

BS 594987:2015+A1:2017



BSI Standards Publication

**Asphalt for roads and other paved  
areas — Specification for transport,  
laying, compaction and product type  
testing protocols**

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# Foreword

## Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 March 2015. It was prepared by Subcommittee B/510/1, *Asphalt products*, under the authority of Technical Committee B/510, *Road materials*. A list of organizations represented on these committees can be obtained on request to their secretary.

## Supersession

BS 594987:2015 superseded BS 594987:2010, which has been withdrawn.

BS 594987:2015+A1:2017 supersedes BS 594987:2015, which is withdrawn.

## Relationship with other publications

BS 594987:2015 was published concurrently with PD 6691:2015 as the two documents were revised and cross referenced each other.

## Information about this document

BS 594987:2015 took into account the change from the Construction Products Directive to the Construction Products Regulation [1] and that CE marking in the UK is now mandatory.

It also clarified errors and anomalies in the previous version and removed references to previous British standards which had been superseded by the European standards.

Text introduced or altered by Amendment No. 1 is indicated in the text by tags **A1** **A1**. Minor editorial corrections are not tagged.

This British Standard specifies requirements for transporting asphalt mixtures, for preparatory site work and for laying and compacting asphalt mixtures, including the covering of concrete and sett paving. Annexes contain protocols to be used for initial product-type testing of asphalt materials in accordance with BS EN 13108-20.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

[Annex A](#) gives recommendations for delivery and rolling temperatures. [Annex B](#) provides indicative rates of spread for average mixture types. [Annex C](#), [Annex D](#), [Annex E](#), [Annex F](#) and [Annex G](#) give recommendations on protocols for the initial product-type testing of asphalt materials in accordance with BS EN 13108-20; in particular, guidance is given on sampling by coring, assessing for target composition, voids, compaction and deformation resistance. [Annex H](#) provides recommendations for a mixture design that determines the design binder content of hot rolled asphalt surface course mixtures. [Annex I](#) provides advice on the calibration procedure for indirect density gauges. [Annex J](#) provides advice on the use of tack coats. [Annex K](#) gives a method for determining the maximum binder content that porous asphalt and other asphalt can carry without excessive binder drainage during transportation and subsequent laying. [Annex L](#) provides guidance on the design of BBA mixtures for airfield pavements.

## Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

Requirements in this standard are drafted in accordance with *Rules for the structure and drafting of UK standards*, subclause **G.1.1**, which states, “Requirements should be expressed using wording such as: ‘When tested as described in [Annex A](#), the product shall ...’”. This means that only those products that are capable of passing the specified test shall conform to this standard.

### **Contractual and legal considerations**

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard cannot confer immunity from legal obligations.**



## 1 Scope

This British Standard specifies requirements for the transport, laying and compaction of asphalt mixtures conforming to BS EN 13108-1, BS EN 13108-4 and BS EN 13108-5, and described in PD 6691, from the time that they leave the mixing plant until they are placed on the road ready to receive a superimposed layer or traffic. It also includes requirements for preliminary work at the laying site needed to ensure that the substrate is fit to receive the asphalt and for the application of bond coats.

Although this standard does not contain explicit requirements for asphalt materials covered in other parts of BS EN 13108 or other proprietary asphalt mixtures, the general requirements of this standard can be applied to those mixtures, in addition to special requirements for particular mixtures specified in individual quality plans and/or method statements.

