
Rubber- or plastics-coated fabrics — Determination of resistance to liquids

*Supports textiles revêtus de caoutchouc ou de plastique —
Détermination de la résistance aux liquides*

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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.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 248, *Textile and textile products*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 6450:2005), which has been technically revised.

The main changes compared to the previous edition are as follows:

- one surface side immersion with liquid has been added as method B;
- in [Clause 10](#) e), the requirement to include CAS registry number when it is available has been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Rubber- or plastics-coated fabrics — Determination of resistance to liquids

WARNING — Persons using this document should be familiar with normal laboratory practice. This document 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 document specifies two methods of evaluating the resistance of rubber- or plastics-coated fabrics to the action of liquids by measurement of selected properties of the materials before and after immersion in selected liquids.

The two methods are as follows:

- Method A: total immersion with liquid;
- Method B: one surface side immersion with liquid.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2231:1989, *Rubber- or plastics-coated fabrics — Standard atmospheres for conditioning and testing*

ISO 2286-1, *Rubber- or plastics-coated fabrics — Determination of roll characteristics — Part 1: Methods for determination of length, width and net mass*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Principle

This document provides a procedure for exposing test pieces to the influence of liquids under defined conditions of temperature and time. Selected properties are determined in accordance with the relevant test method standards. Test pieces are then immersed in selected liquid(s) and the properties determined again. The percentage change or the values before and after immersion are measures of the resistance of the material to the selected liquid(s).

5 Test liquids for method A and B

SAFETY PRECAUTIONS — Appropriate safety precautions should be taken when preparing and handling test liquids, especially those known to be toxic, corrosive or flammable. Products giving off fumes should be handled only under an efficiently ventilated hood, corrosive products should not be allowed to come into contact with the skin or ordinary clothing, and flammable products should be kept away from any source of ignition.

In addition, attention is drawn to the damage which can be caused by corrosive test liquids to test equipment (e.g. clamps or jaws).

As it is possible that commercial liquids do not have an entirely constant composition, a standard immersion liquid consisting of a well-defined chemical compound or a mixture of such compounds should preferably be used. Suitable liquids are given in [Annex A](#).

If a commercial liquid is used, the test report shall mention all the available information about its origin, composition, properties (e.g. viscosity, aniline point) and batch number.

For test purposes, it is usually desirable to use the liquid(s) with which the coated fabric will come into contact during use. When determining the effect of solutions of chemicals, the concentration of the solution should be appropriate to the proposed application.

6 Test conditions for method A and B

6.1 Temperature

Where appropriate, use an immersion temperature T approximating to that encountered during use. Maintain the immersion temperature at $(T \pm 2) ^\circ\text{C}$.

Preferred immersion temperatures are given in [Annex B](#).

6.2 Immersion period

The following immersion periods are recommended:

- 22 h $\pm$ 0,25 h;
- 46 h $\pm$ 0,25 h;
- 72 h $\pm$ 2 h;
- 168 h $\pm$ 2 h;
- multiples of 7 days $\pm$ 2 h.

When determining changes in physical properties, it is advisable to use a period of immersion which is long enough to ensure that equilibrium is reached. To determine this equilibrium point, it is recommended that preliminary measurements be carried out using several different periods of immersion, recording the results as a function of time. Whenever practicable, the total period of immersion should extend well beyond the point at which the change in a property reaches its maximum value.

6.3 Light

Immersion tests shall be conducted in the absence of direct light.

6.4 Time interval between manufacturing and testing

For fabrics coated on one side only, a minimum of 16 h exposure is recommended.

For fabrics coated on both sides, a minimum of 24 h exposure is recommended.

For all test purposes, the minimum time between the manufacture and testing shall be 16 h. For non-product tests, the maximum time between manufacture and testing shall be four weeks and for evaluations intended to be comparable, the tests, as far as possible, shall be carried out after the same time-interval.

