
**Rubber hoses, textile-reinforced, for
compressed air — Specification**

*Tuyaux en caoutchouc renforcés textile pour l'air comprimé —
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 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 sixth edition cancels and replaces the fifth edition (ISO 2398:2006), which has been technically revised with the following main changes.

- [Clause 2](#) has been updated: ISO 1746 and ISO 4672 have been deleted and replaced by ISO 10619-1 and ISO 10619-2. ISO 7326:1991 has been replaced by ISO 7326:2006.
- New clauses ([Clause 8](#), [Clause 9](#) and [Clause 10](#)) describing frequency of testing, routine tests, type tests and production acceptance tests have been added.
- Clause 8 has been renumbered as [Clause 11](#); a), b), f) and the example have been amended.
- [Annex A](#) and [Annex B](#) have been introduced in accordance with ISO/TC 45/SC 1 Guide 976 — Rev 7:2013.
- [Clause 10](#), describing a test report or certificate supplied on request of the purchaser, has been added.

Rubber hoses, textile-reinforced, for compressed air — 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 ensure compliance with any national regulatory conditions.

1 Scope

This document specifies the requirements for three types, three classes and two categories of textile-reinforced rubber hose for compressed air, up to a maximum working pressure of 25 bar with an operating-temperature range of $-40\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$, depending on the type and category.

NOTE 1 bar = 0,1 MPa.

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

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

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

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

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 are designated as one of the following types, depending on their pressure rating.

Type 1: Low pressure — designed for a maximum working pressure of 1 MPa (10 bar)

Type 2: Medium pressure — designed for a maximum working pressure of 1,6 MPa (16 bar)

Type 3: High pressure — designed for a maximum working pressure of 2,5 MPa (25 bar)

These types can be subdivided into three classes depending on their oil resistance.

Class A: Non-oil-resistant

Class B: Normal oil resistance

Class C: Good oil resistance

The types and classes above can also be further subdivided into two categories, depending on their operating-temperature range.

Category N-T (normal temperature): -25 °C to +70 °C

Category L-T (low temperature): -40 °C to +70 °C

5 Materials and construction

The hose shall consist of

- a rubber lining,
- a reinforcement of natural or synthetic textile, applied by any suitable technique, and
- a rubber cover.

The lining and cover shall be of uniform thickness, concentric to comply with the minimum thickness specified, and free from holes, porosity and other defects. The cover finish may be smooth or fabric-marked.

6 Dimensions

6.1 Inside diameters and tolerances

When measured in accordance with ISO 4671, the inside diameters and their tolerances shall conform to the values specified in [Table 1](#).

Table 1 — Minimum and maximum inside diameters

Hose size	Minimum internal diameter mm	Maximum internal diameter mm
4	3,25	4,75
5	4,25	5,75
6,3	5,55	7,05
8	7,25	8,75
10	9,25	10,75
12,5	11,75	13,25
16	15,25	16,75
19	18,25	19,75
20	19,25	20,75
25	23,75	26,25
31,5	30,25	32,75
38	36,50	39,50
40	38,50	41,50
51	49,50	52,50
63	61,50	64,50
76	74,50	77,50
80	78,00	82,00
100	98,00	102,00
102	100,00	104,00

6.2 Concentricity

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

6.3 Tolerance on length

The tolerance on cut lengths shall be as specified in ISO 1307, the length being measured in accordance with ISO 4671.

6.4 Minimum thickness of lining and cover

When measured in accordance with ISO 4671, the minimum thickness of the lining and cover shall be as follows.

- Type 1:** lining 1,0 mm
cover 1,5 mm
- Type 2:** lining 1,5 mm
cover 2,0 mm
- Type 3:** lining 2,0 mm
cover 2,5 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 cure state as the production hoses.

Table 2 — Physical properties of rubber compounds

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)
Resistance to ageing			
Change in tensile strength from original value (max.)	±25 %	±25 %	ISO 188 (3 days at 100 °C ± 1 °C), air oven method ISO 37 (dumb-bell test piece)
Change in elongation at break from original value (max.)	±50 %	±50 %	
Resistance to liquids			
Increase in volume (class A)	N/A	N/A	—
Increase in volume (max.) (class B only)	115 % No shrinkage allowed	N/A	ISO 1817:2015 (72 h at 70 °C ± 2 °C in oil No. 3), gravimetric method
Increase in volume (max.) (class C only)	30 % No shrinkage allowed	75 % No shrinkage allowed	ISO 1817:2015 (72 h at 70 °C ± 2 °C in oil No. 3), gravimetric method

7.2 Finished hose

When determined by the methods listed in [Table 3](#), the physical properties of the finished hose shall conform to the values specified in [Table 3](#).