*NOTE 1 The term “asphalt” used in this standard is the generic term used to describe the wide range of mixtures of aggregate and bituminous binder individually known as asphalt concrete (AC), hot rolled asphalt (HRA), stone mastic asphalt (SMA), porous asphalt (PA) or mastic asphalt and other proprietary materials which are available for use in constructing and maintaining roads and other paved areas that are on the market in the UK.*

*NOTE 2 Methods for ensuring that the correct surface drainage characteristics are imparted to pavements with PA surface course are outside the scope of this British Standard.*

*NOTE 3 BS EN 13108-20 specifies tests for determining the conformity of a mix to any of the other parts of BS EN 13108. This is similar to a mix design validation or job mix trial. BS EN 13108-20 offers some choice in the way in which specimens are to be prepared for the purposes of product-type testing. Requirements for sample preparation for the demonstration of product-type test properties are given in PD 6691:2015, Clause 13 and are linked to the relevant protocols/annexes in this British Standard, as relevant.*

In the case of HRA, a mixture design protocol is provided as informative text in [Annex H](#), and requirements are specified for providing a rough-textured surface on the surface course to provide skid-resistance.

This standard does not specify requirements for asphalt incorporating bitumen emulsion binders.

This standard does not cover additional or specific requirements relating to the laying and compaction of reduced temperature asphalts.

*NOTE 4 BS EN 13108 is being reviewed and it is anticipated that any revisions might cover low-temperature and cold mixtures.*

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 598-1:2011, *Sampling and examination of bituminous mixtures for roads and other paved areas – Part 1: Methods for the measurement of the rate of spread of coated chippings and the temperature of bituminous mixtures using non-contact temperature-measuring devices and for the assessment of the compaction performance of a roller*

BS 1707, *Specification for hot binder distributors for road surface dressing*

BS 2000-223, *Methods of test for petroleum and its products – Part 223: Determination of ash of petroleum products containing mineral matter*

BS EN 932-1, *Tests for general properties of aggregates – Part 1: Methods for sampling*

- BS EN 932-2, *Tests for general properties of aggregates – Part 2: Methods for reducing laboratory samples*
- BS EN 933-1, *Tests for geometrical properties of aggregates – Part 1: Determination of particle size distribution – Sieving method*
- BS EN 1426, BS 2000-49, *Bitumen and bituminous binders – Determination of needle penetration*
- BS EN 1427, BS 2000-58, *Bitumen and bituminous binders – Determination of softening point – Ring and ball method*
- BS EN 12272-1, *Surface dressing – Test methods – Part 1: Rate of spread and accuracy of spread of binder and chippings*
- BS EN 12697-1, *Bituminous mixtures – Test methods for hot mix asphalt – Part 1: Soluble binder content*
- BS EN 12697-2, *Bituminous mixtures – Test methods for hot mix asphalt – Part 2: Determination of particle size distribution*
- BS EN 12697-5:2009, *Bituminous mixtures – Test methods for hot mix asphalt – Part 5: Determination of the maximum density*
- BS EN 12697-6:2012, *Bituminous mixtures – Test methods for hot mix asphalt – Part 6: Determination of bulk density of bituminous specimens*
- BS EN 12697-8, *Bituminous mixtures – Test methods for hot mix asphalt – Part 8: Determination of void characteristics of bituminous specimens*
- BS EN 12697-13, *Bituminous mixtures – Test methods for hot mix asphalt – Part 13: Temperature measurement*
- BS EN 12697-22:2003, *Bituminous mixtures – Test methods for hot mix asphalt – Part 22: Wheel tracking*
- BS EN 12697-25:2005, *Bituminous mixtures – Test methods for hot mix asphalt – Part 25: Cyclic compression test*
- BS EN 12697-26, *Bituminous mixtures – Test methods for hot mix asphalt – Part 26: Stiffness*
- BS EN 12697-27:2001, *Bituminous mixtures – Test methods for hot mix asphalt – Part 27: Sampling*
- BS EN 12697-30, *Bituminous mixtures – Test methods for hot mix asphalt – Part 30: Specimen preparation by impact compactor*
- BS EN 12697-32, *Bituminous mixtures – Test methods for hot mix asphalt – Part 32: Laboratory compaction of bituminous mixtures by vibratory compactor*
- BS EN 12697-34, *Bituminous mixtures – Test methods for hot mix asphalt – Part 34: Marshall test*
- BS EN 12697-35, *Bituminous mixtures – Test methods for hot mix asphalt – Part 35: Laboratory mixing*
- BS EN 13036-1, *Road and airfield surface characteristics – Test methods – Part 1: Measurement of pavement surface macrotexture depth using a volumetric patch technique*
- BS EN 13036-7, *Road and airfield surface characteristics – Test methods – Part 7: Irregularity measurement of pavement courses – The straightedge test*
- BS EN 13108 (all parts)<sup>1</sup>
- BS EN 13588, BS 2000-522, *Bitumen and bituminous binders – Determination of cohesion of bituminous binders with pendulum test*