For products, unless otherwise agreed between the interested parties, the time between the manufacture and testing shall not exceed 3 months.

7 Atmosphere for conditioning and testing for method A and B

7.1 For conditioning

The atmosphere shall be applied the method of conditioning “1” specified in ISO 2231:1989. For fabrics coated on one side only, a minimum of 16 h exposure is recommended. For fabrics coated on both sides, a minimum of 24 h is recommended.

7.2 For testing

The atmosphere shall be selected from A to E specified in ISO 2231:1989. If it is necessary to control both temperature and humidity, select the atmosphere from A to C.

NOTE The temperature 23 °C is normally the testing atmosphere in temperate countries and 27 °C is normally in tropical and subtropical countries.

8 Method A — Total immersion with liquid

8.1 Apparatus

The apparatus to be used is determined by the temperature of immersion, the volatility of the test liquid, the dimensions of the test pieces and the number required for determining the selected property. At temperatures appreciably below the boiling point of the test liquid, use a stoppered vessel, for example, a glass bottle or tube, of such dimensions that the test pieces remain completely immersed in the specified volume of test liquid and all surfaces are completely exposed to the liquid without any restriction. At temperatures near the boiling point of the test liquid, fit the vessel with a reflux condenser, or other suitable means of minimizing evaporation of the test liquid, instead of the stopper.

8.2 Preparation of test pieces

Select properties that are considered relevant to the end-use (e.g. tensile strength, coating adhesion, mass per unit area, tear resistance and/or low-temperature properties).

For each property, cut from the usable width of the roll (in accordance with ISO 2286-1) two sets of test pieces as specified in the relevant test method standard.

NOTE Some commonly used test method standards, such as ISO 1421, ISO 2411, ISO 2286-2, ISO 4674-1, ISO 4674-2 and ISO 4675, are given in the Bibliography.

Condition all the test pieces in accordance with [7.1](#).

8.3 Determination of original properties before immersion

Determine the selected properties on the first set of test pieces using the relevant test method standards.

8.4 Immersion

Place the test piece, suitably separated, in a vessel as described in 8.1, with a volume of test liquid (see Clause 5) that is at least 15 times the combined volume of the test pieces and sufficient to keep them totally immersed. If the conditions of the test do not necessitate the use of a reflux condenser, stopper the vessel. Maintain the test liquid at the immersion temperature T , within a tolerance of ± 2 °C, during the whole of the exposure period.

8.5 Preparation of test pieces for redetermination of properties after immersion

8.5.1 Procedure A1

8.5.1.1 Removal of excess liquid by wiping

At the end of the immersion period, bring the test pieces, if necessary, to the test temperature, preferably by quickly transferring them to a fresh portion of test liquid at this temperature and allowing to stand for 5 min to 10 min.

Take the test pieces out of the test liquid and remove any liquid remaining on the surface of the test pieces using a suitable method. The method of removing the liquid may vary with the nature of the liquid. When mobile, volatile liquids like 2,2,4-Trimethylpentane(iso-octane) and toluene are used, wipe the test pieces with a filter paper or a piece of lint-free fabric. Some difficulty may be experienced in removing viscous, non-volatile liquids completely by this method, and it may be necessary to dip the test pieces quickly in a suitable volatile liquid such as methanol and wipe them again with filter paper or lint-free fabric.

Visually assess the appearance of the test pieces against a piece of non-immersed material and the appearance of the test liquid before and after the immersion. Note and report whether any change has occurred or not and describe any changes observed.

8.5.1.2 Determination of properties after immersion and wiping

Immediately after removal of the liquid, measure the selected physical properties in accordance with the relevant standards.

8.5.2 Procedure A2

8.5.2.1 Drying of the test pieces

At the end of the specified immersion period, remove the test pieces and hang them in a circulating-air oven at a temperature of $70\text{ °C} \pm 2\text{ °C}$ for a period of $2\text{ h} \pm 0,1\text{ h}$. At the end of this drying period, remove the test pieces from the oven and allow them to cool to room temperature.

