Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PRI/22, Physical testing of rubber, upon which the following bodies were represented:

British Rubber Manufacturers' Association Ltd.
GAMBICA (BEAMA Ltd.)
Ministry of Defence
RAPRA Technology Ltd.
SATRA Footwear Technology Centre
Tun Abdul Razak Research Centre

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Amd. No.	Date	Text affected

Contents

National foreword

This Section of BS 903 has been prepared by Technical Committee PRI/22 and is identical with ISO 814 : 1996, *Rubber, vulcanized — Determination of adhesion to metal — Two plate method*, published by the International Organization for Standardization. It supersedes Method A of BS 903 : Part A21 : 1989 which is deleted by amendment.

Cross-references

International standard	Corresponding British Standard
	BS 903 *Physical testing of rubber*
ISO 471 : 1995	Part A35 : 1995 *Temperatures, humidities and times for conditioning and testing of test pieces* (Identical)
ISO 4648 : 1991	Part A38 : 1991 *Methods for the determination of dimensions of test pieces and products for test purposes* (Identical)
ISO 5893 : 1993	BS 5214 *Specification for testing machines for rubbers and plastics* Part 1 : 1995 *Tensile, flexural and compression types (constant rate of traverse)* (Identical)

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Rubber, vulcanized — Determination of adhesion to metal — Two-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 for determining the adhesion strength of rubber-to-metal bonds where the rubber part is assembled between two parallel metal plates, using the adhesive system under investigation.

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 of rubber compounds and control of methods of manufacture.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 471:1995, *Rubber — Temperatures, humidities and times for conditioning and testing.*

ISO 4648:1991, *Rubber, vulcanized or thermoplastic — Determination of dimensions of test pieces and products for test purposes.*

ISO 5893:1993, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Description.*

3 Principle

The test consists in measuring the force required to cause the rupture of a unit of standard dimensions, comprising rubber bonded to two parallel metal plates, the direction of the force being at 90° to the bonded surface.

4 Apparatus

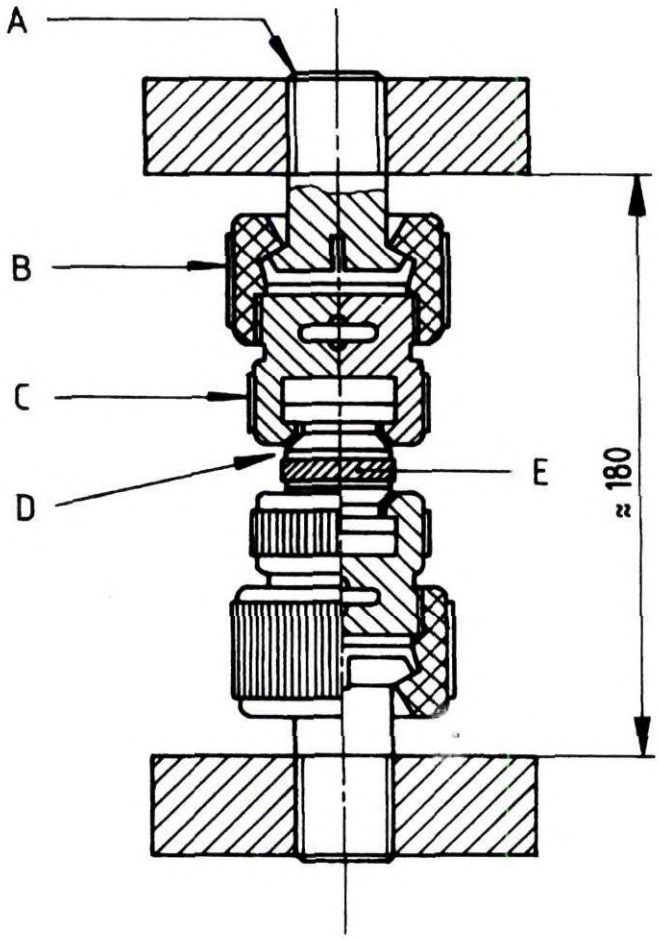
4.1 Tensile-testing machine, complying with the requirements of ISO 5893, capable of measuring force with an accuracy corresponding to grade B as defined in ISO 5893, and with a rate of traverse of the moving grip of 25 mm/min ± 5 mm/min.

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 test machine (4.1), which permit accurate centring of the applied load during the test.

A suitable type of fixture is shown in figure 1.

