INTERNATIONAL STANDARD

ISO 23794

Fourth edition

Rubber, vulcanized or thermoplastic — Abrasion testing — Guidance

Caoutchouc vulcanisé ou thermoplastique — Essais d'abrasion — Lignes directrices

PROOF/ÉPREUVE

Reference number
ISO 23794:2022(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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 2, *Testing and analysis*.

This fourth edition cancels and replaces the third edition (ISO 23794:2015), which has been technically revised.

The main changes are as follows:

— some terms (abradant and abrasion pattern) have been added in Clause 3;

— Figures 1 to 9 have been transferred from Clause 10 to Clause 5;

— some captions for the figures have been changed to proper description;

— in Clause 8, the order of the description has been changed;

— in addition, the text has been editorially revised to improve clarity.

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, vulcanized or thermoplastic — Abrasion testing — Guidance

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 can constitute a local environmental hazard. Reference should be made to appropriate documentation on safe handling and disposal after use.

1 Scope

This document provides guidance on the determination of the abrasion resistance of vulcanized and thermoplastic rubbers. It covers both solid and loose abrasives.

The guidelines given are intended to assist in the selection of an appropriate test method and appropriate test conditions for evaluating a material and assessing its suitability for a product subject to abrasion. Factors influencing the correlation between laboratory abrasion testing and product performance are considered, but, for example this document is not concerned with wear tests developed for specific finished rubber products, for example, trailer tests for tyres.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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:

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

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

3.1
abrasion
loss of material from a surface due to frictional forces

[SOURCE: ISO 1382:2020[1], 3.1]

3.2
abrasion resistance
resistance to wear resulting from mechanical action upon a surface

Note 1 to entry: Abrasion resistance is expressed by the abrasion resistance index.

[SOURCE: ISO 1382:2020[1], 3.2]

3.3
abrasion resistance index
ratio of the loss in volume of a standard rubber to the loss in volume of a test rubber, measured under the same specified conditions and expressed as a percentage

Note 1 to entry: ISO 4649 contains a method for the determination of *abrasion resistance* (3.2) using a rotating drum device.

[SOURCE: ISO 1382:2020[1], 3.3]

3.4
relative volume loss
loss in volume of a test rubber due to abrasion by a specified abradant which causes a reference rubber to lose a defined mass under the same conditions

3.5
abradant
material or means used for grinding, rasping rubber to cause abrasion

3.6
abrasion pattern
patterns on a surface formed by friction

4 Wear mechanisms

The mechanisms by which wear of rubber occurs when it is in moving contact with another material are complex, but the principal factors involved are cutting and abrasion. It is possible to categorize wear mechanisms in various ways and commonly distinction is made between

— abrasive wear,

— fatigue wear, and

— adhesive wear.

Additionally, wear by roll formation is sometimes considered as a separate mechanism.

Abrasive wear is caused by sharp asperities cutting the rubber.

Fatigue wear is caused by particles of rubber being detached as a result of dynamic stressing on a localized scale.

Adhesive wear is the transfer of rubber to another surface as a result of adhesive forces between the two surfaces.

Wear by roll formation is where there is progressive tearing of a layer of rubber which forms a roll.

There can also be corrosive wear due to direct chemical attack on the surface.

The term erosive wear is sometimes used for the action of particles in a liquid stream.

In any particular wear situation, more than one mechanism is usually involved, but one can be predominate. Abrasive wear requires hard, sharp cutting edges, and high friction. Fatigue wear occurs with smooth or rough but blunt surfaces and does not need high friction. Adhesive wear is much less common, but can occur on smooth surfaces. Roll formation requires high friction and relatively poor tear strength. Roll formation results in a characteristic abrasion pattern of ridges and grooves at right angles to the direction of movement.

Abrasive wear or roll formation results in much more rapid wear than fatigue processes. The mechanism and hence the rate of wear can change, perhaps quite suddenly, with the conditions, such as contact pressure, speed, and temperature. In any practical circumstances, the mechanisms can be complex and critically dependent on the conditions. Consequently, the critical factor as regards testing is that the test conditions should essentially reproduce the service conditions if a good correlation is to be obtained. Even a comparison between two rubbers can be invalid if the dominant mechanism is different in testing and in service. The range of conditions encountered in applications such as tyres is so complex, that they cannot be matched by a single test.

It follows that there cannot be a universal standard abrasion test method for rubber, and the test method and test conditions have to be chosen to suit the end application. Also, great care has to be taken if the test is intended to provide a significant degree of acceleration.

5 Types of abrasion test

Many abrasion testing machines have been devised and standardized at national level for use with rubber. The majority of rubber tests involve a relatively sharp abradant and were devised for use with tyre tread materials.