Visually assess the appearance of the test pieces against a piece of non-immersed material and the appearance of the test liquid before and after the immersion. Note and report whether any change has occurred or not and describe any changes observed.

8.5.2.2 Determination of properties after immersion and drying

The time interval between removal of the test pieces from the oven and testing shall not be less than 1 h and not more than 2 h. Measure the selected physical property in accordance with the relevant standard.

8.6 Expression of results

Report the values measured before and after immersion or report the change in the values as a percentage of the original value determined before immersion.

9 Method B — One surface side immersion with liquid

9.1 General

This test is applicable to sheet materials used for the products such as diaphragms, container bags or an inner liner of containers which are exposed to liquid on one surface only during use.

9.2 Apparatus

Capable of holding the test piece in contact with the liquid on only one of its surfaces. A suitable apparatus is illustrated in [Figure 1](#) as an example. It comprises a base-plate (1) and an open-ended cylindrical chamber (2), which is held tightly against the test piece (3) by wing nuts (4) mounted on bolts (5). A hole of approximately 30 mm diameter is allowed in the base-plate for examination of the surface not in contact with the liquid. During the test, the opening on the top of the chamber shall be closed by a close-fitting plug (6).

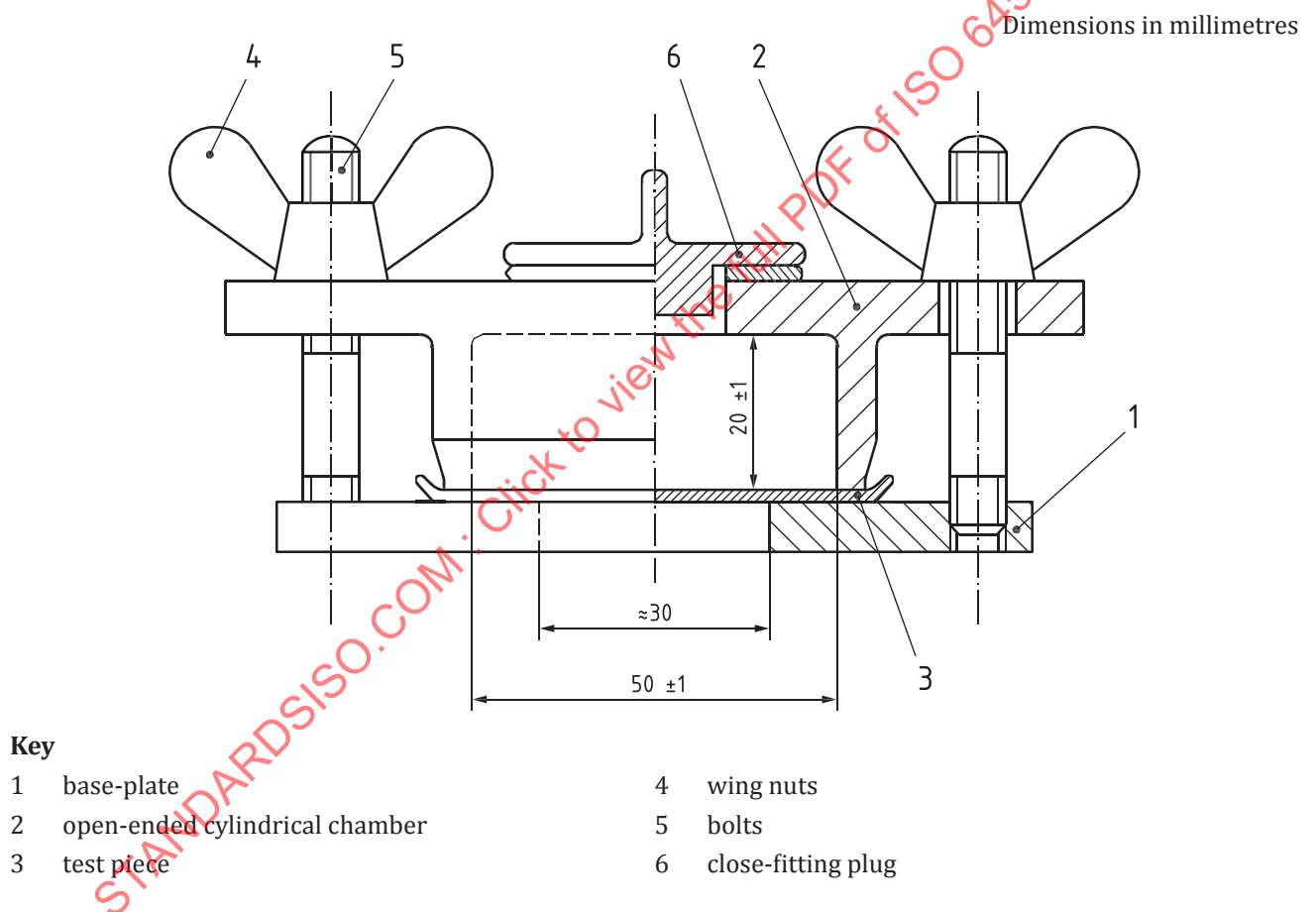


Figure 1 — Example of the apparatus for method B

9.3 Preparation of test pieces

Prepare the test pieces as specified in [8.2](#).

The test piece shall have the inner diameter of the open-ended cylindrical chamber plus 10 mm in drill diameter (it is 60 mm when the apparatus in [Figure 1](#) is used).

9.4 Determination of original properties before immersion

Determine the original properties as specified in [8.3](#).

9.5 Immersion

Place the test piece in the apparatus as indicated in [Figure 1](#). Fill the chamber of the apparatus with the test liquid to a depth of approximately 15 mm and insert the plug (6). Maintain the apparatus at the required temperature for the duration of the test.

