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Rubber hoses and tubing for air and vacuum systems for internal-combustion engines — Specification

Tuyaux et tubes en caoutchouc pour systèmes d'aération et à vide des moteurs à combustion interne — Spécifications

Reference number
ISO 11424:1996(E)

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.

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.

International Standard ISO 11424 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

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Rubber hoses and tubing for air and vacuum systems for internal-combustion engines — Specification

1 Scope

This International Standard specifies requirements for vulcanized-rubber hoses and tubing for use in the various air and vacuum systems found on internal-combustion engines. The standard does not cover hoses used for direct power-brake actuation in trucks and trailers, nor for air intakes and ducting within the passenger compartment. The highest-temperature hoses are generally used for turbocharger applications. All hoses and tubing remain serviceable down to – 40 °C.

NOTE — Although the term vacuum is generally used, in reality the application is one of reduced air pressure used for the purposes of actuation or monitoring of the various engine-system components. The air carried by the tubing or hoses may be clean and free of contaminants but may also contain oil, fuel and their vapours as contamination, due to the particular installation and application.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 37:1994, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties.*

ISO 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD).*

ISO 188:—[1], *Rubber, vulcanized — Accelerated ageing and heat-resistance tests.*

ISO 815:1991, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures.*

ISO 1402:1994, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing.*

ISO 1629:1995, *Rubbers and latices — Nomenclature.*

ISO 1746:1983, *Rubber or plastics hoses and tubing — Bending tests.*

ISO 1817:1985, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 3302-1:1996, *Rubber — Tolerances for products — Part 1: Dimensional tolerances.*

ISO 4639-1:—[2], *Rubber tubing and hoses for fuel circuits for internal-combustion engines — Specification — Part 1: Conventional liquid fuels.*

ISO 4671:1984, *Rubber and plastics hose and hose assemblies — Methods of measurement of dimensions.*

ISO 4672:—[3], *Rubber and plastics hoses — Sub-ambient temperature flexibility tests.*

ISO 7233:1991, *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 8033:1991, *Rubber and plastics hose — Determination of adhesion between components.*

1) To be published (Revision of ISO 188:1982).

2) To be published (Revision of ISO 4639-1:1987).

3) To be published (Revision of ISO 4672:1988).

3 Types and classes

The hoses and tubing described in this International Standard are divided into two types and ten classes to reflect the range of intended operating conditions.

Types

Type A: internally reinforced hose with a working pressure up to 0,3 MPa.

Type B: homogeneous tube with a working pressure up to 0,12 MPa.

Classes

Class 1: Long-term working temperature up to 70 °C, maximum working temperature up to 100 °C. Not recommended for applications where resistance to oils, fuel and their vapours is required.

NOTE — Typically, styrene-butadiene rubber (SBR)[4] can be used.

Class 2: Long-term working temperature up to 100 °C, maximum working temperature up to 125 °C. Resistant to oils and their vapours.

NOTE — Typically, chloroprene rubber (CR) can be used.

Class 3: Long-term working temperature up to 100 °C, maximum working temperature up to 125 °C. Resistant to oils, fuels and their vapours.

NOTE — Typically, acrylonitrile-butadiene rubber (NBR) can be used.

Class 4: Long-term working temperature up to 125 °C, maximum working temperature up to 150 °C. Not recommended for applications where resistance to oils, fuels and their vapours is required.

NOTE — Typically, ethylene-propylene rubber (EPM or EPDM) can be used.

Class 5: Long-term working temperature up to 125 °C, maximum working temperature up to 150 °C. Resistant to oils and their vapours.

NOTE — Typically, chlorinated or chlorosulfonated polyethylene (CM or CSM) can be used.

Class 6: Long-term working temperature up to 125 °C, maximum working temperature up to 150 °C. Resistant to oils, fuels and their vapours.

NOTE — Typically, epichlorohydrin or hydrogenated nitrile rubbers (CO, ECO or HNBR) can be used.

Class 7: Long-term working temperature up to 150 °C, maximum working temperature up to 175 °C. Not recommended for applications where resistance to oils, fuels and their vapours is required.

NOTE — Typically, silicone rubber (VMQ) can be used.

Class 8: Long-term working temperature up to 150 °C, maximum working temperature up to 175 °C. Resistant to oils and their vapours.

NOTE — Typically, acrylic rubber (ACM or AEM) can be used.

Class 9: Long-term working temperature up to 150 °C, maximum working temperature up to 175 °C. Resistant to oils, fuels and their vapours.

NOTE — Typically, fluoroelastomer or fluorosilicone rubbers (FKM or FVMQ) can be used.

Class 10: Long-term working temperature up to 175 °C, maximum working temperature up to 200 °C. Resistant to oils and their vapours.

NOTE — Typically, fluoroelastomer or fluorosilicone rubbers (FKM or FVMQ) can be used.

Hoses will thus be designated with a two-character descriptor such as type A4 or type B6, etc.

