INTERNATIONAL STANDARD

ISO 4639-2

First edition
1995-06-15

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

INTERNATIONAL ISO

Reference number
ISO 4639-2:1995(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 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.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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 — Subambient 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

<table>
<tr><th>Bore diameter</th><th>Tolerance</th><th>Wall thickness</th><th>Outside diameter</th><th>Tolerance</th></tr>
<tr><td>3,5</td><td rowspan="10">± 0,3</td><td rowspan="8">3</td><td>9,5</td><td rowspan="10">± 0,4</td></tr>
<tr><td>4</td><td>10</td></tr>
<tr><td>5</td><td>11</td></tr>
<tr><td>6</td><td>12</td></tr>
<tr><td>7</td><td>13</td></tr>
<tr><td>7,5</td><td>13,5</td></tr>
<tr><td>8</td><td>14</td></tr>
<tr><td>9</td><td>15</td></tr>
<tr><td>11</td><td rowspan="3">3,5</td><td>18</td></tr>
<tr><td>12</td><td>19</td></tr>
<tr><td>13</td><td rowspan="3">± 0,4</td><td>20</td><td rowspan="3">± 0,6</td></tr>
<tr><td>16</td><td rowspan="2">4</td><td>24</td></tr>
<tr><td>21</td><td>29</td></tr>
<tr><td>31,5</td><td rowspan="2">$^{+0,5}_{-1}$</td><td>4,25</td><td>40</td><td rowspan="2">± 1</td></tr>
<tr><td>40</td><td>5</td><td>50</td></tr>
</table>

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: $(72\ ^{0}_{-2})$ h at 120 °C ± 2 °C.

— Grade B tubing, tubing cover and hose cover: $(72\ ^{0}_{-2})$ h at 140 °C ± 2 °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 × 2 (see also table 4).

Partial pressure of ozone:	50 mPa ± 3 mPa
Duration:	$(72\ ^{0}_{-2})$ h
Elongation	
Hose covers and linings:	20 %
Tubing:	50 %
Temperature	40 °C ± 2 °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 $(72\ ^{0}_{-2})$ h of immersion in liquid C at a temperature of 60 °C ± 1 °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 $(72\ ^{0}_{-2})$ 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.

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

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 $^{0}_{-2}$) 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
6.1.1 **6.1.1**	Nominal hardness Tolerance	IRHD IRHD	70 $^{+10}_{-10}$	70 $^{+10}_{-10}$	70 $^{+5}_{-10}$	70 $^{+10}_{-10}$
6.1.2 **6.1.2**	Tensile strength, min. Elongation at break, min.	MPa %	10 250	10 250	8 200	7 200
6.1.3	Accelerated ageing Change in hardness: max. increase[1)] max. decrease Reduction in tensile strength, max. Reduction in elongation at break, max.	 IRHD IRHD % %	 15 0 20 50	 15 0 20 50	 15 0 20 50	 15 0 20 50
6.1.4	Resistance to ozone		No cracks at × 2 magnification			
6.1.5	Compression set, max. (72 $^{0}_{-2}$) h at 100 °C ± 1 °C	%	50	50	50	50
6.1.6.1	Resistance to hydrocarbons Reduction in hardness, max. Reduction in tensile strength, max. Reduction in elongation at break, max. Increase in volume, max.	 IRHD % % %	 25 40 30 30	 — — — —	 25 40 30 30	 — — — —
6.1.6.2	Resistance to oxygenated fuel Reduction in hardness, max. Reduction in tensile strength, max. Reduction in elongation at break, max. Increase in volume, max.	 IRHD % % %	 25 50 40 45	 — — — —	 25 50 40 45	 — — — —
6.1.6.3	Resistance to oxidized fuel Reduction in hardness, max. Reduction in tensile strength, max. Reduction in elongation at break, max. Increase in volume, max.	 IRHD % % %	 25 50 40 45	 — — — —	 25 50 40 45	 — — — —
6.1.7	Resistance to oil No. 3 Reduction in tensile strength, max. Reduction in elongation at break, max. Change in volume: max. increase max. decrease	 % % % %	 20 50 15 15	 50 50 75 5	 — — — —	 50 50 75 5

1) The absolute maximum is 90 IRHD and shall not be exceeded.

and 140 °C ± 2 °C for grade B, shall comply with the values shown in table 4.

6.2 Requirements for finished products

6.2.1 Leak test

This requirement applies only to 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 286-1 and having a diameter equal to the appropriate value given in note 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. The other end of the metal tubing shall be closed and the other end of the rubber 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 (see also table 5).

