

Hot-applied joint sealant systems for concrete pavements —

**Part 2: Code of practice for the
application and use of joint sealants**

Committees responsible for this British Standard

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Concrete Society
 County Surveyors' Society
 Federation of Civil Engineering Contractors
 Hot Extruded Sealant Association
 Institution of Civil Engineers
 Institution of Highways and Transportation
 Department of the Environment (Property Services Agency)
 Department of Transport
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 British Adhesives and Sealants Association
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Foreword

This Part of BS 2499 has been prepared under the direction of Technical Committee B/510 Road Materials. BS 2499:1973 has been revised in three Parts, namely:

- *Part 1: Specification for joint sealants;*
- *Part 2: Code of practice for the application and use of joint sealants;*
- *Part 3: Methods of test.*

BS 2499:1973 will be withdrawn when all three Parts are published.

Requirements for cold-applied joint sealants are specified in BS 5212.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, 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.

1 Scope

This Part of BS 2499 gives recommendations for the preparation of joint sealant slots and for the application and site testing of hot-applied joint sealants for use in joints in roads, airfields and other exposed concrete pavements. Although it applies mainly to new work the principles it contains apply to both new works and repairs, and recommendations for resealing are included.

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

2 Definitions

For the purposes of this Part of BS 2499, the following definitions apply.

2.1

bond breaker

a film or thin strip material applied at the base of a slot to prevent the bottom of the sealant from adhering

2.2

adhesion

when a sealant sticks to the sealant slot surfaces

2.3

ageing

the deterioration of a sealant on exposure to a specific environment

2.4

cohesion

when a sealant holds together by intermolecular attraction when subjected to tensile strain

2.5

compatibility

when a sealant remains in contact with another material without unfavourable physical or chemical interactions

2.6

expansion joint

a joint with compressible joint filler material placed full depth between pavement slabs to allow the slabs to expand and move closer together, and contract and move apart (see Figure 1)

2.7

contraction joint

a joint to allow pavement slabs to contract and move apart, and subsequently expand and move together (see Figure 2)

2.8

tied joint

a joint where differential lateral or vertical displacement between pavement slabs is restrained by a tie, but rotation can occur

2.9

construction joint

a joint between pavement slabs which have been constructed at different times where one face is cast against a construction form (see Figure 3)

2.10

longitudinal joint

a joint between the edges of pavement slabs (see Figure 3)

