the compressed condition for (60 ± 10) s.

Release the compressive force at a rate of (50 ± 5) mm/min.

Remeasure the minimum outside diameter at 1 min and at 10 min after the release of the compressive force.

Then subject the hose sample to the proof pressure test (see annex K, **K.1.2**).

Annex J (normative)
Method for determination of cyclic kinking resistance

Use the following procedures to test hose type B and type C for kink resistance.

a) Prepare the test hose by filling it with liquid B per ISO 1817, leaving it to soak for 168 h.

b) Empty the hose and lightly cap both ends.

c) Bend the empty hose at (20 ± 5) °C to form a kink with an included angle of 60 °.

d) Release the hose and allow it to recover for 2 min to 4 min.

e) Repeat steps c) and d) for 1000 continuous cycles and visually examine the hose for permanent deformation and structural damage. Measure the electrical continuity and electrical resistance while empty to ensure the limits of **11.2** and **11.3** are met, as appropriate.

f) Proof test the hose to 40 bar (see annex K, **K.1.2**).

g) Cut a section of the hose at the location of the kink and carry out a lining/reinforcement adhesion test.

h) Report all findings.

Annex K (normative)
Hydrostatic tests

K.1 Pressure tests on hose lengths and/or hose assemblies

K.1.1 ***Working pressure test***

Raise the pressure to 20 bar at a rate of (0,4 ± 0,25) bar/s and measure the variation in length when compared with the length at 0,7 bar.

K.1.2 ***Proof pressure test***

Fill the hose with a test medium of either clean kerosene or clean water.

NOTE. The test medium should be agreed between the purchaser and the manufacturer.

Subject each length of hose or hose assembly to an internal proof pressure of 40 bar built up at a rate of (0,4 ± 0,25) bar/s.

Maintain the proof pressure for 5 min, then reduce at the same rate to 3 bar, maintaining this pressure for a further 2 min. Remove the test medium completely from the hose.

For type B and type E hoses test for electrical continuity as specified in **11.2**.

For type C and type F hose test for electrical resistance as specified in **11.3**.

K.2 Bursting pressure test on hose lengths

Take a sample out from a hose, approximately 1 m long and having a minimum length of 625 mm clear of test fittings.

Using water as the test medium, let a hydrostatic pressure build up at a rate of (1,2 ± 0,5) bar/s until the hose bursts.

Annex L (normative)

Method of test for vacuum resistance

NOTE. This test applies to type E and type F hoses only.

Insert into the hose a metal ball of the appropriate size given in table L.1. Reduce the internal pressure of the hose to the test vacuum specified in **9.3** and let the metal ball pass through the hose whilst the vacuum is maintained. Examine the hose for any visible structural damage.

Table L.1 Ball diameter for resistance to vacuum test (type E and type F only)

Nominal bore	Ball diameter mm
19	15,00
25	21,60
32	25,00
38	31,75
50	41,27
63	50,00
75	63,50
76	63,50
100	88,90
101	88,90

Annex M (normative)

Method of test for security of coupling attachment

M.1 Apparatus

Test assembly, of 1 m in length, consisting of hose and end couplings.

M.2 Procedure

Using water as the test medium, raise the test pressure to 40 bar and hold for 2 min.

Reduce the applied pressure to zero. Increase the pressure to 10 bar, hold for 2 min and examine for leakage. Reduce the applied pressure to zero.

Increase the pressure to 40 bar, hold for 2 min and examine for leakage. Reduce the applied pressure to zero.

Annex N (normative)

Minimum test frequency

Table N.1 gives the minimum frequency of testing.

Type approval tests are those tests required to obtain type approval.

Type approval is obtained by the manufacturer supplying evidence that all the requirements of this standard are met by his method of manufacture and hose design. Type approval tests shall be repeated a minimum of every five years or whenever a change in the method of manufacture or materials occurs.

Production acceptance tests are those carried out per batch or per 10 batches as indicated in table N.1. A batch is defined as either 500 m of hose or 500 kg of lining and/or cover compound.

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

Annex P (informative)

Recommended practice for hose flushing and handling

P.1 Flushing

Users should establish and perform an initial soak/flush procedure for each new hose assembly. Such a procedure typically entails circulating a minimum of 2000 l of the fuel through the hose assembly after allowing the fuel to soak and stand in the hose for a minimum of 8 h at a minimum temperature of 15 °C.

The user should monitor local operating conditions and conduct a further flushing procedure if fuel left standing in the hose becomes discoloured.

P.2 Handling

Aviation fuelling hose users should establish guidelines for hose handling that include the following precautions.

a) Ensure that the hose does not become snagged or wedged under equipment. The hose needs to be free to move when pressurized.

b) Keep hose and coupling outside surfaces free of oil.

c) Avoid excessive strain on the hose couplings. When manipulating the hose, pull on the hose, not on the coupling.

d) Avoid sharply bending or kinking the hose.

e) To minimize abrasion, carry the nozzle back to the fuelling vehicle before rewinding the hose on the reel.

f) Maintain the reel in good operating condition.

g) Guide the hose onto the reel when rewinding.

