
**Rubber, vulcanized or
thermoplastic — Determination of
compression set —**

**Part 2:
At low temperatures**

iTeh STANDARD PREVIEW
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*Caoutchouc vulcanisé ou thermoplastique — Détermination de la
déformation rémanente après compression —
Partie 2: À basses températures*

ISO 815-2:2019

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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 third edition cancels and replaces the second edition (ISO 815-2:2014), which has been technically revised.

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

- normative references have been updated in [Clause 2](#).
- a precision statement has been added in [Annex B](#).

A list of all parts in the ISO 815 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

The measurement and recording of the compression set at low temperature is very sensitive to testing conditions, and the values obtained can differ a lot especially for type B test pieces. That is why two measurement methods have been introduced. Method 2 generally gives a higher compression set than method 1, and this difference should be taken into account when preparing material specifications.

Those methods are intended to measure the ability of rubbers of hardness within the range 10 IRHD to 95 IRHD to retain their elastic properties at specified temperatures after prolonged compression at constant strain (normally 25 %) under one of the alternative sets of conditions described. For rubber of nominal hardness 80 IRHD and above, a lower compression strain is used: 15 % for a nominal hardness from 80 IRHD to 89 IRHD, and 10 % for a nominal hardness from 90 IRHD to 95 IRHD.

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Rubber, vulcanized or thermoplastic — Determination of compression set —

Part 2: At low temperatures

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 compression set characteristics of vulcanized and thermoplastic rubbers at low temperatures.

Method 1 derives from the methodology used in ISO 815-1. Method 2 uses a specified testing device, allowing to measure and record the test piece thickness during recovery. Due to the load applied during recovery in method 2, no correlation can be established between the results given by both methods.

NOTE When rubber is held under compression, physical or chemical changes that prevent the rubber returning to its original dimensions after release of the deforming force can occur. The result is a set, where the magnitude of which depends on the time and temperature of compression as well as on the time, temperature, and conditions of recovery. At low temperatures, changes resulting from the effects of glass hardening or crystallization become predominant and, since these effects are reversed by raising the temperature, therefore, the measurements are always taken at the test temperature.

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 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

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

4.1 Method 1

A test piece of known thickness is compressed at standard laboratory temperature to a defined strain, which is then maintained constant for a specified time at a fixed low temperature. The compression is totally released and, after the test piece has been allowed to freely recover at the same fixed low temperature, the thickness of the test piece is again measured.

4.2 Method 2

A test piece of known thickness is compressed at standard laboratory temperature to a defined strain, which is then maintained constant for a specified time at a fixed low temperature. The compression is released and the test piece is allowed to recover at this temperature under a given pressure according to ISO 23529 for thickness measurement. The thickness is measured either at intervals after the release of the strain (so that an assessment of compression set characteristics can be obtained by plotting of recovery against time at the low temperature) or a specified time after the release of the strain.

5 Apparatus for low temperature tests

5.1 Method 1

5.1.1 Compression assembly, consisting of compression plates, steel spacers, and clamping device. A typical assembly is shown in [Figure 1](#). A quick release mechanism as shown on [Figure 2](#) may also be used.

5.1.1.1 Compression plates, 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.

5.1.1.2 Steel spacer(s), to provide the required compression, if necessary. Whether spacer(s) will need to be used or not will depend on the design of the compression apparatus.

If used, the spacer(s) shall be of such size and shape that contact with the compressed test piece is avoided.

The height of the spacer(s) shall be chosen so that the compression applied to the test piece is

- (25 ± 2) % for hardnesses below 80 IRHD,
- (15 ± 2) % for hardnesses between 80 IRHD and 89 IRHD,
- (10 ± 1) % for hardnesses of 90 IRHD and higher.

5.1.1.3 Clamping device, a simple screw device (see [Figure 1](#)) or a clamping device as shown on [Figure 2](#) are adequate.

5.1.2 Low-temperature cabinet, capable of maintaining the compression apparatus and test pieces at the test temperature within the tolerance limits specified in 8.2. The low-temperature cabinet can be mechanically refrigerated or it can be cooled directly by dry ice or liquid nitrogen.

The cabinet shall be designed so that it is possible to release the test pieces and carry out the subsequent thickness measurements without direct contact, e.g. by means of hand-holes fitted with gloves or a remote-handling device. The cabinet shall be capable of maintaining the temperature within specified limits while these operations are being carried out.

The time to reach a steady-state temperature depends on the type of cabinet and the overall heat capacity of the compression apparatus. To obtain test results which can be compared with each other, it is necessary, in the case of a 24 h test duration, to reach the steady-state temperature within the specified limits in the interior of the test pieces in not more than 3 h.

5.1.3 Pair of tongs, for handling the test pieces.

5.1.4 Thickness gauge, with an accuracy of $\pm 0,01$ mm (see ISO 23529:2016, 9.1), having a flat solid base-plate and exerting a pressure of $22 \text{ kPa} \pm 5 \text{ kPa}$ for solid rubber of hardness equal to or greater than 35 IRHD, or a pressure of $10 \text{ kPa} \pm 2 \text{ kPa}$ if the hardness is less than 35 IRHD. For comparative tests, the same dimensions of the circular foot shall be used.

