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Rubber, vulcanized or thermoplastic — Determination of the effect of liquids

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National foreword

This British Standard is the UK implementation of ISO 1817:2024. It supersedes BS ISO 1817:2022, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/22, Testing and analysis of rubber.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Apparatus ... **1**
4.1 General ... 1
4.2 Apparatus for method A ... 2
4.3 Apparatus for method B ... 3
4.4 Apparatus for method C ... 3
4.4.1 General ... 3
4.4.2 With air contact ... 4
4.4.3 Without air contact ... 4
4.5 Apparatus for method D ... 5
4.6 Apparatus for method E ... 6
4.7 Additional equipment ... 7
5 Calibration ... **7**
6 Test liquids ... **8**
7 Test pieces ... **9**
7.1 Preparation ... 9
7.2 Dimensions ... 9
7.3 Time interval between vulcanization and testing ... 9
7.4 Conditioning ... 9
8 Immersion in the test liquid ... **10**
8.1 Temperature ... 10
8.2 Duration ... 10
9 Procedure ... **10**
9.1 General ... 10
9.2 Replacement of test liquid ... 11
9.3 Change in mass ... 11
9.4 Change in volume ... 12
9.5 Change in dimensions ... 12
9.6 Change in surface area ... 13
9.7 Change in hardness ... 14
9.8 Change in tensile stress-strain properties ... 15
9.9 Testing with liquid on one surface only ... 15
9.10 Determination of extractable matter ... 16
9.10.1 General ... 16
9.10.2 By weighing the dried test piece ... 16
9.10.3 By evaporating the test liquid ... 16
10 Precision ... **16**
11 Test report ... **16**
Annex A (normative) **Reference liquids** ... **18**
Annex B (normative) **Calibration schedule** ... **23**
Annex C (informative) **Precision** ... **25**
Bibliography ... **31**

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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 document 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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This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This eighth edition cancels and replaces the seventh edition (ISO 1817:2022), which has been technically revised.

The main changes are as follows:

— Clause 4: examples for methods A and C added;

— Clause 6: text added for metalworking fluids;

— 9.6: a method added to enable very short periods between taking the samples out of a liquid and registration of the surface change by the use of photography.

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Introduction

The action of a liquid on vulcanized or thermoplastic rubber can generally result in:

a) absorption of the liquid by the rubber;

b) extraction of soluble constituents from the rubber;

c) a chemical reaction with the rubber.

The amount of absorption [a)] is usually larger than that of extraction [b)], so that the net result is an increase in volume, commonly termed “swelling”. The absorption of liquid can profoundly alter physical and chemical properties and hence change tensile strength, extensibility and hardness of the rubber, so it is important to measure these properties after treatment of the rubber. The extraction of soluble constituents, especially plasticizers and antidegradants can likewise alter the rubber's physical properties and chemical resistance after drying (assuming the liquid to be volatile). Therefore, it is necessary to test these properties following immersion and drying of the rubber. This document describes the methods necessary for determining the following properties after immersion and after immersion and drying:

— change in mass, volume and dimensions;

— extractable matter;

— change in hardness and tensile stress-strain properties.

Although in some respects these tests can simulate service conditions, no direct correlation with service behaviour is implied. Thus, the rubber giving the lowest change in volume is not necessarily the best one in service. The thickness of the rubber needs to be taken into account, since the rate of penetration of liquid is time-dependent and the bulk of a very thick rubber product can remain unaffected for the whole of the projected service life, especially with viscous liquids. Moreover, it is known that the action of a liquid on rubber, especially at high temperatures, can be affected by the presence of atmospheric oxygen. The tests described in this document can, however, provide valuable information on the suitability of a rubber for use with a given liquid and, in particular, constitute a useful control when used for developing rubbers resistant to oils, fuels or other service liquids.

The effect of a liquid can depend on the nature and magnitude of any stress within the rubber. In this document, test pieces are tested in an unstressed condition.

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WARNING 1 — 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 determine the applicability of any other restrictions.

WARNING 2 — Certain procedures specified in this document can involve the use or generation of substances, or the generation of waste, that could constitute a local environmental hazard. Reference should be made to appropriate documentation on safe handling and disposal after use.

