BS ISO 7743:2017

BSI Standards Publication

Rubber, vulcanized or thermoplastic — Determination of compression stress-strain properties

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National foreword

This British Standard is the UK implementation of ISO 7743:2017. It supersedes BS ISO 7743:2011, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/22, Testing and analysis of rubber.

A list of organizations represented on this committee can be obtained on request to its secretary.

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© The British Standards Institution 2017
Published by BSI Standards Limited 2017

ISBN 978 0 580 97193 8

ICS 83.060

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2017.

Amendments/corrigenda issued since publication

Date	Text affected

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INTERNATIONAL STANDARD

ISO 7743

Fifth edition
2017-10-06

Rubber, vulcanized or thermoplastic — Determination of compression stress-strain properties

Caoutchouc vulcanisé ou thermoplastique — Détermination des propriétés de contrainte/déformation en compression

Reference number
ISO 7743:2017(E)

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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).

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For an explanation on 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 the following URL: 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 fifth edition cancels and replaces the fourth edition (ISO 7743:2011), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— the list of normative references has been updated in Clause 2;

— more detailed explanation has been added on the interpretation of the 25 % strain in 12.2.

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Introduction

Knowledge of compression stress-strain properties is important in the design of, for instance, bridge bearings, anti-vibration mountings and O-rings. Measurement of compression stress-strain behaviour is also used for the quality control of small O-rings and other small products (i.e. those under 2 mm thick) where hardness cannot easily be measured. Compression tests are also used to detect the presence of porosity in products such as pipe sealing rings. Compression can be uniaxial or biaxial depending on test piece shape and experimental conditions. If there is no friction at the interface between the test piece and the compression device, compression is uniaxial. If friction is significant, the test piece shape affects the nature of the compression. When the thickness of the test piece is small, Saint Venant's principle is not applicable: the boundary condition at the interface influences the stress and strain fields and compression becomes biaxial (the thinner the test piece, the higher the biaxiality). The test piece behaves as if an additional radial compression were applied (friction hampers the radial expansion due to axial compression) and this phenomenon needs to be taken into account when material properties such as moduli are to be derived from compression results.

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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 methods for the determination of the compression stress-strain properties of vulcanized or thermoplastic rubber using a standard test piece, a product or a part of a product.

Four procedures are given:

— using standard test piece A with the metal plates lubricated (method A);

— using standard test piece A with the metal plates bonded to the test piece (method B);

— using standard test piece B (method C);

— using a product or a part of a product with the metal plates lubricated (method D).

The methods are not suitable for materials that exhibit high set.

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 5893 , *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification*

ISO 18899:2013 , *Rubber — Guide to the calibration of test equipment*

ISO 23529 , *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:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

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3.1
compression stress
stress applied so as to cause a deformation of the test piece in the direction of the applied stress, expressed as the force divided by the original area of cross-section perpendicular to the direction of application of the force

3.2
compression strain
deformation of the test piece in the direction of the applied stress divided by the original dimension in that direction

Note 1 to entry: The compression strain is commonly expressed as a percentage of the original dimension of the test piece.

3.3
compression modulus
secant modulus
applied stress calculated on the original area of cross-section divided by the resultant strain in the direction of application of the stress

3.4
stiffness at 25 % compression
force which needs to be applied to a product or a part of a product to compress it by 25 %

Note 1 to entry: It is expressed in newtons per metre or in newtons, depending on the shape of the test piece.

4 Principle

A test piece (lubricated or bonded) is compressed at a constant speed between the compression plates until a pre-determined strain is reached.

The four procedures do not give the same results. Method A (test piece A, lubricated) gives results which are dependent only on the modulus of the rubber and are independent of the test piece shape, provided that complete slip conditions are achieved. Effective lubrication is sometimes difficult to achieve, however, and it is prudent to inspect the variance in the test results from replicate test pieces for indications of erratic slip conditions. Method B (test piece A, bonded) gives results which are dependent on both the modulus of the rubber and the test piece shape. The dependence on test piece shape is strong and, consequently, the results are markedly different from those obtained with lubricated test pieces. Method C (test piece B) gives results which are independent of both the test piece shape and the lubrication conditions. This test piece is more appropriate and more convenient when intrinsic material properties are to be determined (see Annex A for details). For products (method D), the result is dependent on the shape, but as tests on products are mainly comparative, this is acceptable.

NOTE For well-specified product shapes, such as O-rings, the result can be correlated to the hardness value.

Provision is made for the use of test pieces of different size and/or shape from the specified test pieces, but extrapolation of the results obtained to other sizes and shapes can prove impossible.

Information on the effect of size and shape of test piece and of bonding or lubrication is given in Annex A.

5 Apparatus and materials

5.1 Flat metal plates, of uniform thickness and having lateral dimensions greater than or equal to those of test pieces for bonding or at least 20 mm greater than those of test pieces for lubrication.

For methods A and D, one surface of each plate shall be highly polished.

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.

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