INTERNATIONAL STANDARD 1827

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Rubber, vulcanized — Determination of modulus in shear — Quadruple shear method

Caoutchouc vulcanisé — Détermination du module de cisaillement — Méthode du quadruple cisaillement

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Descriptors : rubber, vulcanized rubber, tests, measurement, shear modulus, shear tests.

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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.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 45 has reviewed ISO Recommendation R 1827 and found it technically suitable for transformation. International Standard ISO 1827 therefore replaces ISO Recommendation R 1827-1971 to which it is technically identical.

ISO Recommendation R 1827 was approved by the Member Bodies of the following countries :

Australia	India	Spain
Austria	Iran	Sri Lanka
Brazil	Israel	Sweden
Canada	Netherlands	Switzerland
Czechoslovakia	New Zealand	Thailand
Egypt, Arab Rep. of	Peru	Turkey
France	Poland	United Kingdom
Greece	Portugal	U.S.S.R.
Hungary	South Africa, Rep. of	

No Member Body expressed disapproval of the Recommendation.

No Member Body disapproved the transformation of ISO/R 1827 into an International Standard.

Printed in Switzerland

Rubber, vulcanized — Determination of modulus in shear — Quadruple shear method

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for the determination of the modulus in shear of rubber bonded between four parallel rigid plates.

The method is applicable primarily to test pieces prepared in the laboratory under standard conditions such as may be used to provide data for the development and control of rubber compounds.

2 PRINCIPLE

Measurement of the forces required to obtain a range of predetermined shear distortions of a unit of standard dimensions comprising four parallelepipeds of rubber symmetrically disposed and bonded to four parallel plates, the forces being parallel to the bonding surfaces and, as a rule, non-destructive, i.e. of maximum values appreciably lower than the bond strength.

3 APPARATUS

3.1 Testing machine, conforming to the requirements of national standards for verification of testing machines. It shall be capable of accurately measuring the deformations and registering the applied forces during the test while maintaining the specified constant rate of separation of the jaws of 25 ± 5 mm/min.

NOTE — Inertia (pendulum) type dynamometers are apt to give results which differ because of frictional or inertial effects. An inertialess (for example electronic or optical transducer) type dynamometer gives results which are free from these effects and is therefore to be preferred.

3.2 Fixtures, for holding the test pieces in the grips, provided with a universal joint to permit accurate centring of the line of action of the applied force.

4 TEST PIECE

4.1 Shape and dimensions

The standard test piece consists of four identical parallelepipedal rubber elements 4 ± 0,1 mm thick, 20 ± 0,1 mm wide and 25 ± 0,1 mm long, bonded on each of their two largest opposite faces to the mating faces of four rigid plates of the same width, and of appropriate lengths to obtain a symmetrical double sandwich arrangement, means being provided at the free external end of each central plate to secure its further assembly to the corresponding holding fixture. The thickness of the rigid plates shall be $5\ ^{0}_{-0,1}$ mm. A typical test piece is shown in figure 1.

4.2 Preparation

The standard test piece shall be prepared as follows :

4.2.1 Rectangular rigid plates of the standard dimensions shall be prepared and treated in accordance with a normal adhesion system.

4.2.2 Unvulcanized rubber blanks shall be cut using a die of such size that a limited amount of flash is obtained on moulding.

4.2.3 The rigid plates and rubber blanks shall then be disposed for vulcanization in the mould. Moulding may be performed in two different ways :

a) by compression moulding, where individual rubber blanks are preassembled in the mould between the rigid plates;

b) by transfer moulding, where a single rubber blank is transferred into a plurality of cavities through appropriate nozzles.

A suitable type of transfer mould accommodating six test parts (24 cavities) is shown in figure 2.

4.2.4 The vulcanization shall be carried out by heating the mould for a definite time at controlled temperature under pressure.

4.2.5 At the conclusion of the vulcanization, great care shall be taken in removing the test pieces from the mould to avoid subjecting the adhered surfaces to undue stress.

4.3 Number

The test shall be carried out on three test pieces.

5 TIME-LAPSE BETWEEN VULCANIZATION AND TESTING

Unless otherwise specified for technical reasons, the following procedures shall be used :

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

5.2 The maximum time between vulcanization and testing shall be 4 weeks, and for evaluations intended to be comparable the test should, as far as possible, be carried out after the same time-interval.

6 CONDITIONING OF TEST PIECES

6.1 When a test is made at a standard laboratory temperature, the prepared test pieces shall be maintained at the conditions of test for at least 16 h immediately before testing.

6.2 When tests are made at higher or lower temperatures, the test pieces shall be maintained at the conditions of test for a period of time sufficient to reach temperature equilibrium with the testing environment, or for the period of time required by the specification covering the material or product being tested, and immediately tested.

