BRITISH STANDARD

BS 3712-1: 1991

# Building and construction sealants —

## Part 1: Methods of test for homogeneity, relative density and penetration

Confirmed December 2011

# 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 Sealants 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

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# Contents

# 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Diverse Materials) for Buildings Standards Policy Committee, is a new edition of and supersedes BS 3712-1:1985 which is withdrawn. This new edition has been necessitated by the need to delete the methods of test for extrudability (which has been published as BS EN 28394) and slump (which has been published as BS EN 27390). Attention is also drawn to BS EN 29048. No review of or technical amendment to the remaining methods of test in this Part of BS 3712 has been made.

BS 3712 provides a body of test methods suitable for the wide range of sealants of different types and properties now available on the market. The primary aim of these test methods is to enable the properties of sealants to be assessed and for their quality to be controlled, particularly in relation to their compatibility with other materials and to their suitability for application to building joints.

Methods of test are included in other Parts of this British Standard for the following sealant properties:

— *Part 2: Methods of test for seepage, staining, shrinkage, shelf life and paintability;*

— *Part 3: Methods of test for application life, skinning properties and tack-free time;*

— *Part 4: Method of test for adhesion in peel.*

It is recognized that the movement capability of a joint sealant is a cardinal property when specifying a material for a specific application. However, there are no generally applicable test methods for the assessment of this property within British Standards, since the withdrawal of DD 69:1980 in November 1989. Two new test methods for movement capability have been developed by ISO Technical Sub-Committee TC 59/SC8, which are to be adopted as European and British Standards. These are ISO 9046:1987 (BS EN 29046) *"Building construction — Sealants — Determination of adhesion/cohesion properties at constant temperature"*, which is appropriate for the assessment of sealants of predominantly plastic properties; and ISO 9047:1989 *"Building construction — Sealants — Determination of adhesion/cohesion properties at variable temperature"*, which is suitable for elastomeric sealants. Further work is in progress by the ISO Technical Sub-Committee to develop a test method for the assessment of the movement capability of high-performance elastomeric sealants capable of withstanding total movement of amplitudes greater than 25 % of the joint width. It is likely that in due course the resulting international standard will be adopted as a European Standard and as a British Standard.

Test methods to allow the assessment of durability of sealants in service are also needed, though progress in this field is likely to be gradual.

At present the following British Standard specifications for sealants are available:

BS 2499, *Specification for hot applied joint sealants for concrete pavements.*

BS 4254, *Specification for two-part polysulphide-based sealants.*

BS 5212, *Cold applied joint sealant systems for concrete pavements.*

BS 5215, *Specification for one-part gun grade polysulphide-based sealants.*

BS 5889, *Specification for one-part gun grade silicone-based sealants.*

Although it is expected that in due course these prescriptive specifications will be superseded by appropriate performance specifications, they contain some methods of test appertaining to performance in service which are not at present included in BS 3712.

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 to iv, pages 1 to 8, 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.

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## 1 Scope

This Part of BS 3712 describes test methods for the following properties of building and construction sealants:

a) homogeneity;

b) relative density;

c) penetration.

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

## 2 Definition

For the purposes of this Part of BS 3712 the following definition applies.

**building sealant**

a joint sealant for building and construction, applied by hand, gun, knife, or trowel, or in strip form, or by pouring, and intended to maintain a seal between the sides of a joint which is subject to some degree of movement

NOTE The strip form materials covered by this definition are plastic at the time of application, i.e. readily deformable but not capable of reverting to their original shape.

## 3 Sampling

Take samples of building sealants as described in either a), b) or c):

a) select at random sufficient unopened packages to provide material for the tests;

b) select sufficient material at random from the bulk supply;

c) take single samples from a gun for specific tests.

## 4 Homogeneity

NOTE The homogeneity of a building sealant, i.e. the uniform dispersion of the ingredients, is an important property which is best assessed by inspection.

### 4.1 Preparation of sample

Condition the sample in closed containers at 25 ± 1 °C for 16 h prior to inspection.

### 4.2 Test procedure

Inspect the samples for separation of components, skin formation or foreign matter.

