INTERNATIONAL STANDARD

**ISO 3384-1**

Second edition
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# Rubber, vulcanized or thermoplastic — Determination of stress relaxation in compression —

## Part 1: Testing at constant temperature

*Caoutchouc vulcanisé ou thermoplastique — Détermination de la relaxation de contrainte en compression —*

*Partie 1: Essais à température constante*



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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 2, *Testing and analysis.*

This second edition cancels and replaces the first edition (ISO 3384-1:2011), which has been technically revised. It also incorporates the Amendment ISO 3384-1:2011/Amd.1:2013.

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

— test procedures have been improved in detail;

— the requirement for compression device (5.1) has been harmonized with other International Standards;

— content of ISO 3384-1:2011/Amd.1:2013 has been incorporated (Annex B).

A list of all parts in the ISO 3384 series can be found on the ISO website.

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.



 

# Introduction

When a constant strain is applied to rubber, the force necessary to maintain that strain is not constant but decreases with time; this behaviour is called "stress relaxation". Conversely, when rubber is subjected to a constant stress, an increase in the deformation takes place with time; this behaviour is called "creep".

Tests in compression are normally made under continuous stress conditions (i.e. the test piece remains strained throughout the test), and are hence a measure of sealing force. Note that the terms continuous and discontinuous used in this standard refer to whether the measure of force is made continuously of at intervals.

Tests to use stress relaxation in tension as a measure of ageing are given in ISO 6914.

The processes responsible for stress relaxation can be physical or chemical in nature, and under all normal conditions both types of process will occur simultaneously. However, at normal or low temperatures and/or short times, stress relaxation is dominated by physical processes, while at high temperatures and/or long times chemical processes are dominant.

If the life-time of a material is to be investigated, it can be determined using the method described in ISO 11346.

In addition to the need to specify the temperatures and time intervals in a stress relaxation test, it is necessary to specify the initial stress and the previous mechanical history of the test piece since these can also influence the measured stress relaxation, particularly in rubbers containing fillers.

The most important factor in achieving good repeatability and reproducibility when making stress relaxation tests is to keep the temperature and compression constant during all measurements.

# Rubber, vulcanized or thermoplastic — Determination of stress relaxation in compression —

## Part 1: Testing at constant temperature

**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 procedures for determining the decrease in counterforce exerted by a test piece of vulcanized or thermoplastic rubber which has been compressed to a constant deformation and maintained thus at a predetermined test temperature.

The counterforce can be determined either by means of a continuous-measurement system or by a discontinuous-measurement one.

Two test methods are specified, method A and method B. In method A the compression and all measurements of counterforce are made at test temperature and in method B the compression and all measurements of counterforce are made at standard laboratory temperature.

Method A and method B do not give the same results, as in method B the shrinkage of the material from the test temperature to standard laboratory temperature is included in the result.

Two forms of test piece are specified in this document: cylindrical test pieces and rings. Comparison of results is valid only when made on test pieces of similar size and shape.

The use of ring test pieces is particularly suitable for the determination of stress relaxation in liquid environments.

This document deals only with testing at constant ambient or elevated temperature. Testing at temperatures below standard laboratory temperature is not specified. The methods have been used for low-temperature testing, but their reliability under these conditions is not proven.

## 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 37:2017, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 188:2011, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

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*

## 3 Terms and definitions

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

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/

**3.1**
**compression stress relaxation**
reduction in compressive force, expressed as a percentage of the initial force, which occurs with time after the application of a constant compressive strain

## 4 Principle

A test piece of vulcanized or thermoplastic rubber is compressed to a constant deformation and maintained at a predetermined test temperature. The decrease in counterforce is then measured.

**In method A**, the compression is applied and all counterforce measurements are made at the test temperature.

**In method B**, the compression is applied and all counterforce measurements are made at a standard laboratory temperature. The test pieces are stored at the test temperature.

The test can be conducted in a gaseous or a liquid environment.

The two measurement methods, A and B, do not give the same values of stress relaxation, and comparison of values obtained from the two methods should be avoided. The method selected for use depends on the purpose of the test. Thus, for fundamental studies and in applications where sealing at elevated temperatures is a problem, method A might be preferred, and in applications where temperature cycling from normal to an elevated temperature is a problem, method B might be preferred.

NOTE Other methods can be used for specific purposes, such as applying the compression at standard laboratory temperature and making all counterforce measurements at a different temperature.

## 5 Apparatus

**5.1 Compression device**, consisting of two parallel, flat, highly polished plates made of chromium-plated steel or stainless-steel or any corrosion-resistant material, between the faces of which the test piece is compressed.

The plates shall be:

— sufficiently rigid to ensure that, with a test piece under load, no compression plate bends by more than 0,01 mm;

— of sufficient size to ensure that the whole of the test piece, when compressed between the plates, remains within the area of the plates and can expand freely laterally.

NOTE A surface finish not worse than *Ra* 0,4 µm (see ISO 4287) has been found to be suitable. Such an *Ra* can be obtained by a grinding or polishing operation.