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Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device

Caoutchouc vulcanisé ou thermoplastique — Détermination de la résistance à l'abrasion à l'aide d'un dispositif à tambour tournant

PROOF

ISO/PRF 4649

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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 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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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 2, *Testing and analysis*.

This fifth edition cancels and replaces the fourth edition (ISO 4649:2017), which has been technically revised.

The main changes are as follows:

- Addition of requirement to report the abrasive sheet cleaning method used.

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.

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Introduction

Various types of laboratory test equipment for wear resistance of rubber compound have been developed depending on the products to which rubber compounds have been applied in the past. Methods and equipment are briefly introduced in ISO 23794 and the test method using a rotating cylindrical drum device is described in detail in this document.

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Because factors such as the grade of abrasive sheet, the type of adhesive used in the manufacture of the sheet and contamination and wear caused by previous testing lead to variations in the absolute values of abrasion loss, all tests are comparative. Runs with a reference compound are included so that the results can be expressed either as a relative volume loss compared to a calibrated abrasive sheet or as an abrasion resistance index compared to a reference compound.

This document describes two methods and specifies two standard reference compounds that can be chosen freely, although some combinations are more frequently used in practice. Considerable experience has been accumulated using the relative volume loss calculation in 10.2 for method A with reference compound no. 1 and method B with reference compounds no. 1 and no. 2.

When using standard reference compound no. 1 with a non-rotating test piece, a very important part of the method is the preparation of the abrasive sheet and its calibration.

Relative volume loss can be calculated for either test method with another reference compound, if the defined mass loss is known.

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Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device

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 might 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 specifies two methods for the determination of the resistance of rubber to abrasion by means of a rotating cylindrical drum device.

The methods involve determination of the volume loss due to the abrasive action of rubbing a test piece over a specified grade of abrasive sheet. Method A is for a non-rotating test piece and method B is for a rotating test piece. For each method, the result can be reported as a relative volume loss or an abrasion resistance index.

These test methods are suitable for comparative testing, quality control, specification compliance testing, referee purposes and research and development work. No close relation between the results of this abrasion test and service performance can be inferred.

NOTE The abrasion loss is often more uniform using the rotating test piece because the whole surface of the test piece is in contact with the abrasive sheet over the duration of the test. However, there is considerable experience using the non-rotating test piece.

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.

<std>ISO 2230, Rubber products — Guidelines for storage</std>

<std>ISO 2393, Rubber test mixes — Preparation, mixing and vulcanization — Equipment and procedures</std>

<std>ISO 2781, Rubber, vulcanized or thermoplastic — Determination of density</std>

<std>ISO 7619-1, Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 1: Durometer method (Shore hardness)</std>

<std>ISO 9298:2017, Rubber compounding ingredients — Zinc oxide — Test methods</std>

<std>ISO 18899:2013, Rubber — Guide to the calibration of test equipment</std>

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ISO 48-4, Rubber, vulcanized or thermoplastic — Determination of hardness — Part 4: Indentation hardness by durometer method (Shore hardness)

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<std>ISO 23529, Rubber — General procedures for preparing and conditioning test pieces for physical test methods</std>

ISO 48-4, Rubber, vulcanized or thermoplastic — Determination of hardness — Part 4: Indentation hardness by durometer method (Shore hardness)

ISO 2230, Rubber products — Guidelines for storage

ISO 2393, Rubber test mixes — Preparation, mixing and vulcanization — Equipment and procedures

ISO 2781, Rubber, vulcanized or thermoplastic — Determination of density

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

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

3 Terms and definitions

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For the purposes of this document, the following terms and definitions apply.

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

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

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

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

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3.1 abrasion resistance

resistance to wear by mechanical action upon a surface

Note 1 to entry: For the purposes of this document, the abrasion resistance is expressed either as a *relative volume loss* (3.2)(3.2) compared to an abrasive sheet calibrated using a standard reference compound or as an *abrasion resistance index* (3.3)(3.3) compared to a reference compound.

3.2 relative volume loss

ΔV_{rel}
volume loss of the test rubber after being subjected to abrasion by an abrasive sheet which will cause a reference compound to lose a defined mass under the same specified conditions of test

Note 1 to entry: Relative volume loss is expressed in cubic millimetres.

