

# INTERNATIONAL STANDARD

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**4639-2**

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

### **Part 2:** Oxygenated fuels

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

*Partie 2: Carburants oxygénés*



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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.

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 4639-2 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

ISO 4639 consists of the following parts, under the general title *Rubber tubing and hoses for fuel circuits for internal-combustion engines — Specification*:

- *Part 1: Conventional liquid fuels*
- *Part 2: Oxygenated fuels*
- *Part 3: Oxidized fuels*

Annexes A, B, C and D form an integral part of this part of ISO 4639.

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

## Part 2: Oxygenated fuels

### 1 Scope

This part of ISO 4639 specifies requirements for rubber tubing and hoses for use in fuel circuits using liquid fuels containing oxygenated compounds such as alcohols. It does not cover equipment used for the distribution of liquid fuels. The hoses and unreinforced tubing are used in conventional carburettor systems where fuel is unlikely to become oxidized. Moderate resistance to oxidized (sour) fuel is, however, provided.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4639. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 4639 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 188:1982, *Rubber, vulcanized — Accelerated ageing or heat-resistance tests.*

ISO 286-1:1988, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits.*

ISO 471:1995, *Rubber — Temperatures, humidities and times for conditioning and testing.*

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

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

ISO 3302:1990, *Rubber — Dimensional tolerances for use with products.*

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

ISO 4672:1988, *Rubber and plastics hoses — Sub-ambient temperature flexibility tests.*

ISO 6133:1981, *Rubber and plastics — Analysis of multi-peak traces obtained in determinations of tear strength and adhesion strength.*

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*.

ISO 8308:1993, *Rubber and plastics hoses and tubing — Determination of transmission of liquids through hose and tubing walls*.

### 3 Types of tubing and hoses

For the purpose of this part of ISO 4639, tubing and hoses are divided into three different types:

- Type 1: Tubing with a working pressure of up to 0,12 MPa inclusive;
- Type 2: Hoses with a working pressure in the range 0 to 0,12 MPa inclusive;
- Type 3: Hoses with a working pressure in the range 0 to 0,3 MPa inclusive.

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 120 °C;
- Grade B: operating in an environmental temperature of up to 140 °C.

Grade B tubing may be provided with a cover.

### 4 Tubing and hose bores

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

## 5 Sizes

### 5.1 Tubing

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

Tolerances shall be selected from the appropriate categories specified in ISO 3302: M3 for moulded hoses, E2 for extrusions.

**Table 1 — Tubing 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 1 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.

### 5.2 Hoses

When determined by the methods described in ISO 4671, 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             | ± 0,4      | 3,5            | 15               | ± 0,6     |
| 11            |            |                | 18               |           |
| 12            |            |                | 19               |           |
| 13            |            |                | 20               |           |
| 16            |            |                | 24               |           |
| 21            | ± 0,4      | 4              | 29               | ± 0,6     |
| 31,5          |            |                | 40               |           |
| 40            |            |                | 50               |           |
|               | +0,5<br>-1 | 4,25           |                  | ± 1       |
|               |            | 5              |                  |           |

**Table 3 — Hose concentricity**

Dimensions in millimetres

| Internal diameter       | Maximum variation from concentricity           |
|-------------------------|------------------------------------------------|
|                         | Ratio of internal diameter to overall diameter |
| Up to and including 3,5 | 0,4                                            |
| Over 3,5                | 0,8                                            |

## 6 Physical tests and specifications

### 6.1 Requirements for materials

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 determinations shall always be carried out on standard test slabs.

#### 6.1.1 Hardness

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

#### 6.1.2 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.

#### 6.1.3 Changes 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 6.1.1 and 6.1.2:

- Grade A tubing, hose cover and hose lining, and grade B hose lining:  $(72 \pm 2) \text{ h}$  at  $120 \text{ °C} \pm 2 \text{ °C}$ .
- Grade B tubing, tubing cover and hose cover:  $(72 \pm 2) \text{ h}$  at  $140 \text{ °C} \pm 2 \text{ °C}$ .

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

#### 6.1.4 Ozone resistance

After accelerated ageing in accordance with 6.1.3, when tested in accordance with the appropriate method in ISO 7326:1991, under the following conditions, the test piece shall show no signs of cracking when examined under a magnification of  $\times 2$  (see also table 4).

|                            |                                    |
|----------------------------|------------------------------------|
| Partial pressure of ozone: | $50 \text{ mPa} \pm 3 \text{ mPa}$ |
| Duration:                  | $(72 \pm 2) \text{ h}$             |
| Elongation                 |                                    |
| Hose covers and linings:   | 20 %                               |
| Tubing:                    | 50 %                               |
| Temperature                | $40 \text{ °C} \pm 2 \text{ °C}$   |

#### 6.1.5 Compression set

The compression set, when determined in accordance with ISO 815:1991, using the large (type A) test piece, under the conditions shown in table 4, shall comply with the values shown in table 4.

#### 6.1.6 Resistance to fuels

**WARNING — Fuels at elevated temperatures are extremely hazardous. Tests should be conducted under reflux in an explosion-proof hood.**

##### 6.1.6.1 Resistance to hydrocarbons (liquid C of ISO 1817:1985)

This requirement applies only to tubing and to the lining of hoses.

Any changes in hardness (see 6.1.1), tensile strength (see 6.1.2), elongation at break (see 6.1.2) and volume, when determined in accordance with the procedures specified in ISO 1817, after a period of  $(72 \pm 2) \text{ h}$  of immersion in liquid C at a temperature of  $60 \text{ °C} \pm 1 \text{ °C}$ , shall comply with the values shown in table 4.

