International Standard 132

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Rubber, vulcanized — Determination of flex cracking (De Mattia)

Caoutchouc vulcanisé — Détermination de la résistance au craquelage par flexion (De Mattia)

Second edition — 1983-02-01

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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 developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

International Standard ISO 132 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*.

This second edition was submitted directly to the ISO Council, in accordance with clause 6.11.2 of part 1 of the Directives for the technical work of ISO. It cancels and replaces the first edition (i.e. ISO 132-1975), which had been approved by the member bodies of the following countries :

Austria	Italy	Sri Lanka
Canada	Netherlands	Sweden
Czechoslovakia	New Zealand	Switzerland
Egypt, Arab Rep. of	Poland	Turkey
France	Portugal	United Kingdom
Germany, F. R.	Romania	USSR
Hungary	South Africa, Rep. of	Yugoslavia
India	Spain	

No member body had expressed disapproval of the document.

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Rubber, vulcanized — Determination of flex cracking (De Mattia)

0 Introduction

Repeated bending or flexing of a rubber vulcanizate causes cracks to develop in that part of the surface where tension stress is set up during flexing or, if this part of the surface contains a crack, causes this crack to extend in a direction perpendicular to the stress. Certain soft vulcanizates, notably those prepared from styrene-butadiene rubber, show marked resistance to crack initiation, but it is possible for these vulcanizates to have a low resistance to growth (propagation) of cracks. It is important, therefore, to measure both the resistance to crack initiation by flexing and the resistance to crack propagation. A method for determining the resistance to growth of an artificially introduced cut is given in ISO 133.

NOTE — The presence of significant amounts of ozone in the laboratory atmosphere affects the results. Periodic checks are advised in order to ensure that the ambient ozone concentration is preferably less than 1 pphm (part per 100 million) parts of air.

1 Scope and field of application

This International Standard specifies a method of test intended for use in comparing the resistance of rubbers to the formation and growth of cracks, when subjected to repeated flexing on the De Mattia-type machine.

2 References

ISO 133, *Rubber, vulcanized — Determination of crack growth (De Mattia).*

ISO 471, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

ISO 1826, *Rubber, vulcanized — Time-interval between vulcanization and testing — Specification.*

ISO 3383, *Rubber — General directions for achieving elevated or sub-normal temperatures for tests.*

3 Apparatus

The essential features of the De Mattia-type machine are as follows :

Stationary parts, provided with grips for holding one end of each of the test pieces in a fixed position, and similar but reciprocating parts for holding the other end of each of the test pieces. The travel is $57 ^{+0,5}_{0}$ mm and is such that the maximum distance between each set of opposing grips is $75 ^{+1}_{0}$ mm (see figure 1).

The reciprocating parts are so arranged that their motion is straight, and in the direction of, and in the same plane as, the common centre line of each opposing pair of grips. The planes of the gripping surfaces of each opposing pair of grips remain parallel throughout the motion.

The eccentric which actuates the reciprocating parts is driven by a constant-speed motor to give 5,00 ± 0,17 Hz, with sufficient power to flex at least six, and preferably twelve, test pieces at one test. The grips hold the test pieces firmly, without undue compression, and enable individual adjustment to be made to the test pieces to ensure accurate insertion.

For testing at elevated temperatures, the machine may be enclosed in a chamber with temperature control near the centre of the test piece to ± 2 °C, if necessary, by using an air circulator.

NOTE — It is useful to arrange the test pieces in two equal groups, so that one group is being flexed while the other group is being straightened, thus reducing the vibration in the machine.

4 Test piece

4.1 Form and dimensions

The test piece shall be a strip with a moulded groove, as shown in figure 2. The strips may be moulded individually in a multiple-cavity mould or may be cut from a wide slab having a moulded groove.

The groove in the test piece shall have a smooth surface and be free from irregularities from which cracks may start prematurely. The groove shall be moulded into the test piece or slab by a half-round ridge in the centre of the cavity. This half-round ridge shall have a radius of 2,38 ± 0,03 mm. The moulded groove shall be perpendicular to the direction of calendering.