7 TEMPERATURE OF TEST

The test should normally be carried out at a standard laboratory temperature (20 ± 2 °C, 23 ± 2 °C or 27 ± 2 °C). When other temperatures are used, these should be selected from the following list of preferred temperatures :

− 75, − 55, − 40, − 25, − 10, 0, 40, 50, 70, 85
100, 125, 150, 175, 200, 225 and 250 °C.

The same temperature shall be used throughout any one test or series of tests intended to be comparable.

9 PROCEDURE

After conditioning as specified in clause 6, immediately mount the test piece in the testing machine, taking care to ensure freedom of longitudinal self-alignment with the direction of force application. Carry out at least five successive, steady, non-destructive, loading and release cycles corresponding to the whole range of shear distortions under investigation, prior to actual deformation measurements, in order to reach a stabilized stress-strain behaviour of the rubber to eliminate the so called "Mullins" effect. Zero the force- and distortion-measuring apparatus while maintaining a slight traction force, for example about 10 N. Immediately apply an increasing traction force at a rate of separation of the jaws of 25 ± 5 mm/min until the maximum shear strain under investigation is reached.

Record the forces corresponding to the predetermined fixed values of deformation or, alternatively, the deformations at a predetermined fixed force.

9 EXPRESSION OF RESULTS

9.1 The shear stress, expressed in pascals*, shall be calculated by dividing the applied force by twice the bonded area, that is twice $20 \times 25 \times 10^{-6}$ m^2.

9.2 The shear strain shall be calculated by dividing one-half the actual deformation of the test piece by the sheared thickness (both expressed in the same units of length).

9.3 The mean apparent shear modulus, expressed in pascals*, at any value of the shear strain, shall be calculated as the ratio of the corresponding shear stress to the shear strain.

10 TEST REPORT

The test report shall include the following particulars :

a) results, for all three test pieces, calculated in accordance with clause 9, for the apparent shear modulus at various shear strains;

b) identification of the rubber compound;

c) moulding process (compression, transfer, casting, etc.);

d) duration and temperature of vulcanization;

e) temperature of test;

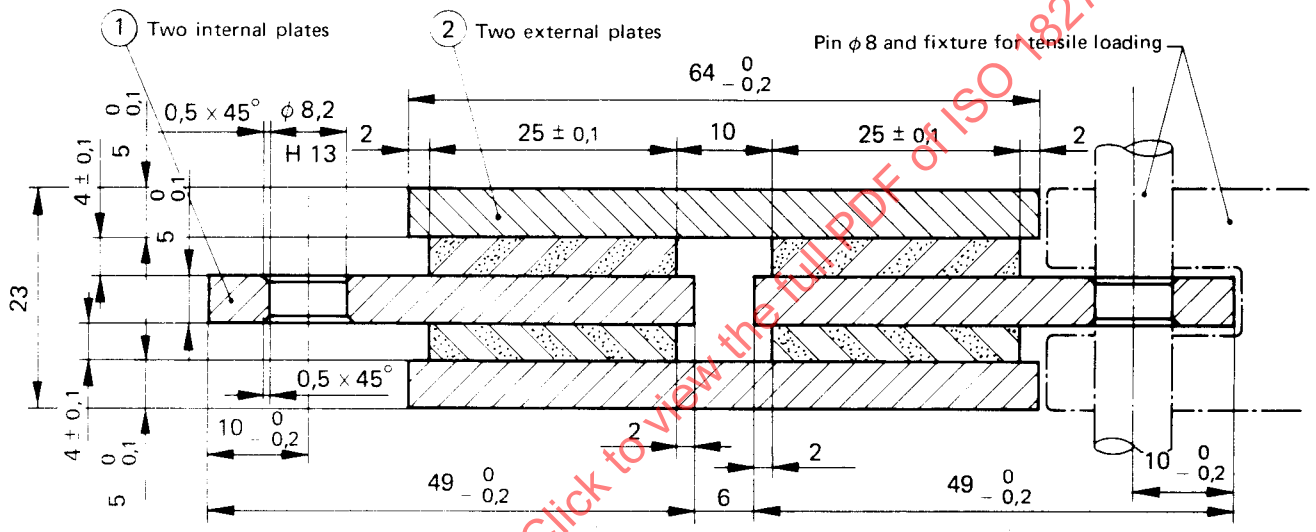
f) date of vulcanization;

g) date of test;

h) failure of test part, if any.

