BRITISH STANDARD

BS 5131-1.9: 1985

Methods of

Test for footwear and footwear materials —

Part 1: Adhesives —

Section 1.9 Measurement of green strength of adhesive joints

NOTE It is recommended that this Section should be read in conjunction with the information in the General introduction to BS 5131, published separately.

UDC 685.31:620.1:665.93:539.219.2

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

This British Standard, having been prepared under the direction of the Textiles and Clothing Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 May 1985

The following BSI references relate to the work on this standard:
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Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

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1 Scope

This Section describes a method for measuring the resistance to peeling of an adhesive joint between two sheet materials immediately after it is made. This is usually known as the green strength.

The main purpose of the test is to enable the green strength of joints made with various solvent-based adhesives between specific soling and upper materials to be compared. The test can also be used for joints between other materials provided that at least one of them is flexible.

NOTE Adequate green strength is especially important for sole-attaching adhesives during shoe manufacture, as otherwise the sole bond may partially fail cohesively, i.e. within the adhesive film, after leaving the press.

2 References

This section refers to the following publications:

BS 903, *Methods of testing vulcanized rubber — Part A26 Determination of hardness.*

BS 5131, *Methods of test for footwear and footwear materials — Subsection 1.1.2 Resistance to peeling — Subsection 1.1.3 Preparation of test assemblies for adhesion tests.*

3 Principle

The two adherends of a bonded assembly are peeled apart immediately after bonding by forces acting at an angle of 180°. The peel angle depends on the flexibility of the adherend materials. The peeling force is recorded continuously and the average value 60 s after application of full bonding pressure is calculated from the graph.

4 Apparatus

4.1 *A tensile testing machine,* as described in BS 5131-1.1.2.

4.2 *A conditioning cabinet or room*, as described in BS 5131-1.1.2.

5 Test assemblies

5.1 Choice of adherends

5.1.1 Select the adherends for the test assemblies according to the type of adhesive, as follows.

a) Polyurethane adhesives. Use polyvinyl chloride (PVC)-coated fabric as upper material bonded to resin rubber as soling material.

b) Polychloroprene adhesives. Use upper leather as upper material bonded to resin rubber as soling material.

c) Other adhesives. Use adherend materials for which the adhesive is intended.

5.1.2 The types of adherend required in **5.1.1** a) and b) shall be as follows.

a) *PVC-coated upper material*, smooth, solid (i.e. non-cellular) PVC-coated woven cotton fabric of overall thickness 1.1 ± 0.2 mm.

b) *Upper leather*, either a pre-buffed, full chrome, pearl split, upper leather of thickness 1.5 ± 0.2 mm, or a chrome grain side leather of thickness about 2.0 mm which will be reduced to a thickness of about 1.5 mm when its grain layer is removed during the preparation of the test joints.

c) Resin rubber soling material, compounded resin rubber, hardness 95 ± 2 IRHD (determined as described in BS 903-A26), thickness 3.5 ± 0.5 mm.

NOTE In certain circumstances, e.g. where particular factory practices are to be simulated, or when adhesion to the adherends listed in **5.1.2** is difficult, other materials of the same type, or different types, may be used.

5.2 Conditioning

Before preparation keep all adherends for at least 24 h in an atmosphere of 20 ± 2 °C and 65 ± 2 % relative humidity, and maintain them under these conditions between preparation, adhesive application and bonding.

5.3 Number of test assemblies

Prepare four test assemblies from adherends which are the exact width required for a single test joint, using the procedures described in **5.4**, **5.5**, **5.6** and **5.7**.

NOTE These assemblies will therefore differ from those prepared for the peel test, described in BS 5131-1.1.2, which requires assemblies to be the width of two test joints plus margins. This is because the joints for measuring green strength are tested immediately after bonding and there is not time to cut them from larger assemblies. Cutting of a "green" assembly would in any case disturb the bond.