### 4.3 Test report

The report shall include the following information:

a) the type of sealant;

b) the manufacturer's batch number (if known);

c) the method of sampling;

d) whether there was any separation of components and, if so, whether the sealant could be restored to a condition suitable for use by normal agitation appropriate to the sealant and its package;

e) whether there was any skin formation;

f) the presence of any foreign matter.

## 5 Relative density

### 5.1 General

Methods for measuring the relative density of pouring grade sealants and sealants which do not flow are described in **5.2** to **5.5**.

### 5.2 Apparatus

**5.2.1** *Balance*, capable of weighing up to 200 g to an accuracy of 0.01 g.

**5.2.2** *Relative density cup*[1)], having a nominal capacity of 100 mL, complete with a cover and a suitable overflow orifice.

**5.2.3** *Constant temperature enclosure*, maintained at 25 ± 1 °C.

### 5.3 Preparation of sample and water

Inspect the sample for separation of components, skin formation or foreign matter. Remove any skin. Condition the sample and the relative density cup (**5.2.2**) in the constant temperature enclosure (**5.2.3**) for not less than 4 h or until the constant temperature is achieved. At the same time, condition an adequate quantity of deionized or distilled water to the same temperature.

### 5.4 Test procedure

#### 5.4.1 *Stage one*

Weigh the empty relative density cup, complete with cover, then fill with conditioned deionized or distilled water. Fit the cover and wipe off any excess water which overflows, ensuring that the container is full to the top of the overflow orifice. Reweigh and record the difference in grams between the mass of the container and the mass of the container filled with water. Empty and dry the cup.

#### 5.4.2 *Stage two*

**5.4.2.1** *Pouring grade sealants*

Fill the cup with sealant, taking care to avoid entrapped air. Fit the cover and wipe off excess sealant, making sure the cup is full to the top of the orifice. Weigh the full cup complete with cover. Record the difference in grams between this mass and the mass of the empty cup complete with cover.

[1)] Commonly known as a "weight per gallon" cup.

**5.4.2.2** *Non-sag and strip sealants*

Place in the cup a volume of sealant not less than 15 mL.

NOTE Non-sag gun-grade sealant can be extruded directly from the cartridge. Preformed strip can be cut from an extruded length. Trowelling grades of sealant can be transferred in the form of a single blob, using a spatula.

Replace the cup lid and reweigh. Completely fill the cup with conditioned deionized or distilled water. During the filling operation, brush the surface of the sealant lightly to remove any air bubbles. Fit the cover and wipe off any excess water which overflows, ensuring that the container is full to the top of the overflow orifice. Weigh the cup and sealant and water.

### 5.5 Expression of results

Calculate the relative density, $r$, to an accuracy of ± 0.05 using the following formulae:

for pouring grade sealants

$$r = \frac{m_1 - m_0}{m_2 - m_0}$$

for non-sag sealants

$$r = \frac{m_1 - m_0}{(m_2 - m_0) - (m_3 - m_1)}$$

where

$m_0$ is the mass of the container;

$m_1$ is the mass of the container plus sealant;

$m_2$ is the mass of the container filled with water;

$m_3$ is the mass of the container filled with sealant and water.

### 5.6 Test report

The report shall include the following information:

a) the type of sealant;

b) the manufacturer's batch number (if known);

c) the method of sampling;

d) whether there was any separation of components and, if so, whether the sealant could be restored to a condition suitable for use by normal agitation appropriate to the sealant and its package;

e) whether there was any skin formation;

f) the presence of any foreign matter;

g) the relative density to an accuracy of ± 0.05.

## 6 Penetration

### 6.1 General

The object of the penetration test is to make an assessment of a property usually referred to as the consistency. It is not suitable for sealants which contain coarse lumps, show visible signs of separation or caking, or show any lack of uniformity within the sample.

The penetration is the distance in tenths of a millimetre which a specified needle (see **6.2.1**) or cone (see **6.2.2**) penetrates vertically into a specimen under specified conditions of loading, time and temperature.

### 6.2 Apparatus

NOTE Each piece of apparatus adopted for use in the penetration test originated from various sources in the UK or elsewhere and was manufactured in accordance with the specification from which it was taken. For this reason it is not always possible to describe all apparatus in rounded off metric dimensions, e.g. as the ball-ended needle and penetration cones are manufactured in imperial sizes, they are described in metric equivalents to the original imperial units.

