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Rubber hoses and hose assemblies for liquefied petroleum gas (LPG) in the liquid or gaseous phase and natural gas up to 25 bar (2,5 MPa) — Specification

Tuyaux et flexibles en caoutchouc pour gaz de pétrole liquéfié (GPL) en phase liquide ou gazeuse et le gaz naturel jusqu'à 25 bar (2,5 MPa) — Spécifications

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 2928 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

This third edition cancels and replaces the second edition (ISO 2928:1986), which has been technically revised.

Rubber hoses and hose assemblies for liquefied petroleum gas (LPG) in the liquid or gaseous phase and natural gas up to 25 bar (2,5 MPa) — Specification

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard 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 health and safety practices and to ensure compliance with any national regulatory conditions.

1 Scope

This International Standard specifies requirements for rubber hoses and rubber hose assemblies used for the transfer of liquefied petroleum gas (LPG) in the liquid or gaseous phase and natural gas and designed for use at working pressures ranging from vacuum to a maximum of 25 bar (2,5 MPa) within the temperature range −30 °C to +70 °C or, for low-temperature hoses (designated -LT), within the temperature range −50 °C to +70 °C.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 188:1998, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

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

ISO 1746, *Rubber or plastics hoses and tubing — Bending tests*

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

ISO 4649:2002, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

ISO 4671:1999, *Rubber and plastics hoses and hose assemblies — Methods of measurement of dimensions*

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

ISO 7233, *Rubber and plastics hoses and hose assemblies — Determination of suction resistance*

ISO 7326:1991, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions*

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

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

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

3 Terms and definitions

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

4 Classification

Hoses shall be one of the following types:

— type D: delivery hose;

— type D-LT: delivery hose, low-temperature;

— type SD: suction and delivery hose, helix-reinforced;

— type SD-LTR: suction and delivery hose, helix-reinforced, low-temperature (rough-bore).

— type SD-LTS: suction and delivery hose, helix-reinforced, low-temperature (smooth-bore);

All these types can be:

— electrically bonded, in which case the hose is additionally designated and marked with the symbol M;

— electrically conducting by virtue of a conducting rubber layer, in which case the hose is additionally designated and marked with the symbol Ω;

— electrically discontinuous, incorporating a metallic wire connection to one end-fitting of the hose assembly only.

5 Materials and construction

The hose shall consist of the following:

— a lining of rubber resistant to *n*-pentane;

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

— an embedded helical reinforcement (types SD, SD-LTR and SD-LTS only);

— two or more low-resistance electrical-bonding wires (for hoses designated M only);

— an outer cover of rubber, resistant to abrasion and outdoor exposure, the cover being pricked to allow gas permeation;

— an internal, non-embedded helical wire, suitable for use at −50 °C (type SD-LTR only).

Assemblies shall incorporate metallic fittings attached to the hose by the assembler.

Chlorinated materials shall not be used in contact with any stainless-steel materials.

6 Dimensions

6.1 Nominal bore, internal diameter, outside diameter, minimum bend radius

For hoses without built-in couplings, and when measured in accordance with method A of ISO 4671:1999, the internal diameter and outside diameter and their tolerances shall conform to the values given in Table 1 or Table 2, depending on the type.

For hoses with built-in couplings, the outside diameters of Table 1 and Table 2 shall not apply.

When tested by the method described in ISO 1746, the value of the minimum bend radius shall conform to the values given in Table 1 or Table 2, depending on the type.

Table 1 — Dimensions of hoses of types D and D-LT

Nominal bore	Internal diameter	Tolerance	Outside diameter	Tolerance	Design minimum bend radius [a]
	mm	mm	mm	mm	mm
12	12,7	± 0,5	22,7	± 1,0	100
15	15	± 0,5	25	± 1,0	120
16	15,9	± 0,5	25,9	± 1,0	125
19	19	± 0,5	31	± 1,0	160
25	25	± 0,5	38	± 1,0	200
32	32	± 0,5	45	± 1,0	250
38	38	± 0,5	52	± 1,0	320
50	50	± 0,6	66	± 1,2	400
51	51	± 0,6	67	± 1,2	400
63	63	± 0,6	81	± 1,2	550
75	75	± 0,6	93	± 1,2	650
76	76	± 0,6	94	± 1,2	650
80	80	± 0,6	98	± 1,2	725
100	100	± 1,6	120	± 1,6	800
150	150	± 2,0	174	± 2,0	1 200
200	200	± 2,0	224	± 2,0	1 600
250	254	± 2,0	—	—	2 000
300	305	± 2,0	—	—	2 500

NOTE Nominal bores 250 and 300 apply to hoses with built-in couplings only.

