

INTERNATIONAL STANDARD



816

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Vulcanized rubbers — Determination of tear strength of small test pieces (Delft test pieces)

Caoutchouc vulcanisé — Détermination de la résistance au déchirement des petites éprouvettes (éprouvettes de Delft)

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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 816 and found it technically suitable for transformation. International Standard ISO 816 therefore replaces ISO Recommendation R 816-1968 to which it is technically identical.

ISO Recommendation R 816 was approved by the Member Bodies of the following countries :

Australia	Germany	New Zealand
Austria	Hungary	Poland
Brazil	India	Spain
Bulgaria	Israel	Switzerland
Canada	Italy	United Kingdom
Chile	Japan	U.S.S.R.
Colombia	Korea, Rep. of	Yugoslavia
Czechoslovakia	Netherlands	

The Member Bodies of the following countries expressed disapproval of the Recommendation on technical grounds :

France*
Sweden
U.S.A.

- * Subsequently, this Member Body approved the Recommendation.

No Member Body disapproved the transformation of ISO/R 816 into an International Standard.

Vulcanized rubbers – Determination of tear strength of small test pieces (Delft test pieces)

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for the determination of the tear strength of small test pieces (Delft test pieces) of vulcanized rubbers.

NOTE – The test does not necessarily give results agreeing with those given by the method described in ISO/R 34, *Determination of tear strength of vulcanized natural and synthetic rubbers (crescent test piece)*.

2 PRINCIPLE

Measurement of the force required to tear across the width of a small test piece containing a slit in the centre. (The slit and the test piece are cut in one operation.)

3 APPARATUS

3.1 Tensile testing machine, capable of a substantially constant rate of traverse of the moving grip equal to 500 ± 50 mm/min.

The capacity of the test machine shall be such that the force required to cause tearing of the test piece will be not less than 15 % or more than 85 % of that capacity.

NOTE – Inertia (pendulum) type dynamometers are apt to give results which differ because of frictional and 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 Die, for cutting the test piece.

The construction of the die and of the knife which cuts the slit is shown in figures 3 and 4.

3.3 Micrometer gauge, having a pressure foot approximately 6 mm in diameter, which exerts a pressure of 20 kPa*.

3.4 Travelling microscope.

4 TEST PIECE

4.1 Shape and dimensions

The test piece shall be rectangular and shall conform to the shape of the die shown in figure 1.

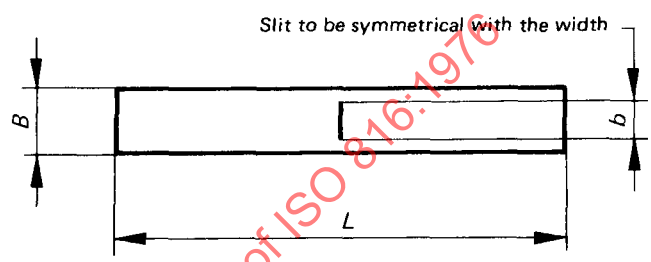


FIGURE 1 – Die

Dimensions of test piece		
Dimension		mm
L	Length	60
B	Width	$9,0 \pm 0,1$
b	Slit length	$5,0 \pm 0,1$

The test piece shall be cut from a sheet by punching with the die (3.2), using a single blow of a mallet or (preferably) a single stroke of a press. The rubber may be wetted with water or a soap solution, and shall be supported on a sheet of slightly yielding material (for example, leather, rubber belting or cardboard) on a flat rigid surface.

The tear strength is particularly susceptible to grain effects in vulcanized rubber. Normally, all test pieces are prepared with the grain at right angles to their length, but in cases where grain effects are significant and are to be evaluated, two sets of test pieces shall be cut from the sheet, one at right angles to the grain and the other parallel to the grain.

The thickness of the test pieces shall be $2,0 \pm 0,2$ mm.

4.2 Measurement of dimensions

The thickness of the test piece shall be measured by means of a micrometer gauge (3.3). Take at least three gauge readings in the region of the slit. If an odd number of readings is taken, the middle value shall be used. If an even number of readings is taken, the average value of the middle two readings shall be used. No reading shall deviate by more than 2 % from the value to be used. For comparative purposes the thickness of any test piece shall not vary by more than 10 % from the mean thickness of all the test pieces.