<sup>1</sup> Dated references are made to BS EN 13108-4:2006, *Bituminous mixtures – Material specifications – Part 4: Hot rolled asphalt*; BS EN 13108-20:2006, *Bituminous mixtures – Material specifications – Part 20: Type testing*; and BS EN 13108-21:2006, *Bituminous mixtures – Material specifications – Part 21: Factory*.

BS EN 13808:2013, *Bitumen and bituminous binders – Framework for specifying cationic bituminous emulsions*

BS EN 14023, *Bitumen and bituminous binders – Specification framework for polymer modified bitumens*

BS EN 15322, *Bitumen and bituminous binders – Framework for specifying cut-back and fluxed bituminous binders*

BS EN ISO 3838, BS 2000-189/190, *Methods of test for petroleum and its products – Crude petroleum and liquid or solid petroleum products – Determination of density or relative density – Capillary-stoppered pyknometer and graduated bicapillary pyknometer methods*

PD 6691:2015, *Guidance on the use of BS EN 13108 Bituminous mixtures – Material specifications*

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### 3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS EN 13108 and the following apply.

#### 3.1 bond coat

proprietary polymer modified bituminous binder used to promote adhesion between and/or sealing of layers in the construction and maintenance of roads and paved areas

*NOTE 1 Bond coats are polymer modified binders classified in accordance with BS EN 13808, BS EN 15322 or BS EN 14023. Bond coats are generally cationic polymer modified bituminous emulsions such as C50BP3 or C65BP3, although other types are sometimes needed for particular purposes and the supplier should be consulted.*

*NOTE 2 Bonding and sealing between and around asphalt layers is essential to keep water out and enhance the durability of the road pavement.*

#### 3.2 tack coat

unmodified bitumen emulsion used to facilitate adhesion between layers in the construction and maintenance of roads and paved areas

*NOTE Although tack coats have traditionally been used, they are no longer regarded as best practice.*

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### 4 Transport and delivery

#### 4.1 Transport

Loading of asphalt shall be carried out such that segregation is minimized, which shall be identified from visual examination.

Asphalt shall be transported to the laying site in insulated and sheeted vehicles to minimize temperature loss and protect against adverse weather conditions.

When using release agents to facilitate discharge of the asphalt, substances that are likely to cause softening or damage to the asphalt (e.g. diesel oil or kerosene) shall not be used.

*NOTE 1 Sealing grit, sand, soap solution, water or a proprietary release agent may be used on the floor and/or other surfaces of the vehicle to facilitate discharge of the asphalt. The amount used should be kept to a minimum.*

*NOTE 2 In the case of PA, only soap solution, water or a proprietary release agent should be used.*

When transporting more than one material in the same vehicle, measures shall be taken to avoid cross-contamination.

*NOTE 3 [Annex K](#) provides a method for determining the maximum binder content that PA and other asphalt can carry without excessive binder drainage during storage, transportation and laying.*

## 4.2 Delivery to the site

Deliveries of asphalt to the site shall be planned to avoid the interruption of the laying process.

Asphalt shall be delivered at a temperature that allows it to be compacted in accordance with [Clause 9](#).

