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

Part 2: Gasoline fuels

Tuyaux de caoutchouc et flexibles pour les circuits de carburant pour les moteurs à combustion interne — Spécifications —
Partie 2: Essences

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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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

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 second edition cancels and replaces the first edition (ISO 19013-2:2005), which has been technically revised.

ISO 19013 consists of the following parts, under the general title *Rubber hoses and tubing for fuel circuits for internal combustion engines — Specification*:

— *Part 1: Diesel fuels*

— *Part 2: Gasoline fuels*

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

Part 2: Gasoline fuels

WARNING — Persons using this part of ISO 19013 should be familiar with normal laboratory practice. This part of ISO 19013 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 ensure compliance with any national regulatory conditions.

1 Scope

This part of ISO 19013 specifies the requirements for rubber tubing and hoses used in gasoline fuel circuits for internal combustion engines. The gasoline fuels covered include those containing oxygenates such as methanol and fuels that have become oxidized ("sour gas"). In addition, this part of ISO 19013 can also be applied as a classification system to enable original equipment manufacturers (OEMs) to detail a "line call-out" of tests for specific applications where these are not covered by the main types specified (see example in Annex C). In this case, the hose or tubing would not carry any marking showing the number of this part of ISO 19013, but may detail the OEM's own identification markings as shown on their part drawings.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

ISO 1629, *Rubber and latices — Nomenclature*

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

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

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

ISO 4926, *Road vehicles — Hydraulic braking systems — Non-petroleum-base reference fluids*

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

ISO 7233:2006, *Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum*

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

ISO 8031:2009, *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 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*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

ASTM D130, *Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test*

SAE J1737, *Test Procedure to Determine the Hydrocarbon Losses from Fuel Tubes, Hoses, Fittings, and Fuel Line Assemblies by Recirculation*

SAE J2027:1998, *Standard for Protective Covers for Gasoline Fuel Line Tubing*

SAE J2044:2002, *Quick Connect Coupling Specification for Liquid Fuel and Vapor/Emissions Systems*

SAE J2260, *Nonmetallic Fuel System Tubing with One or More Layers*

3 Classification

The product shall consist of extruded rubber materials with or without an integral internal or external reinforcement which may or may not be pre-formed before final vulcanization. The product may also have a rubber or thermoplastic barrier layer, either as an internal layer or forming the inner liner, to impart improved fuel resistance and/or reduced fuel vapour permeability.

Seven hoses and tubings for specific applications are specified as follows.

Type 1 Class A = Pressurized [0,7 MPa (7 bar) working pressure] feed and return lines from the fuel tank to the engine compartment (−40 °C to +80 °C continuous).

Class B = Pressurized [0,2 MPa (2 bar) working pressure] feed and return lines from the fuel tank to the engine compartment (−40 °C to +80 °C continuous).

Type 2 Class A = Pressurized [0,7 MPa (7 bar) working pressure] feed and return lines in the engine compartment (−40 °C to +100 °C continuous).

Class B = Pressurized [0,2 MPa (2 bar) working pressure] feed and return lines in the engine compartment (−40 °C to +100 °C continuous).

Type 3 Class A = Pressurized [0,7 MPa (7 bar) working pressure] feed and return lines in the engine compartment (−40 °C to +125 °C continuous).

Class B = Pressurized [0,2 MPa (2 bar) working pressure] feed and return lines in the engine compartment (−40 °C to +125 °C continuous).

Type 4 Low pressure [0,12 Mpa (1,2 bar) working pressure] fuel filler, vent, and vapour handling (−40 °C to +80 °C continuous).

All types and classes can also be designated reduced fuel vapour permeable (RP), e.g. Type 1 Class A RP.

4 Sizes

4.1 Tubing

When determined by the methods described in ISO 4671, inside diameters and wall thicknesses shall be as specified in Table 1.

Tolerances shall be selected from the appropriate categories specified in ISO 3302-1; M3 for moulded hoses and E2 for extrusions.

The thickness of the barrier layer, where applicable, shall be included in the total nominal wall thickness shown in Table 1.

Table 1 — Tubing inside diameters and wall thicknesses

Inside diameter mm	Wall thickness mm
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 mm, 4,5 mm, 6 mm or 6,35 mm, 8 mm, 10 mm, 12 mm, and 14 mm.	

4.2 Hoses

When determined by the methods described in ISO 4671, the dimensions and concentricity of hoses shall comply with Tables 2 and 3.

The thickness of the barrier layer, where applicable, shall be included in the total nominal wall thickness shown in Table 2.

