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ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1747

DETERMINATION OF ADHESION OF VULCANIZED RUBBERS
TO RIGID PLATES IN SHEAR
(QUADRUPLE SHEAR TEST)

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 1747, *Determination of adhesion of vulcanized rubbers to rigid plates in shear (Quadruple shear test)*, was drawn up by Technical Committee ISO/TC 45, *Rubber*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led to the adoption of Draft ISO Recommendation No. 1747, which was circulated to all the ISO Member Bodies for enquiry in December 1968. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	Iran	Spain
Austria	Israel	Sweden
Belgium	Italy	Switzerland
Brazil	Korea, Dem. P. Rep. of	Thailand
Ceylon	Korea, Rep. of	Turkey
Czechoslovakia	Netherlands	U.A.R.
France	New Zealand	United Kingdom
Greece	Peru	U.S.S.R.
Hungary	Poland	
India	South Africa, Rep. of	

No Member Body opposed the approval of the Draft.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

**DETERMINATION OF ADHESION OF VULCANIZED RUBBERS
TO RIGID PLATES IN SHEAR
(QUADRUPLE SHEAR TEST)**

1. SCOPE

This ISO Recommendation describes a procedure for testing the strength of bonds of rubber to metal or other rigid plates where the rubber is assembled between four parallel rigid plates.

It is designed primarily to apply 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 and methods of manufacture of bonded shear units.

2. PRINCIPLE

The test consists in measuring the force required to cause the rupture of a unit of standard dimensions comprising four parallelepipeds of rubber symmetrically disposed and bonded to four parallel rigid plates, the force being parallel to the bonding surfaces.

3. ADHESION FAILURE TERMINOLOGY

The following terminology for adhesion failure should be adopted :

- R indicates that the failure is in the rubber.
- RC indicates that the failure is at the interface between the rubber and the cover cement.
- CP indicates that the failure is at the interface between the cover cement and the prime cement.
- M indicates that the failure is at the interface between the rigid plates and the prime cement.

4. APPARATUS

- 4.1 *Testing machine*, conforming to the requirements of national standards for verification of testing machines. It should be capable of accurately registering the applied forces during the test while maintaining the specified constant rate of separation of the jaws of 50 ± 5 mm per minute.

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.

- 4.2 *Fixtures*, for holding the test pieces in the grips, provided with a universal joint to permit accurate centering of the line of action of the applied force.

5. TEST PIECE

5.1 Dimensions of test piece

The standard 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 should be $5 \begin{smallmatrix} 0 \\ -0.1 \end{smallmatrix}$ mm. A typical test piece is shown in Figure 1.

5.2 Preparation of test piece

The standard test piece should be prepared as follows :

- 5.2.1 Rectangular rigid plates of the standard dimensions should be prepared and treated in accordance with a normal adhesion system.
- 5.2.2 Unvulcanized rubber blanks should be cut using a die of such size that a limited amount of flash is obtained on moulding.
- 5.2.3 The rigid plates and rubber blanks should 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 accomodating six test parts (24 cavities) is shown in Figure 2.
- 5.2.4 During the preparation of the test pieces great care should be taken to keep the exposed surfaces of the rubber and metal free from dust, moisture and foreign matter. The treated surfaces should not be touched by hand during assembly.
- 5.2.5 The vulcanization should be carried out by heating the mould for a definite time at controlled temperature under pressure.
- 5.2.6 At the conclusion of the vulcanization, great care should be taken in removing the test pieces from the mould to avoid subjecting the adhered surfaces to undue stress.

5.3 Number of test pieces

Five test pieces should be tested.

6. TIME LAPSE BETWEEN VULCANIZATION AND TESTING

Unless otherwise specified for technical reasons, the following requirements for time lapse should be observed :

For all test purposes the minimum time between vulcanization and testing should be 16 hours.

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

7. CONDITIONING OF TEST PIECES

- 7.1 When a test is made at a standard laboratory temperature, the test piece should be maintained at the conditions of test for at least 16 hours immediately before testing.
- 7.2 When tests are made at higher or lower temperatures, the test pieces should 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.

8. TEMPERATURE OF TEST

The test should normally be carried out in a standard atmosphere as specified in clause 3.2 of ISO Recommendation R 471, *Standard atmospheres for the conditioning and testing of rubber test pieces*, that is $20 \pm 2^\circ\text{C}$, $23 \pm 2^\circ\text{C}$ or $27 \pm 2^\circ\text{C}$. 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 should be used throughout any one test or series of tests intended to be comparable.

9. PROCEDURE

After conditioning as described in section 7, immediately mount the test piece in the test machine, taking care to ensure freedom of self-alignment with the direction of force application. Apply steadily increasing traction forces at a rate of separation of the jaws of 50 ± 5 mm/min until the test piece breaks. Record the maximum force.

