

INTERNATIONAL STANDARD



815

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Vulcanized rubbers – Determination of compression set under constant deflection at normal and high temperatures

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 815 (originally Draft No. 2287) was drawn up by Technical Committee ISO/TC 45, *Rubber and rubber products*.

It was approved in August 1971 by the Member Bodies of the following countries :

Austria	Italy	Sweden
Canada	Netherlands	Switzerland
Ceylon	New Zealand	Thailand
Egypt, Arab Rep. of	Poland	Turkey
France	Portugal	United Kingdom
Germany	Romania	U.S.A.
Hungary	South Africa, Rep. of	U.S.S.R.
India	Spain	Yugoslavia

No Member Body expressed disapproval of the document.

This International Standard cancels and replaces ISO Recommendation R 815-1968.

Vulcanized rubbers – Determination of compression set under constant deflection at normal and high temperatures

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a test procedure for determining the compression set characteristics of vulcanized rubbers. The test is intended to measure the ability of rubbers of hardness within the range 30 to 94 International Rubber Hardness Degrees (IRHD) to retain their elastic properties after prolonged compression at constant strain under one of the alternative sets of conditions described. With some rubbers, especially those above 85 IRHD, it may not be possible to achieve 25 % compression strain. For such rubbers this method does not apply.

NOTES

1 Two sizes of test piece are described. These do not necessarily give the same values of compression set, and comparison of values obtained from the two sizes should be avoided. Where possible, the use of the large size of test piece is recommended.

2 The preparation of test pieces by either moulding or by cutting is permitted. For some types of rubber, test pieces prepared by the different methods may give different results. Where possible, the preparation of test pieces by moulding is recommended.

3 Laminated test pieces, made up of two or more superimposed disks, may also be used. These do not generally give the same values of compression set as test pieces of the same dimensions formed of one disk.

2 REFERENCES

2.1 ISO/R 471, *Standard atmospheres for the conditioning and testing of rubber test pieces*.

2.2 ISO . . . , *Rubbers – General directions for elevated or sub-normal temperature tests*.¹⁾

2.3 ISO . . . , *Rubbers – Preparation of test pieces*.¹⁾

3 APPARATUS

3.1 **Compression apparatus**, consisting of two or more parallel, flat, highly polished chromium-plated steel or highly polished stainless steel plates, between the faces of which the test pieces are compressed. The finish of the surface of the compression plates shall be not worse than

0,2 μm arithmetical mean deviation from the mean line of the profile. These plates shall be sufficiently rigid to withstand the stress without bending, and of sufficient size to ensure that all the compressed test pieces are within the area of the plates. The plates shall be held together by a bolt or bolts of suitable size. Steel spacers, preferably in the form of rings, shall be used to provide for the recommended compression. The spacers shall be of such a size that contact with the compressed test pieces is avoided.

3.2 **Oven** Any well-designed, uniformly heated air oven in accordance with ISO . . . (see 2.2), capable of maintaining the compression apparatus and test pieces at the recommended test temperature within the tolerance given in section 6.

4 TEST PIECE

4.1 Preparation

Test pieces shall be prepared in general agreement with ISO . . . (see 2.3).

4.1.1 Large type

A cylindrical disk of diameter $29,0 \pm 0,5$ mm and thickness $12,5 \pm 0,5$ mm shall be prepared either by moulding or by cutting. Cutting shall be done by means of a sharp rotating circular die or revolving knife, lubricated with soapy water, and brought carefully into contact with the rubber, which shall preferably be mounted on wood or other suitable backing material, the cutting pressure being kept small enough to avoid "cupping" of the cut surface.

4.1.2 Small type

A cylindrical disk of diameter $13,0 \pm 0,5$ mm and thickness $6,3 \pm 0,3$ mm shall be prepared as described in 4.1.1.

4.1.3 Laminated type

Test pieces conforming to the dimensions given in 4.1.1 or 4.1.2 may be prepared by laminating disks of rubber cut from sheets, provided that the number of disks laminated does not exceed seven for the large type and three for the small type.

1) In preparation.