In cases where type A hose cover and lining are manufactured from materials of different classes, a three-character descriptor shall be used thus: Type A9/5 where the second character describes the lining material and the third character describes the cover material.

Similarly, where type B tubing is of a composite construction, a three-character descriptor is also used thus: Type B3/2.

4 Hose and tubing bores

The bore of all hoses and tubing shall be clean and free from any contamination when examined visually.

5 Dimensions and tolerances

5.1 Hoses

When determined by the methods described in ISO 4671, the dimensions and tolerances shall comply with the values given in table 1.

5.2 Tubing

When determined by the methods described in ISO 4671, bore diameters and wall thicknesses shall be as given in table 2. Tolerances shall be selected from the appropriate categories given in ISO 3302-1.

4) Nomenclature in accordance with ISO 1629.

Table 1 — Hose dimensions and tolerances

Dimensions in millimetres

Bore diameter	Tolerance on bore	Wall thickness	Outside diameter	Tolerance on outside diameter
3,5		3	9,5	
4		3	10	
5		3	11	
6		3	12	
7	All	3	13	All
7,5	± 0,3	3	13,5	± 0,4
8		3	14	
9		3	15	
11		3,5	18	
12		3,5	19	

Table 2 — Bore diameters and wall thickness of tubing

Dimensions in millimetres

Nominal bore	Nominal wall thickness
2	2
2,5	3
4	3,5
5	4
7 to 13	4,5

6 Selection of test pieces

Tests shall be carried out where possible on test pieces cut from finished products. Where this is not possible, test pieces shall be cut from standard test slabs with a state of cure equivalent to that of the finished product. Compression set determination shall always be carried out on standard test slabs for both cover and lining of hoses and on the compound used for the tubing.

7 Requirements for physical properties

7.1 Hardness

Hardness, determined in accordance with the procedure in ISO 48, shall comply with the values given in table 3.

7.2 Tensile strength and elongation at break

Tensile strength and elongation at break, determined in accordance with ISO 37 using a No. 2 dumb-bell, shall comply with the values given in table 3.

7.3 Change in properties after heat-ageing

The change in hardness, tensile strength and elongation at break, after heat-ageing in accordance with ISO 188 in a ventilated drying oven under the conditions given in a) and b) below, using test pieces as described in 6.1 and 6.2 of that standard, shall comply with the values given in table 3.

Class 1

a) (70^{+2}_{0}) h at 100 °C

b) 1 000 h ± 5 h at 70 °C

Classes 2 and 3

a) (70^{+2}_{0}) h at 125 °C

b) 1 000 h ± 5 h at 100 °C

Classes 4, 5 and 6

a) (70^{+2}_{0}) h at 150 °C

b) 1 000 h ± 5 h at 125 °C

Classes 7, 8 and 9

a) (70^{+2}_{0}) h at 175 °C

b) 1 000 h ± 5 h at 150 °C

Class 10

a) (70^{+2}_{0}) h at 200 °C

b) 1 000 h ± 5 h at 175 °C

7.4 Compression set

Compression set, when determined in accordance with ISO 815, using the large test piece and the follow-

ing conditions, shall comply with the values given in table 3.

Class 1: (70^{+2}_{0}) h at 70 °C

Classes 2 and 3: (70^{+2}_{0}) h at 100 °C

Classes 4, 5 and 6: (70^{+2}_{0}) h at 125 °C

Classes 7, 8 and 9: (70^{+2}_{0}) h at 150 °C

Class 10: (70^{+2}_{0}) h at 175 °C

7.5 Resistance to oxygenated fuels

This requirement applies only to the lining of type A hoses and to type B tubing for classes 3, 6 and 9.

Any changes in properties after a period of (70^{+2}_{0}) h of immersion in a mixture of 85 parts by volume of liquid C (see ISO 1817) and 15 parts by volume of methanol at 23 °C ± 2 °C, when determined in accordance with ISO 1817, shall comply with the values given in table 3.

7.6 Resistance to oil No. 3

This requirement applies only to the cover and lining of type A hoses and to type B tubing for classes 2, 3, 5, 6, 8, 9 and 10.

Any change in properties after a period of (70^{+2}_{0}) h of immersion in oil No. 3 at one of the following temperatures, when determined in accordance with ISO 1817, shall comply with the values given in table 3.

Classes 2 and 3: 100 °C ± 2 °C

Classes 5 and 6: 125 °C ± 2 °C

Classes 8, 9 and 10: 150 °C ± 2 °C

7.7 Minimum burst pressure

Minimum burst pressures, when determined in accordance with ISO 1402, shall comply with the values given in table 3.

7.8 Adhesion

This requirement applies to type A hoses of all classes.

The adhesion between hose cover and liner, when determined in accordance with ISO 8033, shall comply with the values given in table 3.

7.9 Ozone resistance

When determined in accordance with ISO 7326, under the following conditions, the ozone resistance shall comply with the requirement given in table 3.

Ozone concentration: 50 mPa ± 5 mPa

Duration: (70^{+2}_{0}) h

Elongation: 20 %

Temperature: 40 °C ± 2 °C

7.10 Low-temperature flexibility after heat-ageing

The low-temperature flexibility after heat-ageing shall be in accordance with the requirement given in table 3.

