BRITISH STANDARD

METHODS OF TESTING VULCANIZED RUBBER

PART A12. DETERMINATION OF RUBBER-TO-FABRIC ADHESION (PLY SEPARATION)

BS 903 : Part A12 : 1968

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The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 4000, fully indexed and with a note of the contents of each, will be found in the British Standards Yearbook, price 15s. The BS Yearbook may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standard:

BS 1610. Methods for the load verification of testing machines.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following BSI references relate to the work on this standard:
Committee references RUC/10, RUC/10/4 Draft for comment 67/22647

CO-OPERATING ORGANIZATIONS

The Rubber Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government department and industrial organizations:

British Association of Synthetic Rubber Manufacturers
*Federation of British Rubber and Allied Manufacturers
*Institution of the Rubber Industry
*Ministry of Technology
Natural Rubber Bureau
**Natural Rubber Producers' Research Association*
*Rubber and Plastics Research Association of Gt. Britain
Rubber Growers' Association
*Society of Motor Manufacturers and Traders Ltd.
Tyre Manufacturers Conference Ltd.

The scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Railways Board
British Rubber and Resin Adhesive Manufacturers' Association
British Society of Rheology
Chemical Industries Association
Electrical Research Association
Institution of Mechanical Engineers
Institution of Municipal Engineers
Institution of Water Engineers
Ministry of Defence (Air Force Dept.)
Ministry of Defence (Army Dept.)
Ministry of Defence (Navy Dept.)
Ministry of Housing and Local Government
National College of Rubber Technology
National Physical Laboratory (Ministry of Technology)
Post Office
Royal Institute of Chemistry

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METHODS OF TESTING VULCANIZED RUBBER

Part A12. Determination of rubber-to-fabric adhesion (Ply separation)

FOREWORD

This revision of this British Standard has been prepared under the authority of the Rubber Industry Standards Committee. The standard was last published in November, 1958 and has been amended to bring it into line with the method now being considered by Technical Committee ISO/TC 45—Rubber—of the International Organization for Standardization (ISO).

The main difference between the last revision and the present method is that the dead load methods have been omitted.

METHOD

1. SUMMARY AND EXPLANATORY NOTE

The method of test described below covers the procedure for measuring the force required to separate, by stripping, two plies of fabric bonded with rubber, or a rubber layer and a fabric ply bonded with rubber. The method is applicable when the ply surfaces are approximately plane or cylindrical as in the case of belting, insertion sheet, hose and tyre carcasses. For surfaces which contain sharp bends, angles or other gross irregularities that cannot be avoided, special methods must be employed. The method is not applicable to proofed fabrics.

2. DEFINITION

For the purposes of this British Standard, the following definition applies:

Adhesion strength. Force required to cause a separation at the interface of the assembled components.

Any separation occurring at any other point, for example inside either component under test, is a failure of the component material, and not a measure of adhesion strength. In such cases the adhesion strength is not less than the strength of the weakest component involved.

3. TEST PIECE

3.1 Strip test piece. The test piece shall be 25 ± 0·5 mm wide and of sufficient length to allow a minimum test length of 100 mm. The thickness of the ply or layer which is to be separated shall not exceed 6 mm. Where the ply or layer which is to be separated exceeds 6 mm it shall be brought to the requisite thickness before proceeding with the test. The thickness of this ply shall be not greater than the thickness of the remainder of the test piece.

3.2 Ring test piece. The test piece shall be a cylinder 25 ± 0·5 mm long. Rings having an internal diameter greater than 50 mm shall be cut through and opened to form strip test pieces. The thickness of the ply or layer which is to be separated shall not exceed 6 mm. Where the ply or layer which is to be separated exceeds 6 mm it shall be brought to the requisite thickness before proceeding with the test. The thickness of this ply shall be not greater than the thickness of the remainder of the test piece.

4. APPARATUS

4.1 Test machine. The testing machine shall be power driven, equipped with a suitable dynamometer, capable of maintaining a substantially constant rate of traverse of the moving head during the test and fitted with an autographic recorder. It shall comply with Grade B of BS 1610*. An inertialess dynamometer (of the electronic or optical type for example) should preferably be used.

NOTE. Pendulum type inertia dynamometers will give inaccurate results because of the effects of inertia and friction. When using an inertia dynamometer, information may be obtained on the adhesion strength in the following way: the capacity of the machine, or the measuring scale selected when a variable range machine is involved, should be such that the separation force read is between 15% and 85% of the rated capacity. During the test the arm of the lever should oscillate freely like a pendulum with the catches disengaged.

4.2 The grips shall be capable of holding the test piece and ply to be separated without slipping. Where the ply to be separated is rubber, self-tightening grips are recommended. For strip test pieces provision shall be made to maintain the strip during the test in the approximate plane of the grips either by the attachment of sufficient weights to the free end of the test piece or by fitting a supporting plate to the non-driven grip.

For testing a ring test piece a mandrel which is a close sliding fit in the test piece shall be provided. This mandrel shall be capable of being fitted into the non-driven head of the machine so that it will rotate freely during the test.

5. NUMBER OF TEST PIECES

Replication will be as appropriate to the product being tested.

* BS 1610, ' Methods for the load verification of testing machines '.

6. CONDITIONING OF TEST PIECES

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

For evaluations intended to be comparable the tests should, as far as possible, be carried out after the same time interval after vulcanization.

Cut test pieces shall be conditioned for a minimum of 24 hours in a standard atmosphere of 20 ± 2 °C, 65 ± 5% relative humidity immediately before testing.

7. TEMPERATURE OF TEST

The test is normally carried out in a standard atmosphere of 20 ± 2 °C. The same temperature should be used throughout any one test or series of tests intended to be comparable.