[a] The design minimum bend radius is measured to the surface of the hose on the inside of the bend.

Table 2 — Dimensions of hoses of types SD and SD-LT

Nominal bore	Internal diameter	Tolerance	Outside diameter	Tolerance	Design minimum bend radius [a]
	mm	mm	mm	mm	mm
12	12,7	± 0,5	22,7	± 1,0	90
15	15	± 0,5	25	± 1,0	95
16	15,9	± 0,5	25,9	± 1,0	95
19	19	± 0,5	31	± 1,0	100
25	25	± 0,5	38	± 1,0	150
32	32	± 0,5	45	± 1,0	200
38	38	± 0,5	52	± 1,0	280
50	50	± 0,6	66	± 1,2	350
51	51	± 0,6	67	± 1,2	350
63	63	± 0,6	81	± 1,2	480
75	75	± 0,6	93	± 1,2	550
76	76	± 0,6	94	± 1,2	550
80	80	± 0,6	98	± 1,2	680
100	100	± 1,6	120	± 1,6	720
150	150	± 2,0	174	± 2,0	1 000
200	200	± 2,0	224	± 2,0	1 400
250	254	± 2,0	—	—	1 750
300	305	± 2,0	—	—	2 100

NOTE Nominal bores 250 and 300 apply to hoses with built-in couplings only.

[a] The design minimum bend radius is measured to the surface of the hose on the inside of the bend.

6.2 Minimum thickness of lining and cover

When measured in accordance with ISO 4671, the minimum thickness of both the lining and the cover of all hoses shall be 1,6 mm.

7 Physical properties

7.1 Compounds

The physical properties of the compounds used for the lining and cover shall conform to the values given in Table 3, when determined by the methods listed in Table 3.

Tests shall be carried out on samples taken either from the hose or from separately vulcanized sheets, vulcanized to the same cured state as the production hoses.

Table 3 — Physical properties of compounds

Property	Unit	Requirements		Method of test
		Lining	Cover	
Tensile strength (min.)	MPa	10	10	ISO 37 (dumb-bell test piece)
Elongation at break (min.)	%	250	250	ISO 37 (dumb-bell test piece)
Abrasion resistance (max.)	mm^3	—	170	ISO 4649:2002, method A
Ageing				ISO 188:1998 (14 days at +70 °C, air-oven method)
Hardness, change from original value (max.)	IRHD	+10	+10	ISO 48
Tensile strength, change from original value (max.)	%	± 30	± 30	ISO 37
Elongation at break, change from original value (max.)	%	−35	−35	ISO 37
Effect of liquids				
Increase in mass (max.)	%	+10	—	ISO 1817, after 7 days immersed in *n*-pentane at +23 °C
Variation in hardness (max.)	IRHD	+10/−3	—	ISO 1817, after 7 days immersed in *n*-pentane at +23 °C and drying for 70 h at +40 °C
Reduction in mass (max.)	%	−5 −10 (-LT types)	—	ISO 1817, after 7 days immersed in *n*-pentane at +23 °C and drying for 70 h at +40 °C

7.2 Finished hose

When tested by the methods listed in Table 4, the physical properties of the finished hose shall conform to the values given in Table 4.