The test shall be carried out in accordance with ISO 4672:—[3], procedure B, after 24 h at − 40 °C ± 2 °C, with the bend radius 12 times the nominal bore for hoses and 25 times the nominal bore for tubing, on hoses and tubing heat-aged under set of conditions b) specified for their class in 7.3.

7.11 Amount of extractable products

The amount of extractable products, determined in accordance with annex A of ISO 4639-1:—[2], using a mixture of 85 parts by volume of liquid C (see ISO 1817) and 15 parts by volume of methanol, shall comply with the values given in table 3.

7.12 Tear resistance

This requirement only applies to type B tubing.

The resistance to tearing, determined in accordance with annex B of ISO 4639-1:—[2], shall comply with the value given in table 3.

7.13 Suction resistance

The suction resistance shall be in accordance with the requirements given in table 3.

The test shall be carried out on straight hoses and tubing only, in accordance with ISO 7233:1991, procedure A, under the following conditions:

Test pressure: 80 kPa ± 1 kPa below atmospheric pressure

Duration: 15 s to 60 s

Ball diameter: 0,8 × nominal bore of hose or tube

7.14 Resistance to kinking

This requirement applies to straight tubing and hoses of 16 mm bore or less. When tested in accordance with ISO 1746, using mandrel diameters of

140 mm for hose and tubing up to and including 11 mm bore,

220 mm for hose and tubing above 11 mm bore,

the coefficient of deformation (T/D) shall comply with the values given in table 3.

8 Marking

Except where the component is too small to label, the tubing and hose shall be marked with the following information:

a) the number of this International Standard;

b) the manufacturer's name or trade-mark;

c) the type and class of the hose or tubing;

d) the month and year of manufacture.

Table 3 — Requirements for physical properties

Subclause	Property	Unit	Requirement		
			Type A hose		Type B tubing
			Lining	Cover	
7.1	Nominal hardness and tolerance	IRHD	70 ± 10	70 ± 10	70 ± 10
7.2	Tensile strength, min.				
	Class 1	MPa	10	10	10
	Class 2	MPa	10	10	10
	Class 3	MPa	10	10	10
	Class 4	MPa	10	10	10
	Class 5	MPa	10	10	10
	Class 6	MPa	10	10	10
	Class 7	MPa	6	6	6
	Class 8	MPa	8	8	8
	Class 9	MPa	6	6	6
	Class 10	MPa	6	6	6
7.2	Elongation at break, max.				
	Class 1	%	250	250	250
	Class 2	%	250	250	250
	Class 3	%	250	250	250
	Class 4	%	200	200	200
	Class 5	%	250	250	250
	Class 6	%	250	250	250
	Class 7	%	150	150	150
	Class 8	%	150	150	150
	Class 9	%	150	150	150
	Class 10	%	150	150	150
7.3	Accelerated ageing				
	Hardness change, max.	IRHD	± 15	± 15	± 15
			Maximum value 90 IRHD		
	Tensile-strength change, max.	%	− 30	− 30	− 30
			Minimum value 5 MPa		
	Elongation at break change, max.	%	− 50	− 50	− 50
			Minimum value 100 %		
7.4	Compression set, all classes	%	50	50	50

Table 3 — Requirements for physical properties *(concluded)*

Subclause	Property	Unit	Requirement		
			Type A hose		Type B tubing
			Lining	Cover	
7.5	Resistance to oxygenated fuels, classes 3, 6 and 9				
	Hardness change, max.	IRHD	− 25	—	− 25
			Minimum value 40 IRHD		
	Tensile-strength change, max.	%	− 50	—	− 50
			Minimum value 5 MPa		
	Elongation at break change, max.	%	− 50	—	− 50
			Minimum value 100 %		
	Change in volume, max.	%	+ 70	—	+ 70
7.6	Resistance to oil No. 3, classes 2, 3, 5, 6, 8, 9 and 10				
	Hardness change, max.	IRHD	− 25	− 25	− 25
			Minimum value 40 IRHD		
	Tensile-strength change, max.	%	− 50	− 50	− 50
			Minimum value 5 MPa		
	Elongation at break change, max.	%	− 50	− 50	− 50
			Minimum value 100 %		
	Change in volume, max.	%	+ 60	+ 60	+ 60
7.7	Minimum burst pressure	MPa	1,5	1,5	0,5
7.8	Adhesion (separation force), min.	kN/mm	1,5	1,5	—
7.9	Ozone resistance		No signs of cracking under ×2 magnification		
7.10	Low-temperature flexibility after heat-ageing		No signs of cracking under ×2 magnification		
7.11	Extractable products, max.	g/m^2	10	10	10
7.12	Tear resistance, min.	kN/m	—	—	8
7.13	Suction resistance		Ball passes freely		
7.14	Resistance to kinking Coefficient of deformation (T/D), max.		0,7	0,7	0,7

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