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

**Part 2:
At low temperatures**

*Caoutchouc vulcanisé ou thermoplastique — Détermination de la
déformation résiduelle après compression —*

Partie 2: À basses températures



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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principle	2
4.1 Method 1	2
4.2 Method 2	2
5 Apparatus for low temperature tests	2
5.1 Method 1	2
5.2 Method 2	5
6 Calibration	8
7 Test pieces	8
7.1 Dimensions	8
7.2 Preparation	9
7.3 Number of test pieces	9
7.4 Time interval between production and testing	9
7.5 Conditioning	9
8 Test conditions	10
8.1 Duration of test	10
8.2 Temperature of test	10
9 Procedure	10
9.1 Method 1	10
9.1.1 Preparation of compression apparatus	10
9.1.2 Thickness measurement	10
9.1.3 Applying the compression	10
9.1.4 Starting the test	10
9.1.5 Terminating the test	10
9.1.6 Internal examination	11
9.2 Method 2	11
9.2.1 Preparation of compression apparatus	11
9.2.2 Thickness measurement	11
9.2.3 Applying the compression	11
9.2.4 Starting the test	11
9.2.5 Terminating the test	11
9.2.6 Measurements	11
9.2.7 Internal examination	12
10 Expression of results	12
11 Precision	12
12 Test report	12
Annex A (normative) Calibration schedule	14
Annex B (informative) Precision	18
Bibliography	20

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).

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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 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.

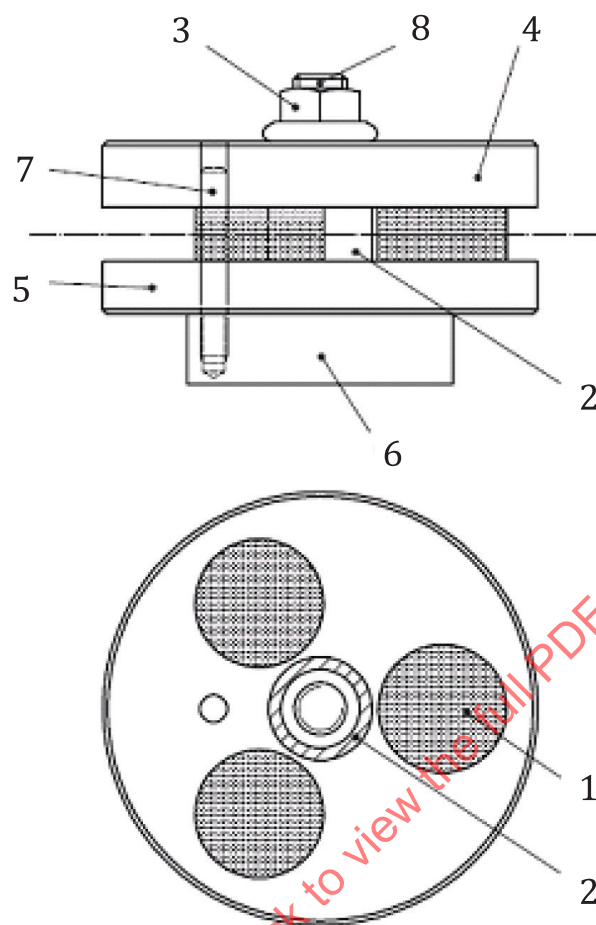
The time to reach a steady-state temperature depends on the type of cabinet and the overall heat capacity of the compression apparatus. To obtain test results which can be compared with each other, it is necessary, in the case of a 24 h test duration, to reach the steady-state temperature within the 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.

