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Rubber hoses and hose assemblies for bulk fuel delivery by truck — Specification

Tuyaux en caoutchouc et assemblages de tuyaux pour livraison en vrac d'hydrocarbures liquides par camions-citernes — 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 fifth edition cancels and replaces the fourth edition (ISO 2929:2014), which has been technically revised.

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

— normative references (Clause 2) updated;

— editorial changes to Clause 9 and Clause 10;

— pressure units changed to MPa (bar).

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 bulk fuel delivery by truck — 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 safety and health practices and to determine the applicability of any other restrictions.

1 Scope

This document specifies the requirements for two groups of rubber hoses and rubber hose assemblies for loading and discharge of liquid hydrocarbon fuels with a maximum working pressure of 1,0 MPa (10 bar).

Both groups of hoses are designed for

a) use with hydrocarbon fuels having an aromatic-hydrocarbon content not exceeding 50 % by volume and containing up to 15 % of oxygenated compounds, and

b) operation within the temperature range of −30 °C to +70 °C, undamaged by climatic conditions of −50 °C to +70 °C when stored in static conditions.

NOTE Hoses for use at temperatures lower than −30 °C can be the subject of discussion between manufacturer and end user.

This document is not applicable to hoses and hose assemblies for LPG systems, aviation fuel systems, fuel station systems or marine applications.

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

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

ISO 1817:2015, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 4649:2017, *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 7233, *Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum*

ISO 7326:2016, *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, *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 8330 apply.

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

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

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

4 Classification

Hoses are designated as belonging to one of the following groups.

a) Group D: delivery hose, or, with certain restrictions, for use in low-vacuum applications (see footnote to Table 3).

b) Group SD: suction and delivery hose, helix-reinforced.

Both of these groups can be

— electrically bonded, in which case the hose is designated and marked M-grade, or

— electrically conductive, using a conductive rubber layer, in which case the hose is designated and marked Ω-grade.

5 Materials and construction

If the hose is mandrel-built, 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 consist of the following:

a) a lining of rubber resistant to hydrocarbon fuels;

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

c) an embedded helix reinforcement (group SD only);

d) two or more low-resistance electrical bonding wires (M-grade only);

e) an outer cover of rubber, resistant to abrasion, outdoor exposure and hydrocarbon fuels.

6 Dimensions

6.1 Nominal bore, internal diameter, outside diameter and their tolerances, service reeling diameter and minimum bend radius

When measured in accordance with ISO 4671, the internal diameter and outside diameter and their tolerances shall conform to the values specified in Table 1.

When determined in accordance with ISO 10619-1, the value of the minimum bend radius shall conform to the values specified in Table 1.

Table 1 — Dimensions

Nominal bore	Internal diameter mm	Tolerance on internal diameter mm	Outside diameter mm	Tolerance on outside diameter mm	Minimum bend radius mm		Minimum external diameter of reeling drum used in service mm	
					Group D	Group SD	Group D	Group SD
19	19,0	±0,5	31,0	±1,0	125	100	250	250
25	25,0		37,0		150	125	300	300
32	32,0		44,0		200	150	400	350
38	38,0		51,0		250	175	500	400
50	50,0	±0,7	66,0	±1,2	300	225	600	500
51	51,0		67,0		300	225	600	500
63	63,0	±0,8	79,0		400	275	800	600
75	75,0		91,0		450	350	900	750
76	76,0		92,0		450	350	900	750
100	100,0		116,0	±1,6	600	450	N.A.	N.A.
101	101,5		118,0		600	450	N.A.	N.A.
150	150,0	±1,6	170,0	±2,0	900	750	N.A.	N.A.
N.A. = not applicable.								

6.2 Concentricity

When determined in accordance with ISO 4671, the concentricity, based on a total indicator reading between the internal diameter and the outside surface of the cover, shall be no greater than 1,0 mm for hoses of nominal bore up to and including 76, and no greater than 1,5 mm for hoses of nominal bore greater than 76.

6.3 Tolerance on length

When measured in accordance with ISO 4671, the length of a hose or hose assembly shall be within ± 1 % of the required length.

