BRITISH STANDARD

BS 5131 :
Section 1.1 :
1991

Methods of test for

Footwear and footwear materials

Part 1. Adhesives

Section 1.1 Resistance of adhesive joints to heat (creep test)

NOTE. It is recommended that this Section should be read in conjunction with BS 5131 : Part 0, published separately.

Méthodes d'essais des chaussures et matériaux pour chaussures
Partie 1. Colles
Section 1.1 Résistance à la chaleur des assemblages collés (essai de fluage)

Prüfung von Schuhwerk und Schuhwerkstoffen
Teil 1. Klebstoffe
Abschnitt 1.1 Wärmebeständigkeit von Klebverbindungen

BSI STANDARDS

Foreword

This Section of BS 5131 has been prepared by the Textiles and Clothing Standards Policy Committee. It supersedes BS 5131 : Subsection 1.1.1 : 1976, which is withdrawn.

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

Contents

Method

1 Scope

This Section of BS 5131 describes a laboratory test method for measuring the heat resistance of a bonded joint.

The main purpose of the method is to compare adhesives and as a consequence recommendations are given as to appropriate adherends. The most common application is the comparison of sole-attaching adhesives, but other types of adhesives may also be compared using this method. In addition, the method may be used for testing any other combination of materials in a bonded assembly, provided that at least one of the adherends is flexible. Joints prepared by the direct bonding of hot melt adhesives are outside the scope of this method, since these joints would require a much higher temperature than that given in the method to soften the adhesive.

NOTE 1. Adequate heat resistance is especially important for sole-attaching adhesives, otherwise the sole bond may fail when footwear is displayed in shop windows, or when exported to warmer climates, or if exposed to high temperatures during wear. The temperatures involved in the test are believed to represent the maximum temperatures likely to be encountered by footwear in normal use. The method can thus be applied to any adhesive to check suitability for use but would not normally be applied to high melting point adhesives such as hot melt lasting adhesives which are used in direct bonding at higher temperatures.

NOTE 2. The titles of the publications referred to in this standard are listed on the inside back page.

2 Principle

Test specimens, consisting of bonded joints, are prepared under controlled conditions in the laboratory and are subjected to a constant peeling force at a controlled elevated temperature over a timed interval. The amount of separation of the bond (i.e. 'creep') is measured and the type of separation noted.

3 Apparatus[1)]

3.1 *Conditioning cabinet or room,* maintaining an atmosphere at a preferred condition of 20 ± 2 °C and 65 ± 2 % r.h., or an allowed condition of 23 ± 2 °C and 50 ± 5 % r.h.

NOTE. The conditioning atmosphere for footwear and footwear materials is normally 20 °C and 65 % r.h., whereas the conditioning atmosphere for adhesives is normally 23 °C and 50 % r.h.

3.2 *Creep test cabinet,* consisting of a compartment (or group of interconnecting compartments) with a heater and air-circulating fan capable of maintaining an internal air temperature of 60 ± 1 °C, 50 ± 1 °C and 70 ± 1 °C, as measured by a mercury-in-glass thermometer, and an air speed of 0.4 m/s to 1.0 m/s at the test specimen positions. The cabinet contains facilities for hanging test specimens from clamps mounted on a cross-bar which can be removed for insertion of the test specimens and then replaced. Hooks attached to a lower set of clamps pass through the bottom of the cabinet so that weights may be hung from these hooks outside the cabinet, thus avoiding the temperature drop which could occur if the cabinet had to be opened.

3.3 *Three sets of five weights,* such that their masses (when the mass of the hook and lower clamp is included) are 0.5 kg, 1.0 kg, 1.5 kg, 2.0 kg and 2.5 kg. The tolerance for each weight is 1 %.

3.4 *Cutting device,* suitable for cutting test assemblies into test specimens, which neither compresses nor tends to split the layers of the test assembly at the edges produced by cutting.

NOTE. As an example, a rotary disc cutter or a sharp hand knife is a suitable tool. A press knife is not suitable because of the large compression force that it applies to the test assembly.