6.2.2 Tension test

This requirement applies only to tubing.

A piece of rubber tubing shall be placed over the end of a piece of metal tubing in the manner described in 6.2.1. This assembly shall then be suspended from the metal tubing in 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.

The tubing shall not rupture nor slip off (see also table 5).

6.2.3 Minimum burst pressure

The minimum burst pressures, determined in accordance with the procedure in ISO 1402, shall comply with the values shown in table 5.

6.2.4 Adhesion

This requirement applies only to hoses.

The adhesion between components, both cover and lining to reinforcement, determined in accordance with the appropriate procedure in ISO 8033, shall comply with the values shown in table 5.

6.2.5 Low-temperature flexibility

The test shall be carried out in accordance with ISO 4672:1988, procedure B, under the following conditions:

Empty tubing or hose:	$(24\ _{-2}^{\ 0})$ h at − 25 °C ± 2 °C
Tubing or hose filled with liquid C:	$(72\ _{-2}^{\ 0})$ h at − 40 °C ± 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 started.

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

After flexing, the tubing or hose shall show no signs of cracking when examined under × 2 magnification (see also table 5).

NOTE 2 The "empty" test, which is widely used by industry, is included only as a referee test.

6.2.6 Cleanliness

The amount of impurities, determined in accordance with annex B, shall comply with the values shown in table 5.

6.2.7 Determination of waxy products extracted by liquid C

The amount of waxy products extractable, determined in accordance with annex B, shall comply with the values shown in table 5.

6.2.8 Permeability to liquid C

The values of permeability to liquid C, determined in accordance with the procedure in ISO 8308, for 100 h ± 2 h at 40 °C ± 1 °C, shall comply with the values shown in table 5.

6.2.9 Tear resistance

This requirement applies only to tubing.

The resistance to tearing, determined in accordance with annex C, shall comply with the values shown in table 5.

6.2.10 Suction resistance

The test shall be carried out on straight hoses only, using ISO 7233:1991, procedure A, under the following conditions:

Vacuum:	80 kPa
Duration:	15 s to 60 s
Ball diameter:	0,8 × nominal bore

The ball shall traverse the full length of the hose (see also table 5).

6.2.11 Resistance to kinking

This requirement applies only to straight tubing and hoses of 16 mm bore size or less.

The test shall be carried out in accordance with the procedure in ISO 1746, using mandrel diameters as follows:

— for tubing and hoses of 7 mm up to and including 11 mm diameter: 140 mm;

— for tubing and hoses of 12 mm up to and including 16 mm diameter: 220 mm.

The coefficient of deformation T/D shall comply with the values given in table 5.

6.2.12 Long-term resistance to oxygenated fuel

Tubing or hose test pieces are subjected to long-term circulation of oxygenated fuel for 1 000 h at 60 °C ± 1 °C in accordance with annex D.

One test piece is then subjected sequentially to the tests in 6.2.12.1 to 6.2.12.4.

A second test piece is subjected to the test in 6.2.12.5.

A third test piece is subjected to the test in 6.2.12.6.

6.2.12.1 Suction resistance: When tested in accordance with the procedure in 6.2.10, the ball shall traverse the full length of the hose (see also table 5).

6.2.12.2 Resistance to kinking: The coefficient of deformation T/D, determined in accordance with 6.2.11, shall comply with the values given in table 5.

6.2.12.3 Ozone resistance: When tested in accordance with method 2 of ISO 7326:1991, under the following conditions, the test piece shall show no signs of cracking when examined under a magnification of × 2 (see also table 5):

Partial pressure of ozone:	50 mPa ± 3 mPa
Duration:	$(72\ ^{0}_{-2})$ h
Elongation	
Hose covers and linings:	20 %
Tubing:	50 %
Temperature:	40 °C ± 2 °C

6.2.12.4 Minimum burst pressure: The minimum burst pressure, determined in accordance with 6.2.3, shall comply with the values shown in table 5.

6.2.12.5 Adhesion: The adhesion between components, both cover and lining to reinforcement, when determined in accordance with 6.2.4 using the second test piece specified in 6.2.12, shall comply with the values shown in table 5.

6.2.12.6 Low-temperature flexibility: When tested in accordance with 6.2.5, the third test piece specified in 6.2.12 shall show no signs of cracking under × 2 magnification (see also table 5).