Abrasion tests can be divided into two main types: those using a loose abradant and those using a solid abradant.

A loose abrasive powder can be used rather in the manner of a shot-blasting machine as a logical way of simulating the action of sand or similar abradants impinging on the rubber in service. A loose abradant can also be used between two sliding surfaces. Conveyor belts or tank linings are examples of products subject to abrasion by loose materials. A car tyre is an example of the situation where there is a combination of abrasion against a solid rough abradant, the road, and abrasion against a free-flowing abradant in the form of grit particles. This situation can also occur in testing as a result of the generation of wear debris from a solid abradant.

Solid abradants can consist of almost anything, but the most common are: abrasive wheels (vitreous or resilient), abrasive papers or cloths, and metal “knives”. The majority of wear situations involve the rubber moving in contact with another solid material.

Distinctions can be made on the basis of the geometry by which the test piece and abradant are rubbed together. Many geometries are possible, and some common configurations are shown in Figure 1 to Figure 9:

Figure 1: The test piece reciprocates linearly against a sheet of abradant (or alternatively a strip of abradant can be moved past a stationary test piece).

Figure 2: The abradant is a rotating disc with the test piece held against it (or vice versa).

Figure 3: Both abradant and test piece are in the form of a wheel, either of which can be the driven member.

Figure 4: The rotating disc test piece is driving, or driven by, the abradant wheel(s). The relative position of test piece and abradant is as the figure and vice versa.

Figure 5: Both the test piece and the abradant are rotating.

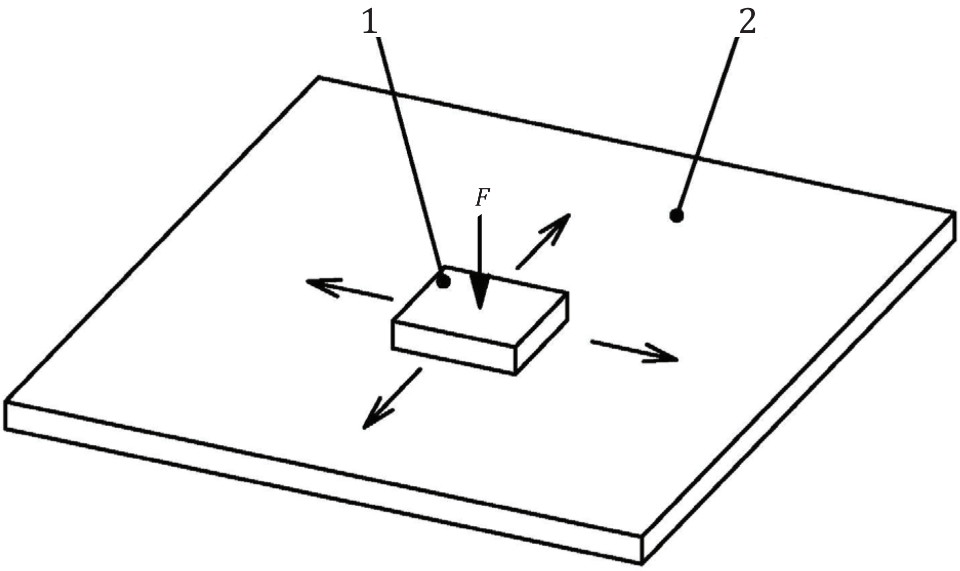
Figure 6: The test piece is held against a rotating drum and traverses the drum. The test piece ~~may~~ can also be rotated.

Figure 7: The test piece revolves in contact with metal knives.

Figure 8: Test pieces are tumbled together with abrasive particles inside a hollow rotating drum.

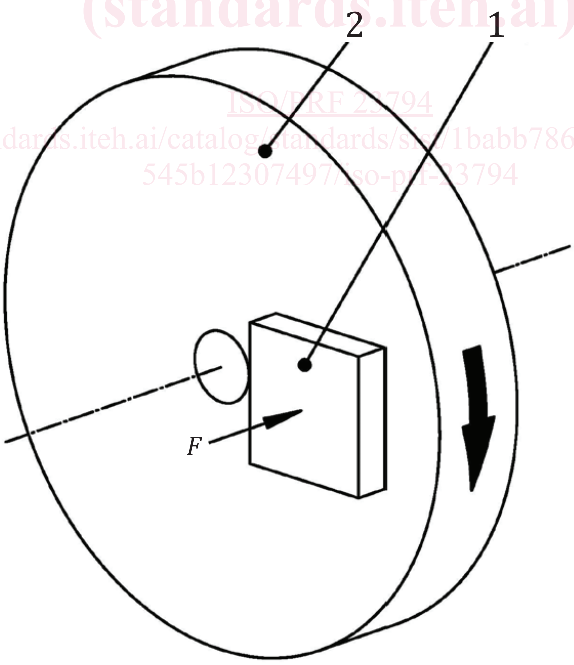
Figure 9: Single metal knife is held against a rotating tube test piece.