4 Choice of adherends[1)]

4.1 Normal option

Where the test is to be carried out in order to determine the performance of a particular adhesive without reference to its usage within a specialized context (see **4.2**), select the adherends for the test assemblies according to the type of adhesive to be tested 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.

Ensure that the types of adherend used in (a) and (b) are as follows.

(1) *Polyvinyl chloride (PVC)-coated fabric.* Use smooth, solid (i.e. non-cellular) PVC-coated woven cotton fabric of overall thickness 1.1 ± 0.2 mm.

(2) *Upper leather.* Use either a pre-buffed, full chrome, 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 1.5 ± 0.2 mm when its grain layer is removed during the preparation of the test assembly.

[1)] For information on the availability of suitable apparatus and materials including adherends to perform this test, apply to Enquiry Section, BSI, Linford Wood, Milton Keynes MK14 6LE, quoting the number of this standard and the clause number referring to the items concerned. Enclose a stamped addressed envelope for reply.

(3) *Resin rubber soling material.* Use a compounded resin rubber, of hardness 95 ± 2 IRHD (determined as described in BS 903 : Part A26), and of thickness 3.5 ± 0.5 mm.

4.2 Special option

Use appropriate adherends within a specialized context (e.g. where particular factory procedures are to be simulated, or where the adhesive is specified by the manufacturer as being suitable for adherend materials different from those given in **4.1**).

NOTE. Adherend materials together with their preparation are given in **4.2** of BS 5131 : Section 1.3 : 1991.

5 Preparation and bonding of test assemblies

Prepare the materials and bond the test assemblies, incorporating a paper or tape insert, as described in BS 5131 : Section 1.7[1)] for indirectly bonded hot melt adhesive bonds and in BS 5131 : Section 1.3 for all other types of bond. Produce test assemblies of sufficient size and number so as to enable 15, 30 or 45 test specimens to be prepared (see clauses **6** and **9**).

NOTE. At present, direct bonded hot melt adhesives are not being used for footwear applications which need to be assessed by the creep test.

6 Conditioning

After bonding the test assemblies and before cutting them into test specimens, store the test assemblies in the conditioning cabinet or room (**3.1**). In those cases where it is known that the bond is formed rapidly within a short period of time after which there is no change, condition one set of test assemblies for a period of 7 ± 1 days. In all other cases, condition one set of test assemblies for a period of 24 ± 1 h, a second set of test assemblies for 7 ± 1 days, and a third set of test assemblies for 14 ± 2 days.

NOTE. By determining the heat resistance after various conditioning periods, any change in the heat resistance due to changes in the adhesive (e.g. increased curing or crystallization) may be assessed.

7 Cutting of test specimens

At the end of the conditioning period given in clause **6**, cut one set of test assemblies into 15 test specimens using a suitable cutting device (**3.4**) as follows.

From the test assemblies cut test specimens 30.0 ± 0.5 mm by approximately 100 mm, discarding two marginal strips approximately 5 mm wide if the test assemblies are approximately 70 mm wide. A test specimen is shown in figure 1.1/1.

8 Procedure

Allow the internal air temperature of the creep test cabinet (**3.2**) to reach 60 ± 1 °C. Fold back the unbonded leg of the more flexible adherends of each test specimen at the paper strip, and mark (e.g. with a ballpoint pen) across the stiffer adherends at the start of the bond between the two adherends.

