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**Rubber, raw and unvulcanized  
compounded — Determination of  
plasticity number and recovery  
number — Parallel-plate method**

*Caoutchouc brut et mélanges non vulcanisés — Détermination de  
l'indice de plasticité et de l'indice de recouvrance — Méthode des  
plateaux parallèles*



Reference number  
ISO 7323:2006(E)

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Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 7323 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This second edition cancels and replaces the first edition (ISO 7323:1985), which has been revised to update the normative references (ISO 471 and ISO 3383 have been replaced by ISO 23529 and ISO 1796 by ISO 1795). It also incorporates the Technical Corrigendum ISO 7323:1985/Cor.1:2003.

# Rubber, raw and unvulcanized compounded — Determination of plasticity number and recovery number — Parallel-plate method

**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

This International Standard specifies a method using the parallel-plate plastometer for the determination of the plasticity number and recovery number of uncompounded, compounded and reclaimed stocks of unvulcanized rubbers and rubber-like materials.

**NOTE** The plasticity number and the recovery number are related to the viscoelastic properties of the material. The plasticity number is related to the flow properties and the recovery number is related to the elastic component. These are useful in predicting the processability characteristics, such as the ease of forming and die swell.

## 2 Normative references

The following referenced documents are indispensable for the application 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 1795, *Rubber, raw natural and raw synthetic — Sampling and further preparative procedures*

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.

### 3.1

#### **plasticity number**

height, in millimetres, multiplied by 100, of a cylindrical test piece of volume 2 cm<sup>3</sup> and initial height approximately 10 mm after it has been subjected to a compressive force of 49 N for a specified time at a specified temperature

### 3.2

#### **recovery number**

difference in height, in millimetres, multiplied by 100, between that of a cylindrical test piece of volume 2 cm<sup>3</sup> and initial height approximately 10 mm after it has been subjected to a compressive force of 49 N for a specified time at a specified temperature and that after it has been allowed to recover for a specified time at a specified temperature after removing the force

## 4 Principle

A test piece of specified volume is preheated to a specified temperature for  $(15 \pm 0,5)$  min and a compressive force of  $(49 \pm 0,5)$  N is applied for a specified time. The height of the test piece (the plasticity number) is measured.

The test piece is allowed to recover at the test temperature for a specified time. The height of the recovered test piece is measured and the difference between the two heights is taken as the recovery number.

## 5 Apparatus

**5.1 Parallel-plate plastometer**, the essential features of which are illustrated in Figure 1.

The plastometer shall comprise the following parts:

**5.1.1 Two plates**, not less than 10 mm thick and of diameter 40 mm, mounted on a suitable frame so that one plate moves with respect to the other and so that the two plates are parallel to within  $1^\circ$  at all times.

The apparatus shall be designed so that a test piece between the parallel plates is subjected to a force of  $(49 \pm 0,5)$  N, including the effect of the spring in the dial indicator gauge, during the test.

**5.1.2 Dial indicator gauge**, calibrated in divisions of 0,01 mm, mounted on the apparatus in such a manner that the distance between the plates can be determined at all times.

**5.2 Oven**, circulating-air type, capable of being controlled to within  $1^\circ\text{C}$ , and capable of containing the plastometer (see ISO 23529).

**5.3 Dial micrometer gauge**, having a presser foot of diameter  $(25 \pm 2)$  mm actuated by a dead weight load of  $(800 \pm 30)$  mN (this is required for the determination of recovery number).

