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Rubber tubing and hoses for fuel circuits for internal combustion engines — Specification —

Part 1: Conventional liquid fuels

Tuyaux et tubes en caoutchouc pour circuits à carburants pour moteurs à combustion interne — Spécifications —

Partie 1: Carburants liquides conventionnels

Reference number
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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4639-1 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Rubber tubing and hoses for fuel circuits for internal combustion engines — Specification —

Part 1:
Conventional liquid fuels

1 Scope and field of application

This part of ISO 4639 specifies requirements for vulcanized compounds and rubber tubing and hoses for use in fuel circuits using conventional liquid fuels (containing non-oxygenated compounds). It does not cover any equipment used for the distribution of liquid fuels.

For the purpose of this International Standard, tubing and hoses are divided into three different types:

— Type 1: Homogeneous tubing for use at working pressures of up to 0,12 MPa inclusive;

— Type 2: Hoses with a working pressure in the 0 to 0,12 MPa inclusive range;

— Type 3: Hoses with a working pressure in the 0 to 0,3 MPa inclusive range;

In addition the three types 1, 2 and 3 are further divided into two grades:

— Grade A: operating in an environmental temperature of up to 100 °C.

— Grade B: operating in an environmental temperature of up to 125 °C.

2 References

ISO 37, *Rubber, vulcanized — Determination of tensile stress-strain properties.*

ISO 48, *Vulcanized rubbers — Determination of hardness (Hardness between 30 and 85 IRHD).*

ISO 188, *Vulcanized rubber — Accelerated ageing or heat-resistance tests.*

ISO/R 286, *ISO system of limits and fits — Part 1: General, tolerances and deviations.*

ISO 471, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

ISO 815, *Vulcanized rubbers — Determination of compression set under constant deflection at normal and high temperatures.*

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

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

ISO 2285, *Rubber, vulcanized — Determination of tension set at normal and high temperatures.*

ISO 3302, *Rubber — Dimensional tolerances of solid moulded and extruded products.*

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

ISO 4672, *Rubber products — Hoses — Low temperature flexibility tests.*

ISO 6133, *Rubber and plastics — Analysis of multi-peak traces obtained in determination of tear strength and adhesion strength.*

ISO 7233, *Rubber and plastics hoses and hose assemblies — Vacuum resistance — Methods of test.*

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

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

ISO 8308, *Rubber and plastics hoses and tubing — Determination of transmission of liquids through hose walls.* [1)]

3 Tubing and hose bores

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

4 Sizes

4.1 Tubing

Bore diameters and wall thicknesses shall be as specified in table 1.

1) At present at the stage of draft.

Tolerances shall be selected from the appropriate categories shown in ISO 3302.

Table 1 — Bore diameters and wall thicknesses

Dimensions in millimetres

Nominal bore	Nominal wall thickness
3,5	3,5
4	3,5
5	4
7	4,5
9	4,5
11	4,5
13	4,5

NOTE — For information, the unions on which the tubing is to be fitted have the following diameters:

4, 4,5, 6 or 6,35, 8, 10, 12 and 14 mm

4.2 Hoses

The dimensions, tolerances and concentricity of hoses shall comply with tables 2 and 3.

Table 2 — Hose dimensions

Dimensions in millimetres

Bore diameter	Tolerance	Wall thickness	Outside diameter	Tolerance
3,5	±0,3	3	9,5	±0,4
4			10	
5			11	
6			12	
7			13	
7,5			13,5	
8			14	
9			15	
11		3,5	18	
12			19	
13	±0,4		20	±0,6
16		4	24	
21			29	
31,5	+0,5 −1	4,25	40	±1
40		5	50	

Table 3 — Hose concentricity[1)]

Dimensions in millimetres

Internal diameter	Maximum variation from concentricity
	Internal diameter to overall diameter
Up to and including 3,5	0,4
Over 3,5	0,8

1) See ISO 4671.

5 Physical tests and specifications

Physical tests and specifications shall be obtained from finished products where possible, or as agreed between manufacturer and user, excluding compression set, which shall be carried out on test stabs.

5.1 Hardness

Hardness, determined in accordance with the procedure in ISO 48 (standard test), shall comply with the values shown in table 4.

5.2 Tensile strength and elongation at break

Tensile strength and elongation at break, determined in accordance with the procedure in ISO 37 and on a No. 2 dumb-bell, shall comply with the values shown in table 4.

5.3 Change in properties after accelerated ageing

Accelerated ageing shall be carried out in accordance with ISO 188 in a ventilated drying oven under the following conditions, using test pieces as described in 5.1 and 5.2:

— Grade A: 70 $^{+2}_{0}$ h at 100 °C

— Grade B: 70 $^{+2}_{0}$ h at 125 °C

In both cases, the change in hardness, tensile strength and elongation at break shall not exceed the values shown in table 4.