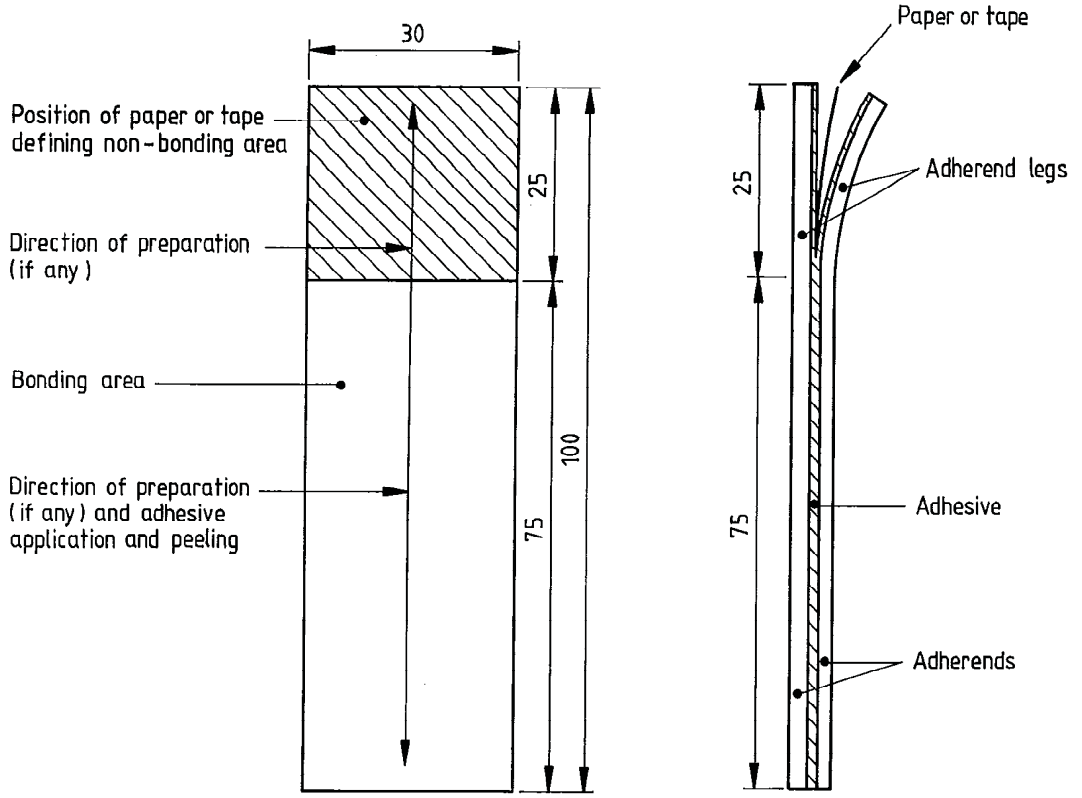
While fitting the test specimens into the cabinet, avoid opening the door more often than is necessary so as to maintain the cabinet temperature.

Remove the cross-bar from the cabinet and insert into each of the upper clamps the stiffer separated leg of each test specimen, with the flexible adherends uppermost. Fold back the separated leg of the flexible adherends of each test specimen, taking care not to produce any additional separation, and attach it to the lower clamp. Put the cross-bar back into the cabinet with the clamps and test joints at the front.

Attach one of the hooks to each lower clamp and close the cabinet. If the hook and lower clamp together weigh more than 50 g, support this assembly prior to warming up so that the test specimen is not stressed during the warm-up time. Allow 1 h for the test specimens to warm up to a temperature of 60 ± 1 °C (see clause **9**).

After the warm-up time of 1 h has elapsed, remove the assembly supports (if any) and hang the test weights on the hooks outside the cabinet so that three test specimens are loaded with 0.5 kg, 1.0 kg, 1.5 kg, 2.0 kg and 2.5 kg masses respectively (a total of 15 test specimens being used). Where there is already information available from previous tests carried out on adhesives of the same class, anticipate whether there are either low loads which will not produce any creep or high loads which will cause complete separation. In such cases, in order to avoid needless testing, carry out the test using fewer than the five loads given above. Where one or more lower loads are omitted, ensure that the lowest load included in the procedure is insufficient to produce creep (thereby justifying the omission of lower loads from the procedure). Where one or more higher loads are omitted, ensure that the highest load used in the test is sufficient to cause complete separation (thereby justifying the omission of higher loads from the procedure). In order to achieve the most effective averaging, ensure that test specimens from the same test assembly are not tested with the same mass.

[1)] In preparation.