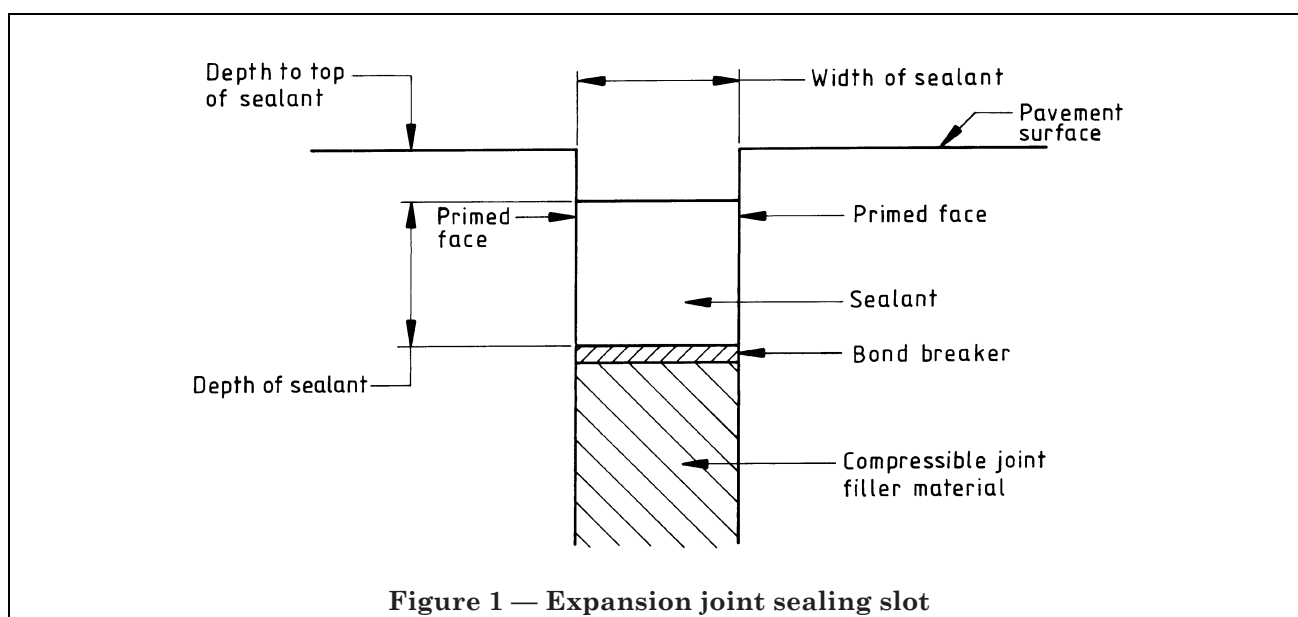


Figure 1 — Expansion joint sealing slot

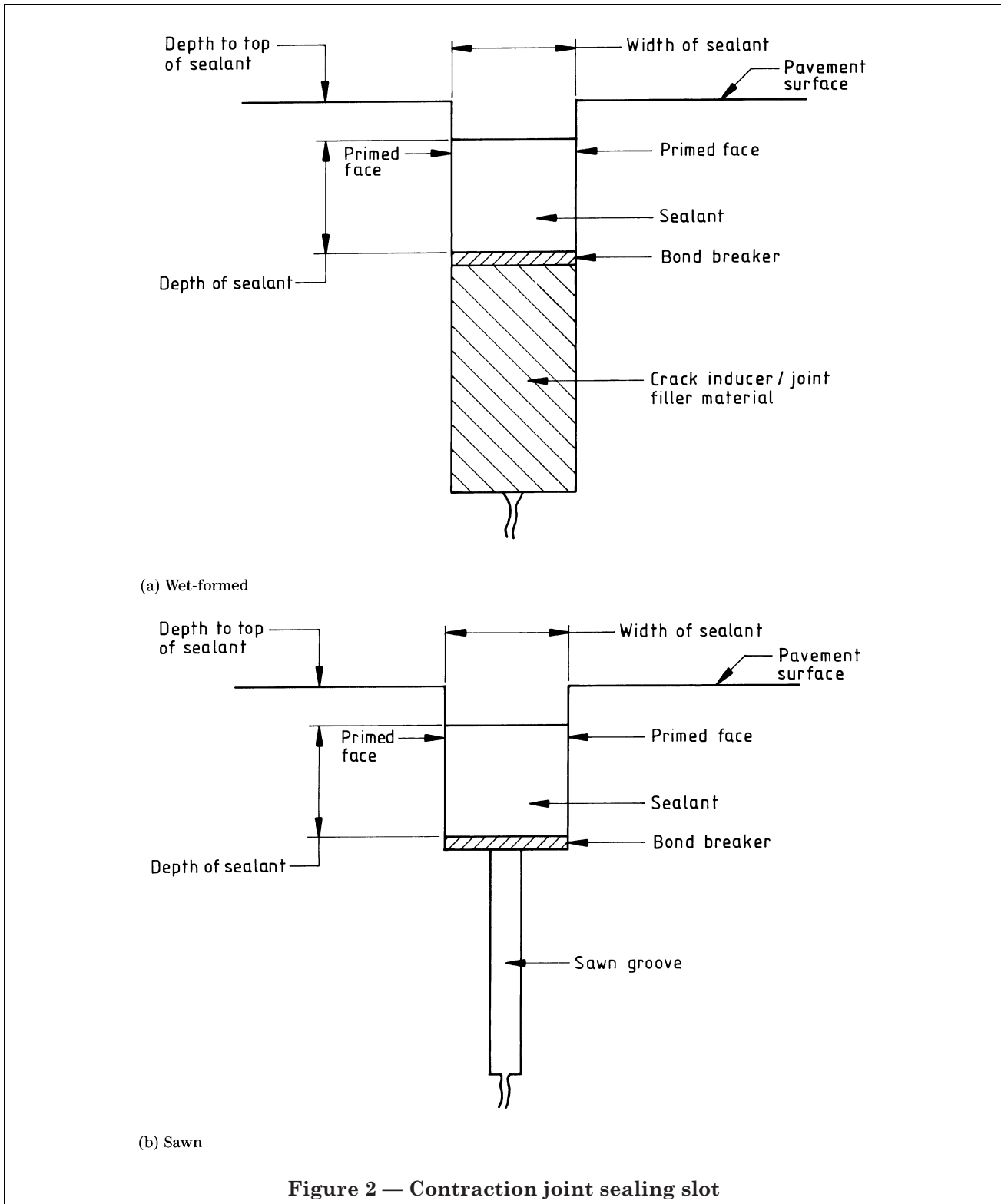


Figure 2 — Contraction joint sealing slot

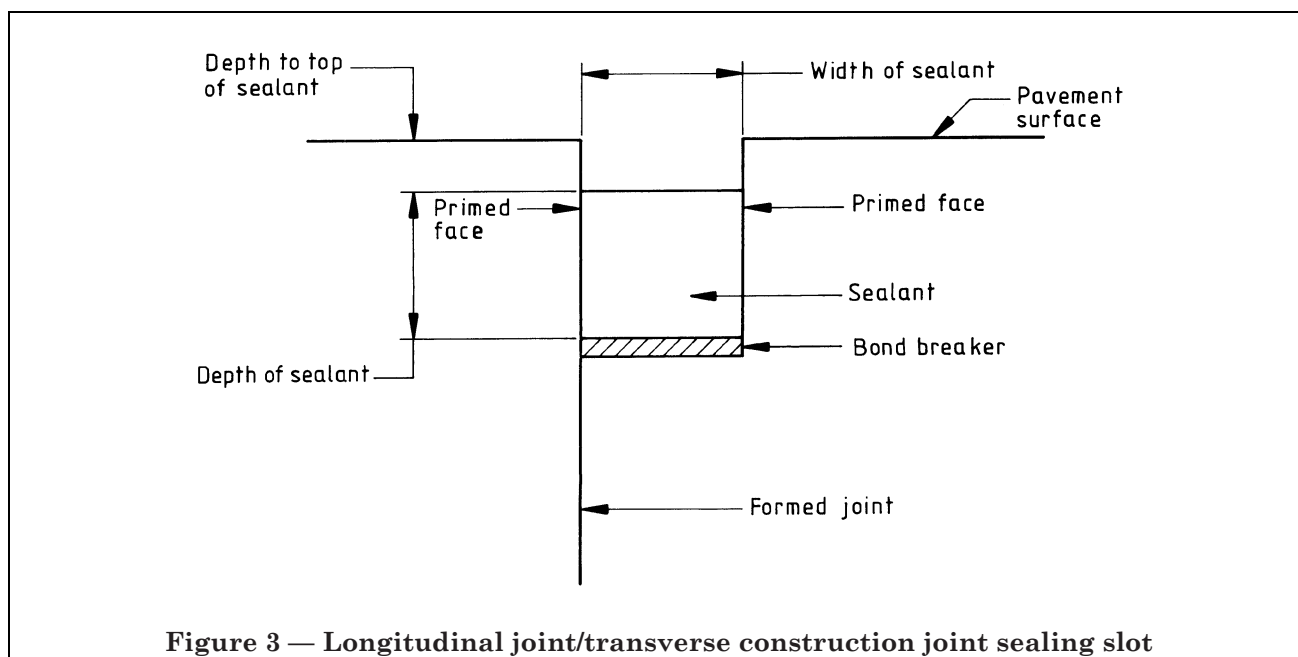


Figure 3 — Longitudinal joint/transverse construction joint sealing slot

3 Joint selection considerations

3.1 General

3.1.1 A seal is formed by applying liquid material into a sealant slot constructed at the top of a joint between concrete pavement slabs. The construction and preparation of the sealant slot is an important part of joint sealant formation, as the slot limits the dimensions and geometry of the sealant, and the joint sides are the surfaces to which the sealant will bond.