* 1 kPa = 1 kN/m²

Variations occur in the length of the slit and in the total width of the test piece when the same die is used to prepare test pieces from rubber of different hardnesses. Moreover, the slit may not be uniform throughout its depth, but may be wider on one surface. One test piece shall therefore be cut out with the die and used for measuring the width to be torn. This test piece shall be cut through with a razor blade in the plane of the slit, and the cut surfaces (width on either side of the slit) shall be measured with a travelling microscope. The slit in the plane of the thickness of the test piece has the curvature shown in figure 2, and an attempt shall be made to compensate for this curvature when measuring the width on either side of the slit.

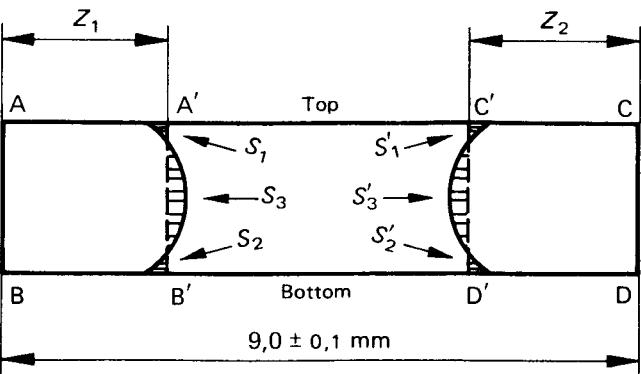


FIGURE 2 – Detail of slit of Delft tear test piece

Take as the left-hand width the length Z_1 , which is the distance from the line AB to an imaginary line A'B' which is situated so that the total area $(S_1 + S_2) = S_3$.

Similarly, on the right-hand side an imaginary line C'D' shall be so situated that the total area $(S'_1 + S'_2) = S'_3$, and Z_2 is the width.

The total width outside the slit (i.e. the rubber to be torn) is then $(Z_1 + Z_2) = W_1$. This is the width which shall be assumed for the portion of the test piece to be torn.

4.3 Number

At least three and preferably six test pieces shall be tested.

4.4 Conditioning

Condition the test pieces for at least 16 h at a standard laboratory temperature immediately before test. The time between vulcanization and testing shall not exceed 6 days. The standard laboratory temperature shall be $20 \pm 2^\circ\text{C}$, $23 \pm 2^\circ\text{C}$ or $27 \pm 2^\circ\text{C}$, the same temperature being used throughout any one test or series of tests intended to be comparable.

5 TEMPERATURE OF TEST

The test shall normally be carried out at a standard laboratory temperature; some rubbers have markedly lower tear strengths at elevated temperature, and hence tests may also have to be carried out at higher temperatures, 100°C being a useful temperature.

6 PROCEDURE

Mount the test piece in the testing machine so that the free length between the points of contact of the grips on the test piece is 30 mm, i.e. each grip will be 15 mm from the slit. Stretch the test piece in the testing machine. Do not interrupt the stretching before the test piece breaks. Note the maximum force reached during the tearing.

7 EXPRESSION OF RESULTS

The tearing force depends on the thickness of the test piece and the width of the rubber to be torn, and the result shall be expressed as the force necessary to tear a test piece of standard width and thickness. This value, F_0 , is given, in newtons, by the formula :

$$F_0 = \frac{F_1 \times W_0 \times d_0}{W_1 \times d_1}$$

where

F_1 is the force, in newtons, required to tear the actual test piece;

W_0 is the width of rubber to be torn in a standard test piece = 4 mm;

W_1 is the width, in millimetres, of rubber torn in the actual test piece (see 4.2);

d_0 is the thickness of a standard test piece = 2 mm;

d_1 is the thickness, in millimetres, of the actual test piece.

Take as the result the average of the middle two values if the number of test pieces is even, or the middle value if the number of test pieces is odd, the various results being arranged in order of increasing value. If only three test pieces are tested, the individual results shall be given.