(a) Plan view of test specimen

(b) Side view of test specimen

All dimensions are in millimetres.

Figure 1.1/1. Test specimen cut from test assembly prepared as described in BS 5131 : Section 1.3 or prepared by indirect bonding as described in BS 5131 : Section 1.7

If maximum separation of a bond (65 mm is the maximum attainable in the apparatus described) occurs within 10 min for any of the test specimens, record the time taken for separation to occur (in minutes).

After 10 min open the cabinet. With the weights still attached, mark the stiffer adherends of each with a ballpoint pen at the start of the remaining bond and then immediately remove the weights. Remove the test specimens from the cabinet. Measure, to the nearest millimetre, the distance between the two marks on the stiffer adherends of each test specimen. Record these distances as the bond separations. Note the type of bond separation, as illustrated in figure 1.2/4 of BS 5131 : Section 1.2 : 1991.

NOTE. Where separation occurs which is not cohesive (i.e. not within the adhesive film) this is not truly indicative of the heat resistance of an adhesive. However, the information obtained may give a guide to the maximum creep value.

9 Additional tests

For special purposes (e.g. for comparative tests on several adhesives, where results at one temperature may not be sufficiently informative), repeat the procedure using one set (or two sets) of 15 test specimens and using a cabinet air temperature of either 50 ± 1 °C or 70 ± 1 °C (or both 50 ± 1°C and 70 ± 1°C).

10 Expression of results

Where a test specimen has not reached maximum separation at the end of the test, take the bond separation as the length in millimetres of bond separation per 10 min.

Where a test specimen has reached maximum separation at the end of the test, multiply the bond separation length by 10 min and divide this by the time taken in minutes to achieve this bond separation. Take this value as the length in millimetres of bond separation per 10 min.

For the three test specimens tested with each mass, calculate the average of the three lengths in millimetres of bond separation per 10 min.

11 Test report

The test report shall include the following items:

(a) temperature and relative humidity of the conditioning atmosphere;

(b) temperature at which the creep test was carried out;

(c) results, expressed in accordance with clause **10**;

(d) type(s) of bond separation as illustrated in figure 1.2/4 of BS 5131 : Section 1.2 : 1991 where bond separation is not caused by a cohesive failure of adhesive;

(e) description of the adherends and their method of preparation;

(f) type of adhesive;

(g) open time (see clause **5.4** of BS 5131 : Section 1.3 : 1991);

(h) reference to this method of test, i.e. BS 5131 : Section 1.1;

(i) date of testing.

Publications referred to

BS 903 Methods of testing vulcanized rubber
Part A26 Determination of hardness

BS 5131 Methods of test for footwear and footwear materials
Part 1 Adhesives
Section 1.2 Resistance of adhesive joints to peeling
Section 1.3 Preparation of test assemblies using adhesives (other than hot melt adhesives) for heat resistance (creep) and peel tests
[1)]Section 1.7 Preparation of test assemblies using hot melt adhesives for heat resistance (creep) and peel tests

[1)] In preparation.

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Textiles and Clothing Standards Policy Committee (TCM/-) to Technical Committee TCM/39, upon which the following bodies were represented:

British Footwear Manufacturers' Federation
British Leather Confederation
British Rubber Manufacturers' Association
British Steel plc
Consumer Standards Advisory Committee of BSI
Cork Industry Federation
Footwear Components Federation
Footwear Distributors' Federation
Institute of Trading Standards Administration
Iron and Steel Trades Confederation
Lancashire Footwear Manufacturers' Association
Mail Order Traders' Association of Great Britain
Ministry of Defence
National Union of Footwear, Leather and Allied Trades
Office of Fair Trading
SATRA Footwear Technology Centre

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Adhesives and Sealants Association
British Paper and Board Industry Federation
British Plastics Federation
Multiple Shoe Retailers' Association
RAPRA Technology Ltd.

This British Standard, having been prepared under the direction of the Textiles and Clothing Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on
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The following BSI references relate to the work on this standard:
Committee reference TCM/39
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Amendments issued since publication

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