The results shall be compared only between test pieces having thicknesses agreeing within the tolerances, when measured close to the groove, because the results of the test are dependent upon the thickness of the test piece.

4.2 Time interval between vulcanization and testing

For all test purposes, the minimum time between vulcanization and testing shall be 16 h in accordance with ISO 1826.

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

As far as possible, samples and tests shall be kept away from exposure to light.

4.3 Conditioning

For tests at a standard laboratory temperature (see clause 6) : individually moulded test pieces, after preparation as necessary, shall be conditioned at the test temperature for a minimum of 3 h immediately before testing, the same test temperature being used throughout any test or series of tests intended to be comparable. Slab samples shall be similarly conditioned before the test pieces are cut. These test pieces may be either tested immediately or kept at the test temperature until tested.

For tests at other temperatures (see clause 6) : after the conditioning period specified above, the test pieces shall be brought to the test temperature by keeping in a chamber at this temperature for 3 h. (See ISO 3383.)

4.4 Number of test pieces

At least three, and preferably six, test pieces from each rubber compound shall be tested, and the results averaged, one or more test pieces being tested simultaneouly with those of other rubbers with which the comparison is to be made.

5 Procedure

Separate the pairs of grips to their maximum extent, and insert the test pieces so that they are flat and not under tension, with the groove in any particular test piece midway between the two grips in which that test piece is held, and on the outside of the angle made by the test piece when it is bent.

Start the machine and continue the test with frequent inspection until the first minute sign of cracking is detected. Record the number of flexing cycles at this point, restart the machine and stop it after intervals in which the number of flexing cycles is increased in geometric progression, a suitable ratio being 1,5 on each occasion. Make the inspection of the flexed test pieces each time with the grips separated to a distance of 65 mm.

It is not desirable to run the test piece until complete rupture occurs, the preferred method being to grade the severity of cracking by comparison with a standard scale of cracked test pieces, as specified in clause 7. The comparison includes an assessment of the length, depth and number of cracks.

The test shall not be made in a room which contains any apparatus that generates ozone, such as a fluorescent lamp, or which for any reason has an ozone content above that in normal indoor air. The motor used to drive the test machine shall be of a type that does not generate ozone.

The results shall be recorded as follows :

a) the grade of cracking reached by each test piece on each occasion the machine is stopped;

b) the flexing cycles which have been run.

6 Temperature of test

Tests are normally performed at standard laboratory temperatures as defined in ISO 471, although elevated temperatures may often be used with advantage. In the latter case, the test temperature shall be one of the preferred temperatures 40, 55, 70, 85, 100, 125, 150 °C.

7 Expression of results

Cracking shall be graded according to the following scale :

Grade 1

The cracks at this stage look like pin pricks to the naked eye.

Grade as 1 if the "pin pricks" are 10 or less in number.

Grade 2

Assess as Grade 2 if either of the following applies :

a) the "pin pricks" exceed 10 in number;

b) the number of cracks is less than 10, but one or more cracks have developed beyond the "pin prick" stage, i.e. have perceptible length without much depth but their length is not more than 0,5 mm.

Grade 3

One or more of the "pin pricks" have become obvious cracks, i.e. have appreciable length and little depth and their length is greater than 0,5 mm but not greater than 1 mm.

Grade 4

The length of the largest crack is greater than 1 mm but not greater than 1,5 mm.

Grade 5

The length of the largest crack is greater than 1,5 mm but not greater than 3 mm.

Grade 6

The length of the largest crack is greater than 3 mm.

NOTES

1 No distinction is made between cracks that have grown in isolation and those that have grown by coalescence.

2 Cracks occurring near the edge of the test piece shall be ignored.

Plot the grades from 1 to 6 against the number of corresponding kilocycles of flexing on linear graph paper and draw a smooth curve through the points. Using graphical interpolation, deduce the number of kilocycles for each grade of cracking.

