BRITISH STANDARD

BS 3712-4: 1991

Building and construction sealants —

Part 4: Method of test for adhesion in peel

Confirmed December 2011

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Elements and Components (of Diverse Materials) for Buildings Standards Policy Committee (ECB/-) to Technical Committee ECB/3, upon which the following bodies were represented:

Aluminium Window Association
Association of Sealant Applicators
British Adhesives and Sealant Association
Building Employers Confederation
Department of the Environment (Building Research Establishment)
Department of the Environment (Property Services Agency)
Flat Glass Manufacturers' Association
Glass and Glazing Federation
Institution of Civil Engineers
Refined Bitumen Association Ltd.
Society of Architectural and Associated Technicians
Society of Chemical Industry
Water Services Association of England and Wales

This British Standard, having been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 30 August 1991

© BSI 05-1999

First published August 1985
Second edition August 1991

The following BSI references relate to the work on this standard:
Committee reference ECB/3
Special announcement in *BSI News* August 1991

ISBN 0 580 19922 3

Amendments issued since publication

Amd. No.	Date	Comments

Contents

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

Foreword

This Part of BS 3712, prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Policy Committee, is a new edition of and supersedes BS 3712-4:1985 which is withdrawn. This new edition has been necessitated by the need to delete the methods of test for tensile properties (which have been published as BS EN 28339 and BS EN 28340), elastic recovery (which has been published as BS EN 27389), and loss of mass after heat ageing (the subject of which is being developed in ISO/TC 59/SC8 as a draft international standard ISO/DIS 10563). No review of or technical amendment to the remaining method of test in this Part of BS 3712 has been made except that in **3.4.1.6** and **3.4.2.8** two alternative British Standard references are given.

The adhesion in peel test is based on the existing tests in BS 4254, BS 5215 and BS 5889, which differ slightly from each other owing to the different cure characteristics of the three types of sealant.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

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

© BSI 05-1999

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

1 Scope

This Part of BS 3712 gives a test method for the following properties of building and construction sealants:

a) adhesion in peel for fresh sealant on specific surfaces;

b) adhesion in peel for fresh sealant on matured sealant.

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

2 Definitions

The definitions given in BS 3712-1, BS 3712-2 and BS 3712-3 apply.

3 Adhesion in peel

3.1 Apparatus and accessory materials

3.1.1 *Testing machine,* with tension grips capable of pulling at a rate of separation of 50 ± 5 mm/min with a dial or chart calibrated to record the force.

3.1.2 *Paper masking tape,* 25 mm wide.

3.1.3 *Spacer bars,* at least 125 mm long × 1.5 mm wide. The bars shall be 1.5 mm thick for testing fresh sealant on specific surfaces or 6 mm thick for testing fresh sealant on matured sealant.

3.1.4 *Thin flexible backing material,* 225 mm × 75 mm to which the compound will adhere throughout the test and which requires a force appreciably less than 25 N to be pulled back at an angle of 180° (e.g. cloth, brass screen, unsized cotton duck fabric, open weave glass cloth).

3.1.5 12 mm *diameter rod,* steel or glass, 150 mm long.

3.1.6 *Ventilated ovens,* capable of being maintained at a temperature in the range of 23 °C to 50 ± 2 °C and a relative humidity in the range 65 ± 5 % r.h. to 95 ± 5 % r.h.

3.1.7 300 W *sunlamp.*

3.1.8 *Power stirrer or spatula,* for mixing multipart sealants.

3.2 Test surfaces

One or more of the following test surfaces shall be used.

a) Two pieces of untreated aluminium alloy approximately 125 mm × 75 mm not less than 3 mm thick of grade 6082 T6 as specified in BS 1470 or grade 6063 T6 or 6082 T6 as specified in BS 1474.

b) Two blocks of cement mortar approximately 125 mm × 75 mm × 25 mm prepared as follows.

1) Mix one part by dry mass of ordinary Portland cement complying with BS 12 with $1\frac{1}{2}$ parts by dry mass of sand complying with BS 4550-6 and add water to give a water cement ratio of 0.35 to 0.40.

The grading of the sand shall be such that 100 % by mass shall pass through a 850 μm sieve complying with BS 410 and 0 % to 10 % by mass shall pass through a 600 μm sieve complying with BS 410.

Ensure that the sand is thoroughly washed and dried before use.

2) Transfer the mortar immediately to rigid plastics moulds in about four layers, each being thoroughly compacted on a suitable vibrating table.

3) Cure the blocks in the moulds for 24 h in an atmosphere of not less than 90 % r.h.

4) Remove blocks from the moulds and cure for a further 28 days in water at room temperature, using a volume of water not less than 400 mL per block.

