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Rubber hoses and hose assemblies for water suction and discharge — Specification

Tuyaux et flexibles en caoutchouc pour aspiration et refoulement d'eau — Spécifications

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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Foreword

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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).

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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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is 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 4641:2010), of which it constitutes a minor revision with the following changes:

— Clause 2 has been updated, where ISO 1746 and ISO 4672 have been deleted and replaced by ISO 10619-1 and ISO 10619-2, respectively;

— tolerance dimension "in mm" has been added to 7.1;

— the text of 8.2.3, 8.2.5, 10.1 and 10.2 has been slightly modified to bring the references up to date;

— Table 4 has been slightly modified to bring the references up to date;

— Bibliography has been updated as ISO 10619-1 and ISO 10619-2 are now published and listed in Clause 2.

— the text has been editorially revised to comply with the most recent editing rules.

Rubber hoses and hose assemblies for water suction and discharge — Specification

1 Scope

This document specifies the minimum requirements for textile-reinforced, smooth-bore rubber water-suction and discharge hoses and hose assemblies.

Three types of hoses and hose assemblies are specified according to their operating duty requirements, i.e. their ambient and water temperature ranges:

— ambient temperatures: –25 °C to +70 °C;

— water temperatures during operation: 0 °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 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 1307:2006, *Rubber and plastics hoses — Hose sizes, minimum and maximum inside diameters, and tolerances on cut-to-length hoses*

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

ISO 2393, *Rubber test mixes — Preparation, mixing and vulcanization — Equipment and procedures*

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

ISO 7233:2016, *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 8033, *Rubber and plastics hoses — Determination of adhesion between components*

ISO 8331, *Rubber and plastics hoses and hose assemblies — Guidelines for selection, storage, use and maintenance*

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

ISO 10619-2:2011, *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 terminological databases for use in standardization at the following addresses:

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

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

4 Classification

Hoses and hose assemblies for this application are classified into three types according to their operating duty requirements.

— Type 1: Light-duty hoses for suction service to −0,063 MPa (−0,63 bar) and for discharge pressures up to 0,3 MPa (3 bar).

— Type 2: Medium-duty hoses for suction service to −0,08 MPa (−0,8 bar) and for discharge pressures up to 0,5 MPa (5 bar).

— Type 3: Heavy-duty hoses for suction service to −0,097 MPa (−0,97 bar) and for discharge pressures up to 1,0 MPa (10 bar).

5 Coupling and fittings

Hoses shall be fitted with end fittings/couplings to form hose assemblies. Annex C lists types of coupling and end fitting.

6 Materials and construction

6.1 Lining

The lining shall consist of suitably compounded water-resistant natural or synthetic rubber. Its internal surface shall be smooth and free from imperfections which could impair the expected use.

6.2 Reinforcement

The reinforcement shall consist of a suitable textile material and may contain a helix that can be metallic wire or of another suitable material.

6.3 Cover

The cover shall consist of suitably compounded natural or synthetic rubber. Its external surface may be corrugated or fluted. An external helix is optional and can be either metallic wire or of another suitable material.

7 Dimensions and tolerances

7.1 Bore (inside diameter)

The nominal size range is 16 to 315 with bore diameters and tolerances in mm as shown in Table 3.

7.2 Enlarged ends

Where enlarged ends are required, the dimensions and tolerances shall be specified by agreement between the purchaser and the manufacturer. The design of the enlarged end shall take into account the hose performance requirements.

7.3 Unit lengths

The unit lengths shall be determined according to the conditions of use as specified by the purchaser. The tolerances, unless otherwise agreed between the purchaser and the manufacturer, shall be those specified in ISO 1307:2006, Table 2.

7.4 Lining

When measured in accordance with ISO 4671, the minimum thickness of the lining shall be 1,5 mm. See Table 4.

7.5 Cover

When measured in accordance with ISO 4671, the minimum thickness of the cover shall be 2 mm. If the cover is fluted, the depth of the flutes shall be not greater than 50 % of the cover thickness. See Table 4.

8 Physical properties

8.1 Rubber compounds

8.1.1 Rubber compounds

Wherever possible, all tests shall be carried out on test pieces cut from the finished hose. Otherwise, take samples from test sheets prepared in accordance with ISO 2393 and vulcanized to the same degree as the hose.

The physical properties of the rubber compounds used for the lining and cover shall conform to the values given in Table 1.

8.1.2 Tensile strength and elongation at break of rubber lining and cover

When tested in accordance with ISO 37, the lining and cover shall have a tensile strength and elongation at break of not less than the values given in Table 1.

8.1.3 Resistance to aging

After ageing as specified in ISO 188 for three days at a temperature of 100 °C ± 1 °C, the tensile strength and elongation at break of the lining and cover, as determined by ISO 37, shall not vary by more than ±25 % and ±50 %, respectively, from the initial values.

