INTERNATIONAL STANDARD

ISO 815-2

Second edition
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Rubber, vulcanized or thermoplastic — Determination of compression set —

Part 2: At low temperatures

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

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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 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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC45, *Rubber and rubber products*, SC 2, *Testing and analysis*.

This second edition cancels and replaces the first edition (ISO 815-2:2008), which has been technically revised, mainly by addition of method 1 and a calibration schedule (Annex A).

ISO 815 consists of the following parts, under the general title *Rubber, vulcanized or thermoplastic — Determination of compression set*:

— *Part 1: At ambient or elevated temperatures*

— *Part 2: At low temperatures*

Introduction

Allowing 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.

Rubber, vulcanized or thermoplastic — Determination of compression set —

Part 2:
At low temperatures

WARNING 1 — Persons using this part of ISO 815 should be familiar with normal laboratory practice. This part of ISO 815 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 ensure compliance with any national regulatory conditions.

WARNING 2 — Certain procedures specified in this part of ISO 815 can involve the use of 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 part of ISO 815 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 can occur that prevent the rubber returning to its original dimensions after release of the deforming force. 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, it is necessary for all measurements to be undertaken at the test temperature.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 23529:2010, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Principle

3.1 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.

3.2 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 23529:2010 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.

4 Apparatus for low temperature tests

4.1 Method 1

4.1.1 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.

4.1.1.1 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.

4.1.1.2 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.

4.1.1.3 Clamping device, a simple screw device (Figure 1) or a clamping device as shown on Figure 2 are adequate.

4.1.2 Low-temperature cabinet, capable of maintaining the compression apparatus and test pieces at the test temperature within the tolerance limits specified in 7.2. 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.

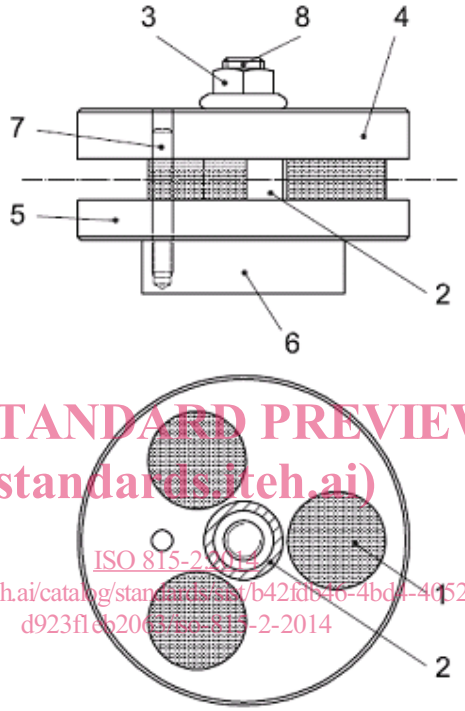
The time to reach a steady-state temperature depends on the type of cabinet and the overall heat capacity of the compression apparatus. To obtain test results which can be compared with each other, it is necessary, in the case of a 24 h test duration, to reach the steady-state temperature within the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

4.1.3 Pair of tongs, for handling the test pieces.

4.1.4 Thickness gauge, with an accuracy of ±0,01 mm (see ISO 23529:2010, 7.1), having a flat solid base-plate and exerting a pressure of 22 kPa ± 5 kPa for solid rubber of hardness equal to or greater than 35 IRHD, or a pressure of 10 kPa ± 2 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.

4.1.5 Timing device, for measuring the recovery time, with a precision 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

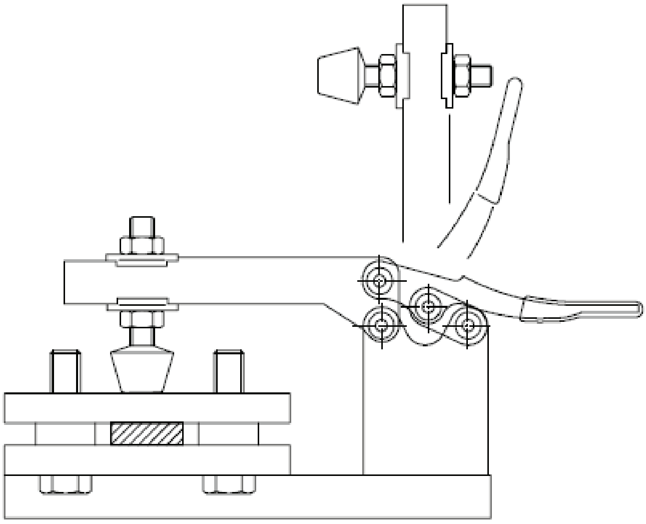


Figure 2 — Example of a quick-release mechanism

4.2 Method 2

4.2.1 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 23529:2010.

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.

4.2.1.1 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.

4.2.1.2 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

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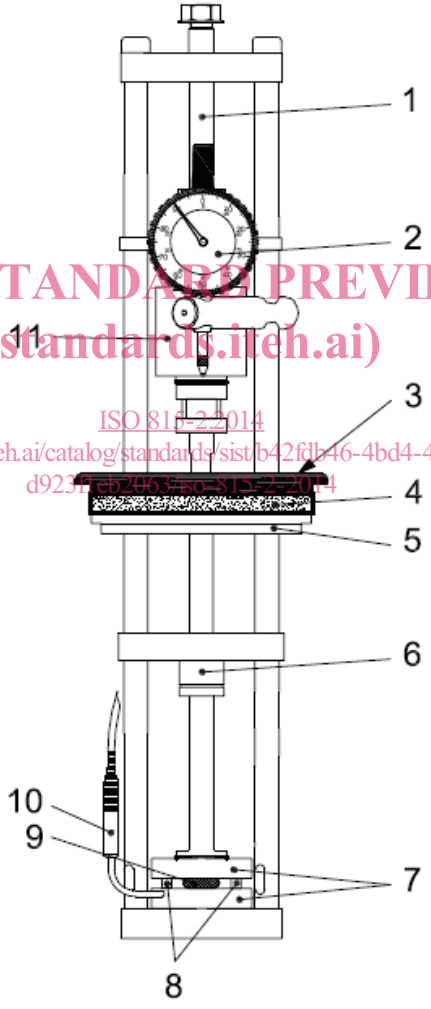
— (15 ± 2) % for hardnesses between 80 IRHD and 89 IRHD,

— (10 ± 1) % for hardnesses of 90 IRHD and higher.

4.2.2 Temperature measurement device, inserted in one of the plates, measuring the temperature directly with an accuracy of ±0,5 °C.



Key

1	screw	7	compression plates
2	thickness measurement gauge	8	spacer (optional)
3	rubber lid	9	test piece
4	insulating lid	10	temperature sensor