5.4 Cutting and preparation of adherend materials

For materials that will not be prepared mechanically, cut two rectangles each approximately 70 mm × 50 mm. Of the materials listed in **5.1**, these will be as follows.

a) PVC-coated fabric, which is solvent wiped.

b) Pearl split upper leather, which normally requires no further preparation.

NOTE If variability of results is suspected due to the pearl split leather, repeat the test ensuring that the pearl split is scoured or wire brush roughed before applying adhesive.

c) Resin rubber, which is normally treated with a primer when a polyurethane adhesive is to be tested.

For materials that will be prepared mechanically, cut one rectangle approximately 70 mm × 100 mm. Of the materials listed in **5.1**, these will be as follows.

a) Grain side upper leather, which needs to have the grain removed by wire brush roughing or scouring.

b) Resin rubber, which is normally prepared by scouring or wire brush roughing when a polychloroprene adhesive is to be tested.

Use the procedures described in **4.2.1** to **4.2.7** of BS 5131-1.1.3:1976 to prepare materials prior to adhesive application. Follow the procedure for peel testing, **4.2.1.3** in those instances where this differs from the procedure for creep testing, **4.2.1.2**. After preparation, cut each 70 mm × 100 mm rectangle into two 70 mm × 50 mm rectangles, as shown in Figure 1.

5.5 Preparation and application of adhesive

Use the procedure described in **5.1** to **5.4** of BS 5131-1.1.3:1976.

NOTE The materials are usually adhesive coated before being cut into the adherend rectangles needed for the individual test joints (see **5.7**). If more convenient, the adherends may be cut to size before adhesive coating, but after surface preparation.

5.6 Open times and drying conditions

"Open time" is the time between applying the adhesive and assembling the joint. Where factory conditions are to be simulated, adopt the open times and the drying conditions used in practice.

For evaluating or comparing adhesives where factory conditions are not known, adopt open times of 60 ± 5 min on the upper and 20 ± 4 h on the sole, drying at ambient temperature.

NOTE The green strength of the bond varies more with the open time used than does the final bond strength. Consequently when measuring green strength it is necessary to specify tighter tolerances for the open time than are needed for the measurement of the final bond strength.

5.7 Cutting of adhesive coated adherends

When the adhesive is adequately dry but before the open time has elapsed, cut each of the two upper and two sole material 70 mm × 50 mm rectangles into two rectangles 30 ± 1 mm wide by not less than 50 mm long, discarding the two marginal strips as shown in Figure 2. Use a press knife, a sharp hand knife, or a rotary disc cutter.

6 Test procedure

Adjust the tensile testing machine to a suitable force range, e.g. 0 to 200 N, and a jaw separation rate of 100 ± 20 mm/min. Set the jaw separation to a distance that will allow the test joint to be clamped and put under tension with the minimum delay once the machine is set in motion.

At the conclusion of the open time, bond one pair of sole and upper adherend rectangles to form a joint using the procedures for adhesive reactivation and bonding described in **6.1** of BS 5131-1.1.3:1976. Since the activation conditions can affect the green strength it is important to use appropriate ones, i.e. either those being used in the factory or the standard conditions described in **6.1** of BS 5131-1.1.3:1976.

When full pressure has been reached, bond at this pressure for 15 ± 2 s and continue timing. After the 15 s bonding period, remove the joint from the press and immediately clamp its free legs in the jaws of the tensile testing machine.

Set the machine in motion so that the time from application of full bonding pressure to the commencement of peel separation of the adherends is 35 ± 5 s. During peeling, mark the force/extension graph at the point corresponding to 60 ± 2 s from the application of full bonding pressure. Examine the test joint after peeling and determine the type of failure as described in **7.1** of BS 5131-1.1.2:1976.

NOTE The failure will often be cohesive, i.e. within the adhesive film.

Repeat the procedure for the other three pairs of adherend rectangles.

7 Calculation and expression of results

7.1 For each of the four test joints make an estimate of the peeling force at the 60 s mark on the force/extension graph. If necessary smooth out the undulations in the trace by drawing an estimate line for the peeling force trend in the 60 s region (see Figure 3).