*NOTE For delivery temperatures, see [Annex A](#) for further guidance. Minimum delivery temperatures, taken within 30 min after arrival on site, should ensure adequate time is available for compaction. However, other temperatures might be specified to suit specific site conditions and mixtures. Temperatures should be measured in accordance with BS EN 12697-13.*

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## 5 Preparatory works at the laying site

### 5.1 General

Where asphalt is to be laid, the surfaces shall be free from loose materials and foreign matter, e.g. mud, slurry or other deleterious material. Prior to commencement of laying, the underlying course shall be prepared to produce a stable surface of appropriate profile on which the asphalt can be placed.

*NOTE 1 The surface on which the asphalt is to be laid should be of adequate strength to bear the equipment and compactive effort to be used in the laying of the asphalt. Some form of permanent lateral support should be given to the layers of asphalt, to minimize the risk of damage at unconfined edges, and also to optimize their compaction.*

*NOTE 2 Trafficking prior to completion of the surface course should, as far as possible, be restricted to plant and equipment used for laying and compaction of the asphalt.*

### 5.2 Surface level tolerances

The sum of the deviations in the level of different pavement layers shall not result in a reduction of the nominal target surface course thickness of more than 12.5% from that specified in the design for the works.

For contracts not covered by the *Manual of Contract Documents for Highway Works – Volume 1* [2] the permitted deviation of the level of the finished surface, at any point on the pavement layer from the true surface level, shall not be greater than the following values:

- a) sub-base to receive base:  $\begin{smallmatrix} +10 \\ -30 \end{smallmatrix}$  mm;
- b) base to receive surface course:  $\pm 8$  mm;
- c) base to receive binder course:  $\pm 15$  mm;
- d) binder course to receive surface course on roads:  $\pm 6$  mm; and
- e) binder course to receive surface course on areas other than roads, e.g. car parks and playgrounds:  $\pm 10$  mm.

### 5.3 Resurfacing

#### 5.3.1 Existing surface and maximum permitted depressions

An existing surface shall only be used as a base or binder course where the maximum depression under a 3 m straight edge placed longitudinally or under a template placed transversely does not exceed:

- a) 25 mm when the resurfacing is to consist of two-course work; or
- b) 13 mm when the resurfacing is to be a single surface course.

If improvement of the surface is required, it shall be carried out by planing and/or by the addition of a regulating course.

*NOTE 1 Prior to the laying of the new asphalt, all weak areas to be surfaced should be strengthened, major inequalities of profile remedied, and depressions filled and thoroughly compacted.*

*NOTE 2 Every effort should be made to prevent or to remove water ponding on the receiving course for the newly laid asphalt.*

### 5.3.2 Existing surface and excess free binder

If the existing surface exhibits excess free binder, the excess shall be removed by planing, milling or other suitable methods.

*NOTE Methods other than planing or milling should be agreed with the specifier.*

### 5.3.3 Overlaying existing concrete pavements

Where asphalt is to be laid on existing concrete pavements with defective joints, in addition to the measures specified in [5.3.1](#) and [5.3.2](#), the joints shall be made good by cleaning out and refilling with a joint-filling material. This material shall be compacted flush with the surface. The jointing material used shall not be adversely affected by, or itself adversely affect, the surfacing.

*NOTE A bespoke design using non-standard materials and treatments should be used to delay the appearance of reflective cracking when overlaying concrete with asphalt. The details of this are outside the scope of this standard.*

### 5.3.4 Overlaying existing sett paving

When overlaying existing sett paving, the following special measures shall be taken in addition to those specified in [5.3.1](#) and [5.3.2](#).

- a) All loose and weak areas of sett paving shall be removed and replaced with an equivalent thickness of either binder course or cement concrete.
- b) Excessive bitumen or pitch used to grout the sett joints shall be removed.
- c) To ensure the best possible key, all joints shall be cleaned of foreign matter to a depth of at least 15 mm.
- d) Bond coat shall be applied in accordance with [5.5](#) or a surface dressing applied.