10. EXPRESSION OF RESULTS

The adhesion value, expressed in meganewtons per square metre, should be calculated by dividing the maximum force by the total bonded area of one of the double sandwiches on the corresponding central rigid plate.

11. TEST REPORT

The test report should include the following particulars :

- (a) the results for all five test pieces, calculated in accordance with section 10, for the adhesion value;
- (b) a description of the type of failure in accordance with section 3;
- (c) identification of the rubber compound;
- (d) nature of the rigid plates;
- (e) a description of the method of securing adhesion;
- (f) moulding process (compression, transfer, casting, etc.);
- (g) date of vulcanization;
- (h) date of test;
- (i) time and temperature of vulcanization;
- (j) temperature of test.

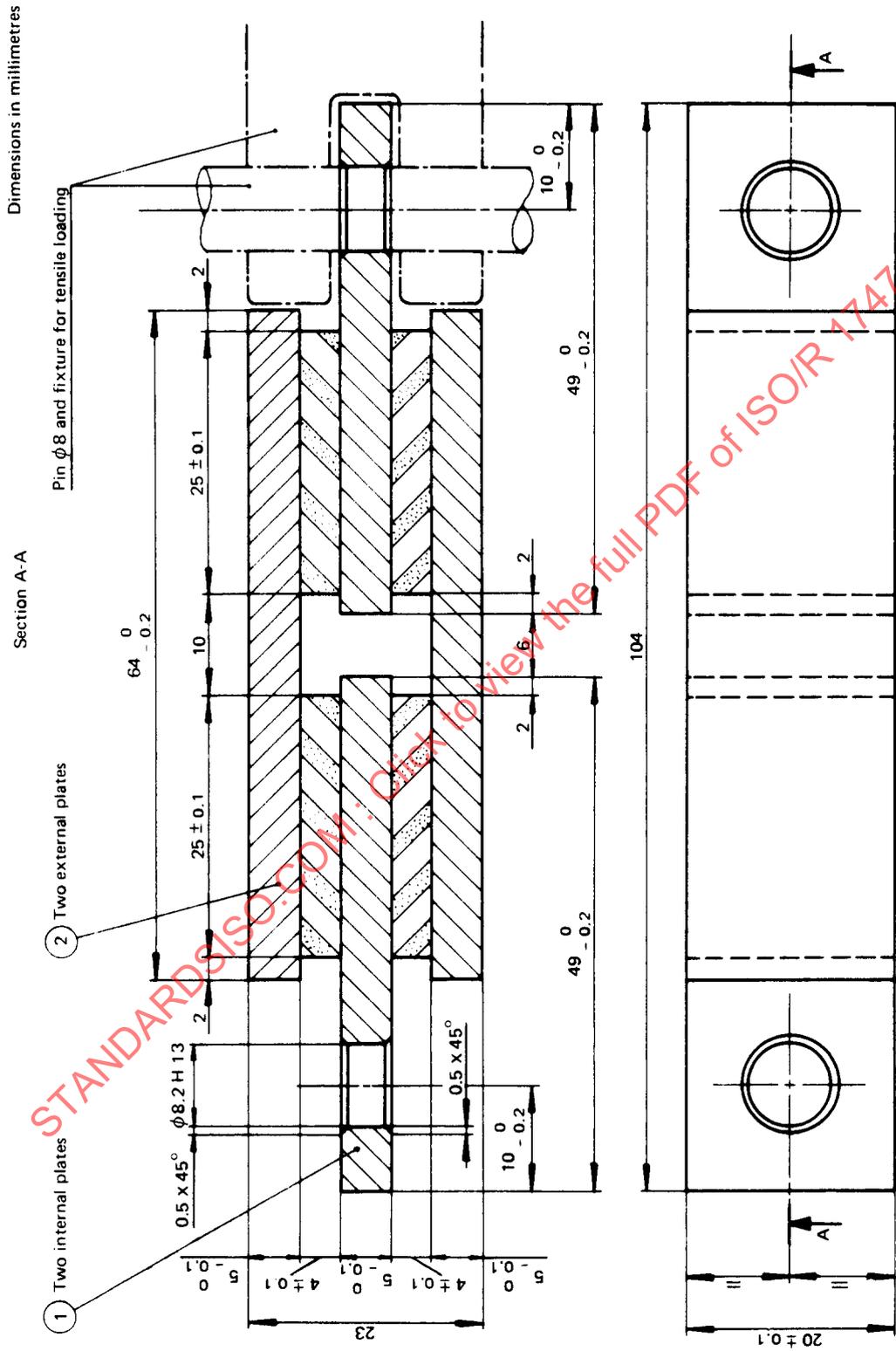


FIG. 1 - Test piece