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

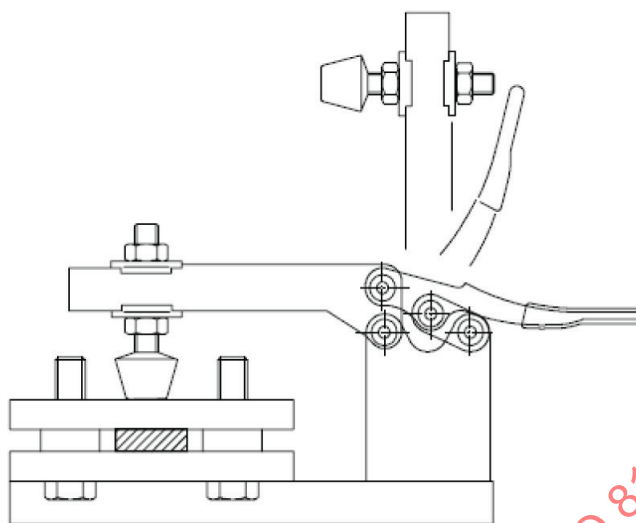


Figure 2 — Example of a quick-release mechanism

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 $Ra\ 0,4\ \mu\text{m}$ (see ISO 4287) has been found to be suitable. Such an Ra can be obtained by a grinding or polishing operation.

5.2.1.2 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.

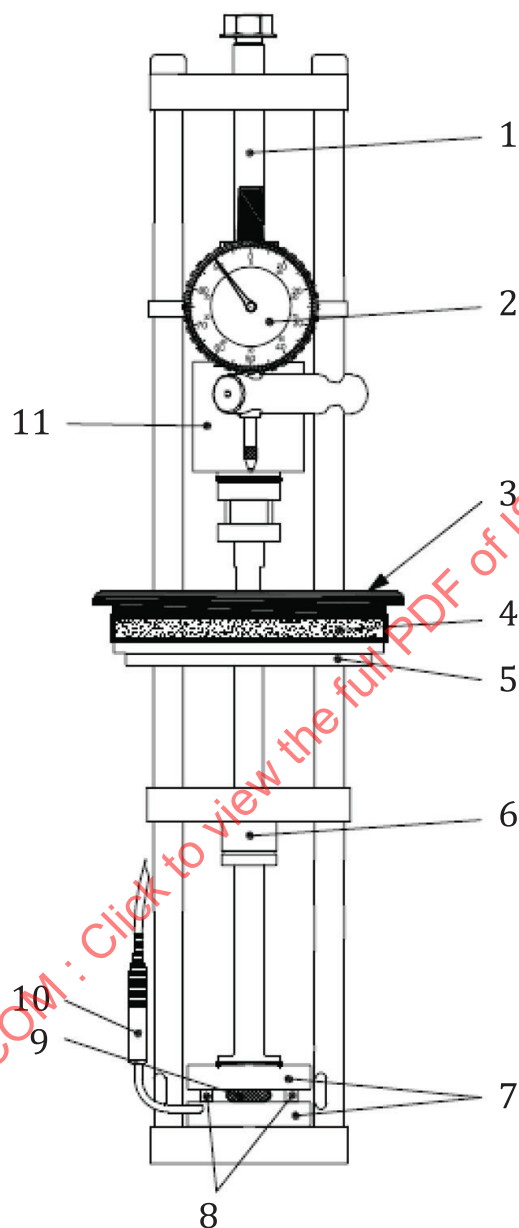
If used, the spacer(s) shall be of such size and shape that contact with the compressed test piece is avoided.

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

- (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.

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5.2.2 Temperature measurement device, inserted in one of the plates, measuring the temperature directly with an accuracy of $\pm 0,5$ °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 |
| 5 aluminium lid | 11 weight for pre-loading test piece |
| 6 linear bearing | |

Figure 3 — Example of a compression apparatus

5.2.3 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.

5.2.4 Thickness gauge, with an accuracy of $\pm 0,01$ mm (see ISO 23529:2016, 9.1), exerting a pressure of 22 kPa $\pm$ 5 kPa for solid rubber of hardness equal to or greater than 35 IRHD, or a pressure of 10 kPa $\pm$ 2 kPa if the hardness is less than 35 IRHD. The thickness gauge shall have a device for applying a pre-load by means of a deadweight or a load-cell system so that it exerts the specified pressure.