5) Dry the blocks at a temperature of 110 °C for at least 12 h and store in a ventilated oven (see **3.1.6**) for at least 28 days at 23 ± 2 °C and 65 ± 5 % r.h.

If blocks are not required for immediate use and are subsequently stored under alternative or uncontrolled conditions, store them for at least a further 7 days at 23 ± 2 °C and 65 ± 5 % r.h. before use.

c) Two pieces of clear float glass, 125 mm × 75 mm, not less than 6 mm thick.

d) Two pieces of any other material 125 mm × 75 mm and of sufficient thickness to withstand distortion during the test.

3.3 Cleaning of test surfaces

Before constructing the test assemblies, clean the test surfaces as follows.

a) *Clear float glass and aluminium.* Remove major contamination by cleaning with water, detergent solution or solvents. Clean the surface with butanone (ethyl methyl ketone) or similar solvent. Wash with dilute detergent solution and rinse with distilled or deionized water. Rinse in industrial methylated spirits and air dry.

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

b) *Mortar.* Remove loose dust by brushing, using a clean stiff bristle brush. If it is found, after the preparation of the block, that the surface has any cavity greater than 2 mm diameter, reject the block.

c) *Other material.* Proceed as directed by the manufacturer of the material.

3.4 Preparation of test assemblies

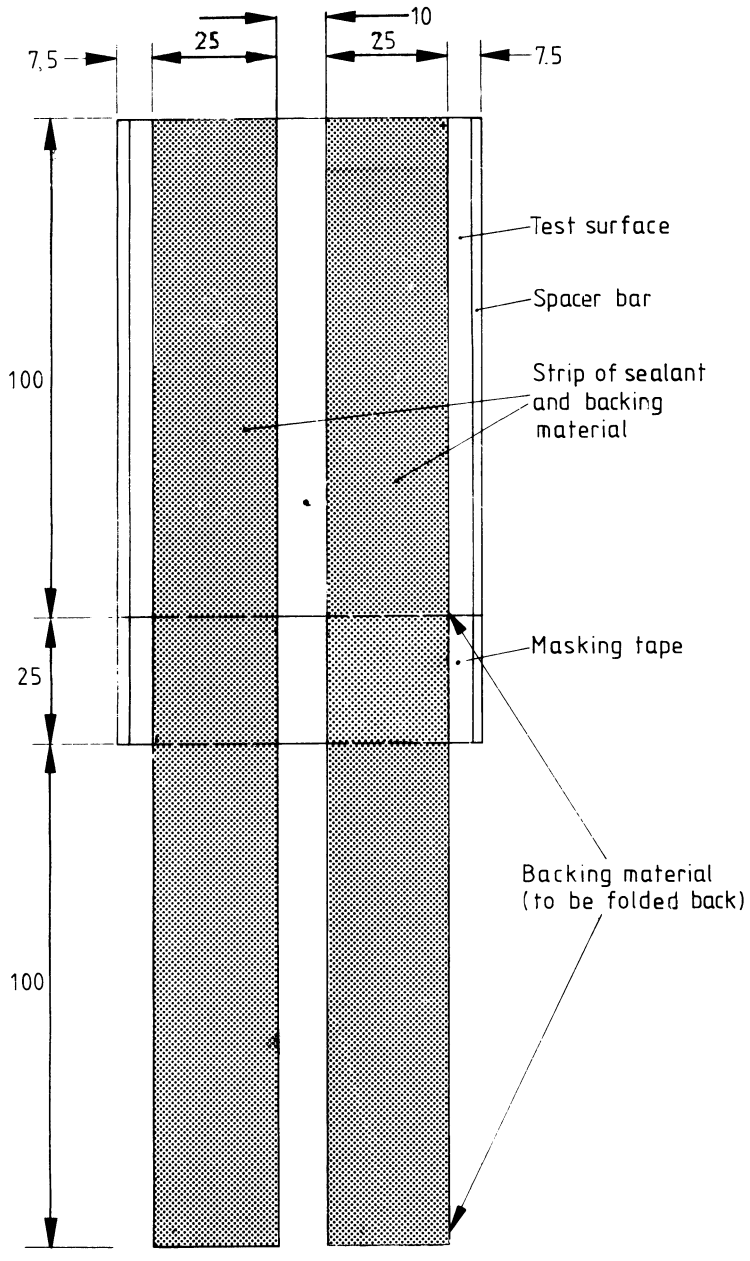
NOTE The procedures described in the clause require special expertise. They should, therefore, be carried out in laboratories having considerable experience in this field.

3.4.1 ***Fresh sealant on specific surface***

3.4.1.1 Prepare not less than two test assemblies for each test surface as described in **3.4.1.2** to **3.4.1.8**.

3.4.1.2 Place a strip of 25 mm paper masking tape (**3.1.2**) across the width of a clean test surface along and parallel to the lower edge, leaving an area of 100 mm × 75 mm exposed (see Figure 1).