**6.2.1** *Penetration needles*

**6.2.1.1** *General.* Use one of the types of polished stainless steel needle described in **6.2.1.2** to **6.2.1.4**.

**6.2.1.2** *Needle*, 50.8 mm long and 1.6 mm diameter, terminating at one end in a 4.8 mm diameter stainless steel ball and at the other end in a brass shank 25.4 mm long and 3.175 mm diameter [see Figure 1(a)].

**6.2.1.3** *Flat-ended cylindrical needle*, 2 mm diameter.

**6.2.1.4** *Needle*, as shown in Figure 1(b) of 1.00 mm to 1.02 mm diameter, symmetrically tapered at one end to a cone approximately 6.35 mm in height. The angle of the cone is within the range 8° 40′ and 9° 40′. After tapering, the needle is "blunted" by grinding to a truncated cone, the smaller base of which is 0.14 mm to 0.16 mm in diameter. The length of the frustrum is 4.8 mm to 5.8 mm. The finished needle is mounted in a brass shank not more than 3.2 mm in diameter, 20 mm to 25 mm long. The total length of the needle protruding from the shank is approximately 50 mm. The mass of the needle and shank is 1.5 g to 2.0 g.

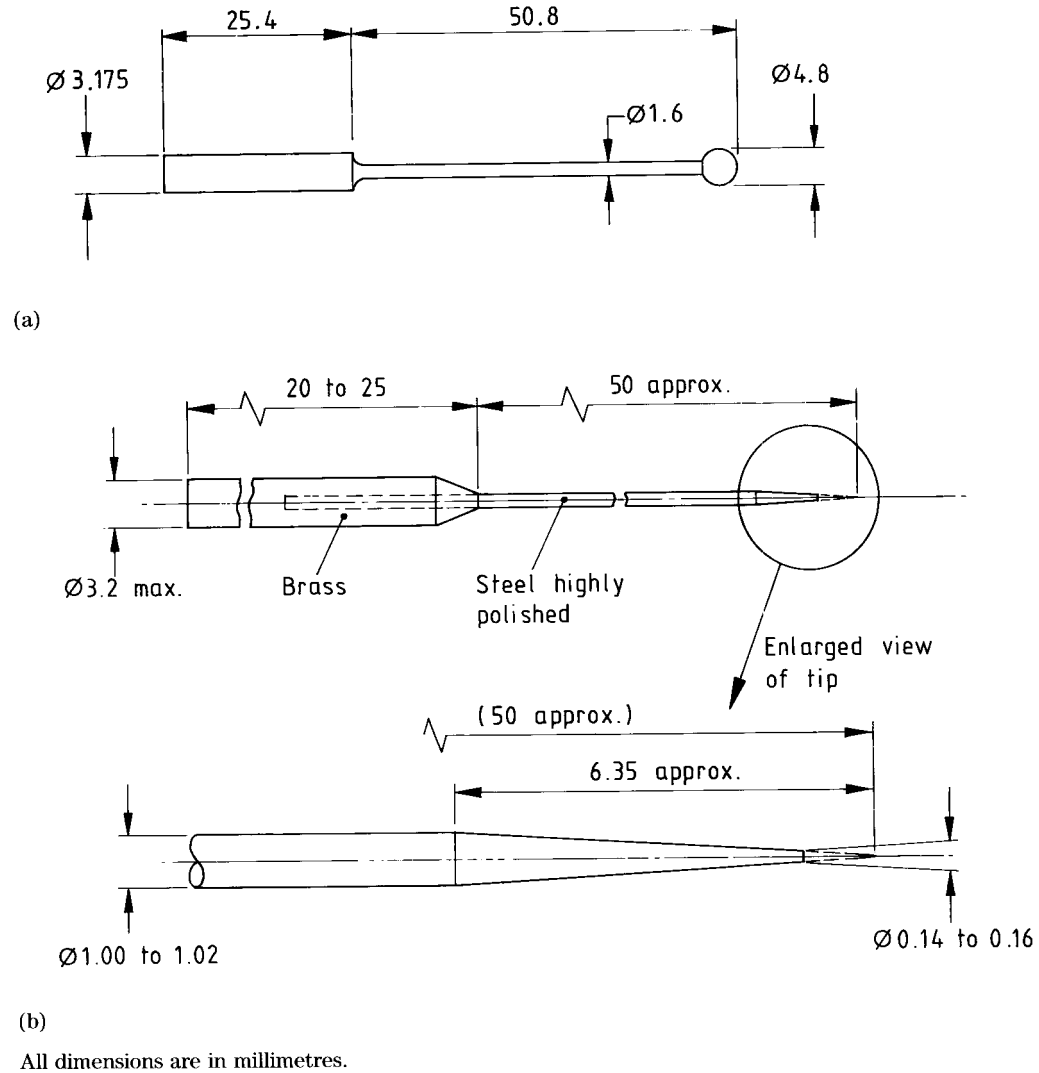



**Figure 1 — Penetration needles**

**6.2.2** *Penetration cones*

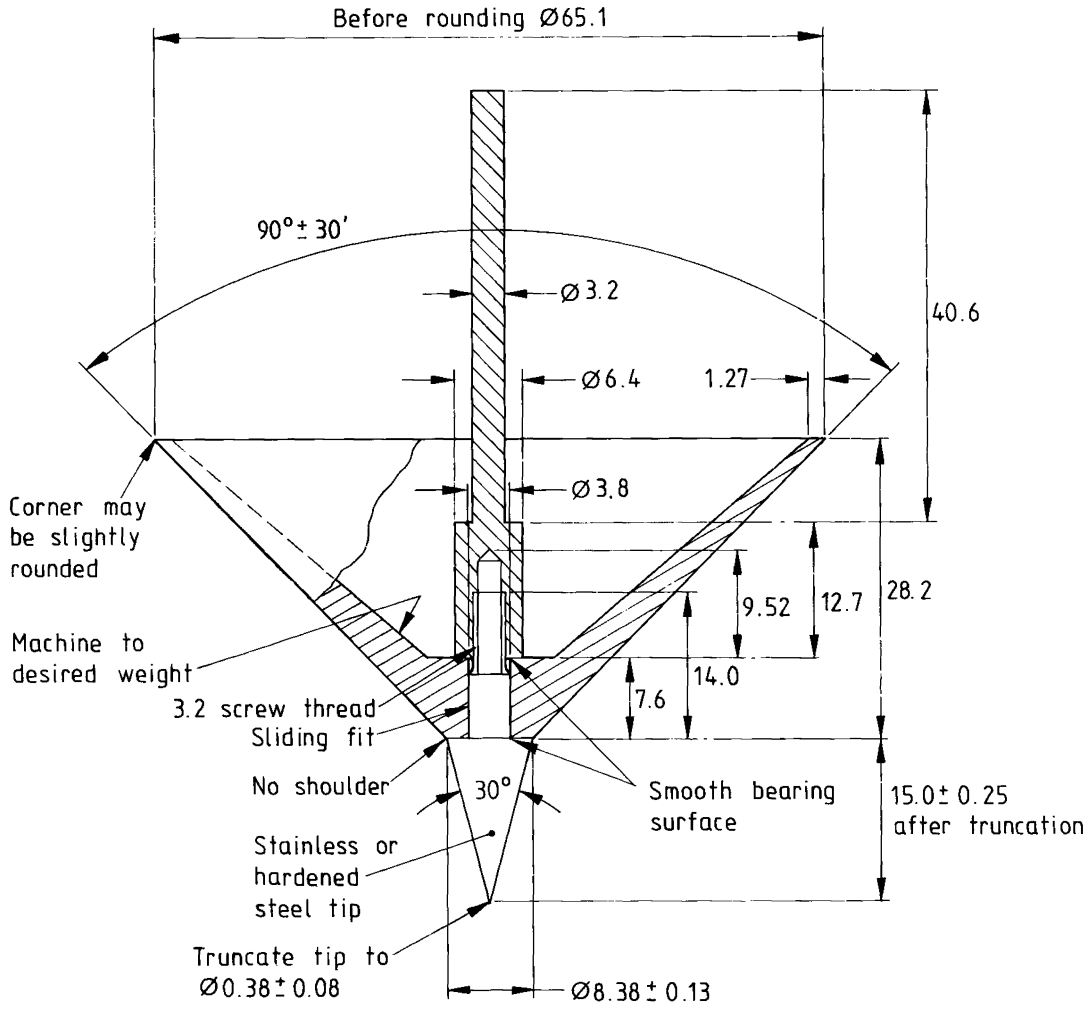
**6.2.2.1** *General*. Use one of the types of cone described in **6.2.2.2** and **6.2.2.3**.