The thickness measurement may also be made using the compression plates.

For comparative purposes, the same dimensions of the circular foot shall be used.

NOTE 1 When using a digital gauge, a resolution of 0,001 mm is needed to obtain the required accuracy.

NOTE 2 The foot of the gauge acts on the top compression plate.

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

6 Calibration

The test apparatus shall be calibrated in accordance with the schedule given in [Annex A](#).

7 Test pieces

7.1 Dimensions

The test pieces shall be one of two sizes, designated as type A and type B.

- Type A: a cylindrical disc of diameter 29,0 mm $\pm$ 0,5 mm and thickness 12,5 mm $\pm$ 0,5 mm.
- Type B: a cylindrical disc of diameter 13,0 mm $\pm$ 0,5 mm and thickness 6,3 mm $\pm$ 0,3 mm.

These two types do not necessarily give the same values for compression set, and comparison of results obtained using test pieces of different sizes shall be avoided when comparing one compound with another.

Type A test pieces are preferred for testing rubbers having low compression set, because of the greater accuracy attainable using these larger test pieces.

Type B test pieces are preferred when it is required to cut test pieces from products. In this case, the test pieces shall be taken as near to the centre of the product as possible, unless otherwise specified. When possible, the test piece shall be cut in such a way that its axis is parallel to the direction of compression of the product in service.

7.2 Preparation

The test pieces shall be prepared by moulding each disc, whenever possible. Preparation by cutting out each disc or by laminating not more than three discs is permitted. The use of test pieces prepared by laminating several discs for control of finished products shall be agreed between interested parties.

Cutting shall be performed in accordance with ISO 23529. When cupping (the formation of a concave surface) is a problem, the test piece shape can be improved by cutting it in two stages: first, cut an oversize test piece, and then, trim it to the exact dimensions with a second cutter.

Laminated test pieces shall conform to the dimensions specified in 7.1 and shall be prepared by laminating discs or rubber cut from sheets without adhesives. Discs may be compressed by a few percent for 1 min, so that they stick together. The number of discs laminated to produce a test piece shall not exceed three. The total thickness shall then be measured.

Test pieces prepared by the different methods described above can give different results and comparison of values shall be avoided.

NOTE Attention is drawn to the marked effects of the state of cure on compression set values. It might be necessary to adjust the cure of moulded test pieces to be representative of different thicknesses of sheets or mouldings.

7.3 Number of test pieces

Three test pieces shall be tested separately or at the same time, depending on the purpose of the test.

7.4 Time interval between production and testing

For all test purposes, the minimum time between production and testing shall be 16 h.

For non-product tests, the maximum time between production and testing shall be 4 weeks and, for evaluations intended to be comparable, the tests, as far as possible, shall be carried out after the same time interval.

For product tests, whenever possible, the time between production and testing shall not exceed three months. In other cases, tests shall be made within two months of the date of receipt of the product by the purchaser (see ISO 23529).

7.5 Conditioning

Samples and test pieces shall be protected from light and heat as much as possible during the interval between production and testing.

In the case of crystallization studies, test pieces shall be conditioned (to remove any existing crystallization) immediately before testing by heating them in an oven at 70 °C for 45 min. They shall then be conditioned at a standard laboratory temperature.

Prepared test pieces shall be conditioned immediately before testing for a minimum period of 3 h at one of the standard laboratory temperatures specified in ISO 23529. The same temperature shall be used throughout any one test or series of tests intended to be comparable.

Test pieces of thermoplastic rubbers shall be annealed before testing by heating in an oven at a temperature and for a length of time that are appropriate to the material in order to release internal stresses caused by the moulding process. They shall then be conditioned at a standard laboratory temperature.

NOTE 70 °C for 30 min is suitable for many materials.

8 Test conditions

8.1 Duration of test

The preferred times are 24_{-2}^{0} h or 72_{-2}^{0} h.

Longer times may be used when studying crystallization, plasticizer migration, or long-term stability at specified temperatures.