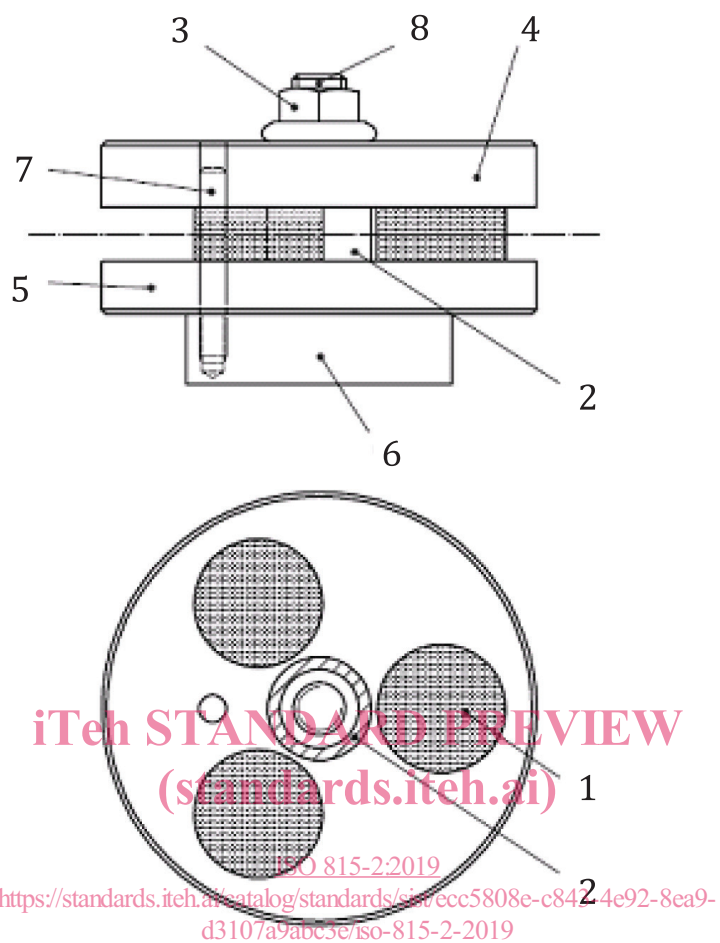
NOTE When using a digital gauge, a resolution of 0,001 mm is needed to obtain the required accuracy.

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5.1.5 **Timing device**, for measuring the recovery time, with an accuracy of ± 1 s.



Key

- | | | | |
|---|-------------|---|------------------------------------|
| 1 | test piece | 5 | lower plate |
| 2 | spacer | 6 | part formed for clamping in a vice |
| 3 | nut | 7 | locating pin |
| 4 | upper plate | 8 | screw |

Figure 1 — Example of assembly for the determination of compression set

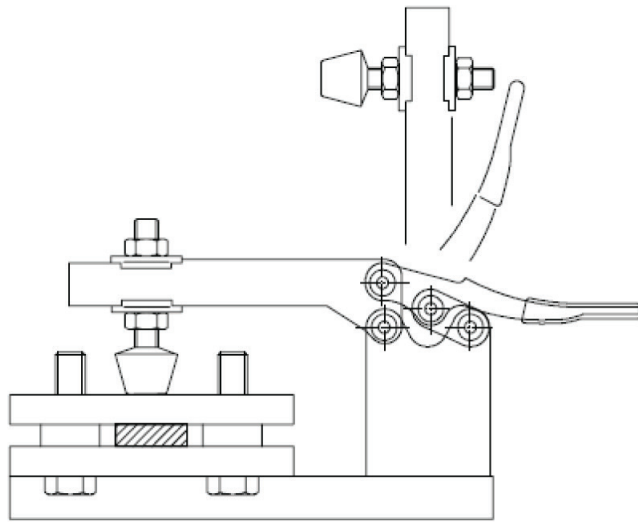


Figure 2 — Example of a quick-release mechanism

5.2 Method 2

5.2.1 Compression apparatus, consisting of compression plates, spacer(s) (optional), a thickness gauge, a temperature sensor, and a device for applying a specified pressure for thickness measurements. The measurement pressure for thickness measurements is the same as that specified in ISO 23529.

The compression apparatus shall be capable of applying the compression and maintaining it during the whole duration of the test, and it shall be possible to keep the apparatus in a low-temperature cabinet at the specified test temperature. Care shall be taken to ensure that there is as little influence on the test as possible by conduction of heat away from the test piece, for example, through metal parts which are connected with the outside of the low-temperature cabinet.

The part of the apparatus with the compression plates and the test piece shall be within the low-temperature cabinet during the whole of the test, but the thickness gauge may be located outside the cabinet.

An example of a compression apparatus is shown in [Figure 3](#).

It shall be possible to release the compression of the test piece without opening the low-temperature cabinet.

5.2.1.1 Compression plates, comprising a pair of parallel, flat, highly polished chromium-plated steel or highly polished stainless-steel plates, 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, and
- of sufficient size to ensure that the whole of the test piece, when compressed between the plates, remains within the area of the plates.

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.