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Thermoplastic multi-layer (non-vulcanized) hoses and hose assemblies for the transfer of hydrocarbons, solvents and chemicals — Specification

Tuyaux et flexibles multicouches (non vulcanisés) thermoplastiques pour le transfert des hydrocarbures, des solvants et des produits chimiques — Spécifications

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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*.

ISO 27126 is based on EN 13765:2010 with the following modifications to comply with the requirements of ISO/TC 45/SC 1:

— the pressure unit "bar" has been replaced by "MPa (bar)";

— all references to EN or EN/ISO standards have been replaced by references to ISO standards wherever possible;

— references in Clause 2 have been amended;

— Table 2 has been amended (tolerance for ID 150 only, the other tolerances are already sufficient to accommodate the required changes of ID to include inch size mandrels);

— Table 3 now requires the change in length and twist to be measured at maximum working pressure instead of proof pressure and Annex H has been amended accordingly;

— in Table 4, the reference to the test method clause, to determine electrical resistance between fittings according to ISO 8031 has been corrected;

— Annex G has been amended in order to describe the method of detection of failure after completion of test;

— in Clause 10, the marking has been amended according ISO/TC45/SC1 remarks.

Thermoplastic multi-layer (non-vulcanized) hoses and hose assemblies for the transfer of hydrocarbons, solvents and chemicals — Specification

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

1 Scope

This International Standard specifies requirements for four types of thermoplastic multi-layer (non-vulcanized) hoses and hose assemblies for carrying hydrocarbons, solvents and chemicals. It specifies bore sizes from 25 mm to 300 mm, working pressures from 0,4 MPa (4 bar) to 1,4 MPa (14 bar) and working temperatures from –30 °C to 150 °C, according to type.

Type 1 hoses are suitable for vapour applications. Types 2 to 4 hoses are suitable for liquid applications.

NOTE 1 See Annex A concerning the selection of the material for the inner wall of layers and any polymeric coating of the internal wire helix related to the chemical(s) to be conveyed by the hoses and/or hose assemblies.

NOTE 2 It is intended that the manufacturer be consulted where a polymeric coated internal wire is being considered for use with low conductivity hydrocarbons or chemicals.

This International Standard does not apply to hoses and hose assemblies for:

— aircraft refuelling — see (ISO 1825);

— fuel dispensing — see (ISO 5772);

— oil burners — see (ISO 6806);

— liquefied petroleum gas and liquefied natural gas — see (ISO 27127);

— fire fighting — see (ISO 14557);

— offshore liquefied natural gas — see (EN 1474–2);

— refrigeration circuits.

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 209, *Aluminium and aluminium alloys — Chemical composition*

ISO 1043-1, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

ISO 1402:2009, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

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

ISO 2411, *Rubber- or plastics-coated fabrics — Determination of coating adhesion*

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

ISO 7233:2006, *Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum*

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

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

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

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

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

ISO 16143-3:2005, *Stainless steels for general purposes — Part 3: Wire*

EN 590, *Automotive fuels — Diesel — Requirements and test methods*

EN 10088-3:2005, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*

3 Terms and definitions

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

4 Classification

Hoses shall be classified according to working pressure and working temperature range as given in Table 1.

Table 1 — Pressure and temperature range

	Type 1		Type 2		Type 3		Type 4	
	MPa	Bar	MPa	Bar	MPa	Bar	MPa	Bar
Maximum working pressure	0,4	4	1,0	10	1,4	14	1,4	14
Proof pressure	0,6	6	1,5	15	2,1	21	2,1	21
Minimum burst pressure	1,6	16	4	40	5,6	56	5,6	56
Vacuum rating	0,05	0,5	0,09	0,9	0,09	0,9	0,09	0,9
Working temperature range (°C)	−20 to +60		−30 to +80		−30 to + 80		−30 to +150	
NOTE 1 bar = 0,1 MPa.								

5 Materials and construction

5.1 General

Hoses shall be constructed as shown in Figure 1 and shall consist of the following:

— an internal wire helix (see 5.2);

— a multi-ply wall of layers of films and fabrics made of thermoplastics that in combination give the required properties and provide a complete seal (see also Annex A);

— a cover consisting of a fabric with abrasion resistant polymeric coating;

— an external wire helix (see 5.2).