5.4 Compression set

The compression set, when determined in accordance with ISO 815, using the large test piece, under the conditions shown in table 4, shall comply with the values shown in table 4.

5.5 Resistance to hydrocarbons

Any change in volume after a period of 70 h of immersion in fluid C at laboratory temperature (ISO 471) shall, when determined in accordance with the procedure shown in ISO 1817, comply with the values shown in table 4. This test shall apply to homogeneous tubing and to hose linings.

5.6 Resistance to oil No. 3

This test applies to homogeneous tubing and to hose covers.

Volumetric changes, when tested in accordance with ISO 1817, for 70 h in oil No. 3 at a temperature of 100 °C shall not exceed the values shown in table 4.

5.7 Leak test on tubing

This test applies only to homogeneous tubing.

The rubber tubing shall be placed over the polished end of a piece of metal tubing, machined to tolerance H14 as defined in ISO/R 286, having a diameter equal to that shown in the note

accompanying table 1. The rubber tubing shall be pushed along the metal tubing to a distance equal to three times the nominal bore of the rubber tubing and the other end of the tubing shall be attached to an air supply.

The assembly shall then be subjected to an internal pressure of 0,12 MPa for a period of 2 min, using liquid C. No leak shall appear during the duration of the test.

5.8 Tension test

This test shall apply only to homogeneous tubing.

A piece of rubber tubing shall be placed over the end of a piece of metal tubing in the manner decribed in 5.7. This assembly shall then be raised to a vertical position in which it shall be capable of withstanding an applied load of 10 N at its other end, which shall be plugged.

Using a manometer, progressively increase the internal air pressure to 0,25 MPa and hold for 2 min. The tubing shall not rupture nor slip off.

5.9 Minimum burst pressure

This test shall be carried out in accordance with ISO 1402.

Minimum burst pressures shall be not less than the values shown in table 4.

5.10 Adhesion

This test shall apply to hoses.

The adhesion between components, when tested in accordance with ISO 8033, shall comply with table 4.

5.11 Ozone resistance after a period of immersion in liquid C

A sample of hose or tubing of suitable length, its two ends plugged without stretching of the material, shall be immersed in a quantity of liquid C at ambient temperature for a period of 72 h. The sample shall then be removed and dried for a period of 72 h at a temperature of 40 °C.

When tested in accordance with ISO 7326, under the following conditions, the sample shall show no signs of cracking when examined under a magnification of X 2:

Concentration : 50 ± 5 pphm*

Duration : 70 $^{+2}_{0}$ h

Elongation : 20 %

Temperature : 40 °C

5.12 Low-temperature flexibility

The test shall be carried out in accordance with ISO 4672, procedure B, under the following conditions:

Empty tubing or hose: 24 h at −25 ± 2 °C

Tubing or hose filled with liquid C: 72 $^{+2}_{0}$ h at −40 ± 2 °C

Not more than 30 min shall be allowed to elapse between the time at which the tubing or hose is filled and that at which cooling is commenced.

The bending radius shall be 12 times the nominal bore size for hose and 25 times the nominal bore size for tubing.

After flexing, the tubing or hose shall show no signs of cracking under X 2 magnification.

5.13 Cleanliness

The amount of impurities, determined by the procedure detailed in annex B, shall not exceed the values shown in table 4.

5.14 Determination of waxy products extracted in liquid C

The amount of waxy products extractable, determined in accordance with annex B, shall not exceed the values shown in table 4.

5.15 Tension set

The test shall apply to homogeneous tubing, hose linings and hose covers and shall be carried out in accordance with ISO 2285. The samples shall be stretched to 1,5 × normal length for 24 h at a temperature corresponding to the appropriate working temperature for the grade of hose.

5.16 Permeability to liquid C

The test shall be carried out in accordance with ISO 8308, using liquid C, and the values of permeability to liquid C shall comply with table 4.

5.17 Tear resistance

The test applies only to homogeneous tubing.

The resistance to tearing, established in accordance with annex A, shall be not less than the values shown in table 4.

5.18 Vacuum resistance

The test shall be carried out on straight hoses only, using ISO 7233, procedure A, under the following conditions:

Vacuum : 80 kPa

Duration : 15 to 60 s

Ball diameter : 0,8 × nominal bore

The result shall comply with values shown in table 4.

* parts per hundred million by volume

6 Marking

Except by agreement between manufacturer and user, 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 grade;
d) the month and year of manufacture.