Table 1 — Physical properties of rubber compounds

Property	Unit	Requirements		Method of test
		Lining	Cover	
Tensile strength, min.	MPa	7	7	ISO 37 (dumb-bell test piece)
Elongation at break, min.	%	200	200	ISO 37 (dumb-bell test piece)
Resistance to ageing				ISO 188 (3 days at 100 °C ± 1 °C); ISO 37 (dumb-bell test piece)
Change in tensile strength from original value (max.)	%	±25	±25	
Change in elongation at break from original value (max.)	%	±50	±50	

8.2 Performance requirements for hoses and hose assemblies

8.2.1 Hydrostatic-pressure requirements (proof pressure test)

The proof pressure test shall be carried out on full lengths of finished hose and on hose assemblies. When tested in accordance with ISO 1402, the hose (and the hose assembly) shall meet the requirements of Table 2. The maximum variation in length and outside diameter at maximum working pressure shall be ±7 %, and the hose/hose assembly shall not burst or fail by showing signs of leakage, cracking, abrupt distortion indicating irregularities in material or manufacture or other signs of failure. See Table 4.

Table 2 — Hydrostatic-pressure requirements

Hose type	Maximum working pressure		Proof pressure		Minimum burst pressure	
	MPa	bar	MPa	bar	MPa	bar
1	0,3	3	0,5	5	1,0	10
2	0,5	5	0,8	8	1,6	16
3	1,0	10	1,5	15	3,0	30

8.2.2 Burst test

When tested by the method specified in ISO 1402, hoses shall meet the requirements of Table 2.

8.2.3 Resistance to bending (minimum bend radius as a function of nominal size)

When subjected to the minimum bend radii given in Table 3, in accordance with one of the methods specified in ISO 10619-1 (the method chosen to be the most appropriate one for the size of hose), hoses shall show no kinking, breaking or peeling under visual examination. The value of T/D shall not be lower than 0,95.

Table 3 — Nominal sizes, tolerances and minimum bend radii

Nominal size	Inside diameter mm		Minimum bend radius mm
	min.	max.	
16	15,4	16,6	50
20	19,4	20,6	60
25	24,2	25,8	75
31,5	30,5	32,5	95
40	39,0	41,0	120
50	48,8	51,2	150
63	61,8	64,2	250
80	78,6	81,4	320
100	98,4	101,6	500
125	123,4	126,6	750
150	148,0	152,0	960
160	158,0	162,0	980
200	197,5	202,5	1 200
250	247,0	253,0	1 500
315	312,0	318,0	1 900

8.2.4 Resistance to suction flattening

The test shall be carried out in accordance with ISO 7233. The test conditions shall be as follows:

— −0,063 MPa (−0,63 bar) for type 1;

— −0,08 MPa (−0,80 bar) for type 2;

— −0,097 MPa (−0,97 bar) for type 3.

Duration of test: 10 min.

For hoses of nominal inside diameter greater than 80 mm (ISO 7233:2016, Method C), the measured collapse shall not exceed 5 % of the nominal inside diameter.

8.2.5 Low-temperature flexibility

When tested at −25 °C by ISO 10619-2:2011, Method B, all types of hose shall be free of cracks and shall pass the proof pressure test as specified in 8.2.1.

8.2.6 Adhesion

When determined in accordance with ISO 8033, the adhesion between the various components (except the helix, when included in the construction of the hose wall) shall be not less than 2 kN/m. See Table 4.

8.2.7 Ozone resistance of the cover

When tested in accordance with ISO 7326:2016, Method 2, all types of hose shall be free of cracks. See Table 4.

Table 4 — Physical properties of finished hoses and hose assemblies

Property	Unit	Requirement	Method of test
Hose dimensions			
Inside diameter	mm	See Table 3	ISO 4671
Cover thickness	mm	Min. 2	ISO 4671
Lining thickness	mm	Min. 1,5	ISO 4671
Length tolerance	%	See ISO 1307:2006, Table 2	ISO 4671
Hose/hose assembly tests			
Proof pressure	MPa (bar)	See 8.2.1 and Table 2	ISO 1402
Variation in length at max. working pressure	%	Max. ±7	ISO 1402
Variation in outside diameter at max. working pressure	%	Max. ±7	ISO 4671
Burst pressure (min.)	MPa (bar)	See 8.2.2 and Table 2	ISO 1402
Vacuum test	MPa (bar)	See 8.2.4	ISO 7233
Resistance to bending	—	See 8.2.3 and Table 3	ISO 10619-1
Low-temperature flexibility	—	See 8.2.5	ISO 10619-2:2011, Method B
Adhesion between components	kN/m	Min. 2	ISO 8033
Ozone resistance (cover)	—	No cracking observed at 0 magnification	ISO 7326:2016, Method 2

9 Frequency of testing

Type and routine testing shall be as specified in Annex A.