8.2 Temperature of test

The temperature of test shall be one of the following temperatures, unless technical reasons dictate otherwise: $0\text{ °C} \pm 2\text{ °C}$, $-10\text{ °C} \pm 2\text{ °C}$, $-25\text{ °C} \pm 2\text{ °C}$, $-40\text{ °C} \pm 2\text{ °C}$, $-55\text{ °C} \pm 2\text{ °C}$, $-70\text{ °C} \pm 2\text{ °C}$, $-80\text{ °C} \pm 2\text{ °C}$, or $-100\text{ °C} \pm 2\text{ °C}$.

9 Procedure

9.1 Method 1

9.1.1 Preparation of compression apparatus

With the compression assembly (5.1.1) at a standard laboratory temperature, carefully clean the operating surfaces. Apply a thin coating of lubricant to the faces of the compression plates (5.1.1.1) that will come into contact with the test pieces. The lubricant used shall have no substantial action on the rubber during the test and it shall be described in the test report (see Clause 12).

NOTE For most purposes, a silicone or fluorosilicone liquid having a nominal kinematic viscosity of $100\text{ mm}^2/\text{s}$ at standard laboratory temperature is a suitable lubricant.

If for any reason a lubricant is not used, this shall be mentioned in the test report.

9.1.2 Thickness measurement

Measure the thickness at the centre of each test piece to the nearest 0,01 mm, at standard laboratory temperature.

9.1.3 Applying the compression

Place the test pieces between the pairs of compression plates together with the spacer(s) (5.1.1.2), avoiding contact between test pieces and bolts or spacer(s). Tighten the clamping device (5.1.1.3), so that the plates are drawn together uniformly until they are in contact with the spacer(s).

The applied compression shall be $(25 \pm 2)\%$ of the original thickness of the test piece, except for higher hardness, for which the applied compression shall be $(15 \pm 2)\%$ or $(10 \pm 1)\%$ (see 5.1.1.2).

9.1.4 Starting the test

Without delay, introduce the compression apparatus containing the test piece into the low-temperature cabinet (5.1.2) operating at the test temperature (see 8.2).

9.1.5 Terminating the test

After the required test duration, fully release the compression and simultaneously start the timing device (5.1.5). Leave them to recover for $30\text{ min} \pm 3\text{ min}$ and then measure their thickness. Both the recovery and the thickness measurement shall be carried out on the sample maintained at the low test temperature.

9.1.6 Internal examination

After completing the test, cut the test piece into two pieces along a diameter. If any internal defects are found, such as gas bubbles, repeat the test.

9.2 Method 2

9.2.1 Preparation of compression apparatus

With the compression apparatus (5.2.1) at a standard laboratory temperature, carefully clean the operating surfaces. Apply a thin coating of lubricant to the faces of the compression plates (5.2.1.1) that will come into contact with the test pieces. The lubricant used shall have no substantial action on the rubber during the test and it shall be described in the test report (see Clause 12).

NOTE For most purposes, a silicone or fluorosilicone liquid having a nominal kinematic viscosity of $100 \text{ mm}^2/\text{s}$ at standard laboratory temperature is a suitable lubricant.

If for any reason a lubricant is not used, this shall be mentioned in the test report.

9.2.2 Thickness measurement

Measure the thickness at the centre of each test piece to the nearest $0,01 \text{ mm}$, at standard laboratory temperature.

9.2.3 Applying the compression

Tighten the compression apparatus (5.2.1) so that the compression plates are drawn together uniformly until the chosen compression is reached. This can be done with or without spacers, depending on the design of the apparatus.

The applied compression shall be $(25 \pm 2) \%$ of the original thickness of the test piece, except for higher hardness, for which the applied compression shall be $(15 \pm 2) \%$ or $(10 \pm 1) \%$ (see 5.2.1.2).

9.2.4 Starting the test

Without delay, introduce the compression apparatus containing the test piece into the low-temperature cabinet (5.2.3) operating at the test temperature (see 8.2).