Table 4 — Requirements for slabs and finished products

Sub-clause	Characteristic	Unit	Requirement		
				Hose	
			Tubing	Lining	Cover
5.1	Nominal hardness	IRHD	70	70	70
5.1	Tolerance	IRHD	$^{+10}_{-5}$	$^{+10}_{-5}$	$^{+10}_{-5}$
5.2	Tensile strength, min.	MPa	10	10	10
5.2	Elongation, min.	%	200	250	250
5.3	Accelerated ageing				
	Change in hardness, max. increase[1)]	IRHD	10	10	10
	decrease	IRHD	0	0	0
	Reduction in tensile strength, max.	%	20	20	20
	Reduction in elongation at break, max.	%	40	40	40
5.4	Compression set, max.				
	Type 1: 24 h at 100 °C	%	65	—	—
	Types 2 and 3, Grade A: 70 $^{+2}_{0}$ h at 100 °C	%	—	50	50
	Types 2 and 3, Grade B: 70 $^{+2}_{0}$ h at 125 °C	%	—	50	50
5.5	Resistance to hydrocarbons				
	Volumetric change, max. increase	%	30	30	—
	decrease	%	0	0	
5.6	Resistance to oil No. 3				
	Volumetric change, max. increase	%	30	30	60
	decrease	%	5	5	5
5.7	Leak test	—	No leaks	—	
5.8	Tension test	—	No breaks Must not slip off	—	
5.9	Minimum burst pressure				
	Type 1	MPa	0,5	—	
	Type 2	MPa	—	1,2	
	Type 3	MPa	—	3,0	
5.10	Adhesion test				
	Separation force, min.	kN/m	—	1,5	
5.11	Resistance to ozone, after extraction	—	No cracks at X 2 magnification		
5.12	Low-temperature flexibility	—	No cracks at X 2 magnification		
5.13	Cleanliness test				
	Insoluble impurities, max.	g/m²	5	5	
	Fuel-soluble solids, max.	g/m²	10	10	
5.14	Waxy extractables, max.				
	Tubing and Grade A hose	g/m²	10	10	
	Grade B hose	g/m²	—	5	
5.15	Tension set				
	Tubing, max.	%	50	50	
	Cover, max.	%	—	50	
5.16	Permeability in liquid C, max.	g/(m²·24 h)	350	350	
5.17	Tear resistance, min.	kN/m	8	—	
5.18	Vacuum resistance	—	Ball passes freely		

1) The absolute maximum is 85 IRHD and shall not be exceeded.

Annex A

Resistance of homogeneous tubing to tearing

(This annex forms an integral part of the Standard)

A.1 Scope and field of application

This annex specifies the conditions governing tear-resistance tests, using a sample taken from homogeneous tubing in which the ratio of internal to external diameters is 0,5 or less.

A.2 Principle

With the aid of a dynamometer, measurements are taken to indicate the amount of force required to propagate a tear initiated in a sample.

A.3 Apparatus

A.3.1 Knife, carefully ground, or **razor blade.**

A.3.2 Inertia-free dynamometer, with the following features:

a) a device for recording load/movement curves for the mobile jaw;

b) scaled loads selected to ensure that tearing occurs at a load between 15 % and 85 % of the maximum of the scale applied;

c) a constant mobile jaw speed equal to 100 ± 10 mm/min;

d) grips capable of securing the sample in position without damage or slip.

A.3.3 Wall thickness gauge, such as a comparator or thread counter.

A.3.4 Conditioned enclosure, with standard laboratory temperature and humidity.

A.4 Samples

A.4.1 Shape and dimensions

The sample shall be of the shape and dimensions shown in figure 1.

A.4.2 Preparation

Take a sample length of 80 ± 1 mm from the tubing.

Using a knife or a razor blade (A.3.1), cut 30 ± 1 mm along the sample along a diameter in the longitudinal plane.

Continue the slit on one side only, following the section marked by the corners A, B, C and D in figure 1.

A.4.3 Number of samples

A minimum of three samples shall be tested.

A.4.4 Conditioning of samples

The samples shall be conditioned in accordance with ISO 471.

A.5 Procedure

Using the apparatus described in clause A.3.3 measure the thickness of the sample.

Mount the sample in the grips (see figure 2).

Adjust the load scale and apply a tensile force until the sample tears along its entire length.

A.6 Results — Calculation and expression

The load/displacement graph will normally resemble that shown in figure 3.

The mean tear strength shall be determined in accordance with ISO 6133.

Dimensions in millimetres

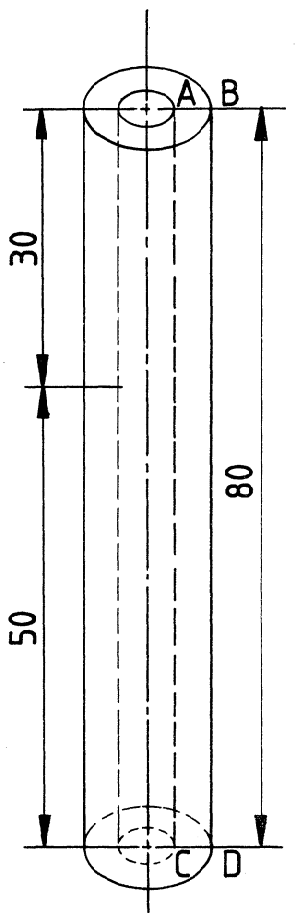

Figure 1 — Shape and dimensions of the sample