6.4 Minimum thickness of lining and cover

When measured in accordance with ISO 4671, the minimum thickness of the lining of all hoses shall be 1,5 mm.

For hoses of nominal bore up to and including 50, the minimum thickness of the cover shall be 1,5 mm.

For hoses of nominal bore greater than 50, the minimum thickness of the cover shall be 2,0 mm.

7 Physical properties

7.1 Rubber compounds

When determined by the methods listed in Table 2, the physical properties of the compounds used for the lining and cover shall conform to the values specified in Table 2.

Tests shall be carried out either on samples taken from the hose or from separately vulcanized sheets, 2 mm in thickness and vulcanized to the same cured state as the production hoses.

Table 2 — Physical properties of rubber compound

Property	Requirement		Test method
	Lining	Cover	
Minimum tensile strength	7,0 MPa	7,0 MPa	ISO 37 (dumb-bell test piece)
Minimum elongation at break	250 %	250 %	ISO 37 (dumb-bell test piece)
Change in volume in fuel	50 %	—	ISO 1817:2015, Clause 7 (72 h at 40 °C in liquid 3)
	—	100 %	ISO 1817:2015, Clause 7 (48 h at 40 °C in liquid B)
Maximum abrasion resistance (relative volume loss ΔV)	—	180 mm^3	ISO 4649:2017, Method A
Resistance to ageing:			ISO 188 (7 days at 70 °C, air-oven method)
Change in tensile strength from original value	±30 %	±30 %	
Change in elongation at break from original value	±30 %	±30 %	

7.2 Finished hoses and hose assemblies

When determined by the methods listed in Table 3, the physical properties of finished hoses and hose assemblies shall conform to the values specified in Table 3.

Table 3 — Physical properties of finished hoses and hose assemblies

Property	Requirements	Test method
Hose tests		
Proof pressure	1,5 MPa (15 bar) and no leakage or other signs of weakness	ISO 1402
Change in length (max.):		ISO 1402
at proof test pressure	Group D: 0 % to +8 %	
	Group SD: 0 % to +10 %	
at −0,8 bar (vacuum)	Group SD: −2 %	
Change in twist at proof test pressure (max.)	8°/m	ISO 1402
Resistance to vacuum (group SD only) at −0,8 bar for 10 min (see footnote)	No structural damage	ISO 7233
Burst pressure (min.)	4,0 MPa (40 bar)	ISO 1402
Adhesion between components:		
dry (min.)	2,4 N/mm	Annex A (Clause A.1)
after contact with fuel (min.)	1,8 N/mm	Annex A (Clause A.2)

Table 3 *(continued)*

Property	Requirements	Test method
Ozone resistance at 40 °C	No cracking observed under × 2 magnification	ISO 7326:2016, method 3 [relative humidity (55 ± 10) %, ozone concentration (50 ± 5) pphm, elongation 20 %]
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 requirements	
at 20 °C		Annex B
at −30 °C		ISO 10619-2
Electrical resistance (max.)	M-grade: 10^2 Ω/length	ISO 8031
	Ω-grade: 10^6 Ω/length	
Deformation of hose external diameter under bending at minimum bend radius and internal pressure of 0,7 bar (group D only) (max.)	10 %	ISO 10619-1
Flammability test	No burning on removal of the burner flame, no visible glowing and no leakage of fluid	Annex C
Hose assembly tests		
Proof pressure	1,5 MPa (15 bar) and no leakage or other signs of weakness	ISO 1402
Burst pressure (min.)	4,0 MPa (40 bar)	ISO 1402
Electrical resistance (max.)	M-grade: 10^2 Ω/assembly	ISO 8031
	Ω-grade: 10^6 Ω/assembly	
Security of coupling attachment	No leakage and no movement of the coupling out of the hose	Annex D
NOTE Smaller sizes of group D hose, i.e. of nominal bore 51 and below, can be used for vacuum applications down to −0,3 bar.		

8 Electrical resistance

8.1 General

Adequate electrical resistance of hoses and hose assemblies shall be obtained in accordance with 8.2 or 8.3.

During and after the hydrostatic tests as 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 coupling to the other.

8.2 M-grade

Two low-resistance bonding wires, applied spirally, shall be incorporated into the hose construction.