*NOTE Where necessary, the bitumen emulsion can be covered with 2.8/6 mm chippings at approximately 6 kg/m<sup>2</sup>.*

## 5.4 Adjustment or regulation of levels

When regulating the levels of the base or underlying surface, whether to provide super-elevation or for any other purpose, binder course mixtures of appropriate nominal aggregate size conforming to BS EN 13108-1, BS EN 13108-4 or BS EN 13108-5 shall be used. Layer thicknesses shall be in accordance with [Table 1A](#) to [Table 1D](#), as applicable.

*NOTE 1 Further guidance can be found in PD 6691.*

*NOTE 2 For layer thicknesses greater than 100 mm, base mixtures may be used.*

*NOTE 3 If the total thickness of the regulating course is less than 40 mm, the use of regulating course HRA conforming to BS EN 13108-4 or SMA of appropriate aggregate size conforming to BS EN 13108-5 is recommended following the guidance provided by PD 6691.*

*NOTE 4 Materials shown in bold in [Table 1A](#) to [Table 1D](#) are preferred mixtures.*

**Table 1A** — Nominal target and minimum compacted layer thicknesses for asphalt concrete (AC) mixtures conforming to BS EN 13108-1 (see PD 6691:2015, Annex B)

| Material description                                    | PD 6691 reference               | Size      | Nominal target layer thickness | Minimum compacted thickness at any point |
|---------------------------------------------------------|---------------------------------|-----------|--------------------------------|------------------------------------------|
|                                                         |                                 | mm        | mm                             | mm                                       |
| Fine graded surface course                              | AC 4 fine surf                  | 4         | 15–25                          | 10                                       |
| <b>Medium graded surface course</b>                     | <b>AC 6 med surf</b>            | <b>6</b>  | <b>20–25</b>                   | <b>15</b>                                |
| <b>Dense surface course</b>                             | <b>AC 6 dense surf</b>          | <b>6</b>  | <b>20–30</b>                   | <b>15</b>                                |
| Open graded surface course                              | AC 10 open surf                 | 10        | 30–35                          | 25                                       |
| <b>Close graded surface course</b>                      | <b>AC 10 close surf</b>         | <b>10</b> | <b>30–40</b>                   | <b>25</b>                                |
| Open graded surface course                              | AC 14 open surf                 | 14        | 35–55                          | 30                                       |
| <b>Close graded surface course</b>                      | <b>AC 14 close surf</b>         | <b>14</b> | <b>40–55</b>                   | <b>35</b>                                |
| Open graded binder course                               | AC 20 open bin                  | 20        | 45–75                          | 40                                       |
| <b>Dense, heavy-duty and high-modulus binder course</b> | <b>AC 20 dense/HDM/HMB bin</b>  | <b>20</b> | <b>50–100</b>                  | <b>40</b>                                |
| Dense, heavy-duty and high-modulus binder course        | AC 32 dense/HDM/HMB bin         | 32        | 70–150                         | 55                                       |
| <b>Dense, heavy-duty and high-modulus base</b>          | <b>AC 32 dense/HDM/HMB base</b> | <b>32</b> | <b>70–150</b>                  | <b>55</b>                                |
| EME 2                                                   | AC 10 EME2 base/bin             | 10        | 60–100                         | 50                                       |
| EME 2                                                   | AC 14 EME2 base/bin             | 14        | 70–130                         | 60                                       |
| EME 2                                                   | AC 20 EME2 base/bin             | 20        | 90–150                         | 80                                       |

<sup>A1</sup> NOTE Nominal target and minimum compacted layer thicknesses for BBA materials for airfields are not included in Table 1A. <sup>A1</sup>