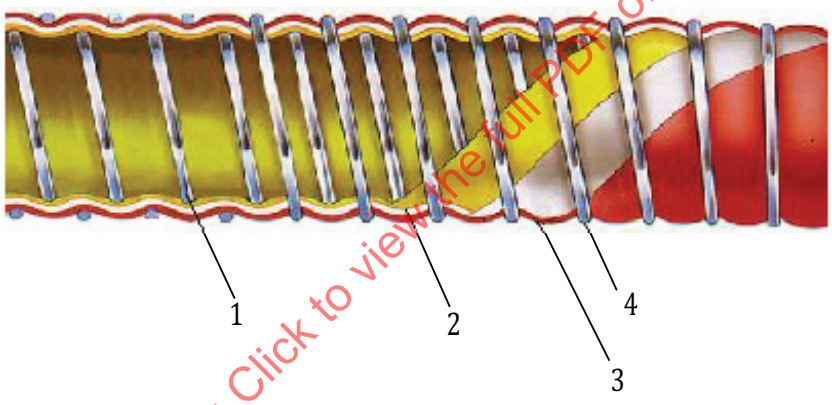
5.2 Internal and external wire

Wire shall be chosen in accordance with its chemical resistance from one of the following materials:

— austenitic stainless steel wire conforming to EN 10088-3, Table 4, numbers 1.4436 (X3CrNiMo 17-13-3) or ISO 16143-3:2005, Table 1: X2CrNi 19-11, X5CrNiMo 17-12-2, X2CrNiMo 17-12-2;

— carbon steel wire conforming to Annex B and either galvanised in accordance with Annex C or sheathed in a polymeric material of a minimum wall thickness of 0,5 mm, resistant to liquid hydrocarbon or liquid chemicals as agreed between purchaser and manufacturer (see Annex A);

— aluminium wire conforming to ISO 209.



Key

1 internal wire
2 film
3 fabric
4 external wire

Figure 1 — Section of a typical thermoplastic multi-layer hose

6 Dimensions

6.1 Inside diameters, with tolerances and minimum bend radii

When measured in accordance with ISO 4671, the values of the internal diameters of the hose shall conform to Table 2. When tested by the method specified in ISO 10619-1 the value of the minimum bend radius shall be as given in Table 2. The hose shall show no sign of permanent deformation of the cross section i.e. kinking.

Table 2 — Dimensions and minimum bend radii

Dimensions in millimetres, except where specified as "inch"

Inside diameter		Tolerance	Minimum bend radii			
mm	Inch		Type 1	Type 2	Type 3	Type 4
25	1	±1	125	125	200	200
32	1,1/4	±1	150	150	200	200
38	1,1/2	±1	150	150	200	200
40	1,1/2	±1	150	150	200	200
50	2	±1	200	200	225	225
65	2,1/2	±2	200	200	225	225
75	3	±2	280	280	300	300
80	3	±2	300	300	350	350
100	4	±2	400	400	400	400
125	5	±2	500	500	500	—
150	6	±3	575	575	575	—
200	8	±3	800	800	800	—
250	10	±3	1 000	1 000	1 000	—
300	12	±3	1 200	1 200	1 200	—

6.2 Tolerance on length

When tested in accordance with ISO 4671, the tolerance on the measured length of delivered hose assemblies shall be $^{+2}_{-1}$ %.

7 Performance requirements of hoses and hose assemblies

7.1 Cover

When tested in accordance with ISO 2411, the adhesion between the fabric used for the outer cover and its abrasion resistant coating shall be not less than 1,5 kN/m.

7.2 Hoses

When tested in accordance with the methods given in Table 3, the physical properties of the hoses shall conform to Table 3.