When attaching fittings to group D hoses, the bonding wires shall be folded into the hose bore, positioned between the lining and the fitting tail and extended by approximately one-third of the length of the fitting tail into the bore.

When attaching fittings to group SD hoses, electrical bonding shall be achieved by using bonding wires as for group D or by using the helix with or without bonding wires attached.

When determined in accordance with ISO 8031, the resistance along the bonding wires in the case of hoses, or the resistance between fittings in the case of hose assemblies, shall not exceed 1×10^2 Ω per length or assembly. When obtaining electrical continuity by this method, the hose shall be marked with the symbol "M".

8.3 Ω-grade

In this type of construction, electrically conducting materials shall be incorporated into the hose lining.

When attaching fittings to this type of hose, an adequate connection between the end-fittings and the conductive layer shall be obtained.

When determined in accordance with ISO 8031, the resistance along the conductive lining in the case of hoses, or the resistance between the fittings in the case of hose assemblies, shall not exceed 1×10^6 Ω per length or assembly. When obtaining electrical resistance by this method, the hose shall be marked with the symbol "Ω".

9 Frequency of testing

Type testing is carried out in order to confirm that all the materials, construction and test requirements of this document are met by the method of manufacture and hose design. Type tests shall be repeated at least every 5 years or whenever a change in method of manufacture or materials occurs.

Routine tests are those tests that shall be carried out on all hoses and hose assemblies prior to dispatch. Production acceptance tests are those tests which should preferably be carried out by the manufacturer to control the quality of its products.

Type tests and routine tests are specified in Annex E.

Production acceptance tests are given in Annex F. The frequencies specified in Annex F are given as a guide only.

10 Marking

10.1 Hoses

Each length of hose shall be legibly and durably marked on the outer cover, at intervals of no greater than 2 m, with the following information:

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

b) the reference number of this document, i.e. ISO 2929;

c) the group, e.g. D;

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

e) the maximum working pressure in MPa and in bars, or in either, with the units indicated, e.g. 1 MPa (10 bar);

f) the conductivity grade, e.g. M;

g) the quarter and last two digits of year of manufacture, e.g. 3Q21.

EXAMPLE XXX/ISO 2929/group D/38/1 MPa (10 bar)/M/3Q21

For item b), the hose manufacturer shall use the latest edition of this document; otherwise, the year of publication shall be included in the marking.

10.2 Hose assemblies

The couplings shall be permanently marked with the following information:

a) the manufacturer's or assembler's name or identification mark;

b) the date of assembly.

Annex A
(normative)

Method of test for strength of adhesion between components

A.1 Dry adhesion

Subject the hose to the adhesion test described in ISO 8033 (for group SD hoses, cut out test pieces parallel to the reinforcing helix) and determine the value, in kN/m, of the strength of adhesion:

a) between lining and reinforcement;

b) between reinforcement and cover;

c) between reinforcement layers.

A.2 Adhesion after contact with fuel

Cut a length measuring approximately 300 mm from the hose to be tested and seal one end.

Fill this test piece with liquid 3 as specified in ISO 1817:2015 and lightly cap the top.

Condition the test piece at (20 ± 5) °C for (168 ± 2) h.

Determine the strength of adhesion between the components as in Clause A.1.

Annex B
(normative)

Method of test for flexibility at 20 °C

Coil an empty hose at (20 ± 5) °C around a test drum having an external diameter as specified in Table B.1.

Uncoil the hose and check for visible structural damage and permanent deformation.

Check that the electrical continuity is intact.

Table B.1 — External diameter of drum for flexibility test

Internal diameter of hose mm	External diameter of test drum mm
19	180
25	230
32	280
38	360
50/51	430
63	460
75/76	460
100/101,5	690

Annex C
(normative)

Method of test for flammability

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.

C.1 Procedure

NOTE This test can be carried out using a reference hose of defined nominal bore, preferably 25. The result thereby obtained can then be applied to hoses of this size and larger, provided the construction materials are the same for all of the sizes.

Bend a hose assembly into a U-shape of radius 10 times to 15 times the outside diameter, as shown in Figure C.1.