P.3 Inspection

Aviation fuelling hoses should be inspected as follows.

a) Visually inspect the hose daily during fuelling operations.

b) At least monthly, pull the hose out to full length in a clean and dry area. Pressurize the hose to normal operating pressure and then conduct an inspection. Pay particular attention to sections at each hose/coupling interface. At zero pressure, determine if there are any ‘soft’ spots which may indicate delamination. Examine couplings for signs of movement or slippage and tighten any fastenings if necessary.

c) Hydrostatic test the hose every 6 months to its allowable pressure (20 bar). Reduce the pressure to zero, then repressurize to 3,5 bar. Check couplings per b) above.

Table N.1 Minimum test frequency

Property	Type approval tests	Production acceptance tests		Routine tests
		Per batch	Per 10 batches	
Compound tests				
Tensile strength and elongation at break	×	×	N.A.	N.A.
Swelling in fuel	×	×	N.A.	N.A.
Fuel-soluble matter	×	×	N.A.	N.A.
Cold embrittlement	×	N.A.	×	N.A.
Abrasion resistance	×	N.A.	×	N.A.
Tensile strength and elongation after ageing	×	N.A.	×	N.A.
Hose tests				
Adhesion (dry)	×	×	N.A.	N.A.
Adhesion (after contact with fuel)	×	×	N.A.	N.A.
Fuel contamination	×	N.A.	N.A.	N.A.
Ozone resistance	×	N.A.	×	N.A.
Flexibility	×	N.A.	×	N.A.
Crush recovery	×	N.A.	×	N.A.
Cyclic linking	×	N.A.	×	N.A.
Measurement of internal diameter	×	N.A.	N.A.	×
Measurement of thickness of lining and cover	×	N.A.	N.A.	×
Measurement of concentricity	×	N.A.	N.A.	×
Measurement of hose length	×	N.A.	N.A.	×
Measurement of mass per unit length	×	N.A.	×	N.A.
Resistance to vacuum	×	N.A.	N.A.	×
Security of coupling attachment	×	N.A.	×	N.A.
Electrical properties	×	N.A.	N.A.	×
Proof pressure	×	N.A.	N.A.	×
Bursting pressure	×	N.A.	×	N.A.

× Test carried out N.A. Not applicable

P.4 Replacement

Fuelling hoses should be taken out of service when any of the following conditions are observed.

a) Soft spots, bulges, or blisters in the hose.

b) Excessive abrasion exposing the reinforcement.

c) Cuts or cracks in the hose which expose the reinforcement.

NOTE. The physical and chemical properties of the hose may gradually deteriorate depending on storage and service conditions. Accordingly, a good practice is to specify a maximum hose life from the date of manufacture; for example, 10 to 15 years.

P.5 Hose recoupling recommended practice

Recoupling of hoses which have been used for aviation fuelling is allowed; however all new aviation fuelling hoses should be coupled by the original manufacturer or his qualified distributor. When hoses are recoupled, the following requirements should be observed.

a) Recoupling should be done by a qualified hose distributor or a user company with a recoupling training programme.

b) The coupling should be marked with a durable label stating the coupler's name and the date of coupling, or otherwise be properly identified and documented.

c) The hose assembly should be tested at proof pressure (40 bar) unless a lower pressure is specified by the user; the allowable pressure (20 bar) is recommended as a minimum.

d) User companies should use a test fluid identical to or wholly compatible with that normally carried by the hose.

Annex Q (informative)

Method of determining torque value

Rotate the test drum using a torque wrench with a dial indicator. The drum should be rotated 180 ° within 10 s (see figure Q.1).

Record the maximum registered torque required to bend the hose around the test drum. Report the result in Newton metres (Nm).

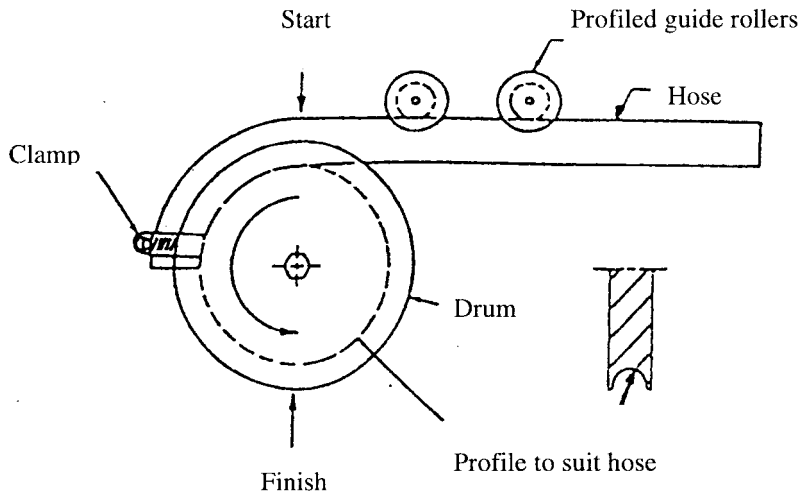

Figure Q.1 Arrangement for torque value

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