9.2.5 Terminating the test

After the required test duration, release the compression and simultaneously start the timing device (5.2.5). The time taken to release the compression shall not exceed 10% of the time between the beginning of release and the first thickness measurement (see 9.2.6). When the relationship between test piece thickness and time is to be determined, however, the compression shall be released as quickly as possible.

9.2.6 Measurements

Without removing the test piece from the cabinet, measure the thickness of the test piece, to the nearest $0,01 \text{ mm}$, at time intervals beginning as quickly as possible after release of the compression and ending after 2 h. This approach makes it possible to plot thickness against the logarithm of time (10 s, 30 s, 1 min, 3 min, 10 min, 30 min, and 2 h are suggested). In this case, remove the test piece from the cabinet after 2 h. Normally, compression set values are calculated after recovery periods of $30 \text{ s} \pm 3 \text{ s}$ and/or $30 \text{ min} \pm 3 \text{ min}$.

NOTE The use of a computer-controlled apparatus can enable the measurements to be made automatically and with improved accuracy.

9.2.7 Internal examination

After completing the test, cut the test piece into two pieces along a diameter. If any internal defects are found, such as gas bubbles, repeat the test.

10 Expression of results

NOTE The rubber industry uses the term equation for the relationships herein termed formula. The term formula is used to describe the table of ingredients in a rubber compound.

10.1 The compression set, expressed as a percentage of the initial compression, is given by [Formula \(1\)](#):

$$\frac{h_0 - h_1}{h_0 - h_s} \times 100 \quad (1)$$

where

h_0 is the initial thickness of the test piece, in millimetres;

h_1 is the thickness of the test piece after recovery, in millimetres;

h_s is the height of the spacer, in millimetres.

Report the result to the nearest 1 %.

10.2 For method 2 only, the results for each test piece may be presented by plotting on semi-logarithmic graph paper, with log time as the abscissa and test piece thickness as the ordinate. An approximately straight line will result in most cases over the normal recovery time range, which permits the value of the thickness after any desired recovery time to be calculated by extrapolation (to two orders of 10 of time) or by interpolation. Normally, compression set values are calculated after recovery periods of 30 s and 30 min.

11 Precision

See [Annex B](#).

12 Test report

The test report shall include the following information:

- a) sample details:
 - 1) full description of the sample and its origin,
 - 2) compound and cure details, where appropriate,
 - 3) method of preparation of test pieces from the samples, for example moulded or cut;
- b) test method:
 - 1) a full reference to the test method used, i.e. the number of this document (ISO 815-2:2019),
 - 2) the test method used, i.e. 1 or 2,
 - 3) the type of test piece used, i.e. A or B, and whether or not it was laminated,
 - 4) the nature of the lubricant used,

- 5) whether the test pieces were tested separately or as a set;
- c) test details:
- 1) the standard laboratory temperature used,
 - 2) the temperature and times of conditioning and of recovery,
 - 3) the duration and temperature of test,
 - 4) the compression used,
 - 5) details of any procedures not specified in this document;
- d) test results:
- 1) the number of test pieces used,
 - 2) the initial thickness of the test pieces, if required,
 - 3) the thickness of the test pieces after recovery, if required,
 - 4) the median value of the compression set and the individual test results,
 - 5) a graphical presentation of the results;
- e) the date of the test.

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Annex A (normative)

Calibration schedule

A.1 Inspection

Before any calibration is undertaken, the condition of the items to be calibrated shall be ascertained by inspection and recorded on any calibration report or certificate. It shall be reported whether calibration is made in the 'as-received' condition or after rectification of any abnormality or fault.

It shall be ascertained that the apparatus is generally fit for the intended purpose, including any parameters specified as approximate and for which the apparatus does not therefore need to be formally calibrated. If such parameters are liable to change, then the need for periodic checks shall be written into the detailed calibration procedures.