Type testing is carried out in order to confirm that all the material, construction and test requirements specified in this document have been met by the method of manufacture and the hose design. Type testing shall be repeated at intervals of, at the most, five years or whenever a change in the method of manufacture or the materials occurs and shall be performed on the largest-diameter hose of each design in the manufacturer's range for each type.

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

Production tests are those tests carried out per batch (see the schedule given in Annex B, which is for guidance only).

10 Marking

10.1 Hoses

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

a) the manufacturer's name or trade mark;

b) the manufacturer's product identification;

c) the number and year of publication of this document, i.e. ISO 4641:2016;

d) the hose classification, i.e. the type;

e) the nominal size;

f) the maximum working pressure [in megapascals and in bars, with the units indicated, e.g. 1 MPa (10 bar)];

g) the quarter and year of manufacture.

EXAMPLE MAN/XXX/ISO 4641:2016/Type 3/size 250/1 MPa (10 bar)/4Q2016

10.2 Hose assemblies

The couplings/end fittings shall be permanently marked with the following minimum information:

a) the name or identification of the producer/assembler of the hose assembly;

b) the maximum working pressure of the assembly [in megapascals and in bars, with the units indicated, e.g. 1 MPa (10 bar)];

c) two digits indicating the month of assembly followed by a slash and the last two digits of the year of assembly (e.g. 12/16);

d) the name or logo of the coupling manufacturer;

e) (optional) identification of the coupling/end fitting material (if required by the purchaser).

EXAMPLE MAN/1 MPa (10 bar)/12/16 + coupling manufacturer's logo and identification of material

11 Test report/certificate

When requested by the purchaser, the manufacturer or supplier shall provide a test report or test certificate with each length of hose or batch of hoses supplied to the purchaser.

12 Packaging and storage

Packaging and storage shall be in accordance with ISO 8331.

Annex A
(normative)

Type tests and routine tests

Table A.1 gives the tests to be carried out for type and routine testing as defined in Clause 9.

Table A.1

Property	Type testing	Routine testing
Compound tests		
Tensile strength and elongation at break	X	N.A.
Resistance to ageing	X	N.A.
Hose tests		
Adhesion	X	N.A.
Ozone resistance (cover)	X	N.A.
Resistance to bending	X	N.A.
Low-temperature flexibility	X	N.A.
Inside diameter	X	X
Thickness of lining	X	N.A.
Thickness of cover	X	N.A.
Resistance to suction	X	X
Resistance to proof pressure	X	X
Variation in length at max. working pressure	X	X
Variation in O.D. at max. working pressure	X	X
Burst strength	X	N.A.
Hose assembly tests		
Length of assembly	X	X
Resistance to suction	X	X
Resistance to proof pressure	X	X
Variation in length at max. working pressure	X	X
Variation in O.D. at max. working pressure	X	X
Burst strength	X	N.A.
X Test shall be carried out. N.A. Test not applicable.		

Annex B
(informative)

Production tests

Table B.1 gives the suggested frequency of production tests (see Clause 9), to be carried out per batch or every 10 batches as indicated in the table.

A batch is defined as either 500 m of hose or 10 000 kg of lining and/or cover compound.

Table B.1 — Recommended test frequency

Property	Production testing	
	Per batch	Every 10 batches
Compound tests		
Tensile strength and elongation at break	X	N.A.
Resistance to ageing	N.A.	X
Hose tests		
Adhesion	X	N.A.
Ozone resistance (cover)	N.A.	X
Resistance to bending	X	X
Low-temperature flexibility	N.A.	X
Inside diameter	X	N.A.
Thickness of lining	X[a]	N.A.
Thickness of cover	X[a]	N.A.
Length of hose	N.A.	N.A.
Resistance to suction	X	X
Resistance to proof pressure	X	X
Variation in length at max. working pressure	X	X
Variation in O.D. at max. working pressure	X	X
Burst strength	N.A.	N.A.

X Test carried out.

N.A. Test not applicable.

[a] One check per hose production batch.

Annex C
(informative)

Couplings and end fittings

Hoses may be fitted with the following coupling types to form hose assemblies:

— built-in (special cases only);

— clamped;

— swaged or crimped;

— banded.

The end fitting may be of the following connection type:

— quick-release/quick-acting;

— screw thread;

— flanged;

— union;

— special type (camlock, Storz, claw type, etc.).

Guidance on coupling types is given in ISO/TR 17784.

Bibliography

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

[2] ISO 10619-3, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 3: Bending tests at high and low temperatures*

[3] ISO/TR 17784, *Rubber and plastics hoses and hose assemblies — Guide for use by purchasers, assemblers, installers and operating personnel*

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