3.1.2 The dimensions and geometry of sealants used in road and airfield pavements should take account of the length of slabs between joints and whether the joint is a contraction, tied or expansion joint.

3.1.3 When the joint sealant is compressed by closure of the joint it will tend to bulge upwards since the volume of the sealant remains constant. For this reason a sealant should be applied so that its top surface is below the level of the adjacent pavement surface in order that at no time during the joint movement cycle will the sealant extrude above the top surface of the concrete pavement and be subjected to vehicular damage.

3.1.4 The bottom of the sealant should be prevented from bonding to the base of the slot so as to avoid high local stress concentrations when the joint opens or closes. For narrow joint slots which are often formed deeper than the required sealant depth, a compressible joint filler should be used in the bottom of the joint slot and with some types this filler also acts as a debonding layer. For wider slots a bond breaker tape should be used at the base, since the slot is usually formed in the concrete to the required depth.

3.2 Types of sealant

3.2.1 Sealants should comply with BS 2499-1.

3.2.2 Fuel-resistant sealants should be specified for locations where spillage or leakage is likely from parked aircraft or vehicles, or where aircraft or vehicles regularly come to a halt. Fuel resistance should be assessed against the standard test fuel specified in BS 2499-3. Should resistance to other types of spillage be required, e.g. hydraulic oil, diesel, separate assessment against the spillage should be made using the test methods described in BS 2499-3.

3.2.3 Sealants for use adjacent to asphalt surfaces should comply with the asphalt compatibility test in BS 2499-1.

3.3 Factors affecting joint movement

3.3.1 The movement to which a sealant will be subjected with given joint spacing and concrete constituents depends principally upon the following factors.

- a) The temperature range, which will equal the difference between the maximum and minimum average slab temperature that the concrete pavement will experience throughout its life. Generally, this will be related to the difference between the highest expected summer air temperature and the lowest expected winter air temperature. The temperature range adopted for the design of the joint should be based on meteorological records for the area in which the pavement is to be constructed.
- b) The ambient temperature at the time of sealing. Generally, for joints sealed in the summer, when they will be closed, the sealant will tend to be in tension for the majority of its life. Conversely, for joints sealed in the winter, when they will be open, the sealant will tend to be in compression for the majority of its life. These seasonal movements should also be taken into account when designing the joint.

3.3.2 Joints in pavements with short slabs may not all move equally and some may not move at all. This effect is dependent upon many factors, for example:

- a) variation in friction between slab and sub-base;
- b) variation in resistance to movement of dowel bars;
- c) differential temperatures between night and day during construction;
- d) gradient of pavement;
- e) shrinkage and thermal movement;
- f) position of the joint relative to the ends of the concrete pavement.

Therefore, the design and construction of the joints should seek to achieve uniformity of condition wherever possible.

3.4 Methods of formation of joint slots

3.4.1 *Wet-formed joints*

In the production of a wet-formed contraction joint, a slot should be formed in the plastic concrete at the time of construction, usually by vibrating a bar vertically into the concrete. A joint former should be inserted into the slot produced and the concrete should be recompact against the joint former to give dense concrete surfaces on either side. The former may act as a temporary sealer and should be removed with care before preparing the joints for sealant application. The joint former should be tapered to avoid spalling the concrete on removal. Often the joint former is in two sections, the top section being removable for sealing and the lower section remaining as a crack inducer.