**Table 1B** — Nominal target and minimum compacted layer thicknesses for HRA mixtures conforming to BS EN 13108-4 (see PD 6691:2015, Annex C)

| Material description                   | PD 6691 reference         | Size      | Nominal target layer thickness | Minimum compacted thickness at any point |
|----------------------------------------|---------------------------|-----------|--------------------------------|------------------------------------------|
|                                        |                           | mm        | mm                             | mm                                       |
| HRA regulating and binder 50/10        | HRA 50/10 reg/bin         | 10        | 25–50                          | 20                                       |
| <b>HRA regulating and binder 50/14</b> | <b>HRA 50/14 reg/bin</b>  | <b>14</b> | <b>35–65</b>                   | <b>30</b>                                |
| HRA base and binder 50/20              | HRA 50/20 bin/base        | 20        | 45–80                          | 40                                       |
| HRA base and binder 60/20              | HRA 60/20 bin/base        | 20        | 45–80                          | 40                                       |
| <b>HRA base and binder 60/32</b>       | <b>HRA 60/32 bin/base</b> | <b>32</b> | <b>60–150</b>                  | <b>55</b>                                |
| <b>HRA surface course type F 0/2</b>   | <b>HRA 0/2 F surf</b>     | <b>2</b>  | <b>25</b>                      | <b>20</b>                                |
| <b>HRA surface course type F 15/10</b> | <b>HRA 15/10 F surf</b>   | <b>10</b> | <b>30</b>                      | <b>25</b>                                |
| HRA surface course type F 30/10        | HRA 30/10 F surf          | 10        | 35                             | 30                                       |
| HRA surface course type F 55/10        | HRA 55/10 F surf          | 10        | 40                             | 35                                       |
| <b>HRA surface course type F 30/14</b> | <b>HRA 30/14 F surf</b>   | <b>14</b> | <b>40</b>                      | <b>35</b>                                |

<sup>A1</sup> In favourable conditions, HRA surface course Type C 35/14 and Type F 35/14 may also be laid at a nominal target layer thickness of 45 mm with a minimum compacted thickness at any point of 40 mm. Further guidance can be found in Transport and Road Research Laboratory Research Report 4 [3].

**Table 1B** (continued)

| Material description                                 | PD 6691 reference       | Size      | Nominal target layer thickness | Minimum compacted thickness at any point |
|------------------------------------------------------|-------------------------|-----------|--------------------------------|------------------------------------------|
|                                                      |                         | mm        | mm                             | mm                                       |
| <b>HRA surface course type F 35/14</b> <sup>A)</sup> | <b>HRA 35/14 F surf</b> | <b>14</b> | <b>45–50</b>                   | <b>40</b>                                |
| HRA surface course type F 55/14                      | HRA 55/14 F surf        | 14        | 45                             | 40                                       |
| HRA surface course type C 0/2                        | HRA 0/2 C surf          | 2         | 25                             | 20                                       |
| HRA surface course type C 55/10                      | HRA 55/10 C surf        | 10        | 40                             | 35                                       |
| <b>HRA surface course type C 30/14</b>               | <b>HRA 30/14 C surf</b> | <b>14</b> | <b>40</b>                      | <b>35</b>                                |
| <b>HRA surface course type C 35/14</b> <sup>A)</sup> | <b>HRA 35/14 C surf</b> | <b>14</b> | <b>50</b>                      | <b>45</b>                                |
| HRA surface course type C 55/14                      | HRA 55/14 C surf        | 14        | 45                             | 40                                       |

<sup>A)</sup> In favourable conditions, HRA surface course Type C 35/14 and Type F 35/14 may also be laid at a nominal target layer thickness of 45 mm with a minimum compacted thickness at any point of 40 mm. Further guidance can be found in Transport and Road Research Laboratory Research Report 4 [3].