Table 3 — Physical properties of finished hose

Property	Requirement			Test method
		MPa	bar	
Proof pressure				ISO 1402
	type 1	2	20	
	type 2	3,2	32	
	type 3	5	50	
Change in length at maximum working pressure	±5 %			ISO 1402
Change in diameter at maximum working pressure	±5 %			ISO 1402
Minimum burst pressure		MPa	bar	ISO 1402
	type 1	4	40	
	type 2	6,4	64	
	type 3	10	100	
Adhesion between components	2,0 kN/m (min.)			ISO 8033

Table 3 (continued)

Property	Requirement	Test method
Ozone resistance	No cracking observed under × 2 magnification	ISO 7326:2006 — method 1 (up to 25 mm id) — method 2 or 3 for other sizes
Flexibility at 23 °C	<i>T/D</i> not less than 0,8	ISO 10619-1
Low-temperature flexibility	No cracks and shall pass the proof pressure test specified above	ISO 10619-2:2011 Category N-T at -25 °C ± 2 °C Category L-T at -40 °C ± 2 °C

8 Frequency of testing

The minimum frequency of testing (routine tests and type tests) shall conform to the schedule given in [Annex A](#). The recommended frequency of production acceptance testing, carried out per batch, is given in [Annex B](#) and is for guidance only.

Routine tests are those tests carried out on each length of finished hose to verify that the hose design, materials and method of manufacture meet all the requirements of this document. Production acceptance tests are those tests, carried out per batch or per 10 batches, by the manufacturer to monitor the quality of his production.

9 Type testing

Type tests are carried out by the manufacturer to confirm that all the materials, construction and test requirements of this document have been met by the method of manufacture and design. Type testing shall be repeated at a maximum of five years or whenever a change in the method of manufacture or materials occurs. Type testing shall be performed for all sizes and types except those of the same size and construction.

10 Test report or certificate

Upon the purchaser's request, the manufacturer shall supply a test report or certificate, positively identifying the hoses supplied to the purchaser.

11 Marking

The hose shall be continuously and durably marked with the following minimum information:

- a) the manufacturer's name or identification (XXXX);
- b) the number and year of publication of this document (ISO 2398:2016);
- c) the hose type and class;
- d) the category, if low-temperature (L-T);
- e) the inside diameter, in mm;
- f) the maximum working pressure, in MPa and bar, with units stated;
- g) the date of manufacture, by giving the quarter and year of manufacture or using another suitable date code.

EXAMPLE XXXX/ISO 2398:2016/2B/L-T/25 mm/1,6 MPa/16 bar/2Q16.

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 8](#).

Table A.1 — Type and routine test frequency

Property	Type tests	Routine tests
Compound tests		
Tensile strength/elongation at break, lining and cover: Table 2	X	N.A.
Resistance to ageing, lining and cover: Table 2	X	N.A.
Resistance to liquids, lining and cover: Table 2	X	N.A.
Hose tests		
Inside diameter and tolerance: Table 1	X	X
Concentricity: 6.2	X	X
Tolerance on length: 6.3	X	X
Minimum thickness of lining and cover: 6.4	X	X
Hydrostatic proof pressure test: Table 3	X	X
Change in length at maximum working pressure: Table 3	X	X
Change in diameter at maximum working pressure: Table 3	X	N.A.
Burst strength test: Table 3	X	N.A.
Adhesion between compounds: Table 3	X	N.A.
Ozone resistance test: Table 3	X	N.A.
Flexibility/bending test at ambient temperature: Table 3	X	N.A.
Low-temperature flexibility: Table 3	X	N.A.
X Test shall be carried out.		
N.A. Test not applicable.		

Annex B (informative)

Productions acceptance tests

[Table B.1](#) gives the recommended frequency of production acceptance tests (see [Clause 8](#)) to be carried out per batch or per 10 batches of identical hose as indicated in the table.

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

Table B.1 — Recommended test frequency

Property	Production test	
	Per batch	Every 10 batches
Compound tests		
Tensile strength and elongation at break, lining and cover: Table 2	X	X
Resistance to ageing, lining and cover: Table 2	N.A.	X
Resistance to liquids, lining and cover: Table 2	N.A.	X
Hose tests		
Inside diameter and tolerance: Table 1	N.A.	N.A.
Concentricity: 6.2	N.A.	N.A.
Tolerance on length: 6.3	N.A.	N.A.
Minimum thickness of lining and cover: 6.4	N.A.	N.A.
Hydrostatic proof pressure test: Table 3	N.A.	N.A.
Change in length at maximum working pressure: Table 3	N.A.	N.A.
Change in diameter at maximum working pressure: Table 3	N.A.	N.A.
Burst strength test: Table 3	N.A.	X
Adhesion between compounds: Table 3	X	X
Ozone resistance test: Table 3	X	X
Flexibility/bending test at ambient temperature: Table 3	X	X
Low-temperature flexibility: Table 3	N.A.	X
X Test to be carried out.		
N.A. Test not applicable.		