At the end of the contact period, bring the apparatus, if necessary, to the standard laboratory temperature. Remove the liquid and release the test piece.

9.6 Preparation of test pieces for redetermination of properties after immersion

9.6.1 Procedure B1

9.6.1.1 Removal of excess liquid by wiping

After releasing the test pieces, remove any liquid remaining on the surface of the test pieces using a suitable method. The method of removing the liquid may vary with the nature of the liquid. When mobile, volatile liquids like 2,2,4-Trimethylpentane(iso-octane) and toluene are used, wipe the test pieces with a filter paper or a piece of lint-free fabric. Some difficulty may be experienced in removing viscous, non-volatile liquids completely by this method, and it may be necessary to wipe the test pieces again with the filter paper or lint-free fabric quickly dipped with a suitable volatile liquid such as methanol.

Visually assess the appearance of the test pieces against a piece of non-immersed material and the appearance of the test liquid before and after the immersion. Note and report whether any change has occurred or not and describe any changes observed.

9.6.1.2 Determination of properties after immersion and wiping

Immediately after removal of the liquid, measure the selected physical properties in accordance with the relevant standards.

9.6.2 Procedure B2

9.6.2.1 Drying of the test pieces

After releasing the test pieces, hang them in a circulating-air oven at a temperature of $70\text{ °C} \pm 2\text{ °C}$ for a period of $2\text{ h} \pm 0,1\text{ h}$. At the end of this drying period, remove the test pieces from the oven and allow them to cool to room temperature.

Visually assess the appearance of the test pieces against a piece of non-immersed material and the appearance of the test liquid before and after the immersion. Note and report whether any change has occurred or not and describe any changes observed.

9.6.2.2 Determination of properties after immersion and drying

The time interval between removal of the test pieces from the oven and testing shall not be less than 1 h and not more than 2 h. Measure the selected physical property in accordance with the relevant standard.