Table 4 — Physical properties of finished hoses and hose assemblies

Property	Unit	Requirements	Method of test
Hoses			
Proof test pressure (min.)	bar	37,5 (no leakage or other signs of weakness)	ISO 1402
Change in length (max.) at proof test pressure.	%	Types D and D-LT: +5 Types SD, SD-LTR and SD-LTS: +10	ISO 1402
Change in twist (max.) at proof test pressure	°/m	8	ISO 1402
Resistance to suction (types SD, SD-LTS and SD-LTR only) at 0,8 bar for 10 min.	—	No structural damage, no collapse	ISO 7233
Burst pressure (min.)	bar	100	ISO 1402
Adhesion between components (min.)	kN/m	2,4	ISO 8033
Ozone resistance of cover at +40 °C	—	No cracking observed under ×2 magnification after 72 h	ISO 7326:1991, method 1 up to 25 nominal bore, method 3 above 25 nominal bore; relative humidity (55 ± 10) %; ozone concentration (50 ± 5) pphm; elongation 20 % (method 3 only)
Low-temperature flexibility: at −30 °C (types D and SD) at −50 °C (types D-LT, SD-LTR and SD-LTS)	—	No permanent deformation or visible structural damage, no increase in electrical resistance, no impairment of electrical continuity	ISO 4672:1997, method B
Electrical resistance	Ω	Electrical properties of hose shall be such that electrical requirements for hose assemblies are met	ISO 8031
Flammability	—	Ceases to burn immediately, or no glowing visible after 2 min	Annex A
Coefficient of deformation (max.) of external hose diameter at min. bend radius (at an internal pressure of 0,7 bar for types D and D-LT)	—	$T/D \geqslant 0{,}9$	ISO 1746
Hose assemblies			
Proof test pressure (min.)	bar	37,5 (no leakage or other signs of weakness)	ISO 1402
Change in length (max.) at proof test pressure	%	Types D and D-LT: +5 Types SD, SD-LTR and SD-LTS: +10	ISO 1402
Change in twist (max.) at proof test pressure	°/m	8	ISO 1402
Resistance to suction at 0,8 bar for 10 min (types SD, SD-LTS and SD-LTR only)	—	No structural damage, no collapse	ISO 7233
Electrical resistance	Ω/finished assembly	M-type: max. 10^2; Ω-type: max. 10^6; discontinuous type: min. $2{,}5 \times 10^4$	ISO 8031

8 Electrical resistance

The electrical resistance of hoses and hose assemblies shall be determined by any of the three methods a) to c) listed below.

a) Textile-reinforced hoses with bonding wires

Two low-resistance bonding wires shall be incorporated into the hose construction. Each of these shall run in a spiral.

When attaching fittings to such hoses, the bonding wires shall be folded into the hose bore, between the lining and the fitting tail and extending approximately 1/3 of the length of the fitting tail into the bore.

When determined in accordance with ISO 8031, the resistance along the bonding wires, in the case of hoses, or the resistance between the fittings, in the case of hose assemblies, shall not exceed $1 \times 10^2\ \Omega$ per manufactured length. When electrical continuity is demonstrated in this way, the hose shall be marked with the symbol M.

b) Textile-reinforced hoses incorporating conducting materials

An electrically conducting layer shall be incorporated in the hose construction.

When attaching end-fittings to such hoses, an adequate connection between the fittings and the conducting layer shall be ensured.

When determined in accordance with ISO 8031, the resistance along the conducting layer, in the case of hoses, or the resistance between the fittings, in the case of hose assemblies, shall not exceed $1 \times 10^6\ \Omega$ per manufactured length. When electrical continuity is demonstrated in this way, the hose shall be marked with the symbol Ω.

c) Wire-reinforced hoses

Braided or spirally wound wire shall be incorporated in the construction and shall be in direct contact with the fitting.

When determined in accordance with ISO 8031, the resistance between the fittings, in the case of hose assemblies, shall not exceed $1 \times 10^2\ \Omega$ per manufactured length. When electrical continuity is demonstrated in this way, the hose shall be marked with the symbol M.

During and after the hydrostatic tests described in ISO 1402, the electrical continuity of each hose shall be maintained from end to end and electrical continuity of each hose assembly shall be maintained from one fitting to the other.

9 Frequency of testing

The frequency of type approval and routine testing shall be as specified in Annex B.

Type approval is obtained by the manufacturer demonstrating that all requirements of this International Standard are met by a particular hose design manufactured by a particular method. The tests shall be repeated at a maximum of five-year intervals, or whenever a change in the method of manufacture or materials used occurs.

Routine tests shall be carried out on each finished length of hose or hose assembly prior to despatch.

Production acceptance tests are those tests, specified in Annex C, which should preferably be carried out by the manufacturer to verify the quality of his product. The frequencies in Annex C are given for guidance only.

10 Marking

10.1 Hoses

Each length of hose shall be legibly and durably marked on the outer cover continuously along its length, in lettering at least 5 mm high, with the following information:

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

b) the number and year of publication of this International Standard, i.e. ISO 2928:2003;

c) the type, e.g. D;

d) the nominal bore, e.g. 38;

e) the maximum working pressure, in bars[1)];

f) the symbol for the electrical conductivity, e.g. M;

g) the quarter and year of manufacture, e.g. 3Q-02.