Joint arrises may be radiused or chamfered if required.

A wet-formed construction joint occurs where a pavement slab is placed against an adjacent slab that has already hardened. The joint former should be fastened at the top of the vertical surface of the adjacent hardened slab before the slab is cast. As the joint former has been fastened to one face it cannot easily be pulled out, and should generally be removed by sawing. Where appropriate a similar slot may be produced using a vertical shutter with a joint slot former incorporated into the top edge.

3.4.2 *Sawn joints*

To produce a contraction joint, a slot should be formed in the hardened concrete using a powered disc cutter. A deep narrow saw cut should be made at each joint very soon after casting to act as a crack inducer. To form a sealed contraction joint the cut should be subsequently widened by sawing to form the sealant slot at the top of the joint. Some hard aggregates, such as flint gravel, are more difficult to saw, especially for the initial crack-inducing saw cut when the concrete strength is low and there is a risk of the aggregate plucking out.

3.5 Geometry and size of sealant

3.5.1 Width of sealant

Due to the nature of concrete construction there will be some variation in the joint slot section to be sealed. Slots may need to be widened by sawing to remove areas of unsound concrete on the faces of the joint slot, or because of misalignment of the joint former. Joints may have opened after the joint was constructed. The joint slot sides may also be tapered due to the formation process. For these reasons it is normal to specify a minimum width of joint slot only. A width of 13 mm should be regarded as a minimum value that allows sufficient space for joint slot preparation, inspection and sealant application. Normally the maximum width of joint slot used in new construction should be 30 mm.

3.5.2 Depth of sealant

The depth of sealant is shown in Figure 1, Figure 2 or Figure 3 as appropriate.

The depth of sealant is controlled by the placing of the joint filler and the level to which the sealant is poured. A depth of 20 mm should be regarded as a minimum value that will allow adequate bond to the joint slot surfaces for hot-applied sealants. A greater depth may be specified.

3.5.3 Depth to top of sealant

The depth to the top of the sealant, described in 3.1.3, needed to prevent damage to the sealant from tyres, will depend upon the width of the joint, and the use of the pavement. A depth of 5 mm measured in accordance with 6.4 is regarded as suitable for normal vehicle and aircraft traffic. For joints wider than 25 mm in roads, this value should be increased to 7 mm and to 10 mm if sealing takes place in cold weather.

4 Joint slot preparation

4.1 Joint slot formation

4.1.1 The joint slot faces should be of sound dense concrete. The joint slot should be widened if defective or contaminated concrete is encountered in the original joint slot faces.

4.1.2 The resulting joint slot faces should be plane and within 10° of the vertical. The maximum difference in width between joint slot faces at depths coinciding with the top and bottom levels of the sealant should be 2 mm. The joint slot width when measured at any point coinciding with the top level of the sealant should be not less than the minimum specified.

4.2 Joint slot surface preparation

4.2.1 Debris from the formation of the joint slot should be removed, e.g. by water-jetting. Slurry remaining after sawing concrete can harden if left to dry out and should therefore be removed as soon as possible.

4.2.2 Temporary caulking material should be inserted into joints that have been prepared but not sealed, to prevent debris from entering the induced crack or formed joint.

4.2.3 Joint slot faces to which the sealant will bond should have any laitance removed and, since they are likely to be smooth and polished, should always be roughened to provide a surface which the primer and sealant can key into. A surface with a texture resembling that of fine sandpaper is ideal.

4.2.4 The following methods of joint slot face roughening should be considered as being suitable for removing laitance and providing a roughened surface.

- a) *Dry abrasive blasting.* The abrasive dust may be a hazard where sealing joints in close proximity to aircraft or vehicles. The hazard should be avoided by the use of vacuum equipment.
- b) *Grinding.* This is often considered a suitable method of surface preparation but it can polish hard aggregates like flint gravel at the joint surfaces rather than roughen them.

In narrow slots each face should be treated separately unless special nozzles are used.