Table 3 — Physical properties of hoses

Property	Unit	Requirements	Method(s)
Proof pressure	MPa bar	No leakage or other signs of damage at pressure given in Table 1.	ISO 1402 with pressure increase not less than 0,17 MPa/min (1,7 bar/min)
Change in length at maximum working pressure	%	8	ISO 1402:2009, 8.2 initial length measured when the hose is pressurized to 0,07 MPa (0,7 bar) for 2 min
Twist at maximum working pressure	°/m	8	ISO 1402:2009, 8.2 initial reading taken when hose is pressurized to 0,07 MPa (0,7 bar) for 2 min
Burst pressure	MPa bar	≥ values in Table 1	ISO 1402
Bend	—	No leakage or visible damage when the hose is bent to the radius given in Table 2 and subjected to proof pressure.	ISO 10619-1
Vacuum	MPa bar	No damage after 30 min when subjected to values in Table 1.	ISO 7233:2006, method B
Crush recovery (max.)	%	3	Annex D
Fuel resistance	MPa bar	No leakage at proof pressure	Annex E
Thermal ageing	—	No leakage at proof pressure given in Table 1.	Annex F
Flammability	—	See Annex G.	Annex G
Low temperature flexibility	—	Test at minimum temperature given in Table 1	ISO 10619-2
Ozone resistance (cover only)	—	No cracks after 72 h at 40°C at ×2 magnification	ISO 7326:2006, method 3

7.3 End fittings

End fittings shall be made from materials depending on their chemical resistance to the product conveyed.

For all types of end fittings, the part of the fitting that enters the hose and forms the means by which the fitting is connected to the hose shall be provided with scrolls or protrusions on the surface that correspond to the pitch of the internal helix wire of the hose.

7.4 Hose assemblies

Hose assemblies shall be fitted with end fittings as described in 7.3.

End fittings shall be attached to the hose by one of the following methods:

a) by the use of a seal and a metal ferrule which is swaged or crimped;

b) by the use of a thermoset resin e.g. epoxy and a metal ferrule that is swaged or crimped.

When tested in accordance with the methods given in Table 4, the physical properties of hose assemblies shall conform to Table 4.

Table 4 — Physical properties of hose assemblies

Property	Unit	Requirements	Method(s)
Proof pressure	MPa bar	No leakage or other signs of weakness at pressure given in Table 1	ISO 1402 with pressure increase not less than 0,17 MPa/min (1,7 bar/min)
Bend	—	No leakage or visible damage when the hose is bent to the radius given in Table 2 and subjected to proof pressure.	ISO 10619-1
Series of hydrostatic tests	MPa bar % °/m	≥ burst pressure given in Table 1, change in length given in Table 3, twist as given in Table 3	Annex H
Security of end fitting	MPa bar	No leakage at proof pressure given in Table 1	Annex I and ISO 1402
Electrical resistance between end fittings	Ω	≤ 2,5 Ω/m for sizes less than 50 mm. ≤ 1,0 Ω/m for the 50 mm size and above sizes	ISO 8031:2009, 4.8.1 and 5.1
Burst pressure	MPa bar	≥ value given in Table 1	ISO 1402
Leak tightness	—	No leakage of air when subjected to 0,35 MPa (3,5 bar) for 5 min	Annex J

7.5 Electrical continuity

There shall be electrical continuity between both internal and external wires and the end fittings. Where a wire is sheathed in polymeric material the sheath shall be stripped back for some of the length that engages with the fittings or the ferrule to ensure continuity.

Manufacturers shall demonstrate by testing or calculation that the measured overall electrical resistance of the hose assembly incorporates both internal and external wires being part of the circuit.

For the transfer of non conductive fluids the use of a hose with a non polymeric coated internal wire should be considered.

8 Test frequency

Routine tests shall be carried out on each hose assembly and in accordance with Annex K.

It is recommended that batch tests are carried out for every 10 000 m of manufacture or once a year, varying the sizes and types and in accordance with Annex L.

9 Type tests

Type tests are those tests carried out to determine that the hose assembly design, materials and methods of manufacture confirm that the hose/assembly meets all the requirements of this International Standard.

Type tests shall be carried out on at least three sizes of hose including the smallest and the largest size of each type in the manufacturer's range.

Type tests shall be repeated and the results recorded at least once every five years or whenever a change in the materials and/or method of manufacture is made.

10 Marking

10.1 Hose marking

Each hose shall be permanently marked at an interval of not greater than 1 m with lettering of a minimum height of 10 mm and with at least the following information:

a) manufacturer's identification, e.g. XXX Ltd;

b) number and year of this International Standard, i.e. ISO 27126:2014;

c) hose identification e.g. Type 2;

d) inside diameter, e.g. 40 mm;

e) maximum working pressure in MPa and bar;

f) maximum working temperature;

g) material of hose inner liquid barrier layer as referenced in ISO 1043-1, e.g. PP (for polypropylene) or PET (for polyethylene terephthalate);

h) quarter and year of hose manufacture.