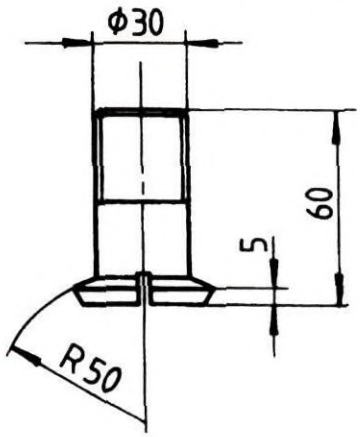
Dimensions in millimetre



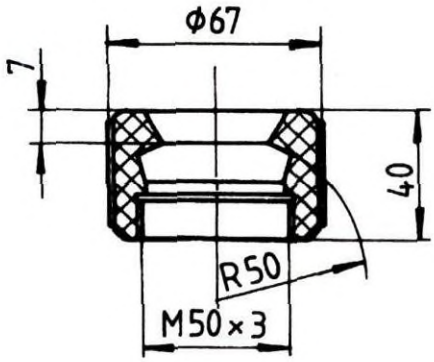
Assembly of parts

D = metal part of test piece

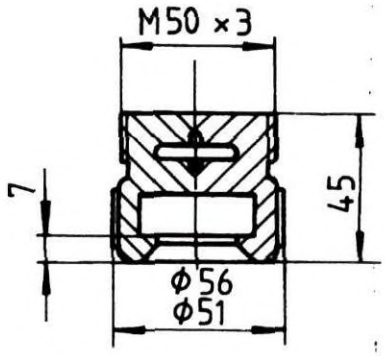
E = rubber



Part A – Tail fillet to suit test machine



Part B – Bridle fillet threaded to take part C



Part C – Split across centre to accept test piece and threaded to fit into part B

Figure 1 — Example of test fixture for holding rubber-to-metal bond test pieces

5 Test piece

5.1 Dimensions

The standard test piece shall consist of a rubber cylinder 3 mm ± 0,1 mm thick and of diameter between 35 mm and 40 mm known to the nearest 0,1 mm, having its circular ends bonded to the faces of two metal plates of equal diameter, the determination of dimensions of the test piece being in accordance with ISO 4648. The diameter of the metal plates shall be approximately 0,1 mm less than that of the rubber cylinder.

The thickness of the metal plates shall be not less than 9 mm. A typical test piece is shown in figure 2.

Dimensions in millimetres

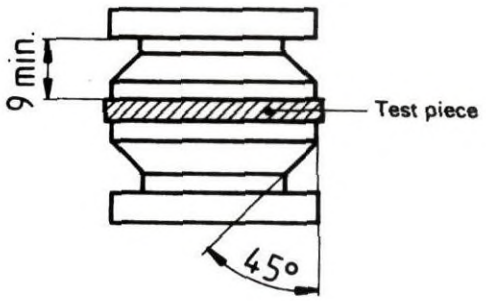


Figure 2 — Example of standard test piece

5.2 Preparation

5.2.1 Circular metal parts of the standard dimensions shall be prepared preferably from rolled carbon steel bar. Other metals may be used provided that the parts are in conformity with the essential dimensions. The smooth metal parts shall be prepared and treated in accordance with the adhesion system under investigation.

5.2.2 Unvulcanized rubber discs shall be cut using a circular die of such size that a limited amount of flash is obtained on moulding. The surface of the rubber to be bonded to the metal shall be treated in accordance with the method being investigated.

5.2.3 The rubber discs and metal end pieces shall then be assembled for vulcanization in the mould. The mould shall be constructed so that the rubber projects beyond the edges of the metal end pieces by approximately 0,05 mm in order to prevent tearing of the rubber by the edge of the metal during test.

5.2.4 During the preparation of the test piece, great care shall be taken to keep the exposed surfaces of the rubber and metal free from dust, moisture and foreign matter. The surfaces shall not be touched by hand during assembly.

5.2.5 Vulcanization shall then be carried out by heating in the mould under pressure for a definite time at a controlled temperature in a suitable vulcanizing press. The time and temperature of vulcanization shall be in accordance with the system being investigated.

5.2.6 At the conclusion of the cure, great care shall be taken in removing the test pieces from the mould to avoid subjecting the bonded surfaces to undue stress before the test pieces have cooled.

5.3 Number

At least three test pieces shall be tested.

5.4 Conditioning

5.4.1 The test pieces shall be conditioned in accordance with the requirements of ISO 471 for at least 16 h at a standard temperature (23 °C ± 3 °C or 27 °C ± 2 °C) immediately before test, the same temperature being used throughout any one test or series of tests intended to be comparable.

5.4.2 The time-interval between vulcanization and testing shall be in accordance with the requirements of ISO 471.

6 Procedure

6.1 Mount the test piece in the fixtures (4.2) in the test machine (4.1). Extreme care is necessary in centring and adjusting the test piece so that the tension is uniformly distributed over the cross-section during the test.

6.2 Apply tension by separating the jaws at a constant rate of 25 mm/min ± 5 mm/min until the test piece breaks. Record the maximum force.

7 Expression of results

7.1 Adhesion value

The adhesion shall be calculated by dividing the maximum force by the cross-sectional area of the test piece. It shall be expressed in pascals.

7.2 Adhesion failure symbols

a) R indicates that the failure is in the rubber.

b) RC indicates that the failure is at the interface between the rubber and the cover cement.

c) CP indicates that the failure is at the interface between the cover cement and the prime cement.

d) M indicates that the failure is at the interface between the metal and the prime cement.

8 Test report

The test report shall include the following information:

a) a reference to this International standard;

b) the test result for each test piece, expressed in accordance with 7.1;

c) a description of the type (or types) of failure, expressed in accordance with 7.2, indicating the percentage failure of each type which occurs;

d) a description of the test piece and the methoc used to ensure adhesion;

e) the date of vulcanization;

f) the date of the test;

g) the time and temperature of vulcanization;

h) the temperature of the test;

i) the metal used, if other than the steel specified;

j) any unusual features noted during the determination;

k) any operation not included in this International Standard or in the International Standards to which reference is made, as well as any operation regarded as optional.

List of references

See national foreword.

BS 903 :
Part A21 :
Section 21.2 :
1997
ISO 814 : 1996

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