
**Rubber, vulcanized or thermoplastic —
Determination of elongation, creep and
tension set at constant load**

*Caoutchouc vulcanisé ou thermoplastique — Détermination de
l'allongement, du fluage et de la déformation rémanente en tension
sous charge constante*

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12244 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Physical and degradation tests*.

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Rubber, vulcanized or thermoplastic — Determination of elongation, creep and tension set at constant load

WARNING - Persons using this International Standard should be familiar with normal laboratory practice. This standard 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.

1 Scope

Sometimes it is desirable to determine the elastic properties of a rubber more quickly than in a conventional tension set or compression set test, e.g. to measure the state of cure or for quality control measurements on thin-walled products.

This International Standard specifies a method for the quick determination of elongation, creep and tension set of vulcanized or thermoplastic rubber test pieces at constant load and at standard laboratory temperature.

The test is intended to measure the elastic properties of rubber in the hardness range of 20 IRHD to 94 IRHD.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 471:1995, *Rubber - Temperatures, humidities and times for conditioning and testing.*

ISO 4648:1991, *Rubber, vulcanized or thermoplastic - Determination of dimensions of test pieces and products for test purposes.*

ISO 4661-1:1993, *Rubber, vulcanized or thermoplastic - Preparation of samples and test pieces - Part 1: Physical tests.*

3 Definitions

For the purposes of this International Standard, the following definitions apply:

3.1 creep: The change in elongation of a test piece at constant load during a specified time, expressed as a percentage of the elongation at the beginning of that time.

3.2 tension set: The elongation remaining in a test piece in the unloaded condition after it has been subjected to a constant load during a specified time, expressed as a percentage of the original unloaded length.

4 Apparatus

4.1 Straining device

Clamps and weights for loading the test pieces (see figure 1).

4.2 Measuring devices

The thickness of each test piece shall be measured with a gauge as specified in ISO 4648:1991, method A.

The width of each test piece shall be taken as the distance between the cutting edges of the die in the narrow part, and this distance shall be measured in accordance with ISO 4661-1 to the nearest 0,05 mm.

The length of each test piece between the gauge marks shall be measured as specified in ISO 4648:1991, method B.

5 Test pieces

5.1 Preparation

Test pieces shall be prepared in general accordance to ISO 4661-1.

5.1.1 Strip test pieces

Test pieces shall be cut from a $2 \text{ mm} \pm 0,2 \text{ mm}$ thick rubber sheet with a cutter, the contour of which is shown in figure 2, having a cutting edge as specified in ISO 4661-1.

5.1.2 Test pieces from finished products

Test pieces may be cut from finished products with a cutter, the contour of which is shown in figure 2, having a cutting edge as specified in ISO 4661-1. Materials thicker than 2 mm shall be slit or abraded down to a thickness of $2 \text{ mm} \pm 0,2 \text{ mm}$ in accordance with ISO 4661-1.

5.2 Marking

Two gauge marks (A and B) at a distance of $90 \text{ mm} \pm 0,5 \text{ mm}$ from each other (measured length L_1) shall be marked on the test pieces (see figure 2).

5.3 Number of test pieces

For each test, a minimum of three test pieces shall be used (for material with calandering grain, three test pieces shall be taken in each direction at right angles to each other).

5.4 Time-interval between vulcanization and testing

The time interval between vulcanization and testing shall be in accordance with ISO 471.

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

5.5 Conditioning

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

6 Procedure

Before placing a test piece under load, measure the length of the test piece between the gauge marks, the thickness of the test piece and the width of the test piece as described in subclause 4.2 at standard laboratory temperature.

The test pieces shall be clamped and loaded to a stress of 2,5 MPa ± 0,1 MPa, taking account of the actual area of the original cross-section. The loading shall be carried out without shock.

Note - If, during the testing, a stress of 2,5 MPa proves to be too high, a stress of 1,0 MPa ± 0,1 MPa may be used.

6.1 Elongation

The distance between the gauge marks shall be measured 30 s after loading the test piece (measured length L_2).

6.2 Creep

After 60 min ± 1 min, a new measurement shall be taken between the gauge marks (measured length L_3).

6.3 Tension set

After the creep measurement, the test piece shall be unloaded without shock, freed and allowed to rest on a flat surface for 10 min ± 1 min, after which the distance between the gauge marks shall be measured again (measured length L_4).

7 Calculation of results

7.1 Elongation (ϵ_1)

$$\epsilon_1 = \left\{ \frac{L_2 - L_1}{L_1} \right\} \cdot 100$$

7.2 Creep (ϵ_2)

$$\epsilon_2 = \left\{ \frac{L_3 - L_2}{L_2 - L_1} \right\} \cdot 100$$

7.3 Tension set (ϵ_3)

$$\epsilon_3 = \left\{ \frac{L_4 - L_1}{L_1} \right\} \cdot 100$$

where

L_1 = measured length, in millimetres, before loading;

L_2 = measured length, in millimetres, after 30 s when subject to a stress of 2,5 MPa or 1 MPa;

L_3 = measured length, in millimetres, after 60 min when subject to a stress of 2,5 MPa or 1 MPa;

L_4 = measured length, in millimetres, after 10 min rest following measurement of length L_3 ;

ϵ_1 = elongation, in percent;

ϵ_2 = creep, in percent;

ϵ_3 = tension set, in percent.

8 Expression of results

Report the median of the individual results obtained for the elongation, creep and tension set measurements (ϵ_1 , ϵ_2 and ϵ_3).

If required, report the range and/or the individual results.

If an individual result differs from the median by more than 10 %, test three further test pieces and report the median of all the results obtained (and range and/or the individual results, if required).

9 Test report

The test report shall include the following information:

- a) a reference to this International Standard;
- b) sample details:
 - 1) a full description of the sample and its origin,
 - 2) compound details and curing conditions, if known,
 - 3) the direction in which the test pieces were cut, relative to the grain,
 - 4) the dimensions of the original cross-section of the narrow part of the test pieces,
 - 5) the details of any sample preparation, e.g. buffing;
- c) test details:
 - 1) if appropriate, details of ageing,
 - 2) the stress applied,
 - 3) any deviations from the standard procedure;
- d) test results:
 - 1) the number of test pieces used,
 - 2) the median values of the elongation, creep and tension set,
 - 3) the range of results and/or the individual results, if required;
- e) the date of the test.