7.2 Calculate the arithmetic mean of the four peeling forces and divide this by the width of the test joint to express the result in N/mm. Record this as the green strength of the bonded assembly.

8 Test report

Include the following items in the test report:

a) the green strength expressed in accordance with clause **7**;

b) types of failure observed and the percentage of the total peeled area that each failure type represents;

c) description of the adherends and their method of preparation;

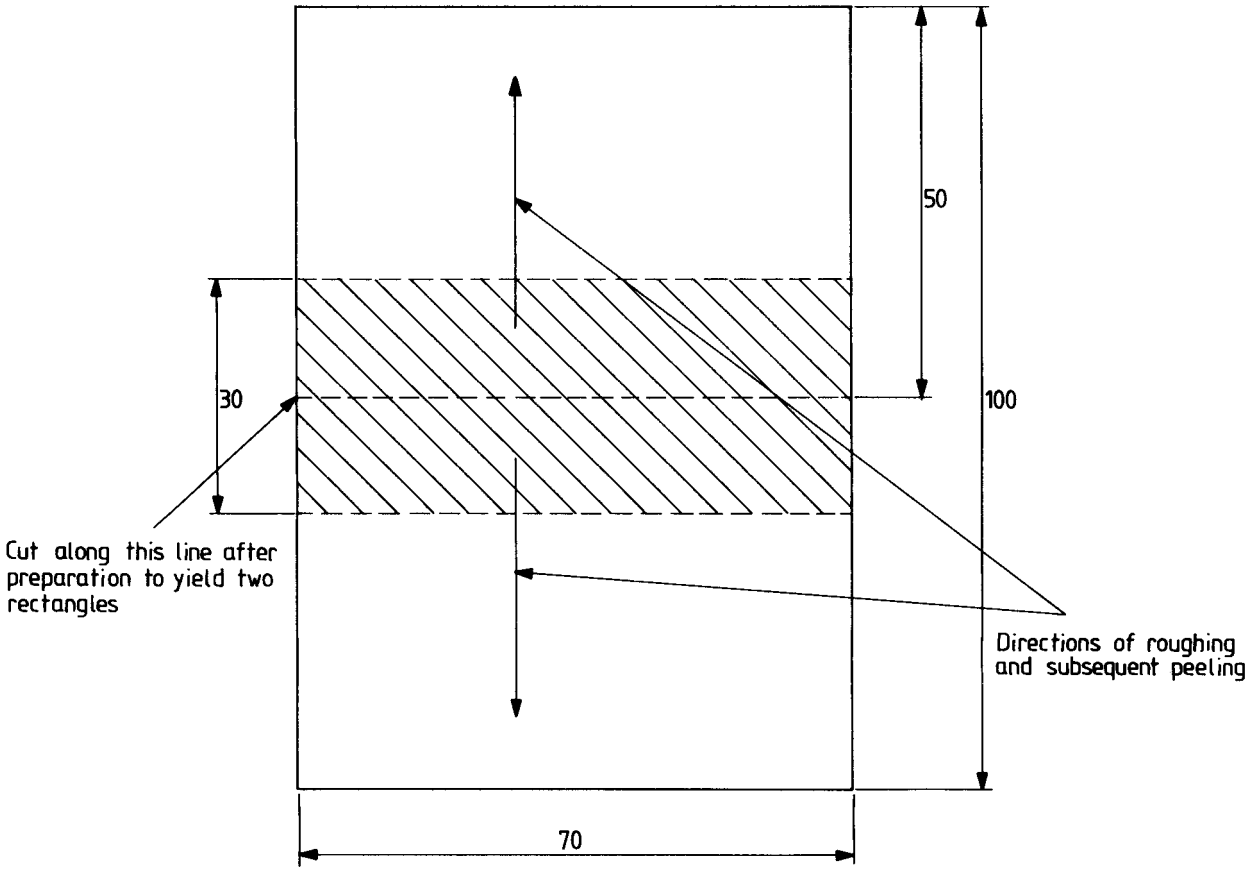
d) the type of adhesive, method of application and number of coats applied;

e) adhesive drying conditions and open time;

f) details of activation of adhesive;