3.3 abrasion resistance index
ARI

I_{AR}
ratio of the volume loss of a reference compound to the volume loss of the test rubber, measured under the same specified conditions of test

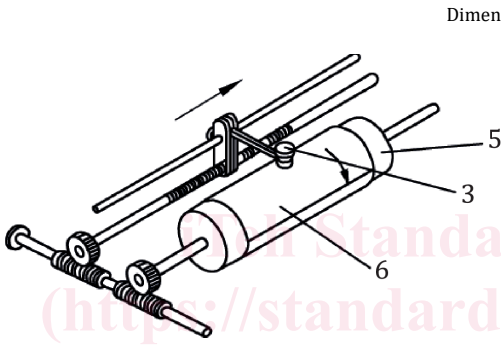
Note 1 to entry: A smaller number indicates a lower *abrasion resistance* (3.1)(3.1).

Note_2_to entry: The abrasion resistance index is expressed as a percentage.

4 Principle

A cylindrical rubber test piece is made to slide over an abrasive sheet of specified abrasive grade under a specified pressure over a given distance. The test piece may be rotating or non-rotating during the test. The abrasive sheet is attached to a rotating cylindrical rotating drum against which the test piece is held and across which it traverses.

The loss of mass of the test piece is determined and used together with the density of the test piece material to calculate the volume loss. The volume loss of the test piece is compared to that of a reference compound tested under the same conditions.



Overhead view

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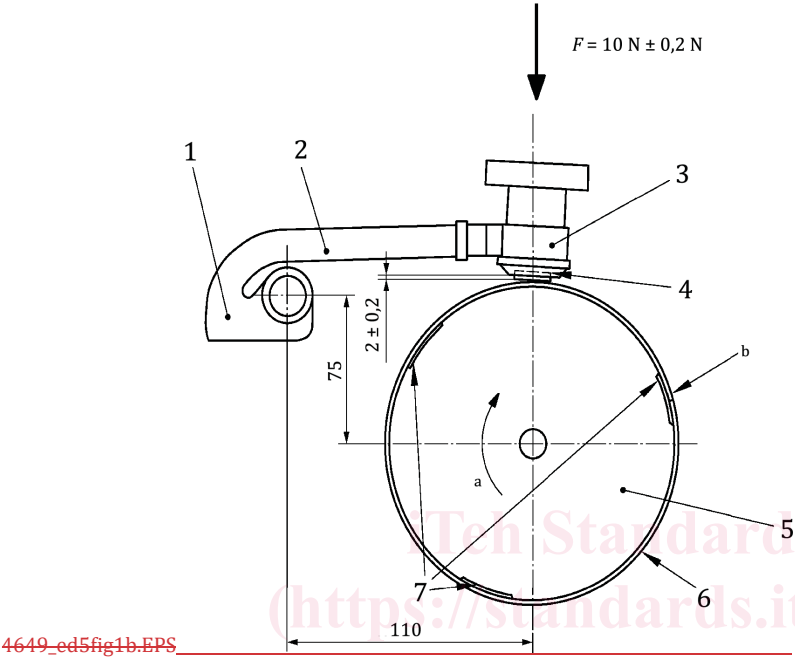
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Key

- | | |
|---|---|
| 1 sledge | 6 abrasive sheet |
| 2 swivel arm | 7 double-sided adhesive tape |
| 3 test piece holder | F vertical force |
| 4 test piece | ω Rotational speed 40 r/min \pm 1 r/min. |
| 5 cylinder, diameter 150 mm \pm 0,2 mm, length 500 mm | b Gap of size \leq 2 mm. |

Figure 1 — Schematic illustration of apparatus

5 Apparatus and materials

5.1 Abrasion machine.

The test apparatus (see Figure 1) consists of a laterally movable test piece holder and a rotatable cylinder to which the abrasive sheet (5.2)(5.2) is fixed.

The cylinder shall have a diameter of 150 mm \pm 0,2 mm and a length of about 500 mm and shall be rotated at a speed of 40 r/min \pm 1 r/min, the direction of rotation being as indicated in Figure 1.

The test piece holder shall have a cylindrical opening, the diameter of which can be adjusted from 15,5 mm to 16,3 mm and a device for adjusting the length of the test piece protruding from the opening to 2 mm \pm 0,2 mm. The holder shall be mounted on a swivel arm that, in turn, is attached to a sledge that can be moved laterally on a spindle. The lateral displacement of the holder shall be 4,20 mm \pm 0,04 mm per revolution of the drum

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