**6.2.2.2** *Cone*, consisting of brass or corrosion resistant steel with a detachable hardened steel or stainless steel tip, of the external dimensions shown in Figure 2(a). The outside surface of the cone and tip are given a very smooth finish. The total moving mass is 150 g.

NOTE The internal construction and dimensions are intended as suggestions only and may be modified as desired.

**6.2.2.3** *Cone*, of magnesium or other suitable material with a detachable hardened steel tip, of the dimensions shown in Figure 2(b). The total mass of the cone is 102.5 ± 0.05 g and of the shaft, collet and stop rings 47.5 ± 0.05 g. The shaft is a rigid, smooth rod having a stop at its upper end and a suitable means for engaging the cone at its lower end. The outer surface is polished to a smooth finish.

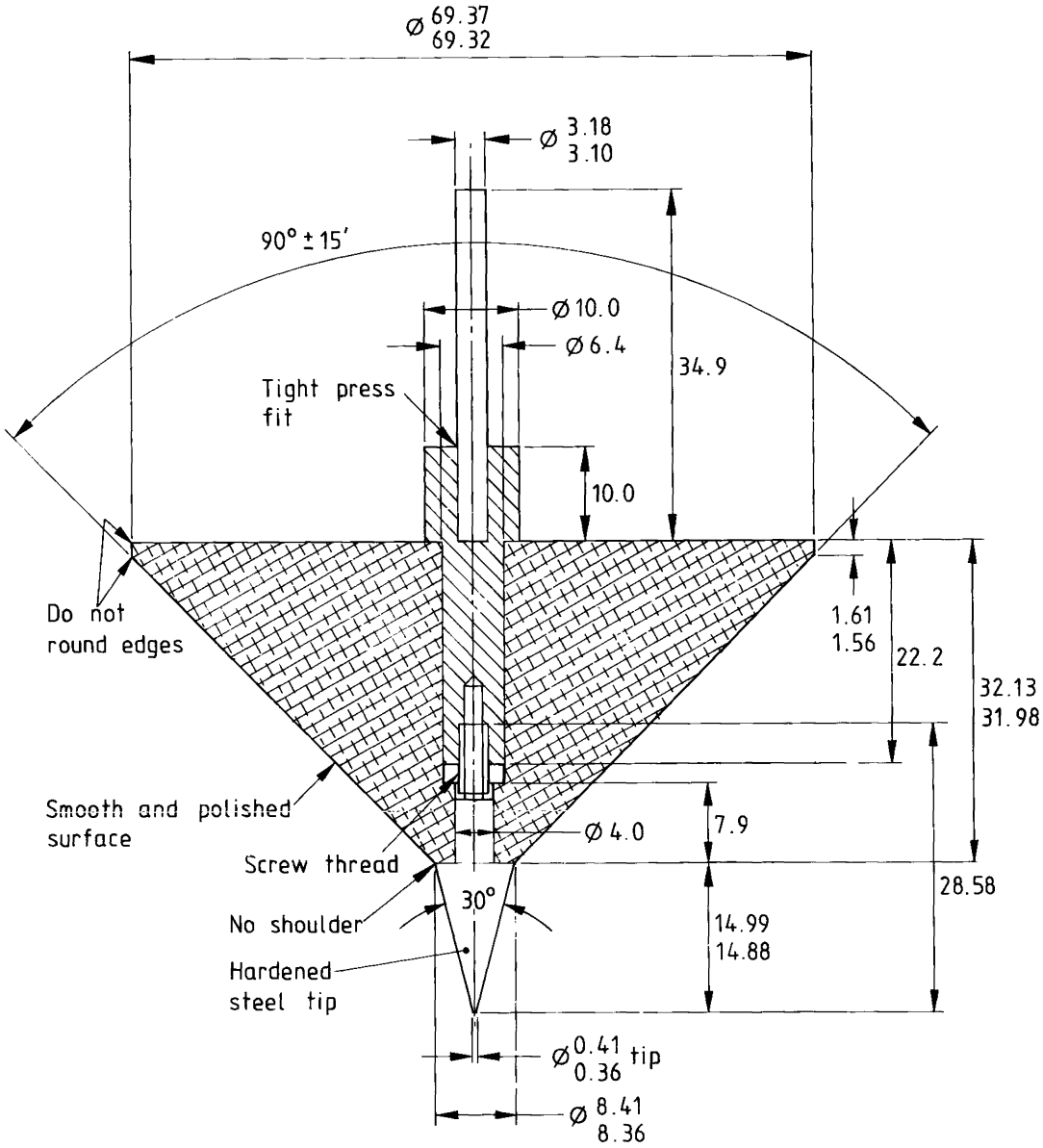
NOTE The interior construction may be modified to achieve the specified mass, provided the general contour and mass distribution are not altered.