Table 2 — Hose dimensions

Dimensions in millimetres

Inside diameter	Tolerance	Wall thickness	Outside diameter	Tolerance
3,5	±0,3	3	9,5	±0,4
4	±0,3	3	10	±0,4
5	±0,3	3	11	±0,4
6	±0,3	3	12	±0,4
7	±0,3	3	13	±0,4
7,5	±0,3	3	13,5	±0,4
8	±0,3	3	14	±0,4
9	±0,3	3	15	±0,4
11	±0,3	3,5	18	±0,4
12	±0,3	3,5	19	±0,4
13	±0,4	3,5	20	±0,6
16	±0,4	4	24	±0,6
21	±0,4	4	29	±0,6
31,5	$^{+0,5}_{-1}$	4,25	40	±1
40	$^{+0,5}_{-1}$	5	50	±1

Table 3 — Hose concentricity

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

5 Performance requirements for hose and tubing

Tests shall be selected from the following list for each application of hose or tubing based on the performance requirements for the finished product. Type tests (as defined in Clause 6) for each hose or tubing group are given in Annex H.

a) **Burst pressure**: When determined in accordance with ISO 1402, the minimum burst pressure for Types 1, 2, and 3, Class A shall be 3,0 MPa gauge (30 bar) and shall be 1,2 MPa gauge (12 bar) for Class B. Type 4 shall be 0,5 MPa gauge (5 bar). Additionally, after fuel resistance testing [test m)], hoses and tubing shall not have a burst pressure of less than 75 % of the original burst pressure.

b) **Proof pressure**: When determined in accordance with ISO 1402, the test pressure for Types 1, 2, and 3, Class A shall be 1,5 MPa gauge (15 bar) and shall be 0,6 MPa gauge (6 bar) for Class B. Type 4 shall be 0,25 MPa gauge (2,5 bar). The hose shall not burst or not fail by showing sign of leakage.

c) **Adhesion** (for all constructions with two or more bonded layers only): When determined by the appropriate procedure in ISO 8033, the adhesion between each pair of bonded layers shall not be less than 1,5 kN/m.

d) **Low-temperature flexibility**: When tested in accordance with ISO 10619-2:2011, method B, a length of hose or tubing which has been previously kept filled with ISO 1817 liquid C for 72 h ± 2 h at 21 °C ± 2 °C and then kept cooled at −40 °C ± 2 °C for 72 h ± 2 h shall not exhibit any cracking when examined under ×2 magnification after bending around a similarly cooled mandrel, the radius of which is 12 times the nominal size of the hose or 25 times the nominal size of the tubing. The hose or tubing shall then conform to the burst strength requirement of test a).

e) **Internal cleanliness**: When determined in accordance with Annex A, the insoluble impurities shall not exceed 5 g/m² and the fuel-soluble impurities shall not exceed 3 g/m².

f) **Extractable waxy materials**: When determined in accordance with Annex A, the extractable waxy materials shall not exceed 2,5 g/m².

g) **Tear resistance** (applicable to tubing only): When determined in accordance to Annex B, the minimum tear resistance shall be 4,5 kN/m.

h) **Ozone resistance**: When tested in accordance with ISO 7326:2006, method 1 under the following conditions, the hose or tubing shall not show cracking when examined under ×2 magnification:

Partial pressure of ozone	50 mPa ± 3 mPa
Duration	72 h ± 2 h
Temperature	40 °C ± 2 °C
Elongation	20 %

i) **Heat ageing resistance**: After ageing for one or more of the following times and temperatures in accordance with ISO 188, all constructions shall meet the adhesion requirements of test b), the low-temperature flexibility requirements of test c), and the ozone resistance requirements of test g).

1) 1 000 h at 80 °C.

2) 1 000 h at 100 °C.

3) 1 000 h at 125 °C.

4) 168 h at 100 °C.

5) 168 h at 125 °C.

6) 168 h at 140 °C.

NOTE The 1 000 h tests represent long-term working temperatures and the 168 h tests represent short-term peak working temperatures.

j) **Resistance to surface contamination by engine oil**: When tested in accordance with Annex C using ISO 1817 oil 3, all constructions shall meet the adhesion requirements of test b), the cold flexibility requirements of test c) and the ozone resistance requirements of test g).

k) **Resistance to surface contamination by non-petroleum hydraulic (brake/clutch) fluid**: When tested in accordance with Annex C using hydraulic fluid to ISO 4926, all constructions shall meet the adhesion requirements of test b), the cold flexibility requirements of test c), and the ozone resistance requirements of test g).

l) **Resistance to kinking** (this requirement applies only to straight hoses and tubing with a nominal size of 16 mm or less): When determined in accordance with ISO 10619-1, the maximum coefficient of deformation (T/D) shall not exceed 0,7. The mandrel diameter shall be 140 mm for hoses and tubing up to nominal size 11 mm and 220 mm for hoses and tubing of nominal size from 12 mm to 16 mm.

m) **Resistance to vacuum** (this requirement applies only to straight hoses and tubing): When the hose or tubing is tested in accordance with ISO 7233:2006, method A at 0,08 MPa absolute (0,8 bar) for 15 s to 60 s duration with a ball of diameter 0,8 × the nominal size, the ball shall traverse the full length of the hose or tubing.

n) **Resistance to fuels**: When tested by the methanol fuel resistance test of SAE J2260 for a test duration of 5 000 h using one or more of the following test fuels at a fuel temperature of 60 °C ± 2 °C, all constructions shall meet the adhesion requirements of test b), the cold flexibility requirements of test c), the ozone resistance requirements of test g), the kinking resistance of test k), and the suction resistance of test l).