EXAMPLE XXX Ltd — ISO 27126:2014 — Type 2 — 40 — 1 MPa (10 bar) — 80 °C — PP — 2Q/14

10.2 Hose assembly marking

Each hose assembly shall be permanently marked on the ferrule at one end with all the information given in 10.1 and in addition:

a) the hose assembly serial number;

b) the last test date of the hose assembly;

c) quarter and year of hose assembly manufacture. e.g. 2Q/14.

Annex A
(informative)

Resistance to chemical(s) conveyed

It is the responsibility of the user, in consultation with the manufacturer, to ensure that the materials of the inner layers of the hoses or hose assemblies and any polymeric covering of the internal wire helix are suitable to be resistant to the chemical(s) to be conveyed.

Annex B
(normative)

Carbon steel wire

B.1 Manufacture

B.1.1 Steel rod

The rod used for the manufacture of the wire shall be produced from steel made by any process, except the air or air/oxygen bottom blown processes.

The rod quality shall be of a grade typical of standard steel making and rod rolling practice.

NOTE Standard practice can mean the following according to the type of steel.

a) *Low carbon steel (mild steel)*. This has an absence of pipe and an inclusion content commensurate with balanced or killed steels of low carbon content. The maximum surface defect depth in the rod should be generally not more than 3,5 % of the rod diameter.

b) *Carbon steel*. This has an absence of piping and an inclusion content commensurate with killed carbon steels. The maximum depth of partial decarburization and surface defects should be generally not more than 3 % of the rod diameter.

B.1.2 Steel composition

The ladle analysis of the steel shall show sulfur and phosphorus contents each not greater than 0,040 % (mass fractions).

B.1.3 Wire

The wire shall be cold drawn or rolled to the finished dimensions. The wire shall not be welded after the final sizing operation. Where appropriate for the tensile strength grade, an inter-process heat treatment shall be applied.

The wire shall have one of the following coatings:

a) zinc: in accordance with Annex C;

b) polymeric.

B.2 Condition of finished wire

The wire shall be free from rust and shall not be oiled.

The wire in coil shall be “dead cast”, i.e. when a complete turn of wire is removed from the coil without tension and placed on a smooth horizontal surface without restraint, the wire circle shall have a diameter approximately that of the coil and any corkscrew set, measured by the deviation of one cut end from the horizontal plane, shall not exceed 50 mm.

B.3 Properties

B.3.1 Tensile strength

The tensile strength of the wire shall be between 650 N/mm^2 and 850 N/mm^2.

B.3.2 Ductility wrap

The wire shall withstand without sign of fracture the wrap of eight turns on the wire diameter and unwrap of seven turns.

Annex C
(normative)

Galvanized zinc coating

C.1 Adhesion of coating

The adhesion shall be tested by wrapping the wire at least six close turns round a cylindrical mandrel using the following ratio of mandrel diameter to wire diameter:

up to and including 3,8 mm = 4 × wire diameter;

over 3,8 mm = 5 × wire diameter;

The zinc shall remain firmly adhered to the steel, and shall not crack or flake to such an extent that any flakes of zinc can be removed by rubbing with bare fingers.

C.2 Minimum mass of coating

Table C.1 — Minimum mass of coating

Diameter of coated wire, d mm	**Minimum mass of coating** g/m^2
$2{,}15 \leq d < 2{,}80$	125
$2{,}80 \leq d < 4{,}40$	135
$4{,}40 \leq d < 8{,}00$	150

Annex D
(normative)

Method of test for crush recovery

The following test shall be conducted at room temperature (23 ± 3) °C.

Place a test piece of length $l \geq 350$ mm on a rigid, flat base plate so that it is not taut.

Place a 100 mm square and 10 mm thick test plate centrally on the test piece. Measure the distance (d_1) between two plates (see Figure D.1).

Apply test force, F, (see Table D.1) to the test plate for a period of 3 min.

The hose outside diameter can be reduced ≤ 15 % at this stage.

Remove the test force, and after 5 min re-measure the distance between the two plates, (d_2).