(a)

All dimensions are in millimetres.

**Figure 2 — Penetration cones**




NOTE Tolerances on all dimensions 1.6 min.

(b)

All dimensions are in millimetres.

**Figure 2 — Penetration cones** *(concluded)*

**6.2.3** *Penetrometer*, which permits the needle holder to move vertically in the guide without appreciable friction and which is capable of indicating the depth of penetration to the nearest 0.1 mm. The sides of the guide are vertical. When used with a needle, the total moving mass (needle, holder and superimposed weight) is 50 ± 0.25 g, and is adjustable to give total moving masses such as 25 g (by removing superimposed weights), 100 g (by adding more weights), or any intermediate loading. When used with a cone, the total moving mass (cone, holder and superimposed weights) is 150 ± 0.1 g.

**6.2.4** *Constant temperature enclosure*, maintained at 25 ± 1 °C and otherwise complying with BS 2648.

**6.2.5** *Metal penetration tins*, flat bottomed, having an approximate diameter of 55 mm and an approximate internal depth of 35 mm or 60 mm, for measurements below and above penetrations of 225 tenths of a millimetre respectively, provided with lids.

**6.2.6** *Insulated containers* (for penetration tins and blocks of preformed compound) of adequate dimensions to ensure specimens are maintained at the appropriate temperature for the duration of the test, provided with a means of ensuring a firm bearing and preventing rocking of the penetration tin, or block.

**6.2.7** *Timing device*, capable of ensuring a time of penetration of 5.0 ± 0.2 s.

NOTE Where an automatic timing device is used, this should be checked periodically against some other timing device.

### 6.3 Preparation of specimens

#### 6.3.1 *Single-part sealants*

Inspect the sample for separation of components, skin formation or foreign matter. Remove any skin. Take sufficient sealant from the sample and, working it as little as possible, fill two penetration tins (**6.2.5**) taking care to avoid entrapped air and leaving a smooth level surface. Immediately after filling, place the lids firmly on the penetration tins, taking care to avoid contact with the surface of the compound.

Place one specimen in a constant temperature enclosure, maintained at 25 ± 1 °C (**6.2.4**), for at least 1½ h prior to the test.

Remove any skin on the surface of the specimen immediately prior to the test, smoothing the surface with as few strokes as possible so as to minimize disturbance of the sealant.

#### 6.3.2 *Preformed sealants*

Inspect the sample for separation of components, skin formation or foreign matter. Remove any skin. Where the sealant is preformed, mould it with as little effort as possible into two blocks at least 50 mm long by 25 mm wide by 25 mm deep.

Immediately after moulding, place the blocks in a constant temperature enclosure, maintained at 25 ± 1 °C (**6.2.4**), for at least 1½ h prior to the test.

#### 6.3.3 *Multi-part sealants*

NOTE Multi-part sealants cure and change in consistency after mixing. It is essential to carry out the penetration test on the sealant at a specified interval of time after conditioning in the constant temperature enclosure.

**6.3.3.1** Inspect the sample for separation of components, skin formation or foreign matter. Remove any skin. Take a penetration tin (**6.2.5**) and sufficient unmixed components in closed containers and place them in the constant temperature enclosure (**6.2.4**). Maintain packs containing 500 g or less at these conditions for at least 4 h and larger packs for a longer period to ensure that the entire sample achieves the controlled temperature conditions.