1 Scope

This document describes methods of evaluating the resistance of vulcanized and thermoplastic rubbers to the action of liquids by measurement of properties of the rubbers before and after immersion in test liquids. The liquids concerned include current service liquids, such as petroleum derivatives, organic solvents and chemical reagents, as well as reference test liquids.

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 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 48-2, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

ISO 18899:2013, *Rubber — Guide to the calibration of test equipment*

ISO 23529:2016, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

ASTM D5964, *Standard Practice for Rubber IRM 901, IRM 902, and IRM 903 Replacement Oils for ASTM No. 1, ASTM No. 2, and ASTM No. 3 Oils*

3 Terms and definitions

No terms and definitions are listed in this document.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Apparatus

4.1 General

Five different methods are defined, all with different equipment.

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Method A – Glass vessel with glass lid. Suitable for test with non-volatile and volatile liquids, below the boiling point. Examples of non-volatile liquids are different type of oils (mineral or synthetic), for example engine, gearbox and hydraulic oils.

Method B – Glass vessel with stopper or lid, in order to prevent and minimize evaporation of the test liquid and the ingress of air. Suitable for test with non-volatile and volatile liquids, below the boiling point.

Method C – Glass vessel with reflux condenser. For test with high volatile liquids, near the boiling point.

Method D – Pressure vessel with hermetically closed lid, allowing for test at overpressure. For test, for example, above the boiling point, with flammable liquids, or where evaporation of the liquid and ingress of air shall be completely hindered.

Method E – Apparatus for testing one surface only.

In method A, the liquid to test piece volume ratio shall be (80 ± 10):1 and the amount of air above the liquid shall be 10 % ± 2 % of the total vessel volume. If the test deviates from this, it shall be clearly stated in the report. This means that the size of the vessel depends on the size and the amount of test pieces to be tested.

In methods B to D, the volume of liquid shall be at least 15 times the combined volume of the test pieces and the volume of air above the liquid shall be kept to a minimum.

The test pieces in methods A to D shall be mounted hanging on a rod or wire and separated from any adjacent test piece. For a greater number of test pieces, use of a test piece holder can be useful. A possible test piece holder preventing the contact and the floating of samples with lower density is shown in Figures 1 and 2.

The materials of the hanger, as well as of the apparatus, shall be inert to the test liquid and to the rubber; for example, materials containing copper shall not be used.

Stirring of the liquid is not permitted except in method C.

Heating of the vessels shall be done by storing the vessel in an air heated oven, except for method C where a heating mantle is recommended.

Example on apparatus for methods A to D are shown in Figure 1 to 7.

4.2 Apparatus for method A

The glass vessel shall be of flange type with ground surface. The lid shall have a ground surface where it seals to the vessel flange and shall be clamped by suitable means, for example by a wire or steel bracket. The size of the vessel shall be so that the liquid to test piece volume ratio is (80 ± 10):1. Greasing or use of rubber sealant on the flanges is not permitted.

Measurements are needed to avoid sticking of test pieces in a vessel (shown in Figure 3).

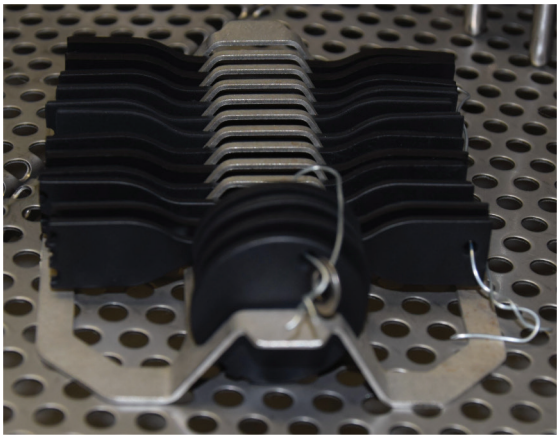

Figure 1 — Example of test piece rack with trays and test pieces (S2 dumbbells and discs)