Where appropriate, prime the surface to which the sealant is intended to adhere.



All dimensions are in millimetres.

Figure 1 — Diagram showing arrangement of test strips for the adhesion in peel test

© BSI 05-1999

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

3.4.1.3 Condition an appropriate quantity of the sealant at 23 ± 2 °C in a closed container or an unopened cartridge for a period of at least 16 h. Then mix appropriate amounts of the conditioned components of multipart sealants, either by hand for 10 min, using a spatula, or by using a power stirrer (**3.1.8**) until uniform mixing is achieved, the speed of rotation being such that the minimum amount of air is entrained in the mixed sealant.

3.4.1.4 Spread a portion of the sealant to a minimum thickness of 2 mm over the whole area of the test surface, including the tape (i.e. 125 mm × 75 mm).

3.4.1.5 Insert the spacer bars (**3.1.3**) on the long edge of the test surface (see Figure 1). Then smear the backing material with the mixed sealant at one end over an area of 125 mm × 75 mm and force the sealant into the backing material using a spatula. Lay the impregnated material over the sealant on the test surface, taking care that the minimum amount of air is entrapped. Roll the backing material with the rod to obtain a thickness of sealant of 1.5 mm between the backing material and the test surface.

3.4.1.6 Cure the assembly for 7n days, where n is a specified whole number, at 23 ± 2 °C and 50 ± 5 % r.h. or 65 ± 5 % r.h. in a ventilated oven, or as required in BS 5215 or BS 5889.

NOTE To aid adhesion of the backing material, the test assembly may be coated with a 1 mm layer of the same sealant within a period of 3 days, thereafter returning the assembly to the enclosure and resuming the curing cycle.

3.4.1.7 After curing, subject sealant assemblies made from transparent glazing materials to the following procedure.

Continuously expose the transparent side of the assemblies to the radiation from a sunlamp (**3.1.7**) for 96 h at a distance of 300 mm from the surface of the lamp and normal to the axis of the lamp. Before placing the assemblies under the lamp, switch on for 15 min. Then check the ultraviolet output of the lamp using a meter[1)] operating in the range 300 nm to 400 nm. The ultraviolet intensity shall be not less than 25 W/m^2 at a distance of 300 mm from the outside of the lamp glass on the centreline of the lamp. Provide ventilation so that the temperature of the glass surface of each assembly does not exceed 50 °C. Do not test more than two assemblies at the same time under one lamp.

3.4.1.8 For all assemblies, cut through the backing material and sealant to the test surface along its whole length with a sharp knife or razor blade, leaving two strips of sealant and backing material 25 mm wide separated by a space approximately 10 mm wide (see Figure 1). Immerse the assembly in distilled or deionized water at 23 ± 2 °C for 7 days.

3.4.2 *Fresh sealant on matured sealant*

NOTE The object of this test is to assess the adhesion between freshly applied sealant and matured sealant. This property is of particular relevance for sealant application started on one day and completed on the next and for multiple application of sealants, especially curable sealants. The test may, with caution, be modified to assess the adhesion between two dissimilar materials used in the same joint but attention is drawn to the need to determine the compatibility of the materials. The conditions of exposure may be changed by agreement.

3.4.2.1 Prepare not less than two test assemblies for each test surface as described in **3.4.2.2** to **3.4.2.9**.

3.4.2.2 Place a strip of 25 mm paper masking tape (**3.1.2**) across the width of a clean test surface along and parallel to the lower edge, leaving an area of 100 mm × 75 mm exposed (see Figure 1).

Where appropriate, prime the surface to which the sealant is intended to adhere.

3.4.2.3 Condition an appropriate quantity of the sealant at 23 ± 2 °C in a closed container or an unopened cartridge for a period of at least 16 h. Then mix appropriate amounts of the conditioned components of multipart sealants, either by hand for 10 min, using a spatula, or by using a power stirrer (**3.1.8**) until uniform mixing is achieved, the speed of rotation being such that the minimum amount of air is entrained in the mixed sealant.

3.4.2.4 Spread a portion of the sealant to a minimum thickness of 2 mm over the whole area of the test surface including the tape (i.e. 125 mm × 75 mm).

3.4.2.5 Expose the sealant on the plate in a ventilated oven (**3.1.6**) for 7 days at 23 ± 2 °C and 80 ± 5 % r.h. and for a further 7 days at 50 ± 1 °C and 80 ± 5 % r.h.

3.4.2.6 Remove the assembly from the oven and allow to cool. Clean the surface of the matured sealant as specified by the manufacturer. Then cover the matured sealant with fresh sealant prepared as described in **3.4.2.3** to give a total sealant thickness of 6 mm.