6.2.13 Change in properties after accelerated ageing

A test piece of tubing or hose of suitable length, bent into a free loop approximately 250 mm in diameter until its ends meet, is aged in an air-circulating oven for $(72\ ^{0}_{-2})$ h at 150 °C ± 3 °C. At the end of the ageing period, the test piece is straightened over a period of 4 s to 8 s. After straightening, it shall show no signs of cracking or disintegration, internally or externally, when examined under × 2 magnification (see also table 5).

7 Marking

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

a) fuel;

b) the manufacturer's name or trade mark;

c) the number and date of this part of ISO 4639;

d) the type and grade;

e) the month and year of manufacture;

f) the bore.

EXAMPLE

FUEL; MN; ISO 4639-2:1995; 2B; 08/1995; 7 mm

Table 5 — Requirements for finished products

Subclause	Characteristic	Unit	Requirement: Tubing	Requirement: Hose
6.2.1	Leak test	—	No leak	—
6.2.2	Tension test	—	No rupture; shall not slip off	—
6.2.3	Minimum burst pressure	MPa	0,5	3,0
6.2.4	Adhesion (cover and lining to reinforcement) Separation force, min.	kN/m	—	1,5
6.2.5	Low-temperature flexibility	—	No cracks at × 2 magnification	
6.2.6	Cleanliness Insoluble impurities, max. Fuel-soluble solids, max.	 g/m^2 g/m^2	 5 3	 5 3
6.2.7	Waxy extractables, max.	g/m^2	1,5	1,5
6.2.8	Permeability to liquid C	cm^3/m^2	25	25
6.2.9	Tear resistance, min.	kN/m	6	—
6.2.10	Suction resistance	—	Ball shall traverse the full length of the hose	
6.2.11	Resistance to kinking Coefficient of deformation T/D, min.	—	0,7	0,7
6.2.12	Long-term resistance to oxygenated fuel			
6.2.12.1	Suction resistance	—	Ball shall traverse the full length of the hose	
6.2.12.2	Resistance to kinking Coefficient of deformation T/D, min.	—	0,7	0,7
6.2.12.3	Resistance to ozone	—	No cracks at × 2 magnification	
6.2.12.4	Minimum burst pressure	MPa	—	1,2
6.2.12.5	Adhesion (cover and lining to reinforcement) Separation force, min.	kN/m	—	0,8
6.2.12.6	Low-temperature flexibility	—	No cracks at × 2 magnification	
6.2.13	Accelerated ageing	—	No cracking or disintegration internally or externally at × 2 magnification	

Annex A
(normative)

Preparation of oxidized-fuel test liquid

A.1 Scope

This annex specifies a method of preparing oxidized ("sour") gasoline test solutions for use in the determination of their effects on elastomeric, plastic and metallic materials and components. The annex covers the preparation of a solution with peroxide number PN90 using a mixture of a *t*-butyl hydroperoxide (70 % aqueous solution), soluble cupric ion $(0{,}01\ \text{mg/dm}^3)$ and a base fuel consisting of 80 % ISO 1817 liquid C, 15 % methanol and 5 % 2-methylpropan-2-ol (*t*-butyl alcohol), by volume. Other base fuels and peroxide numbers may be used as required by the engineering drawing or specification, but it should be noted that some base fuels may give rise to separation of the aqueous phase of the hydroperoxide solution.

This annex also describes the determination of the peroxide number of fuel.

A.2 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

A.2.1 *t*-Butyl hydroperoxide, 70 % aqueous solution, $\rho = 0{,}935\ \text{g/cm}^3$.

A.2.2 Cupric ion concentrate, solution of cupric naphthenate containing 6 % to 12 % by mass of copper in an appropriate hydrocarbon solvent.

A.2.3 2,2,4-trimethylpentane (iso-octane).

CAUTION — Low flash point.

A.2.4 Toluene.

CAUTION — Low flash point.

A.2.5 Methanol.

CAUTION — Low flash point.

A.2.6 2-Methylpropan-2-ol (*t*-butyl alcohol).

CAUTION — Low flash point.

A.3 Apparatus

A.3.1 Polyethylene bottle, capacity 1 000 ml, wide-mouth, with screw cap.

A.3.2 Glass volumetric flasks, capacity 1 000 cm^3.

A.3.3 Graduated glass pipettes, capacity 10 cm^3.

A.3.4 Graduated glass measuring cylinders, capacity 100 cm^3 and 1 000 cm^3.

A.4 Procedure

CAUTION — This procedure must be carried out under a fume hood. Eye protection and disposable plastic gloves must be worn.