EXAMPLE MAN - ISO 2928:2003 - Type D-38 - 10 - M-3Q-02

10.2 Hose assemblies

When the coupling is not built-in, i.e. not an integral part of the hose, it shall be marked with the assembler's name or identification and the date of assembly.

1) 1 bar = 100 kPa

Annex A
(normative)

Flammability test

WARNING — Attention is drawn to the need for ensuring that this test is carried out under suitable environmental conditions and that personnel are adequately protected against risk of fire and inhalation of smoke and/or toxic products of combustion.

A.1 Procedure

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

Fill the test piece with liquid F as specified in ISO 1817.

Expose the test piece to a naked propane (LPG) 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, and other details of the test, shall be in accordance with Figure A.1.

A.2 Assessment

The hose test piece is deemed to be non-flammable if

a) it ceases to burn immediately on removal of the burner flame;

or

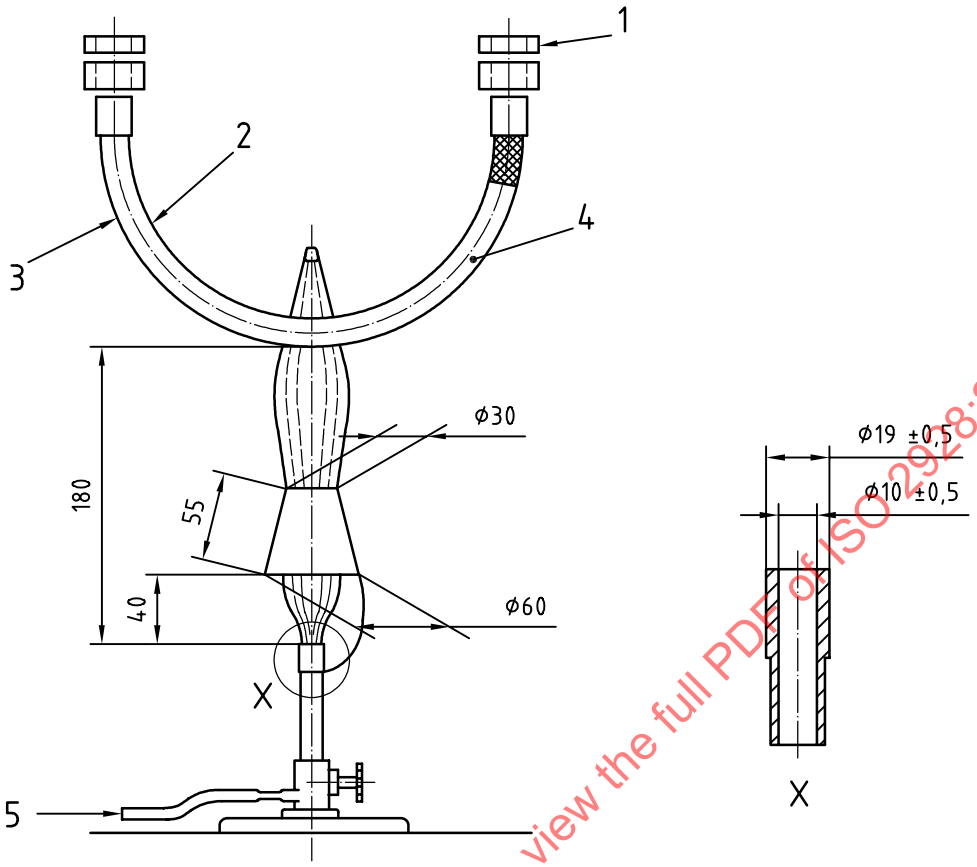
b) there is no glowing visible 2 min after removal of the burner flame.

On completion of the test, the test piece shall be impervious to fluids, when checked visually.

The result shall be applicable to the reference size and larger diameters, where the construction materials are the same for all the sizes.

NOTE The test may be carried out on a reference nominal-bore hose, preferably nominal bore 12 or 25.

Dimensions in millimetres



Key

1 cap
2 bend radius 10 to 15 times outside diameter
3 hose test piece
4 liquid F as specified in ISO 1817
5 propane (LPG) at 50 mbar

Figure A.1 — Arrangement for flammability test