**6.3.3.2** After conditioning, mix the components together in accordance with the manufacturer's instructions. If possible, carry out mixing in the constant temperature enclosure; if not, place the container in an insulated container (**6.2.6**) conditioned at the same temperature, to minimize temperature change. Take each penetration tin from the enclosure and fill as rapidly as possible, taking care not to entrap air. Strike off the sealant level with the top of the tin, leaving a smooth surface. Immediately after filling, place the lid firmly on the penetration tin, taking care to avoid contact with the surface of the sealant, replace the tin in the enclosure for the specified time prior to the test.

Remove any skin on the surface of the specimen immediately prior to the test, smoothing the surface with as few strokes as possible so as to minimize disturbance of the sealant.

### 6.4 Test procedure

Examine the holder and guide on the penetrometer (**6.2.3**) to ensure that the holder will fall freely. Select a needle as described in **6.2.1** or a cone as described in **6.2.2**. Clean the needle or cone and insert into the penetrometer. Adjust the total moving mass to 50 ± 0.1 g or 150 ± 0.1 g as appropriate.

**Table 1 — Penetration determinations**

| Penetration (tenths of a millimetre) | 0 to 12 | 13 to 70 | 71 to 125 | 126 to 180 | 181 to 225 | Above 225 |
|---|---|---|---|---|---|---|
| Maximum difference between highest and lowest determinations | 2 | 3 | 4 | 5 | 6 | 3 % of lowest value |

Place the penetrometer in the constant temperature enclosure (**6.2.4**) or remove the penetration tin (**6.2.5**) or moulded block from the enclosure and place it in an insulated container (**6.2.6**) conditioned in the enclosure. Place the specimen on the table of the penetrometer and ensure a firm bearing to prevent rocking of the specimen. Lower the needle or cone slowly until the tip just makes contact with the surface of the sample.

NOTE A suitably placed light is an aid in obtaining precise adjustment of the needle to the sample surface.

Note the penetrometer dial reading or bring the pointer to zero (depending on the type of penetrometer used). Release the needle quickly and hold free for 5 ± 0.2 s. Read and record the depth of penetration in tenths of a millimetre from the scale reading. Observe the penetration tin or moulded block as the needle is applied; if any movement of the specimen is noted, ignore the determination.

Make three determinations on the sample as quickly as possible. Use a clean needle or cone for each determination. In making repeat determinations, start with the tip at least 10 mm from the edge of the penetration tin or block and at least 10 mm from any previously made hole. (If it is difficult to remove a needle from the specimen without seriously disturbing the compound, then leave the needle in the specimen.)

If the difference between the highest and lowest determination exceeds the appropriate value in Table 1, repeat the procedure. If the appropriate value is again exceeded, repeat the entire test, using another sample.

**6.5 Test report**

The report shall include the following information:

a) the type of sealant;

b) the manufacturer's batch number (if known);

c) the method of sampling;

d) whether there was any separation of components and, if so, whether the sealant could be restored to a condition suitable for use by normal agitation appropriate to the sealant and its package;

e) whether there was any skin formation;

f) the presence of any foreign matter;

g) the average penetration of the three determinations to the nearest tenth of a millimetre;

h) the temperature at which the test was carried out;

i) the type of apparatus used, e.g. needle or cone;

j) the total moving mass;

k) the time of penetration;

l) for multi-part sealants, the time between mixing and testing.

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# Publication(s) referred to

BS 2499, *Specification for hot applied joint sealants for concrete pavements*[2)].

BS 2648, *Performance requirements for electrically-heated laboratory drying ovens.*

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

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 3712-4, *Method of test for adhesion in peel.*

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

BS 5212, *Cold applied joint sealant systems for concrete pavements*[2)].

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

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

BS EN 27390, *Building construction — Jointing products — Determination of resistance to flow*[2)].

BS EN 28394, *Building construction — Jointing products — Determination of extrudability of one-component sealants*[2)].

BS EN 29046, *Building construction — Sealants — Determination of adhesion/cohesion properties at constant temperature*[2)].

BS EN 29048, *Building construction — Jointing products — Determination of extrudability of sealants using standardized apparatus*[2)].

ISO 9047, *Building construction — Sealants — Determination of adhesion/cohesion properties at variable temperatures*[2)].

[2)] Referred to in the foreword only.

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