A.4.1 Preparation of test liquids

A.4.1.1 Base fuel mixture

Prepare ISO 1817 liquid C by mixing equal volumes of 2,2,4-trimethylpentane (A.2.3) and toluene (A.2.4). Store in a dark-glass bottle.

Mix the ISO 1817 liquid C, methanol (A.2.5) and 2-methylpropan-2-ol (A.2.6) in the ratio 80:15:5 by volume to make the base fuel. Store in a dark-glass bottle.

A.4.1.2 Cupric ion stock solution (1 mg/dm³)

Add the appropriate volume of cupric ion concentrate (A.2.2) to base fuel to produce 1 000 cm^3 of a 1,140 mg/cm^3 cupric ion solution (Cu-1). Store in a dark-glass bottle.

Add 100 cm^3 of Cu-1 to 1 040 cm^3 of base fuel to produce a 0,1 mg/cm^3 cupric ion solution (Cu-2). Store in a dark-glass bottle.

Add 10 cm^3 of Cu-2 to 990 cm^3 of base fuel to produce a 1,0 mg/dm^3 cupric ion stock solution (CSS). Store in a dark-glass bottle.

A.4.1.3 Preparation of oxidized-fuel test liquid

Use the mixture specified in table A.1 to produce an oxidized-gasoline test liquid of the required working strength. Store in a polyethylene bottle in the dark for no longer than 4 weeks. Check the peroxide number immediately after mixing and before subsequent use by means of the titrimetric test method described in A.5.

Add the *t*-butyl hydroperoxide solution (A.2.1) and cupric ion stock solution (CSS) (A.4.1.2) to 500 cm^3 of base fuel in a 1 000 cm^3 volumetric flask (A.3.2), then make up to 1 000 cm^3 with base fuel, shaking well to dissolve the water from the hydroperoxide solution in the alcohol phase of the base fuel.

Table A.1 — Preparation of oxidized-fuel test liquid

Desired peroxide number	70 % *t*-butyl hydroperoxide solution	Cupric ion stock solution (CSS)	Base fuel
90 PN	12,39 cm^3	10 cm^3	to 1 000 cm^3

NOTE 3 1 peroxide number (PN) = 1 $mmol/dm^3$

Recheck the PN of the test liquid after every 70 h of use. If it falls below 80 PN, replace the old test liquid with fresh test liquid.

A.5 Titrimetric determination of the peroxide number of oxidized-fuel test liquid

A.5.1 Scope

This clause specifies a titrimetric method for determining the peroxide number of oxidized ("sour") gasoline test liquids prepared using the procedure contained in A.4.

The method can be used to determine the peroxide number of the oxidized-gasoline test liquid during the course of an immersion test. However, the following precautions shall be observed:

a) Most immersion tests involving elastomers will result in the test liquid becoming yellowed by the extraction of additives in the rubber. This shall be taken into account when determining the end-point of the titration.

b) The additives extracted from the material under test may themselves be capable of liberating free iodine from the iodide solution. A blank shall therefore be carried out in a duplicate immersion test using the base fuel containing no hydroperoxide.

The method can also be used (with certain precautions) to measure the depletion of the peroxide number during the course of immersion tests using the test liquid so that the need to replenish the test liquid can be determined.

A.5.2 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

A.5.2.1 Potassium iodide, 100 g/dm^3 solution. Store in a dark-glass reagent bottle. Discard if the solution gives a peroxide number of 2 when carrying out a blank titration.

A.5.2.2 Sodium thiosulfate, standard volumetric solution, $c(Na_2S_2O_3) = 0,1\ mol/dm^3$.

A.5.2.3 Ethanoic acid/propan-2-ol mixture.

Mix 100 ml of glacial ethanoic acid with 1 150 ml of propan-2-ol. Store in a glass bottle.

A.5.3 Apparatus

A.5.3.1 Conical (Erlenmeyer) flask, capacity 250 cm^3, with ground-glass neck.

A.5.3.2 Condenser, Allihn or Liebig water-cooled type, with ground-glass joint to fit the conical flask (A.5.3.1).

A.5.3.3 Graduated glass measuring cylinder, capacity 100 cm^3.

A.5.3.4 Hotplate, or other means of heating, suitable for heating the conical flask with condenser fitted to reflux the reagents.

A.5.3.5 Glass burette, capacity 10 cm^3.

A.5.4 Procedure

A.5.4.1 Add 25 cm^3 of ethanoic acid/propan-2-ol mixture (A.5.2.3) to a 250 cm^3 conical flask (A.5.3.1).