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Rubber, unvulcanized — Determination of plasticity — Rapid-plastimeter method

*Caoutchouc non vulcanisé — Détermination de la plasticité — Méthode
au plastomètre rapide*



Reference number
ISO 2007:1991(E)

Foreword

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International Standard ISO 2007 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Sub-Committee SC 2, *Physical and degradation tests*.

This third edition cancels and replaces the second edition (ISO 2007:1981), of which it constitutes a technical revision.

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Rubber, unvulcanized — Determination of plasticity — Rapid-plastimeter method

1 Scope

This International Standard specifies a method for the rapid determination of the plasticity of raw rubber and unvulcanized compounded rubber. It is applicable to the determination of the plasticity retention index (PRI) (see ISO 2930).

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 1796:1982, *Rubber, raw — Sample preparation*.

ISO 2930:1981, *Rubber, raw natural — Determination of plasticity retention index (PRI)*.

3 Principle

A disc-shaped test piece is compressed rapidly between small parallel platens to a fixed thickness of 1 mm. The test piece is maintained at this compression for 15 s to enable it to reach approximate temperature equilibrium with the platens. After this period, the test piece is subjected to a constant compressive force of $100 \text{ N} \pm 1 \text{ N}$ for 15 s. Its thickness at the end of this period is taken as the measure of plasticity.

4 Apparatus

4.1 Parallel-plate plastimeter, consisting of the following elements:

4.1.1 Two parallel, circular platens, having smooth, flat surfaces, movable in relation to each other, both provided with suitable means of heating, and a **jacket** so that the material being tested and the area surrounding it may be maintained at the specified test temperature.

One of the two platens shall be a right cylinder of stainless steel and shall have one of the following diameters: 7,30 mm, 10,00 mm or 14,00 mm (tolerance $\pm 0,02 \text{ mm}$), its effective depth shall be $4,50 \text{ mm} \pm 0,15 \text{ mm}$ and care shall be taken to ensure that the edge of the working face is neither worn nor damaged. The diameter shall be selected so that the measured plasticity (see clause 9) lies between 20 and 85. The other platen may be of chromium-plated brass or stainless steel and shall be of a larger diameter than the first platen. Its effective depth of inclusion within any heating jacket shall be $3,50 \text{ mm} \pm 0,25 \text{ mm}$.

4.1.2 Means for moving one or other of the two platens normal to its surface, to compress the test piece to a thickness of $1,00 \text{ mm} \pm 0,01 \text{ mm}$.

The mode of movement of the platen and the forces applied in this operation shall be such that, with or without the test piece in place, the movement is always completed within a period of 2 s. A force of at least 300 N is required and may be conveniently provided by springs.

4.1.3 Means of applying to one or other platen a test force of $100 \text{ N} \pm 1 \text{ N}$ normal to its surface to compress the test piece.

4.1.4 Means for indicating the thickness of the test piece to the nearest 0,01 mm when it is between the platens.

4.1.5 Timing device, so that the test may be timed in seconds to an accuracy of 0,2 s.

4.2 Punch, for preparation of the test pieces.

The purpose of the punch is to produce test pieces of approximately constant volume quickly and without difficulty. The punch shall consist of a flat-ended cylindrical anvil and a coaxial tubular knife moving independently of one another; a single action of the handle shall compress a portion of the material to a thickness of approximately 3 mm and shall cut out a disc of approximately 13 mm diameter. The test piece need only be approximately constant in volume because the final shaping to exact dimensions is carried out in the instrument during the preheating period.

4.3 Bleached, unglazed, acid-free tissue paper, of approximately 17 g/m².

For interlaboratory testing, paper from the same source shall be used.

5 Test piece

Raw rubber shall be homogenized when comparative tests are to be carried out. The preparation and homogenization of the sample shall be carried out in accordance with the provisions of ISO 1796.

The test piece shall be a disc of rubber approximately 13 mm in diameter and approximately 3 mm thick, having a volume of $0,40 \text{ cm}^3 \pm 0,04 \text{ cm}^3$.

If the specified thickness is attained by compressing an initially thicker sheet, the latter shall be not more than 4 mm thick.

6 Calibration

The settings of the rapid plastimeter shall be checked against the maker's instructions. The loading spring shall be recalibrated (at $100 \text{ N} \pm 1 \text{ N}$) every 6 weeks, and the timing unit [pre-heating time ($15 \text{ s} \pm 0,1 \text{ s}$) and test period $15 \text{ s} \pm 0,2 \text{ s}$] every 4 weeks. The position of the top platen shall be checked before each test.

A sample of standard butyl rubber can be used to check whether the machine is in working order. The test pieces shall in this case be prepared from a sheet approximately 3 mm thick, cut from the standard butyl rubber sample.

The standard rubber may be obtained from a National Testing Office or from the National Institute of Standards and Technology (NIST), Washington, USA (designation: NBS-388). The plasticity number of the standard rubber is $31,0 \pm 0,5$.

7 Temperature of test

Unless otherwise stated, the test shall be carried out at $100 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$.

8 Procedure

Place two pieces of tissue paper (4.3), each measuring $35 \text{ mm} \times 35 \text{ mm}$, between the heated platens (4.1.1) and set the thickness-measuring device (4.1.4) to zero when the platens are closed. Insert the test piece centrally between the two pieces of tissue paper, and place the whole between the heated platens. Compress the test piece to a thickness of $1,00 \text{ mm} \pm 0,01 \text{ mm}$ with the platen-moving device (4.1.2), and hold it in the compressed state for a pre-heating period of ($15 \text{ s} \pm 0,1 \text{ s}$).

On completion of the pre-heating period, apply a test force of $100 \text{ N} \pm 1 \text{ N}$ to the movable platen for a period of $15 \text{ s} \pm 0,2 \text{ s}$ with the force-application device (4.1.3). At the end of this time, measure the thickness of the test piece. Take the reading of thickness at the moment the 15 s test period is completed. On models with electronic digital read-out, the measurements will be held until the instrument is re-set. On instruments with dial gauge read-out, the reading shall be taken immediately before any drop-back occurs, and before the locking mechanism operates.

9 Expression of results

The median value of the thickness of three test pieces at the end of the 15 s compression period, expressed in hundredths of a millimetre, shall be taken as the plasticity number.

10 Test report

The test report shall include the following information:

- a) a full description and identification of the sample tested, including:
 - 1) its origin,
 - 2) preparation of test pieces, for example the milling procedure used (see ISO 1796),
 - 3) details of compounded rubbers, if applicable;
- b) test method:
 - 1) a reference to this International Standard,
 - 2) any special data concerning the apparatus;

c) test details:

- 1) the size of platen used (as given in 4.1.1),
- 2) the temperature of test;

d) the test result, i.e. the plasticity number expressed as specified in clause 9;

e) the date of the test.

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