If the abrasion is unidirectional, abrasion patterns will develop which can markedly affect abrasion loss.



Key
1 test piece
2 abradant
F load

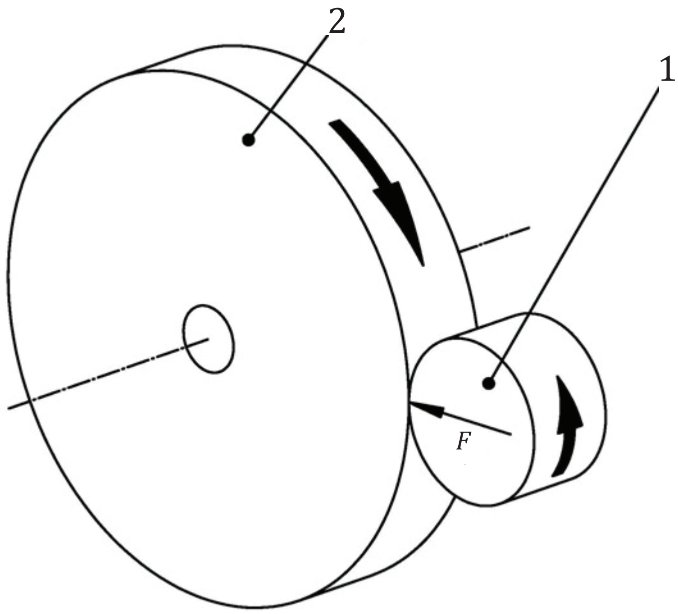
Figure 1 — Test piece reciprocating linearly against a sheet of abradant



Key
1 test piece
2 abradant
F load

Figure 2 — Test piece held against a rotating disc of abradant

 PROOF/ÉPREUVE



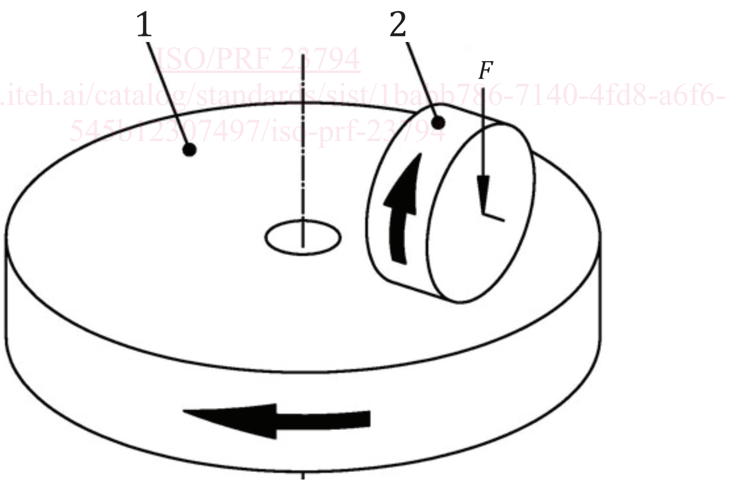
Key

1 test piece

2 abradant

F load

Figure 3 — Test piece and abradant in the form of wheels either of which can be driven



Key

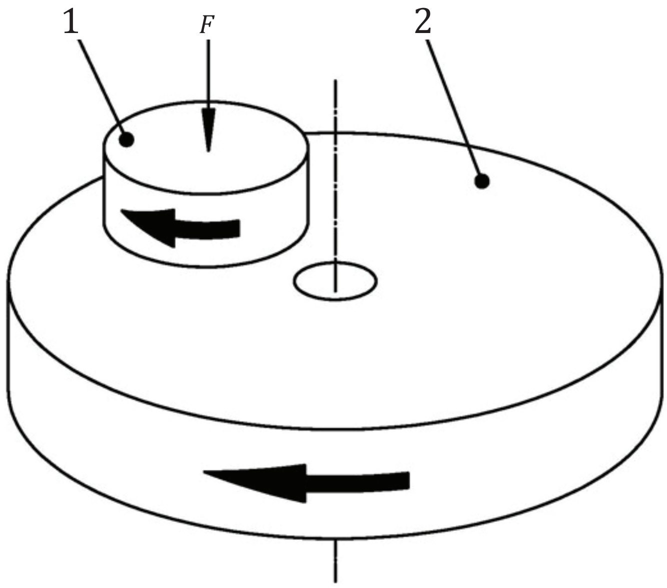
1 test piece

2 abradant

F load

NOTE The relative position of test piece and abradant is as the figure and vice versa.