8 TEST REPORT

The test report shall include the following particulars :

- a) the tear strength, calculated according to clause 7;
- b) the temperature of test;
- c) the direction of grain in the test piece.

Dimensions in millimetres

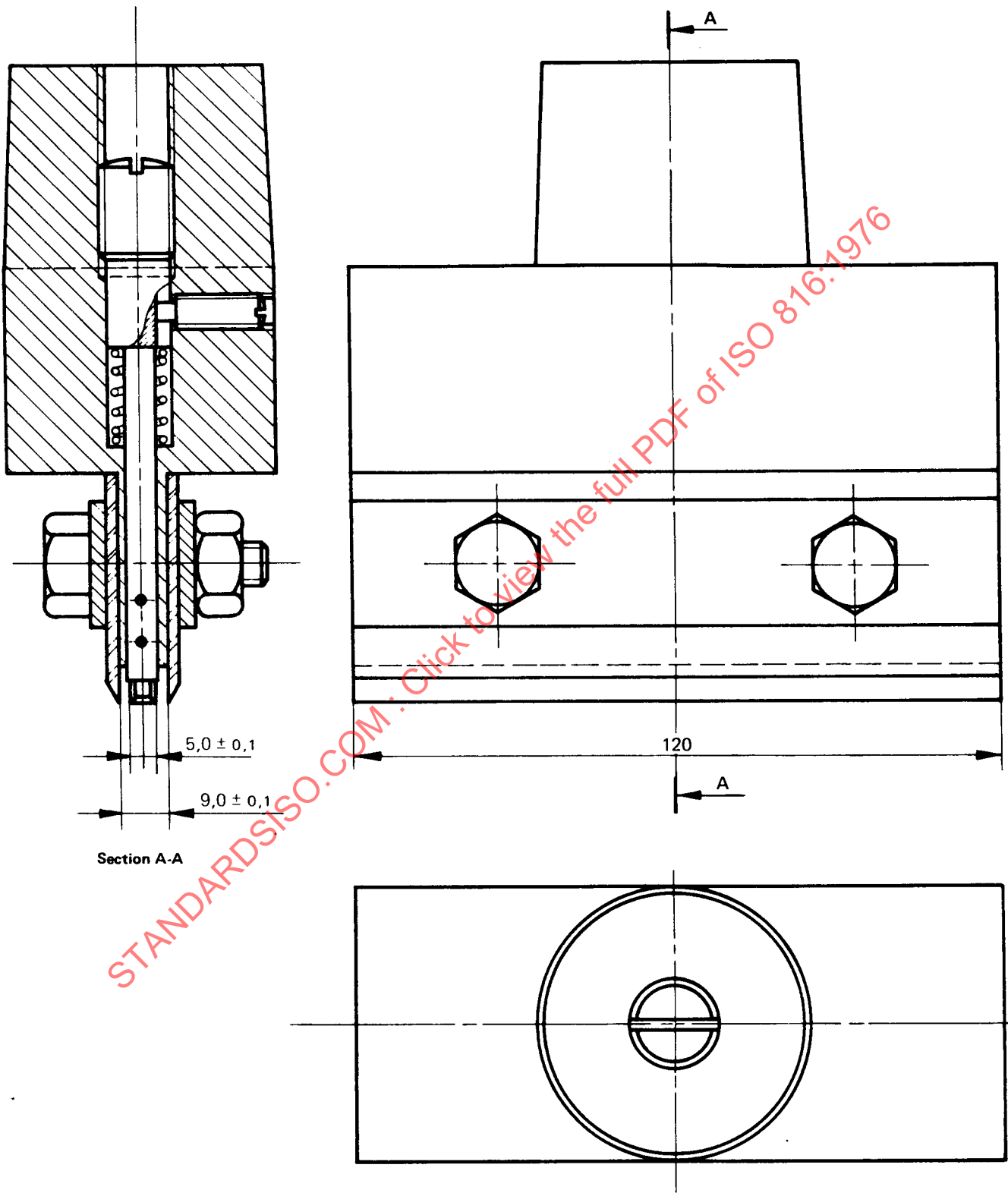


FIGURE 3 – Die for Delft tear test piece