9.7 Expression of results

Report the values measured before and after immersion or report the change in the values as a percentage of the original value determined before immersion.

10 Test report

The test report shall include the following information:

- a) a reference to this document including its year of publication, i.e. ISO 6450:2021;
- b) the date of the test;
- c) the conditioning and test atmosphere;
- d) all details necessary for identification of the coated fabric tested;
- e) a description of the test liquid (see [Clause 5](#)), including CAS Number when it is available;
- f) the method used (method A followed by A1 or A2 , or method B followed by B1 or B2);
- g) the immersion temperature;
- h) the immersion period;
- i) a description of the appearance of the test pieces after immersion;
- j) a description of the appearance of the immersed liquid after immersion;
- k) the values of the measured properties before and after immersion, or the percentage changes in the properties;
- l) any deviation from the specified procedure.

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Annex A (informative)

Reference liquids

WARNING — Appropriate safety precautions should be taken when preparing and handling test liquids, especially those known to be toxic, corrosive or flammable. Products giving off fumes should be handled only under an efficiently ventilated hood, corrosive products should not be allowed to come into contact with the skin or ordinary clothing, and flammable products should be kept away from any source of ignition.

A.1 Standard simulated fuels

Commercial fuels vary widely in composition even within the same grade (i.e. knock rating) and from the same source. There are hydrocarbon-based fuels with and without oxygen compounds as well as alcohol-based fuels. The grade of gasoline is improved by adding aromatic or oxygen-containing compounds, but these additives increase the effect of fuels on normally fuel-resistant rubbers. The composition varies with the situation on the gasoline market and with the geographical area and can change rapidly. Hence, several test liquids which are used in practice are recommended in [Tables A.1](#) and [A.2](#) to cover the range of different compositions. They may also serve as guidelines for the formulation of other suitable test liquids. Analytical reagent quality materials shall be used in making up the test liquids. Test liquids containing alcohol shall not be used if the fuels involved are known to be free of alcohol.

Table A.1 — Standard simulated fuels without oxygen compounds

Liquid	Constituents	CAS registry number	Content % (by volume)
A	2,2,4-Trimethylpentane	540-84-1	100
B	2,2,4-Trimethylpentane	540-84-1	70
	Toluene	108-88-3	30
C	2,2,4-Trimethylpentane	540-84-1	50
	Toluene	108-88-3	50
D	2,2,4-Trimethylpentane	540-84-1	60
	Toluene	108-88-3	40
E	Toluene	108-88-3	100
F	Straight-chain paraffins (C ₁₂ to C ₁₈)	68476-34-6	80
	1-Methylnaphthalene	90-12-0	20

NOTE Liquids B, C and D simulate petroleum-derived fuels without oxygen compounds. Liquid F is intended to simulate diesel fuel, domestic heating oils and similar light furnace oils.

Table A.2 — Standard simulated fuels containing oxygen compounds (alcohols)

Liquid	Constituents	CAS registry number	Content % (by volume)
1	2,2,4-Trimethylpentane	540-84-1	30
	Toluene	108-88-3	50
	Di-isobutylene	25167-70-8	15
	Ethanol	64-17-5	5
2	2,2,4-Trimethylpentane	540-84-1	25,35 ^a
	Toluene	108-88-3	42,25 ^a
	Di-isobutylene	25167-70-8	12,68 ^a
	Ethanol	64-17-5	4,22 ^a
	Methanol	67-56-1	15,00
	Water	7732-18-5	0,50
3	2,2,4-Trimethylpentane	540-84-1	45
	Toluene	108-88-3	45
	Ethanol	64-17-5	7
	Methanol	67-56-1	3
4	2,2,4-Trimethylpentane	540-84-1	42,5
	Toluene	108-88-3	42,5
	Methanol	67-56-1	15
5	2,2,4-Trimethylpentane	540-84-1	43
	Toluene	108-88-3	43
	Methyl <i>tert</i> -butyl ether ^b	1634-04-4	10
	Ethanol	64-17-5	2
	Methanol	67-56-1	2

a Together, these four constituents are equivalent to 84,5 % (by volume) of liquid 1 above.

b Occasionally, dimethyl ether is used.