##### 6.1.6.2 Resistance to oxygenated fuel

This requirement applies only to tubing and to the lining of hoses.

Any changes in hardness (see 6.1.1), tensile strength (see 6.1.2), elongation at break (see 6.1.2) and volume, when determined in accordance with the procedures specified in ISO 1817, after a period of  $(72 \pm 2) \text{ h}$  of immersion in a liquid comprising a mixture of 85 % by volume of liquid C (ISO 1817) and 15 % by volume of methanol, at a temperature of

60 °C ± 1 °C, shall comply with the values shown in table 4.

in annex A, at a temperature of 60 °C ± 1 °C, shall comply with the values shown in table 4.

### 6.1.6.3 Resistance to oxidized fuel

This requirement applies only to tubing and to the lining of hoses.

Any changes in hardness (see 6.1.1), tensile strength (see 6.1.2), elongation at break (see 6.1.2) and volume, when determined in accordance with the procedures specified in ISO 1817, after a period of 140 h ± 2 h of immersion in the test liquid specified

### 6.1.7 Resistance to oil No. 3

This requirement applies only to tubing and hose covers.

Any changes in tensile strength (see 6.1.2), elongation at break (see 6.1.2) and volume, when determined in accordance with the procedures specified in ISO 1817, after a period of (72  $\pm$  2) h immersion in oil No. 3 at a temperature of 120 °C ± 2 °C for grade A

**Table 4 — Requirements for materials**

| Subclause                                                     | Characteristic                                                                                                                                                             | Unit                       | Requirements for grade A and grade B                     |                                                          |                                                         |                                                          |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|
|                                                               |                                                                                                                                                                            |                            | Tubing                                                   | Cover, if required                                       | Hose lining                                             | Hose cover                                               |
| <b>6.1.1</b><br><b>6.1.1</b>                                  | Nominal hardness<br>Tolerance                                                                                                                                              | IRHD<br>IRHD               | 70<br>$\begin{smallmatrix} +10 \\ -10 \end{smallmatrix}$ | 70<br>$\begin{smallmatrix} +10 \\ -10 \end{smallmatrix}$ | 70<br>$\begin{smallmatrix} +5 \\ -10 \end{smallmatrix}$ | 70<br>$\begin{smallmatrix} +10 \\ -10 \end{smallmatrix}$ |
| <b>6.1.2</b><br><b>6.1.2</b>                                  | Tensile strength, min.<br>Elongation at break, min.                                                                                                                        | MPa<br>%                   | 10<br>250                                                | 10<br>250                                                | 8<br>200                                                | 7<br>200                                                 |
| <b>6.1.3</b>                                                  | Accelerated ageing<br>Change in hardness:<br>max. increase <sup>1)</sup><br>max. decrease<br>Reduction in tensile strength, max.<br>Reduction in elongation at break, max. | <br>IRHD<br>IRHD<br>%<br>% | <br>15<br>0<br>20<br>50                                  | <br>15<br>0<br>20<br>50                                  | <br>15<br>0<br>20<br>50                                 | <br>15<br>0<br>20<br>50                                  |
| <b>6.1.4</b>                                                  | Resistance to ozone                                                                                                                                                        |                            | No cracks at × 2 magnification                           |                                                          |                                                         |                                                          |
| <b>6.1.5</b>                                                  | Compression set, max.<br>(72 $\pm$ 2) h at 100 °C ± 1 °C                                                                                                                   | %                          | 50                                                       | 50                                                       | 50                                                      | 50                                                       |
| <b>6.1.6.1</b>                                                | Resistance to hydrocarbons<br>Reduction in hardness, max.<br>Reduction in tensile strength, max.<br>Reduction in elongation at break, max.<br>Increase in volume, max.     | IRHD<br>%<br>%<br>%        | 25<br>40<br>30<br>30                                     | —<br>—<br>—<br>—                                         | 25<br>40<br>30<br>30                                    | —<br>—<br>—<br>—                                         |
| <b>6.1.6.2</b>                                                | Resistance to oxygenated fuel<br>Reduction in hardness, max.<br>Reduction in tensile strength, max.<br>Reduction in elongation at break, max.<br>Increase in volume, max.  | IRHD<br>%<br>%<br>%        | 25<br>50<br>40<br>45                                     | —<br>—<br>—<br>—                                         | 25<br>50<br>40<br>45                                    | —<br>—<br>—<br>—                                         |
| <b>6.1.6.3</b>                                                | Resistance to oxidized fuel<br>Reduction in hardness, max.<br>Reduction in tensile strength, max.<br>Reduction in elongation at break, max.<br>Increase in volume, max.    | IRHD<br>%<br>%<br>%        | 25<br>50<br>40<br>45                                     | —<br>—<br>—<br>—                                         | 25<br>50<br>40<br>45                                    | —<br>—<br>—<br>—                                         |
| <b>6.1.7</b>                                                  | Resistance to oil No. 3<br>Reduction in tensile strength, max.<br>Reduction in elongation at break, max.<br>Change in volume:<br>max. increase<br>max. decrease            | <br>%<br>%<br>%<br>%<br>%  | <br>20<br>50<br>15<br>15                                 | <br>50<br>50<br>75<br>5                                  | <br>—<br>—<br>—<br>—                                    | <br>50<br>50<br>75<br>5                                  |
| 1) The absolute maximum is 90 IRHD and shall not be exceeded. |                                                                                                                                                                            |                            |                                                          |                                                          |                                                         |                                                          |