8. PROCEDURE

The test piece as described in 3.1 or 3.2 is taken from the conditioning atmosphere and a ply of fabric or a rubber layer is separated by hand for a distance of approximately 50 mm. The separated ends of the test piece are fixed in the grips of the testing machine and adjusted so that the tension is distributed uniformly and that no twisting of the test piece occurs during the test. The body of the test piece is placed in the non-driven grip and the ply to be separated in the power-driven grip so that the angle of separation is approximately 180° for strip or 90° for ring test pieces. It is important to ensure that the axis of the strips of the test piece held in the grips and the line of separation of the plies lie in the same plane.

The rate of travel of the power-driven grip should be 100 ± 10 mm/min so as to give a rate of ply separation of 50 mm/min for strip test pieces or 100 mm/min for ring test pieces.

After zeroing the force measuring system the machine is started. The ply separation is continued and the force is recorded over a length of separation of at least 100 mm or the maximum distance possible if the ply is less than 100 mm long in the case of ring test pieces.

If separation occurs at any other point, e.g. inside either component under test this failure is noted and the force at which it occurs is reported.

9. EXPRESSION OF RESULTS

The adhesion strength of the test piece is calculated as the mean of the lowest 50% of peak values taken from the central 50% of the stripping trace. The adhesion strength is expressed in N/mm width. The adhesion strength reported is the average of results determined for the test pieces.

9.1 Example. A typical trace for an adhesion test is reproduced in Fig. 1. For *the calculation of the adhesion strength* a ' peak ' is defined as a part of the

trace where either the force measured maintains a steady value for a significant time or shows a rise to a maximum followed by a fall. Such ' peaks ' are indicated by arrows on the reproduction.

In the example ' peaks ' are present at the following forces, reading from left to right, in the central 50% of the trace:

43·6, 41·0, 41·3, 43·0, 42·5, 37·8, 37·5, 36·7, 43·0, 42·8, 43·4, 43·0, 40·7, 43·3, 41·1, 42·4, 43·3, 43·2, 41·2, 42·6, 42·0, 41·7, 40·3, 40·3, 39·9, 43·2, 43·5, 42·1, 40·4, 42·5, 42·3, 42·2, 42·1, 41·1 units.

The lowest 50% of these ' peaks ' are:

41·0, 41·3, 37·8, 37·5, 36·7, 40·7, 41·1, 41·2, 42·0, 41·7, 40·3, 40·3, 39·9, 42·1, 40·4, 42·1 and 41·1 units.

The mean of these 17 readings is 40·4 units which is quoted as the adhesion strength.

10. TEST REPORT

The report should include:

(1) The type of test piece and the direction of test.

(2) The adhesion strength as calculated in Clause 9 or the calculated strength and description of the weakest component.

(3) The temperature of test if other than 20 °C.

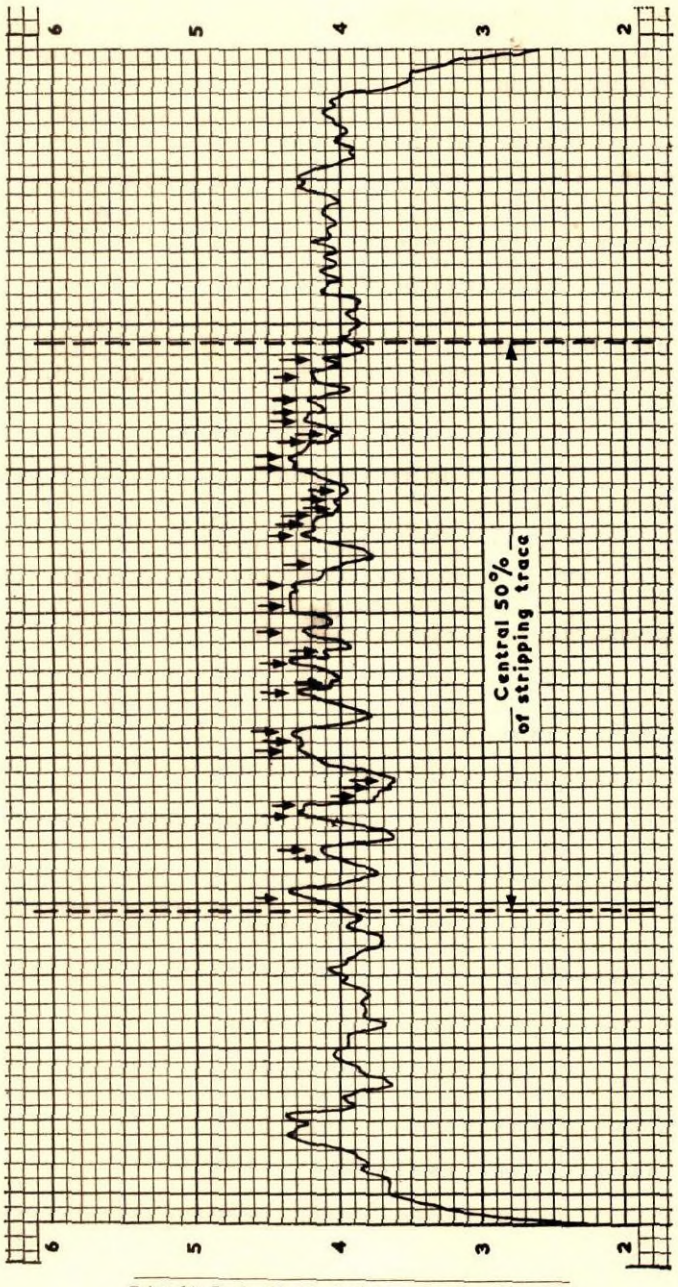

Fig. 1. Typical trace for adhesion test

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