A.2 Schedule

Verification/calibration of the test apparatus is a normative part of this document. The frequency of calibration and the procedures used are, unless otherwise stated, at the discretion of the individual laboratory using ISO 18899 for guidance.

The calibration schedules given in [Table A.1](#) and [Table A.2](#) have been compiled by listing all of the parameters specified in the test method, together with the specified requirement. A parameter and requirement can relate to the main test apparatus, part of that apparatus or to an ancillary apparatus necessary for the test.

For each parameter, a calibration procedure is indicated by reference to ISO 18899, to another publication, or to a procedure particular to the test method which is detailed (whenever a more specific or detailed calibration procedure than in ISO 18899 is available, it shall be used in preference).

The verification frequency for each parameter is given by a code letter.

The code letters used in the calibration schedules are

- C: requirement to be confirmed but no measurement,
- N: initial verification only,
- S: standard interval as given in ISO 18899, and
- U: in use.

Table A.1 — Calibration schedule — Method 1

Parameter	Requirement	Procedure ISO 18899:2013	Verification frequency	Notes
Compression plates	two parallel, flat, highly polished plates from corrosion resistant material	—	C	
	plates not to distort by more than 0,01 mm when load applied	—	C	Roughness profile <i>Ra</i> not worse than 0,4 µm has been found suitable.

Table A.1 (continued)

Parameter	Requirement	Procedure ISO 18899:2013	Verification frequency	Notes
	plates of sufficient size to ensure that the whole of the test piece remains within the area of the plates after compression	—	C	
Steel spacer(s)	of such size and shape that contact with the compressed test piece is avoided	—	C	
	height 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.	15.2	U	
Clamping device	simple screw device or any other technology	—	C	
Low temperature cabinet	capable of maintaining the compression assembly and test pieces at the test temperature within the tolerance specified in 8.2	—	S	
	steady-state temperature within the specified tolerances reached in the interior of the test pieces in not more than 3 h	—	S	
Thickness gauge	with an accuracy of $\pm 0,01$ mm	15.2	S	For digital gauges, a resolution of 0,001 mm is needed to obtain the required accuracy.
	exerting a pressure of $22 \text{ kPa} \pm 5 \text{ kPa}$ for 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	—	N	
Timing device	accuracy of ± 1 s	23.1	S	

In addition to the items listed in Table A.1, use of the following is implied, which shall be calibrated in accordance with ISO 18899:

- instruments for determining dimensions of the test pieces.

Table A.2 — Calibration schedule — Method 2

Parameter	Requirement	Procedure ISO 18899:2013	Verification frequency	Notes
Compression apparatus	capable of applying the compression and maintaining it during the test	—	C	
	the apparatus other than the thickness gauge to be positioned within the low temperature cabinet throughout the test	—	C	
	having facility to release the compression and make the thickness measurement without opening cabinet	—	C	
Compression plates	two parallel, flat, highly polished plates from corrosion resistant material	—	C	Roughness profile R_a not worse than $0,4 \mu\text{m}$ has been found suitable.
	plates not to distort by more than $0,01 \text{ mm}$ when load applied	—	C	
	plates of sufficient size to ensure that the whole of the test piece remains within the area of the plates after compression	—	C	
Steel spacer(s)	of such size and shape that contact with the compressed test piece is avoided	—	C	
	height chosen so that the compression applied to the test piece is			
	— $(25 \pm 2) \%$ for hardnesses below 80 IRHD, — $(15 \pm 2) \%$ for hardnesses between 80 IRHD and 89 IRHD, — $(10 \pm 1) \%$ for hardnesses of 90 IRHD and higher.	15.2	U	
Thickness gauge	with an accuracy of $\pm 0,01 \text{ mm}$	15.2	S	For digital gauges, a resolution of $0,001 \text{ mm}$ is needed to obtain the required accuracy.
	exerting a pressure of $22 \text{ kPa} \pm 5 \text{ kPa}$ for 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	—	N	
Temperature measurement device	accuracy of $\pm 0,5 \text{ }^\circ\text{C}$	18	S	