Fill the hose assembly with liquid F as specified in ISO 1817:2015.

Expose the hose assembly to a naked flame from a Bunsen burner having a barrel of inside diameter 10 mm for a period of 3 min, with the airflow to the burner shut off. The distance between the burner and the hose assembly shall be as indicated in Figure C.1.

C.2 Assessment

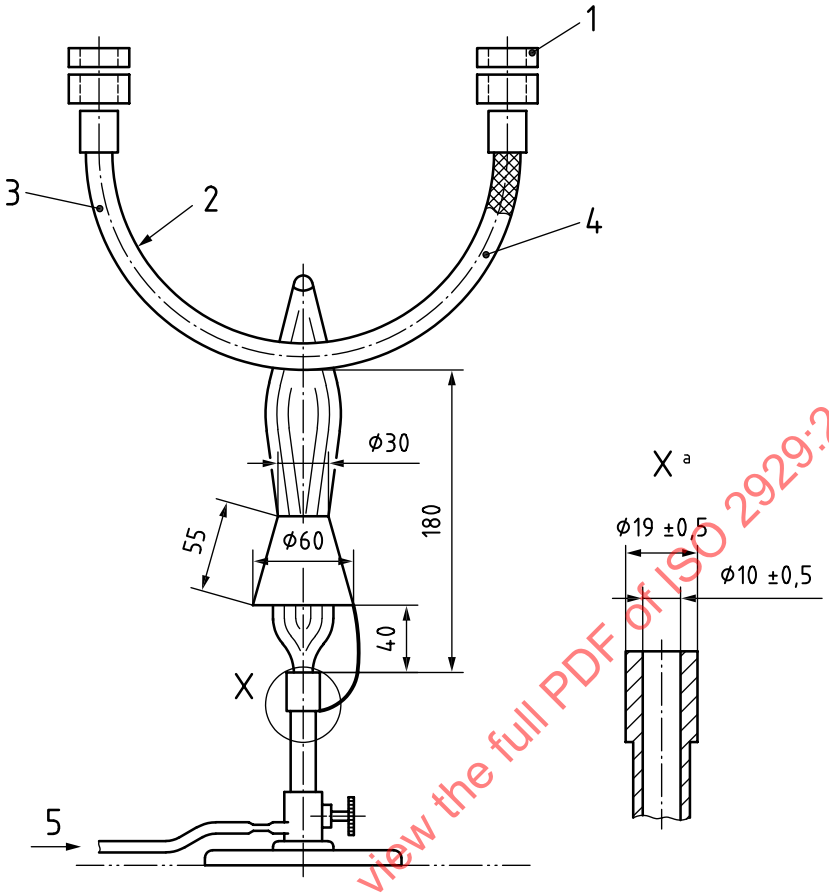
Examine the hose assembly with regard to:

a) whether it ceases to show flames on removal of the burner flame;

b) whether any glowing is visible 2 min after removal of the burner flame;

c) whether there are any visible signs of leakage on completion of the procedure (i.e. after the additional 2 min to check for glowing).

Dimensions in millimetres



Key

1 cap
2 bend radius is 10 times to 15 times the outside diameter
3 hose assembly
4 liquid F as specified in ISO 1817:2015
5 propane (LPG) at pressure ≈ 0,005 MPa (0,05 bar)
[a] Cross-section of detail.

Figure C.1 — Arrangement for flammability test

Annex D
(normative)

Test method for security of coupling attachment

D.1 Test piece

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

D.2 Procedure

Use water as the test medium. Raise the test pressure to 1,5 MPa (15 bar) and hold for 2 min.

Reduce the applied pressure to 0,07 MPa (0,7 bar). Increase the pressure to 1,0 MPa (10 bar), hold for 2 min and examine for leakage. Reduce the applied pressure to 0,7 bar.

Increase the pressure to 1,5 MPa (15 bar) hold for 2 min and examine for leakage. Reduce the applied pressure to 0,07 MPa (0,7 bar).

D.3 Assessment

Examine the hose assembly with regard to:

a) whether there were any visible signs of leakage during or on completion of the procedure;

b) whether any movement of the coupling out of the hose has occurred.