The reduction in thickness, d_r, shall be calculated and expressed as a percentage according to the equation:

$$d_r = \frac{d_1 - d_2}{d_1} \times 100$$

where

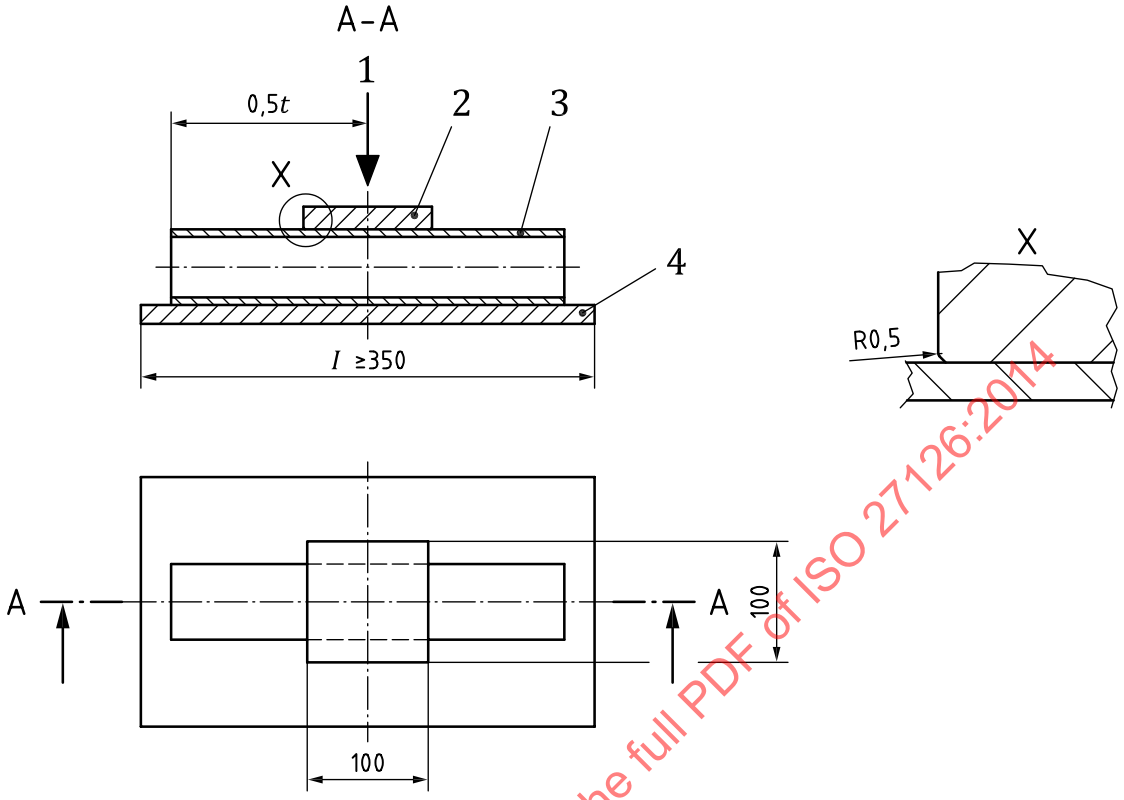
d_1 is the original thickness in millimetres (mm);

d_2 is the final thickness in millimetres (mm).

Table D.1 — Test force

Inside diameter mm	Test force, F N
≤ 50	≈ 1 500
> 50	≈ 2 000

Dimensions in millimetres



Key

1 test force, *F*
2 test plate
3 test piece
4 baseplate

Figure D.1 — Arrangement for crush recovery test

Annex E
(normative)

Method of test for fuel resistance

Fill a length of hose or a hose assembly with liquid B, as specified in ISO 1817.

Maintain the filled test piece at (40 ± 1) °C for 7 days.

Empty the test piece and allow it to drain for 30 min.

Carry out the proof pressure test in accordance with Table 4.

Annex F
(normative)

Method of test for thermal ageing

Fill a hose assembly with water or a silicone-based oil for Type 4 hose, excluding all air, and cap both ends.

Heat the test piece at the maximum working temperature appropriate to the type as given in Table 1 for 200 h.

Keeping the hose assembly at the maximum working temperature, raise the internal pressure to 1,5 times the maximum working pressure (as given in Table 1) for a period of 15 min.

Annex G
(normative)

Method of test flammability

Bend the hose test assembly into a U-shape of radius as indicated in Figure G.1.

Fill the test assembly with liquid F of ISO 1817 (flash point 55 °C, heating power 42 MJ/kg).

Expose the test assembly to a naked flame from a Bunsen burner of approximately 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 as indicated in Figure G.1.