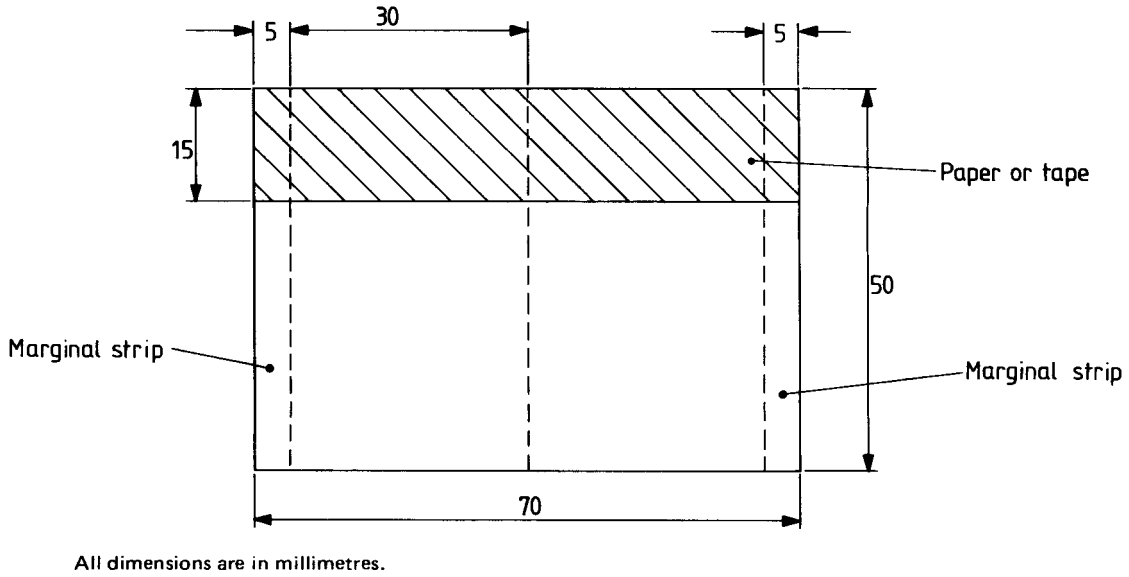
g) reference to the method of test, i.e. BS 5131-1.9;

h) date of testing.



NOTE The shaded area shows the subsequent position of the paper or tape insert in the test joints (see **5.5**).

Figure 1 — Plan of rectangle for mechanical preparation



All dimensions are in millimetres.

Figure 2 — Cutting of adherends

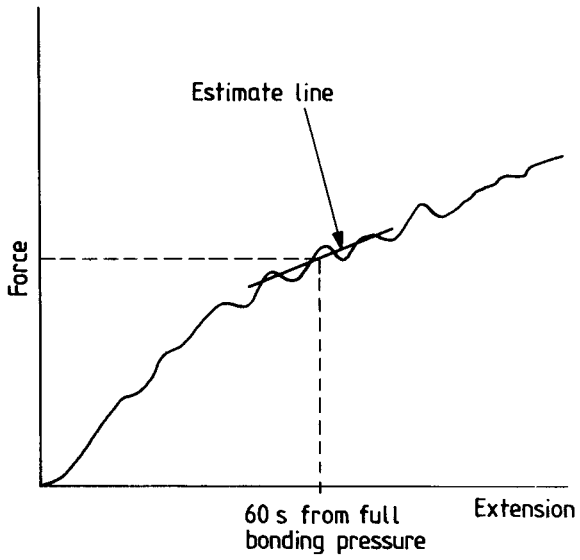


Figure 3 — Force/extension graph

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