4.2.5 As final preparation for sealing and prior to priming where necessary, the joint slot should be thoroughly cleaned using oil-free compressed air at a maximum pressure of 0.5 N/mm².

4.3 Joint filler

4.3.1 A joint filler or bond breaker tape, or both, as recommended by the sealant manufacturer, should be inserted without twisting and should be firmly located so as not to become displaced before or during sealant application.

NOTE A selection of joint fillers of different dimensions may be required as the widths of joints at the time of sealing are likely to be variable.

Where bond breaker or joint filler is applied after cleaning and priming, contamination of the slot faces should be prevented.

4.3.2 The depth of the top surface of the placed joint filler should equal the required sealant depth plus the required distance between the top surface of the sealant and the adjacent pavement surface, within a tolerance of ± 2 mm.

4.3.3 The primer and sealant should be compatible with the bond breaker tape or joint filler material used.

4.4 Priming NOTE Joints sealed in accordance with this standard only need to be primed where recommended by the manufacturer.

4.4.1 The recommended primer used should be as named on the certificate, required by BS 2499-1. It should provide a visual indication of its presence.

4.4.2 Any primer should be applied to the joint faces by spray or brush as soon as possible after surface preparation. Primer should be applied carefully so that the joint surfaces are evenly coated. Pools of excess primer should be avoided, as these may be detrimental to the subsequent performance of the sealant.

4.4.3 At the time of priming, where recommended, the prepared joint slot should be clean and dry.

4.4.4 Joints should be primed when the adjacent concrete has sufficient strength. The moisture content of the concrete surface should also be considered. The moisture content at the concrete surface should be sufficiently low so that it does not detrimentally affect the bond of the primer or sealing material. It should be noted that, if the concrete has sufficient strength, the required moisture level for priming can be achieved by gentle heating by, for example, warm air.

4.4.5 When condensation occurs in the joint slots following cool nights or when the joint slots are wet due to recent rain, suitable dry conditions for priming may be achieved by the application of heat to the joint by hot compressed air or by infra-red heaters. The method used should not heat the concrete to such temperatures as would damage either the concrete or any plastic groove formers, and should not leave combustion deposits or unburnt fuel on the concrete that might adversely affect the bond of the sealant.

4.4.6 Priming should not be carried out when the naturally occurring temperature in the joint groove to be sealed is below 7 °C except on a rising temperature when it may be carried out at 5 °C and above.

4.4.7 Heating the concrete in cold weather to raise its temperature to a suitable level for priming is not recommended because the heat will quickly be lost, and at low temperature there is an increased risk of condensation in the joint slot.

4.4.8 The primed joint slot should be protected from weather, dust and any other contamination until the sealant is applied. The primed joint slot should not be heated or reheated after priming.

5 Sealant application

5.1 For primed joints the sealant should be applied to the prepared joint slot within the times stated by the sealant manufacturer for the primer used.

Where this is not possible the joint slot faces should be reprimed before sealant application in accordance with the manufacturer's instructions.

5.2 For unprimed joints the sealant should be applied to the prepared joint when it is dry and the temperature of the concrete is above the minimum specified in BS 2499-1 for the type of sealant. The concrete should remain above the minimum temperature during the cooling/hardening process to ensure an adequate adherence bond is formed.

NOTE It is unlikely that satisfactory sealing will be possible at temperatures below 4 °C.

5.3 The recommendations and advice in 4.4.4, 4.4.5, and 4.4.7 concerning priming should also be applied to sealing where no primer is used.

5.4 The sealant should be heated indirectly using temperature-controlled equipment fitted with thermometers on heating and storage vessels. The sealant should be continuously agitated to avoid local overheating throughout the heating and pouring operation. The temperature of the material should not be allowed to rise above that stated by the manufacturer nor should the material be maintained at application temperature for a longer period of time than indicated by the manufacturer.