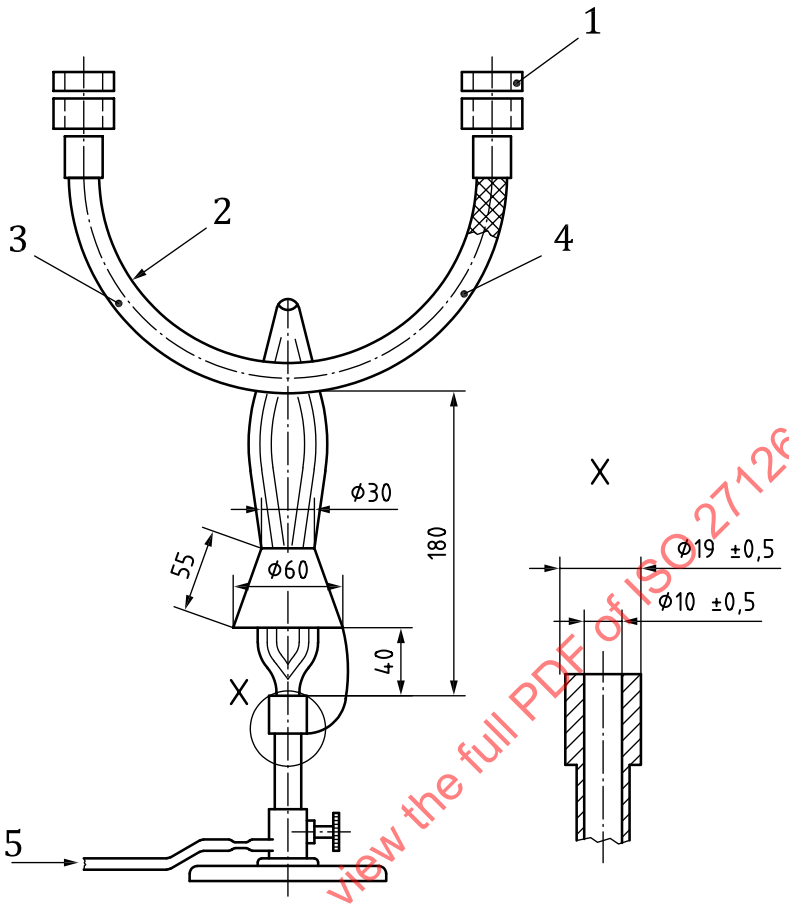
The hose test assembly shall be deemed to be non-flammable if:

a) it ceased to burn with a naked flame after 20 s of the removal of the burner, and

b) there is no further glowing visible 120 s after removing the burner flame.

On completion of the test the hose test assembly shall be proof tested with water and must not show any signs of fluid or leak when visually examined.

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) ≈ 0,005 MPa (0,005 bar)

Figure G.1 — Arrangement for flammability test

Annex H
(normative)

Sequence of hydrostatic tests

The following sequence of tests shall be carried out on a hose assembly for type testing:

a) measure the electrical resistance between end fittings in accordance with ISO 8031;

b) maintain the hose at a pressure of 0,07 MPa (0,7 bar) for the time given in ISO 1402:2009, 8.2;

c) raise the pressure at a rate of at least 0,17 MPa/min (1,7 bar/min) to the proof pressure appropriate to the type of the hose, see Table 1 and hold pressure for 5 min (according ISO 1402:2009, 8.1) and examine the assembly for leakage, cracking, abrupt distortions or other signs of failure;

d) release the pressure and wait for 5 min;

e) raise the pressure to 0,07 MPa (0,7 bar) maintain it for the time given in ISO 1402:2009, 8.2; mark and measure the hose in accordance with ISO 1402:2009, 8.2;

f) raise the pressure at a rate of at least 0,17 MPa/min (1,7 bar/min) to the maximum working pressure appropriate to the type of the hose, see Table 1;

g) re-measure the marks in e) and determine the increase/decrease in length and the twist;

h) release the pressure, bend the hose to the appropriate radius given in Table 2, and repeat c) above;

i) release the bend in the hose and increase the pressure over a period of at least 15 min to the appropriate minimum burst pressure for the type of hose and hold for a further 15 min; check the electrical resistance between fittings;

j) raise the pressure further until the hose bursts and record the pressure value.