**Table 1C** — Nominal target and minimum compacted layer thicknesses for SMA surface course mixtures conforming to BS EN 13108-5 (see PD 6691:2015, [Annex D](#))

| Material description | PD 6691 reference | Size | Nominal target layer thickness | Minimum compacted thickness at any point |
|----------------------|-------------------|------|--------------------------------|------------------------------------------|
|                      |                   | mm   | mm                             | mm                                       |
| SMA 6                | SMA 6 surf        | 6    | 20–40                          | 15                                       |
| SMA 10               | SMA 10 surf       | 10   | 25–50                          | 20                                       |
| SMA 14               | SMA 14 surf       | 14   | 35–50                          | 30                                       |

**Table 1D** — Nominal target and minimum compacted layer thicknesses for other SMA mixtures conforming to BS EN 13108-5 (see PD 6691:2015, [Annex D](#))

| Material description | PD 6691 reference   | Size | Nominal target layer thickness | Minimum compacted thickness at any point |
|----------------------|---------------------|------|--------------------------------|------------------------------------------|
|                      |                     | mm   | mm                             | mm                                       |
| SMA 6                | SMA 6 reg           | 6    | 15–40                          | 10                                       |
| SMA 10               | SMA 10 reg          | 10   | 20–50                          | 15                                       |
| SMA 14               | SMA 14 bin/reg      | 14   | 30–60                          | 25                                       |
| SMA 20               | SMA 20 bin/base/reg | 20   | 50–100                         | 40                                       |

## 5.5 Application of bond coats

### 5.5.1 General

A bond coat shall be applied prior to the laying of a new asphalt layer on any bound substrate. Bond coats conforming to BS EN 13808, BS EN 15322 or BS EN 14023 having a minimum peak cohesion value of 1.0 J/cm<sup>2</sup> by pendulum test in accordance with BS EN 13588 shall be applied in accordance with [5.5.2](#).

*NOTE 1 The enhanced adhesive and cohesive properties of bond coats are designed to provide greater confidence in the adhesion between layers, or to allow heavier rates of application to improve the impermeability of the surface of the lower layer, when compared with conventional bitumen emulsion tack coats. Although tack coats*

have traditionally been used, they are no longer regarded as best practice. For specifiers who wish to use tack coats, information and guidance is given in [Annex J](#).

**NOTE 2** Hot applied polymer modified bituminous binders conforming to BS EN 15322 or BS EN 14023 with equivalent performance may also be used.

**NOTE 3** Higher levels of cohesion for bond coats might be beneficial depending on the surface course thickness, the traffic stress and substrate type.

**A1** For application to planed or milled asphalt, the minimum target rate of spread for bond coats shall provide not less than 0.35 kg/m<sup>2</sup> of residual binder.

For application to newly laid asphalt or overlaying existing (un-planed or un-milled) asphalt, the minimum target rate of spread for bond coats shall provide not less than 0.2 kg/m<sup>2</sup> of residual binder (see [Table 2](#)).

**NOTE 4** The above rates are minimums and a higher rate may be specified as appropriate, depending on the site conditions. **A1**

**Table 2** — An example of bond coat minimum target rate of spread in litres per square metre of emulsion

| Class of polymer modified bituminous emulsion <sup>A)</sup> | <b>A1</b> Newly laid and existing asphalt substrate <b>A1</b><br>Residual binder 0.2 kg/m <sup>2</sup> | <b>A1</b> Planed (milled) substrates <b>A1</b><br>Residual binder 0.35 kg/m <sup>2</sup> |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| C50BP(2 to 5)                                               | 0.40 L/m <sup>2</sup>                                                                                  | 0.70 L/m <sup>2</sup>                                                                    |
| C60BP(2 to 5)                                               | 0.33 L/m <sup>2</sup>                                                                                  | 0.58 L/m <sup>2</sup>                                                                    |
| C65BP(2 to 5)                                               | 0.31 L/m <sup>2</sup>                                                                                  | 0.54 L/m <sup>2</sup>                                                                    |

<sup>A)</sup> The breaking class 2 to class 5 from BS EN 13808:2013 is shown in brackets and does not affect binder content, but is agreed between producer and purchaser for the intended use.

### 5.5.2 Application by machine

Bond coats shall be machine applied at a uniform rate by calibrated metered mechanical spraying equipment, spray tanker or spraying device integral with the paving machine.