A.2 Reference oils

A.2.1 General descriptions

Oil No.1 (IRM 901) is a “low volume increase” oil, oil No. 2 (IRM 902) is a “medium volume increase” oil and oil No. 3 (IRM 903) is a “high volume increase” oil.

These reference oils are representative of low-additive mineral oils.

NOTE IRM stands for Industrial Reference Material.

A.2.2 Requirements

The oils shall contain no additives except, possibly, a trace (approximately 0,1 %) of a pour-point depressant, and shall have the properties specified in [Table A.3](#). The properties given in [Table A.4](#) are typical of the oils but cannot be guaranteed by suppliers.

When these reference oils are required as test liquids, only those obtained from recognized suppliers shall be used for referee purposes and they shall be available for general use. However, in the event that they are not available, alternative oils can be used for routine testing only, provided that they comply with the requirements of [Table A.3](#) and also have shown to give results similar to those obtained with the reference oils when testing rubbers of the same type of composition as those on which the routine tests are to be carried out.

Table A.3 — Specifications of reference oils

Property	Requirements		
	Oil No. 1	Oil No. 2	Oil No. 3
Aniline point, °C	124 ± 1	93 ± 3	70 ± 1
Kinematic viscosity, m ² /s (× 10 ⁻⁶)	18,12 to 20,34 ^a	19,2 to 21,5 ^a	31,9 to 34,1 ^b
Flash point, °C, min.	243	232	163
API ^c gravity at 16 °C	27,8 to 29,8	19,0 to 21,0	21,0 to 23,0
Viscosity-gravity constant	0,790 to 0,805	0,860 to 0,870	0,875 to 0,885
Naphthenics content, c _N , %	27 (average)	35, min.	40, min.
Paraffinics content, c _P , %	65, min.	50, max.	45, max.
^a Measured at 99 °C.			
^b Measured at 37,8 °C.			
^c API stands for The American Petroleum Institute.			

Table A.4 — Typical properties of reference oils

Property	Requirements		
	Oil No. 1	Oil No. 2	Oil No. 3
Pour point, °C	-12	-12	-31
ASTM colour	L3,5	L2,5	L0,5
Refractive index at 20 °C	1,484 8	1,510 5	1,502 6
UV absorbance at 260 nm	0,8	4,0	2,2
Aromatics content, c _A , %	3	12	14

A.3 Simulated service liquids

A.3.1 General

NOTE Liquid 102 has been removed from the present edition of this document because no supplier can be found. For information, the composition of the liquid is given below.

Liquid 102 is intended to simulate certain high pressure hydraulic oils. It is a blend comprising 95 % (by mass) of oil No. 1 and 5 % (by mass) of a hydrocarbon-compound oil additive containing 29,5 % (by mass) to 33 % (by mass) of sulfur, 1,5 % to 2 % (by mass) of phosphorus and 0,7 % (by mass) of nitrogen.

A.3.2 Liquid 101

Liquid 101 is intended to simulate synthetic di-ester-type lubricating oils. It is a blend comprising 99,5 % (by mass) of di-2-ethylhexyl sebacate (CAS registry number: 122-62-3) and 0,5 % (by mass) of phenothiazine (CAS registry number: 92-84-2).

A.3.3 Liquid 103

Liquid 103 is intended to simulate phosphate-ester hydraulic oils used in aircraft. It is tri-n-butyl phosphate (CAS registry number: 126-73-8).

A.4 Chemical reagents

Tests with chemical reagents shall be carried out using the same chemicals at the same concentrations as those to be encountered in the intended use of the product. For general purposes, where no specification is known, the list of chemical reagents given in ISO 175 can be useful.