4.2 Measurement of thickness

Preferably, and for reference purposes, thickness shall be measured by a micrometer dial gauge having two contact members with domed surfaces of spherical radius 12,5 mm formed on rods 10 mm in diameter. Alternatively, a micrometer dial gauge can be used having a raised platform 9,5 mm in diameter, and a spherical contact member 6,35 mm in diameter. The gauge shall be operated under a dead-weight load of $0,85 \pm 0,03$ N and have a scale graduated in unit divisions of 0,01 mm.

The thickness shall be measured at the central portion of the test piece.

4.3 Number of test pieces

Three pieces shall be tested separately or as a set.

4.4 Time lapse between vulcanization and testing

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

For non-product tests, the maximum time between vulcanization 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 vulcanization and testing shall not exceed 3 months. In other cases, tests shall be made within 2 months of the date of receipt by the customer of the product.

4.4.2 Samples and test pieces shall be protected from light as completely as possible during the interval between vulcanization and testing.

4.5 Conditioning

Prepared test pieces shall be conditioned immediately before testing for a minimum period of 3 h at the standard laboratory temperature in accordance with ISO/R 471. The same temperature shall be used throughout any one test or series of tests intended to be comparable.

5 PROCEDURE

5.1 The compression apparatus shall be at the standard laboratory temperature and its operating surfaces shall be carefully cleaned before use. Where a lubricant is applied, it shall consist of a thin coating of a lubricant having substantially no action on rubber. For most purposes a silicone or fluorosilicone fluid is suitable.

NOTE — Lubrication of the operating surfaces of the compression apparatus is optional. While giving more reproducible results, lubrication may somewhat alter the compression set values. If lubricant is not employed the test piece surfaces shall be free from mould lubricants or dusting powder.

5.2 Measure the thickness of each test piece.

5.3 Place the test pieces between the pairs of plates together with the requisite spacer(s). Tighten the bolt or bolts so that the plates are drawn together uniformly until they are in contact with the spacer(s). The applied compression shall be approximately 25 % of the original thickness of the test piece. Spacers 9,38 \pm 0,01 mm in thickness may be used for large test pieces having a thickness between 12 and 13 mm, and spacers 4,72 \pm 0,01 mm in thickness may be used for small test pieces having a thickness between 6,0 and 6,6 mm.

5.4 Without delay, introduce the compression apparatus containing the test pieces into the central part of an oven which is operating at the test temperature (see section 6). Upon completion of the necessary time of test (see section 6), remove the compression apparatus from the oven, loosen the bolts and transfer the test pieces quickly to a wooden bench. Leave them to recover at the standard laboratory temperature for 30 \pm 3 min, then measure their thickness.

5.5 Cut the test pieces in two along a diameter; if any internal defects such as gas bubbles are found, discard the test result.

6 DURATION AND TEMPERATURE OF TEST

6.1 Duration of test

The time of test shall be 24_{-2}^{+0} , 72_{-2}^{+0} , or 168_{-2}^{+0} h.

6.2 Temperature of test

The temperature of test shall be one of the following :

standard laboratory temperature

70 ± 1 °C

85 ± 1 °C

100 ± 1 °C

125 ± 2 °C

150 ± 2 °C

175 ± 2 °C

200 ± 2 °C

225 ± 2 °C

250 ± 2 °C

7 EXPRESSION OF RESULTS

The compression set (C), expressed as a percentage of the initial deflection, shall be calculated as follows :

$$C = \frac{t_0 - t_1}{t_0 - t_s} \times 100$$

where

t_0 is the initial thickness of the test piece;

t_1 is the thickness of the test piece after recovery;

t_s is the height of the spacer.

The results for the three test pieces shall agree within 5 % of the mean compression set value; if they do not, the test must be repeated.

8 TEST REPORT

The test report shall include the following information :

- a) the mean value of the three test results, expressed in accordance with section 7;
- b) the temperature of conditioning and of recovery;
- c) the duration and temperature of test;
- d) the initial dimensions of the test pieces, including the initial thickness t_0 ;
- e) the thickness of the test pieces after recovery, t_1 ;
- f) the type of test piece used, i.e. moulded or cut, and the number of disks laminated, if test pieces of the type described in 4.1.3 are used;
- g) whether or not the operating surfaces of the clamps are lubricated;
- h) whether the test pieces are tested separately or as a set.

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