1) A mixture of 85 % by volume of liquid C (ISO 1817) and 15 % by volume of methanol.

2) A mixture of 75 % by volume of liquid C (ISO 1817) and 25 % by volume of methanol.

3) A mixture of 50 % by volume of liquid C (ISO 1817) and 50 % by volume of methanol.

4) A mixture of 85 % by volume of methanol and 15 % by volume of liquid C (ISO 1817).

5) 100 % by volume of methanol.

6) A mixture prepared in accordance with Annex D and peroxidized to a peroxide number of 90. Recheck the peroxide number of the test fuel using the method given in D.5 after each 70 h of testing. If the peroxide number falls below 80, replace the test fuel with fresh test fuel.

o) **Burn-through resistance**: When tested in accordance with SAE J2027, the hose or tubing shall withstand a minimum of 60 s exposure to flame without loss of pressure.

p) **Fuel permeability by recirculation** (RP hoses and tubing only): When determined in accordance with SAE J1737, the permeability to a mixture of 75 % by volume of liquid C (ISO 1817) and 25 % by volume of methanol at 60 °C and 13,8 kPa shall not exceed 60 g/m^2/24 h.

q) **Electrical resistance**: When determined in accordance with ISO 8031:2009, 4.5 to 4.7, the electrical resistance shall not exceed 10 MΩ.

r) **Copper corrosion and crystalline salt formation**: When tested in accordance with Annex E, there shall be no tarnish on the copper strip greater than ASTM D130 classification 1. Nor shall there be any formation of crystalline material on the copper strip, on the inner liner material, or on the bottom of the test tube.

s) **Life-cycle test** (types 1, 2, and 3 only): When tested in accordance with Annex F, hose and tubing shall meet the adhesion requirements of test b), the cold flexibility requirements of test c), and the ozone resistance requirements of test g).

6 Frequency of testing

Type tests and routine tests shall be as specified in Annexes I and J, respectively.

Type tests are those required to confirm that a particular hose or hose assembly design manufactured by a particular method from particular materials meets all the requirements of this part of ISO 19013. The tests shall be repeated at a maximum of five-year intervals or whenever a change in the method of manufacture or materials used occurs. They shall be performed on all sizes and types except those of the same size and construction.

Routine tests are those required to be carried out on each length of finished hose or hose assembly prior to dispatch.

Production tests are those specified in Annex J which should preferably be carried out to control the quality of manufacture. The frequencies in the Annex are given as a guide only.

7 Marking

All constructions shall be continuously marked with the following:

a) the manufacturer's name or trade mark;

b) the number and year of publication of this part of ISO 19013;

c) the classification in accordance with Clause 3;

d) the inside diameter, in millimetres;

e) the fuel, i.e. gasoline;

f) the year and quarter of manufacture;

g) the recycling code for the construction material in accordance with ISO 1629.

EXAMPLE XXX/ISO 19013-2:2015/Type 2 Class A RP/11/Gasoline/1Q15/NBR/FKM.

Annex A
(normative)

Cleanliness and extractables test

A.1 General

This annex specifies a method for the determination of the quantity of insoluble impurities ("dirt"), liquid C solubles, and waxy extractables present in hoses and tubing used in liquid-fuel circuits.

A.2 Principle

A quantity of ISO 1817 liquid C is left for a period of 24 h at ambient temperature inside a length of hose or tubing. After this time, the test piece is emptied and the inside washed by gravity flow of liquid C.

The total solution is collected and the insoluble matter filtered out, dried, and weighed. The remaining solution is evaporated to dryness and the total content of liquid C soluble material calculated. The waxy material is dissolved from this residue with methanol and the resulting solution is evaporated to dryness and weighed.

A.3 Apparatus and materials

A.3.1 Glass filter funnel.

A.3.2 Evaporating dishes (two).

A.3.3 Beaker, 250 cm.

A.3.4 Fuel evaporator, fitted with an extraction hood.

A.3.5 Ventilated drying oven, capable of being maintained at 85 °C ± 5 °C.

A.3.6 Balance, accurate to 0,1 mg.

A.3.7 Sintered-glass filter, porosity grade P3.

A.3.8 Liquid C, as specified in ISO 1817.

A.3.9 Methanol, minimum purity 99 %.

A.3.10 Metal stoppers, to seal the ends of the hoses/tubing.

A.4 Procedure

Take a length of hose or tubing between 300 mm and 500 mm in length and measure its internal dimensions. Plug one end with a metal stopper (A.3.10) and hang vertically. Fill this test piece fully with liquid C (A.3.8) and seal the top end with another metal stopper. Calculate the internal surface area in contact with liquid C taking into account the area in contact with the stoppers. Leave the test pieces for 24 h ± 30 min at 21 °C ± 2 °C.