5.5 The sealant should be heated to and maintained within the manufacturer's recommended application temperature range and should be applied into the sealing slot within this range. Regular temperature checks should be made at the nozzle. Type B1 (see Table 1 of BS 2499:1973) sealants should be applied using extruding machines which pump the material into the sealing slot.

5.6 The performance of a hot poured sealant is crucially dependent on its being heated within safe temperature ranges and period, which should be as recommended by the manufacturer and as given in BS 2499-1.

5.7 Sealants which are not permitted to be remelted should be discarded at the end of a working shift.

5.8 The sealant should be applied so that the top surface of the cooled sealant is the required distance below the surface of the adjacent pavement surface as given in 3.5.3 within a tolerance of ± 2 mm. Where the pavement surface is textured, the distance should be measured from the lowest point of the textured surface.

5.9 The minimum depth of the sealant should be not less than the depth recommended in 3.5.2 and measured in accordance with 6.4.

5.10 The sealant, until solidified, should be protected from damage caused by weather, dust and any other contamination. When necessary, the sealant may be trafficked at the end of the cooling period but guidance should be obtained from the manufacturer.

5.11 Where the crossfall is steeper than 2.5 %, e.g. on superelevated road pavements, measures should be taken to prevent the sealant flowing along the joint. Flow is also likely to occur with joints wider than 20 mm. Methods of application in these conditions should include one or more of the following.

- a) Placing material in thin layers and allowing each layer to stiffen before placing the next layer. Care is required to protect the surface and ensure the layers bond to each other and the primed joint faces. Each joint should be completed within one working shift.
- b) Forming dams at intervals along the joint to restrict the flow. The dams should be cut out and replaced with sealant.

6 Site testing

6.1 Samples of the sealant components may be taken by the purchaser at any time and should comply with BS 2499-1.

6.2 Where required by the purchaser, samples of liquid sealant should be taken at the point of application to check that the components have been combined correctly. The sample rate should generally be not less than one per 1 000 m of joint, or not less than one per day. Samples should be taken and tested in accordance with BS 2499-1.

6.3 Samples of applied sealant should be cut from joints to check that the sealant has been applied correctly in accordance with Appendix A. Joints should be sampled at a rate of not less than one per 1 000 m of joint, or not less than one per day's run of sealing. The void formed by sampling should be refilled with the same product as the material sampled.

6.4 Depth measurements should be taken to the top surface of the installed bond breaker or joint filler, and the top surface of the sealant. Measurements should be taken at three locations along a transverse joint, or at 1 m spacing. The locations should be marked so that measurements before and after sealant application are taken at the same position. The rate should be not less than one every 10 transverse joints, or every 50 m. The depth should be measured mid-width of the joint to an accuracy of ± 0.5 mm using a metal ruler and a 150 mm straightedge placed centrally across the joint and perpendicular to it.

7 Resealing

7.1 The manufacturer's recommendation should be followed regarding the installation of the new sealant system.

7.2 The old sealant should be removed and surfaces repaired to the conditions recommended in 4.2.

7.3 Where it is apparent that the degree of movement in a joint has been sufficient to overstress the existing sealant, the joint slot width should, if appropriate, be increased so as to reduce the strain in the replacement sealant. It may also be necessary to increase the depth of the slot (see 3.5).

7.4 The joint should be resealed as recommended in clause 5.

Appendix A Method of sampling sealant from joints

Three samples of sealant should be cut from a transverse joint, or at 1 mm spacing. Samples should be taken not less than 300 mm from the ends of joints. A thin sharp-bladed knife should be used to cut along the sides and across the width of the joint. Cutting and removal should be carried out carefully so as not to deform the sealant. Samples should be nominally 75 mm long.

Publication(s) referred to

BS 2499, *Hot applied joint sealant systems for concrete pavements*.

BS 2499-1, *Specification for joint sealants*¹⁾.

BS 2499-3, *Methods of test*¹⁾.

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

¹⁾ In preparation.

²⁾ Mentioned in the foreword only.

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