## 6 Test pieces

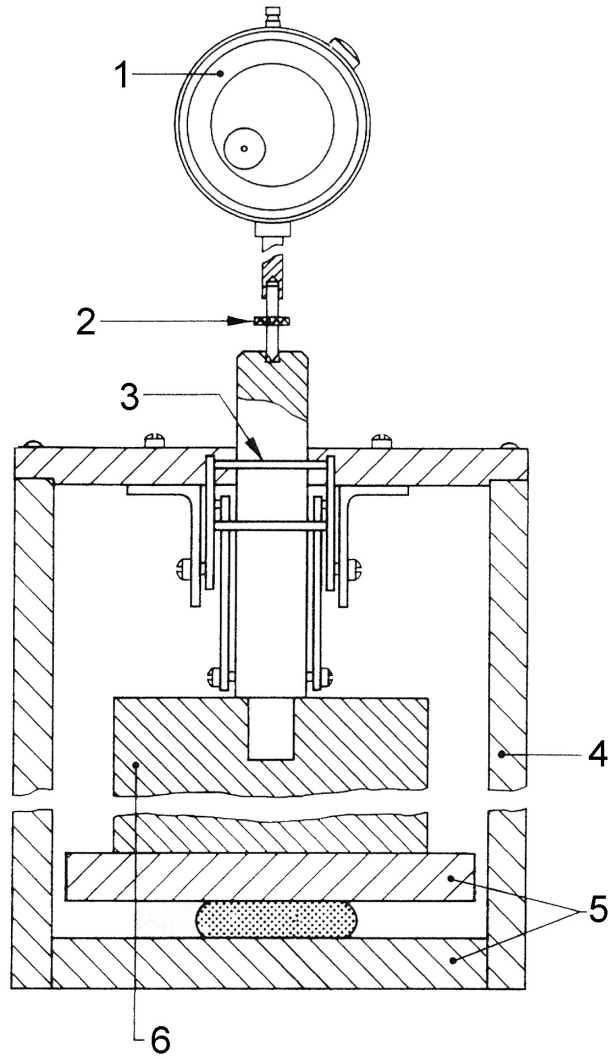
### 6.1 Preparation

The test pieces shall be free from air pockets, and shall be cylindrical in shape and of volume  $(2,00 \pm 0,02)$  cm<sup>3</sup> (a cylinder of diameter 16 mm and height 10 mm is appropriate). They may be prepared from either a solid or a plied sheet of unvulcanized rubber approximately 15 mm thick, care being taken to exclude air pockets in the sheet. They may be cut from the sheet either by means of two mating dies as shown in Figure 2, which produces cylinders of the correct volume, or by means of a rotating die having an internal diameter of approximately 16 mm. If the density is known, weighing procedures may be used to adjust to the correct volume. Three test pieces shall be prepared, lightly dusted with dusting powder, and placed in a suitable holder so that they are not appreciably deformed before testing.

The method of preparation of the piece of unvulcanized rubber (see ISO 1795) from which the test pieces are cut can affect the results. For comparative results, the method chosen should be rigidly adhered to. The time between preparation of the test piece and carrying out the test shall be constant and not less than 1 h, and shall be stated in the test report.

### 6.2 Number

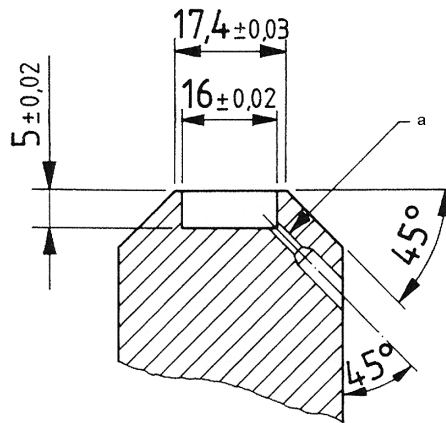
Three test pieces shall be tested.



**Key**

- |                         |  |
|-------------------------|--|
| 1 dial indicator gauge  | 4 guide frame  |
| 2 dial adjustment screw | 5 parallel plates                                      |
| 3 lift lever            | 6 system to give compressive force of $(49 \pm 0,5)$ N |

**Figure 1 — Typical parallel-plate plastometer**



<sup>a</sup> Drill to approximately 0,2 mm diameter.

**Figure 2 — Hardened steel die for forming the test piece**  
(two are required)

## 7 Test conditions

**7.1** The preferred test temperatures are  $(70 \pm 1) ^\circ\text{C}$  and  $(100 \pm 1) ^\circ\text{C}$ . If other temperatures between room temperature and  $100 ^\circ\text{C}$  are used, they should be selected from those given in ISO 23529.

**7.2** Readings may be taken at any desired time following application of the load and removal of the force. The preferred intervals are 3 min following application of the force for plasticity number and 1 min following removal of the force for recovery number.

**7.3** The total force on the test piece, including the effect of the spring in the dial gauge, during the test shall be  $(49 \pm 0,5) \text{ N}$  (see 5.1.1)

## 8 Procedure

### 8.1 General

Insert the plastometer in the oven and maintain the oven and plates at the test temperature throughout the test (see 7.1).

### 8.2 Determination of plasticity number

Place the test piece between two pieces of release material such as Holland cloth (preferably with a count of  $27 \times 21$  threads/cm or finer) to prevent the test piece sticking to the plates.

Set the dial indicator gauge (5.1.2) to read zero with two thicknesses of the release material between the plates.

Preheat the test piece at the test temperature for  $(15 \pm 0,5) \text{ min}$ . Place the preheated test piece between the two parallel plates, lower the weight and, after the desired time (see 7.2), read the dial indicator gauge to the nearest 0,01 mm and record the height  $h_1$  of the test piece in millimetres.

### 8.3 Determination of recovery number

At the end of the compression period, after reading the dial indicator gauge, remove the force on the upper plate and permit the test piece to recover for the desired time at the test temperature. At the end of this period, measure the height  $h_2$  of the test piece at the test temperature using the dial micrometer gauge (5.3). Record this value as the "recovery height" in millimetres.



## 9 Expression of results

### 9.1 Plasticity number

The plasticity number is given by the formula

$$100h_1$$

where  $h_1$  is the height, in millimetres, of the test piece under load (see 8.2).

Record the median value for the three test pieces.

### 9.2 Recovery number

The recovery number is given by the formula

$$100(h_2 - h_1)$$

where

$h_1$  is as defined in 9.1;

$h_2$  is the recovery height, in millimetres (see 8.3).

Record the median value for the three test pieces.

## 10 Test report

The test report shall include the following information:

a) Sample details:

- 1) a full description of the sample and its origin;
- 2) details of the preparation of the test pieces, for example milling procedure (see ISO 1795), whether plied, and the time between preparation and test;
- 3) compound details, where appropriate.

a) Test method:

a full reference to the test method used, i.e. the number of this International Standard (ISO 7323:2006).

b) Test details:

- 1) the temperature of the oven during the test;
- 2) the duration of application of the force to the test piece;
- 3) the duration of recovery.

c) Test results:

- 1) the plasticity number;
- 2) the recovery number.

d) Date of test.

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