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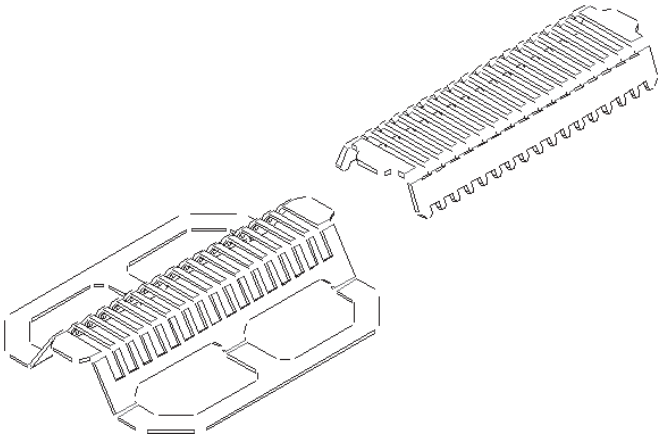

Figure 2 — Example of tray and tray-weight for test pieces with low density

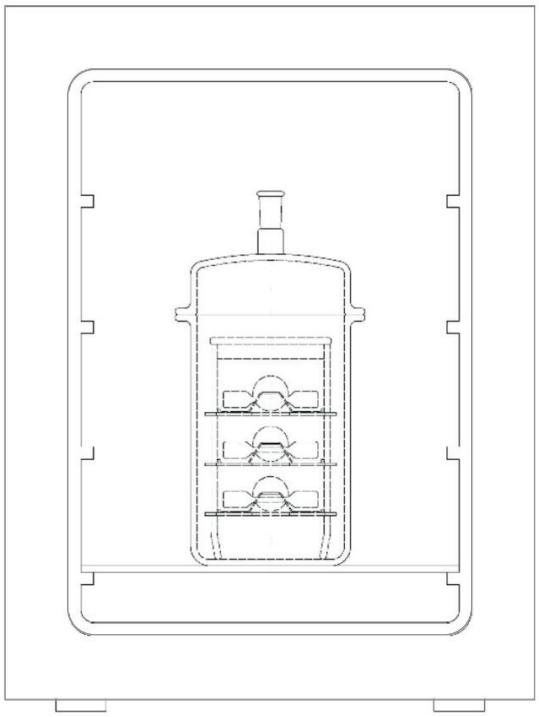

Figure 3 — Example of glass vessel with lid and inside oven

For pressure relief, if the vessel is closed with a glass stopper it could be necessary to open this shortly after the desired temperature is stable inside the oven (vessel).

4.3 Apparatus for method B

A glass vessel with stopper or lid shall be used to prevent the ingress of air.

4.4 Apparatus for method C

4.4.1 General

A glass vessel fitted with a reflux condenser shall be used.

Vessel usually heated up on a heating plate with a magnetic stirrer.

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4.4.2 With air contact

Figure 4 gives an example configuration of a reflux condenser and, if necessary, additional openings to have contact to the atmosphere so that a contact of air or oxygen is possible via the surface of the test liquid.

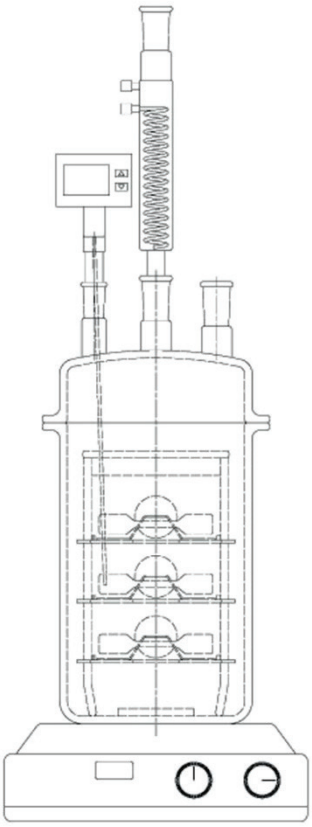

Figure 4 — Example configuration of reflux condenser with air contact

4.4.3 Without air contact

To prevent air (oxygen) contact with the atmosphere, it is possible to connect the reflux condenser with two bottles with a separation liquid. The liquid should not react or generate volatiles which can react with the test liquid. This is shown in Figure 5.

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