8 Test report

The test report shall include the following information :

a) reference to this International Standard;

b) the average number of kilocycles to reach each grade of cracking 1 to 6, given in clause 7, or

the mean flex cracking resistance, determined by the number of kilocycles to reach grade 3 or the number of kilocycles, preferably 10, 50 or 100, as appropriate, at which no cracks occur;

c) the number of test pieces used;

d) temperature of test.

Dimensions in millimetres

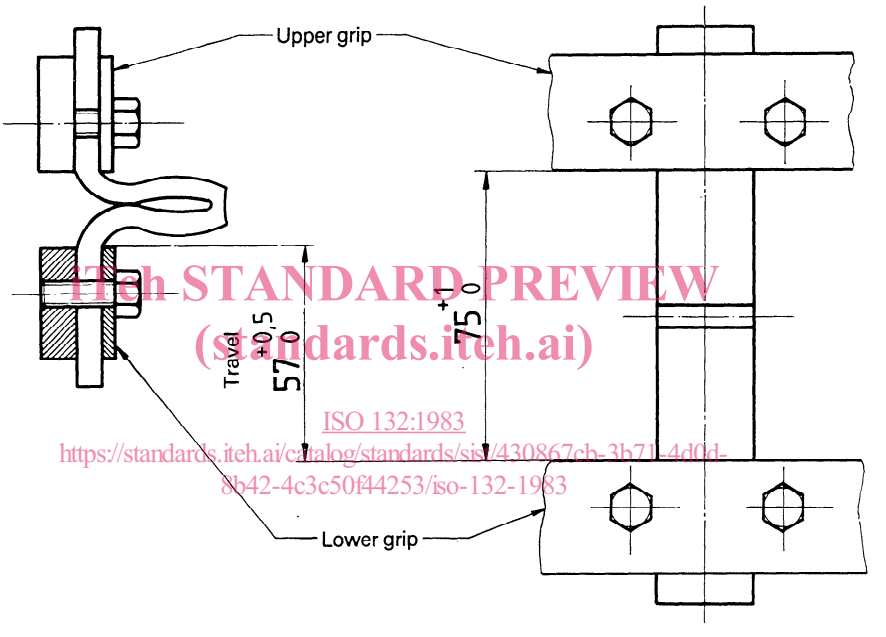

Figure 1 — De Mattia-type machine

Dimensions in millimetres

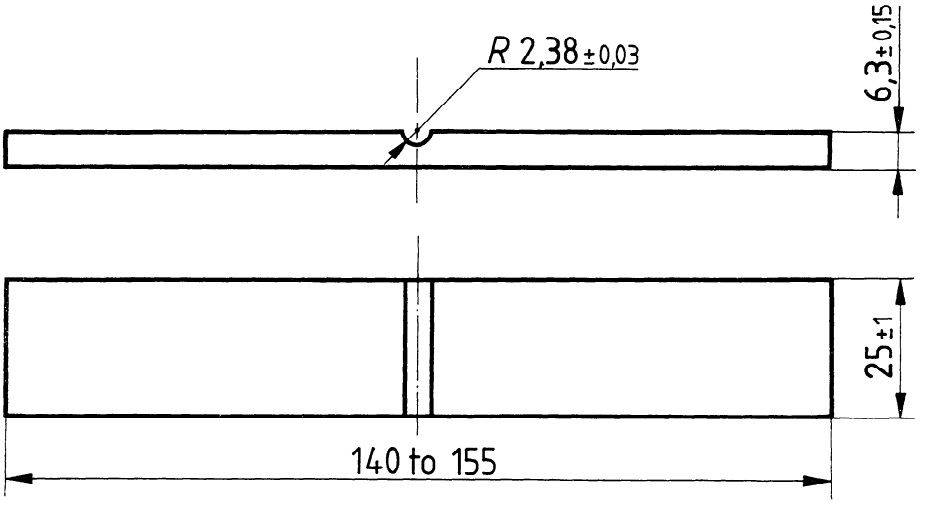

Figure 2 — Test piece