* 1Pa = 1 N/m^2

Dimensions in millimetres



Section A-A

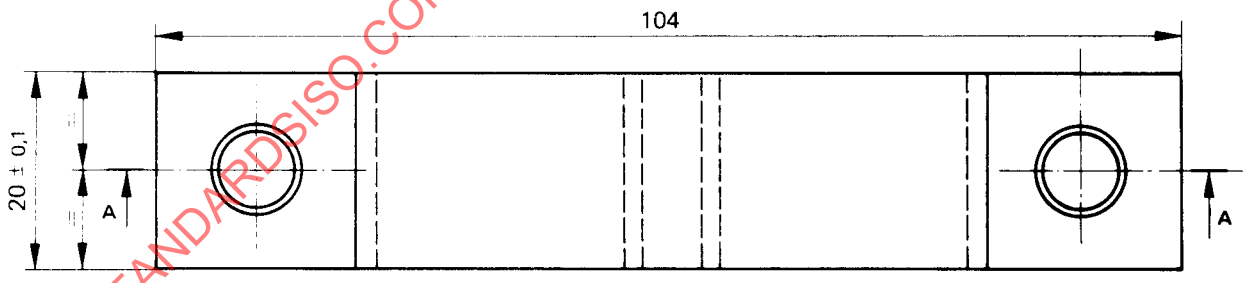


FIGURE 1 — **Test piece**

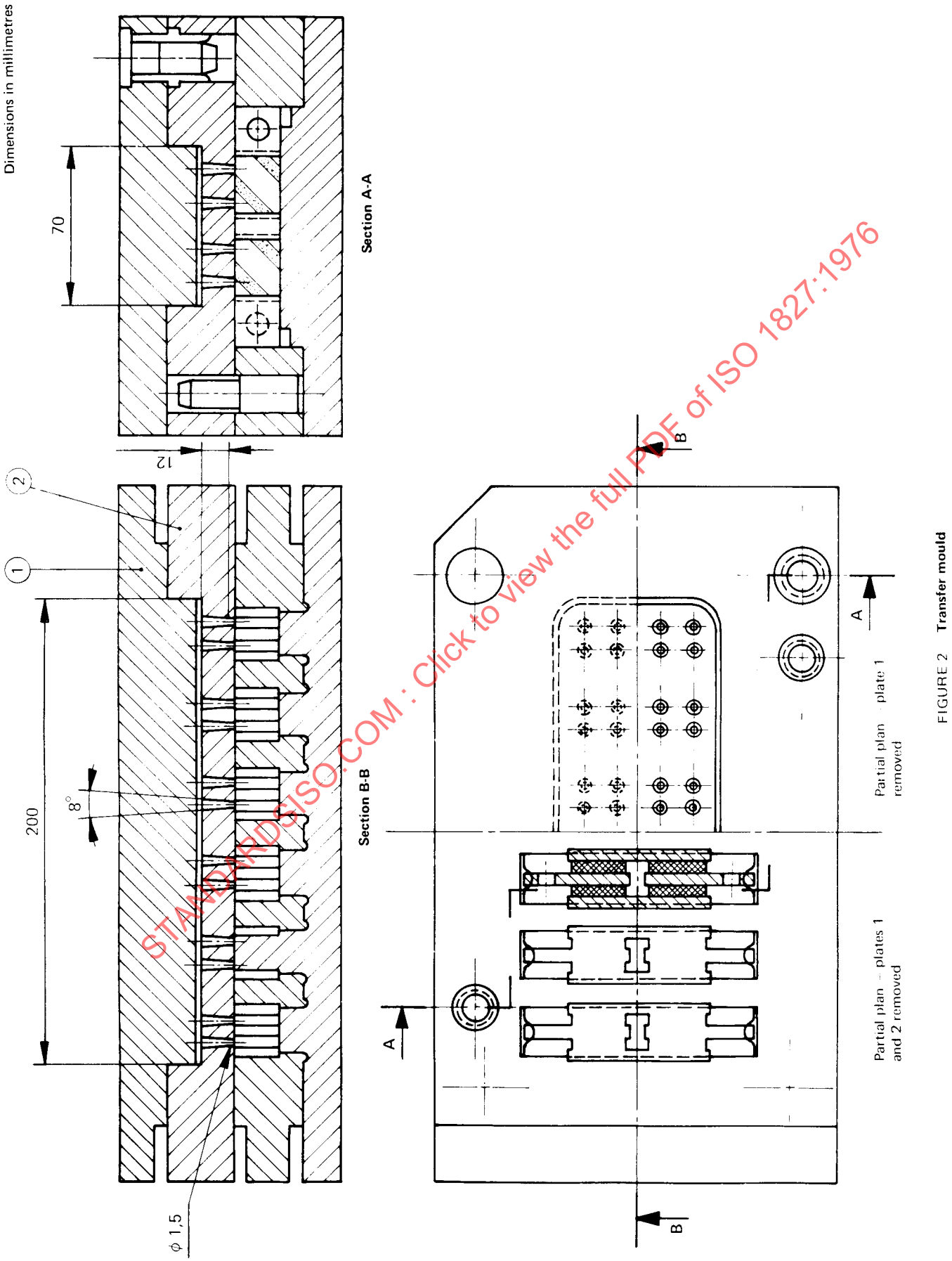


FIGURE 2 Transfer mould