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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 2,5 MPa (25 bar) — Specification

Tuyaux et flexibles en caoutchouc pour gaz de pétrole liquéfié (GPL) en phase liquide ou gazeuse et le gaz naturel jusqu'à 2,5 MPa (25 bar) — 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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

This fourth edition cancels and replaces the third edition (ISO 2928:2003), which has been technically revised.

The main changes compared to the previous edition are as follows:

— renaming of nominal size 9 into nominal size 10 and of nominal size 12 into nominal size 13 in Tables 1 and 2;

— addition of hoses with a nominal size 10 in Table 1;

— addition of non-pricked hoses in Table 3;

— expansion of the hose/hose assembly classes in Clause 4.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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

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 health and safety practices and to consider any national regulatory conditions.

1 Scope

This document 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 2,5 MPa (25 bar) 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 documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 48-2, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

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

ISO 1382, *Rubber — Vocabulary*

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

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

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

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

ISO 6179:2017, *Rubber, vulcanized or thermoplastic — Rubber sheets and rubber-coated fabrics — Determination of transmission rate of volatile liquids (gravimetric technique)*

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

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

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

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

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 10619-2:2017, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 2: Bending tests at sub-ambient temperatures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1382 and ISO 8330 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Classification

Hoses and hose assemblies 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.

5 Materials and construction of hose and hose assembly

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;

— a cover of black or coloured synthetic rubber, resistant to abrasion and outdoor exposure;

— for hoses designated M only, they shall additionally have two or more low-resistance electrical-bonding wires;

— for hoses designated Ω only, cover and/or lining shall be conducting rubber;

— the cover shall be being pricked or unpricked to allow gas permeation; if the cover is unpricked a comparative measurement of permeation between the rubber materials of cover and lining shall be carried out, see Table 3.

— for hoses types D and D-LT the materials and construction shall be as described above.

— for types SD, SD-LTR and SD-LTS only, shall additionally have an embedded helical wire reinforcement.

— for type SD-LTR only, an internal, non-embedded helical wire, suitable for −50 °C. For pricked hoses, the material shall be stainless steel.

Assemblies shall incorporate metallic fittings attached to the hose by the assembler or built in by the manufacturer. In order to produce the required electrical properties, the couplings should be attached in accordance with Clause 8.

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

6 Dimensions

6.1 Nominal size, inside diameter, outside diameter, minimum bend radius

For hoses without built-in couplings, and when measured in accordance with method A of ISO 10619-2:2017, the inside 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 10619-1, 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 size	Inside diameter mm	Tolerance mm	Outside diameter mm	Tolerance mm	Design minimum bend radius[a] mm
10	9,7	±0,5	19,5	±1,0	90
13	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 sizes 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 size	Inside diameter	Tolerance	Outside diameter	Tolerance	Design minimum bend radius [a]
	mm	mm	mm	mm	mm
10	9,7	±0,5	19,5	±1,0	80
13	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 sizes 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

The minimum thickness of both the lining and the cover of hoses shall be 1,6 mm. They shall be tested in accordance with ISO 4671.

6.3 Concentricity

The concentricity based on a total indicator reading shall be 1 mm for hoses of a nominal size 9 to 76 and 1,5 mm for hoses of nominal size 80 to 200. They shall be tested in accordance with ISO 4671.

6.4 Tolerances in length

The tolerances on the measured length of hoses and hose assemblies shall be ±1 %.

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 (maximum)	mm^3	—		ISO 4649, method A
— for black hoses			170	
— for coloured hoses			500[a]	
Ageing				ISO 188 (14 d at +70 °C, air-oven method)
Hardness, change from original value (maximum)	IRHD	+10	+10	ISO 48-2
Tensile strength, change from original value (maximum)	%	±30	±30	ISO 37
Elongation at break, change from original value (maximum)	%	−35	−35	ISO 37
Effect of liquids				
Increase in mass (maximum)	%	+10	—	ISO 1817, after 7 d immersed in *n*-pentane at +23 °C
Hardness change (maximum)	IRHD	+10/−3	—	ISO 1817, after 7 d immersed in *n*-pentane at +23 °C and drying for 70 h at +40 °C
Hardness value (maximum)	IRHD	85		
Reduction in mass (maximum)	%	−5	—	ISO 1817, after 7 d immersed in *n*-pentane at +23 °C and drying for 70 h at +40 °C
		−10 (-LT types)		
Permeation ratio between lining and cover (only for hoses which are not pricked)	—	minimum 1:15		ISO 6179:2017, Method B Test liquid: *n*-pentane
[a] Only for hoses with a nominal size of 13, 16 and 19 for LPG gas dispensers.				

7.2 Finished hose and hose assemblies

When tested by the methods listed in Table 4, the physical properties of the finished hose and hose assemblies 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.)	MPa/bar	3,75/37,5 (no leakage or other signs of weakness)	ISO 1402
Change in length (maximum) at proof test pressure.	%	Types D and D-LT: +5 Types SD, SD-LTR and SD-LTS: +10	ISO 1402
Change in twist (maximum) 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.)	MPa/bar	10/100	ISO 1402
Adhesion between components (min.)	kN/m	2,4	ISO 8033

Table 4 *(continued)*

Property	Unit	Requirements	Method of test
Hoses			
Ozone resistance of cover at +40 °C	—	No cracking observed under ×2 magnification after 72 h	ISO 7326, method 1 up to 25 nominal size, method 3 above 25 nominal size; 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 10619-2:2017
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 (maximum) of external hose diameter at min. bend radius (at an internal pressure of 0,7 bar for types D and D-LT)	— %	10	ISO 10619-1
Hose assemblies			
Proof test pressure (min.)	MPa/bar	3,75 /37,5 (no leakage or other signs of weakness)	ISO 1402
Change in length (maximum) at proof test pressure	%	Types D and D-LT: +5 Types SD, SD-LTR and SD-LTS: +10	ISO 1402
Change in twist (maximum) 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: maximum 10^2; Ω-type: maximum 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 four methods a) to d) listed below.

a) Textile-reinforced hoses with bonding wires: Two low-resistance bonding wires shall be incorporated into the hose construction. These shall by spirally applied and shall be positioned in such a way to cross uniformly.

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 1×10^2 Ω per assembled length. When electrical continuity is demonstrated in this way, the hose shall be marked with the symbol M.