[1)] A U.P.V. J.221 long wave UV meter is known to be suitable.

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

3.4.2.7 Insert the spacer bars (**3.1.3**) on the long edge of the test surface (see Figure 1). Then smear the backing material with the mixed sealant at one end over an area of 125 mm × 75 mm and force the sealant into the backing material using a spatula. Lay the impregnated material over the sealant on the test surface, taking care that the minimum amount of air is entrapped. Roll the backing material with the rod to obtain a thickness of sealant of 6 mm, using appropriate size spacer bars (**3.1.3**), between the backing material and the test surface.

3.4.2.8 Cure the assembly for 7n days, where n is a specified whole number, at 23 ± 2 °C and 50 ± 5 % r.h. or 65 ± 6 % r.h. in a ventilated oven, or as required in BS 5215 or BS 5889.

NOTE To aid adhesion of the backing material, the test assembly may be coated with a 1 mm layer of the same sealant within a period of 3 days, thereafter returning the assembly to the enclosure and resuming the curing cycle.

3.4.2.9 Cut through the backing material and sealant to the test surface along its whole length with a sharp knife or razor blade, leaving two strips of sealant and backing material 25 mm wide separated by a space approximately 10 mm wide (see Figure 1). Immerse the assembly in distilled or deionized water at 23 ± 2 °C for 7 days.

3.5 Procedure

3.5.1 Immediately after removing each assembly from the water, wipe it dry and release the portion of the backing material covering the masking tape. Fold back the two strips of backing material at an angle of 180° and place the assembly in the testing machine (**3.1.1**).

3.5.2 Pull one strip of backing material at a rate of separation of 50 mm/min for 1 min. After a reasonably steady value has been obtained on the testing machine, record the peel strength in newtons shown on the dial or recording chart. Measure the area over which the sealant has failed in adhesion to the test surface. For fresh sealant applied to mature sealant, note where failure occurs.

If the backing material peels from the sealant during the test, disregard the result and repeat the test.

3.5.3 Repeat the procedure described in **3.5.2** for the other strip of backing material.

3.6 Test report

The test report shall contain the following information:

a) the number of this British Standard, i.e. BS 3712-4;

b) the name and type of sealant;

c) the batch of sealant from which test samples were taken (if known) and expiry date;

d) the batch number and expiry date of primer used, where applicable;

e) the test surfaces used;

f) the duration and conditions of cure;

g) the average peel strength in newtons for each test surface;

h) the area over which sealant has failed in adhesion to the substrate for each strip of backing material;

i) where failure occurred, for fresh sealant applied to matured sealant.

© BSI 05-1999

Publication(s) referred to

BS 12, *Specification for Portland cements.*

BS 410, *Specification for test sieves.*

BS 1470, *Specification for wrought aluminium and aluminium alloys for general engineering purposes: plate, sheet and strip.*

BS 1474, *Specification for wrought aluminium and aluminium alloys for general engineering purposes: bars, extruded round tubes and sections.*

BS 3712, *Building and construction sealants*[2)].

BS 3712-1, *Methods of test for homogeneity, relative density and penetration.*

BS 3712-2, *Methods of test for seepage, staining, shrinkage, shelf life and paintability.*

BS 3712-3, *Methods of test for application life, skinning properties and tack-free time.*

BS 4254, *Specification for two-part polysulphide-based sealants*[2)].

BS 4550, *Methods of testing cement.*

BS 4550-6, *Standard sand for mortar cubes.*

BS 5215, *Specification for one-part gun grade polysulphide-based sealants*[2)].

BS 5889, *Specification for one-part gun grade silcone-based sealants*[2)].

BS EN 27389, *Building construction — Jointing products — Determination of elastic recovery*[2)].

BS EN 28339, *Building construction — Jointing products — Sealants — Determination of tensile properties*[2)].

BS EN 28340, *Building construction — Jointing products — Sealants — Determination of tensile properties at maintained extension*[2)].

ISO/DIS 10563, *Building construction — Sealants for joints — Determination of change in mass and volume*[2)].

[2)] Referred to in the foreword only.

© BSI 05-1999

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

Licensed copy: Lee Shau Kee Library, HKUST, Version correct as of 03/01/2015, (c) The British Standards Institution 2013

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

Copyright subsists in all BSI publications. BSI also holds the copyright, in the UK, of the publications of the internationalstandardization bodies. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI.

This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any other purpose than implementation then the prior written permission of BSI must be obtained.

If permission is granted, the terms may include royalty payments or a licensing agreement. Details and advice can be obtained from the Copyright Manager. Tel: 020 8996 7070.

BSI
389 Chiswick High Road
London
W4 4AL