Figure 4 — Rotating disc test piece driving, or driven by, the abradant wheel(s)



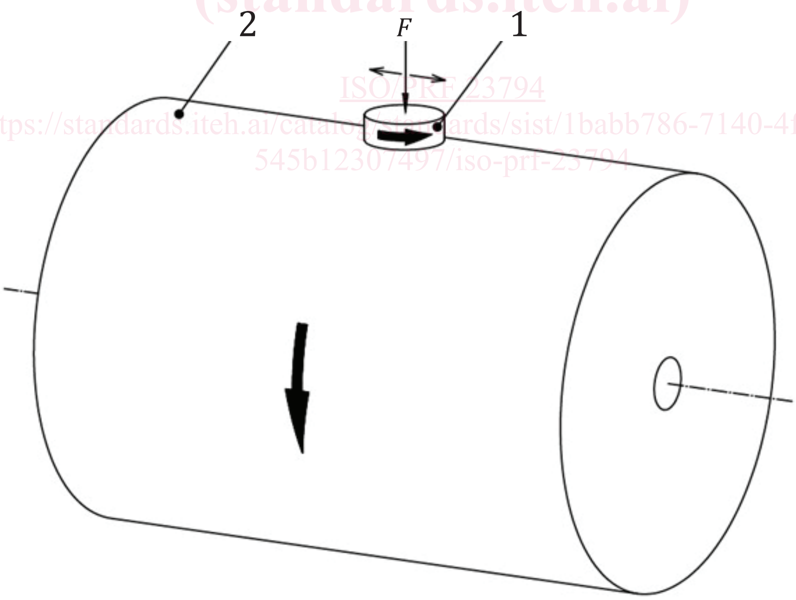
Key

1 test piece

2 abradant

F load

Figure 5 — Rotating test piece held against a rotating abradant disc



Key

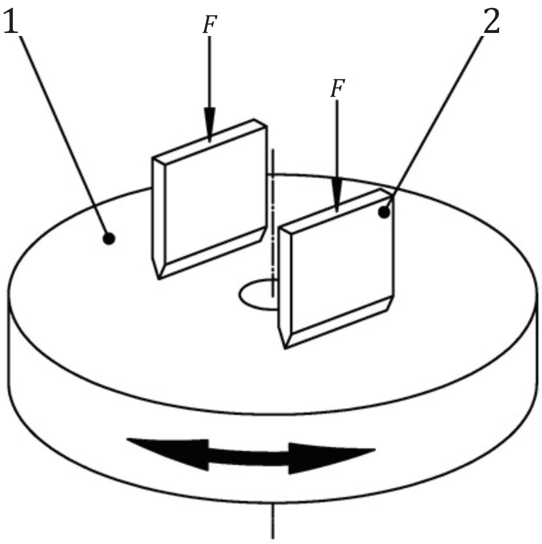
1 test piece

2 abradant

F load

NOTE The test piece can also be rotated.

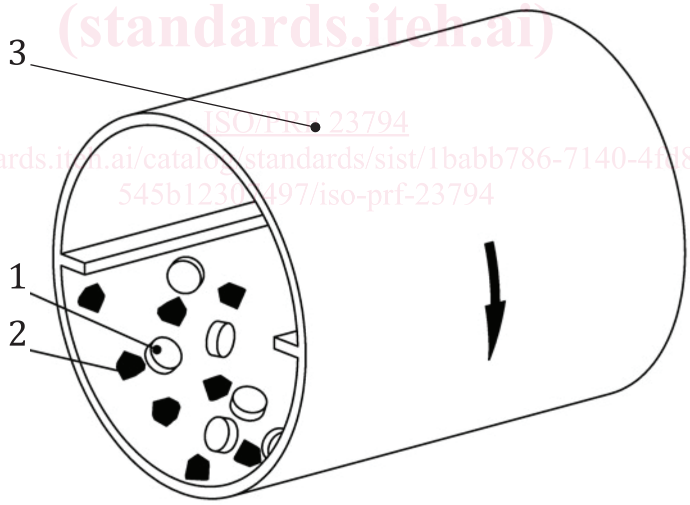
Figure 6 — Test piece held against a rotating drum and traverses the drum



Key

1 test piece
2 abradant
F load

Figure 7 — Knife-type abradant held against test piece in the form of a rotating disc



Key

1 test piece
2 abradant
3 rotating drum (mill)

Figure 8 — Test pieces and abradants inside a rotating drum