For adoptable highways, the contractor shall implement a quality management scheme, and document and record the findings. The scope of the quality management scheme shall include the application of bond coats, with documented procedures included for carrying out rate of spread and accuracy of spread tests in accordance with BS EN 12272-1.

**NOTE 1** For works other than adoptable highways, suitable control systems may be implemented.

**NOTE 2** The quality plan should have methods detailed to check the spraying equipment and to reconcile volume or mass used with areas treated and to visually assess accuracy of spread.

**NOTE 3** Guidance on workforce competency is found in National Highways Sector Scheme 13 [4].

The tolerance on the specified rate of spread shall not exceed ±20% and the accuracy of the spread shall not exceed 15%.

During the works the contractor shall repeat the test for rate of spread of binder at a minimum frequency of one test for every 50 000 m<sup>2</sup>, or once per month, whichever is the most frequent.

The accuracy of spread of binder, which should be in accordance with BS EN 12272-1, shall be tested every six months.

Alternatively the accuracy of spread of the sprayer shall be calibrated in accordance with BS 1707 using the depot tray test every six months. Documentation shall be recorded and retained.

The tests shall also be carried out whenever there is a change in binder source or the spraying system has been altered. The results shall be made available on request.

Where application is approved by the specifier to be carried out by hand, the rate of spread shall be measured by calculating the volume or mass applied per m<sup>2</sup>. The maximum contiguous area sprayed by hand shall be no greater than 100 m<sup>2</sup> unless otherwise agreed by the specifier.

There shall be no bare strips or areas having less than the minimum specified rate of spread. Transverse joints shall have an overlap not wider than 300 mm. Longitudinal joints shall have an overlap to ensure that the minimum permitted rate of spread is achieved across the joint.

*NOTE 4 For quartering (using part of the spraybar) the longitudinal joint overlap width may be extended to a maximum of 300 mm.*

Paver integral sprayers shall provide a wet edge to ensure spray overlap under adjacent overlays such that the minimum permitted rate of spread is achieved across the longitudinal joint.

Where the longitudinal spray overlap causes the effective rate of spread to be increased by more than 50% of the specified rate, then the width of overlap shall be not greater than 100 mm and shall be outside the location of the wheel tracks for the lane.

*NOTE 5 Most sprayers might have much greater accuracy than this and might therefore save material.*

*NOTE 6 Where additional protection against water ingress might be required, higher spread rates than the minimum might be applicable. For example, under permeable or porous surface courses.*

The installation shall be undertaken to allow sufficient time for the bituminous emulsion to break (i.e. turn from brown to black) before the asphalt is laid, unless it is applied by a paver with an integral spray bar, where the heat of the asphalt aids the break.

*NOTE 7 Hot applied bond coats conforming to BS EN 14023 or BS EN 15322 may be overlaid immediately, but care is needed to obtain adhesion to the substrate when damp. Any bituminous emulsion accumulating in hollows should be dispersed by brushing and allowed to break before it is overlaid.*

*NOTE 8 In unduly cold or humid weather conditions breaking of the emulsion could be delayed; for example, where temperatures are below 5 °C or humidity is above 70%. Breaking can be accelerated by the use of chemicals and/or heat.*

*NOTE 9 During periods of hot weather, pick up of binder on the tyres of delivery vehicles and paver might be a problem, especially at the higher rates of spread. Avoidance measures include using special non-tacky bond coats, the sparing use of 6 mm or smaller single-sized chippings, or the use of breaking agents.*

*NOTE 10 Adjacent to pedestrian refuges, crossings, street furniture, kerbs, road markings, etc., hand application (canning and brushing) is acceptable. However, the specifier generally limits this to a width not exceeding 100 mm to be overlapped by machine spraying.*

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## 6 Layings

### 6.1 General

Asphalt shall be machine-laid by a self-propelled paver (see [6.3](#)), except when hand laying.

*NOTE 1 Further guidance on when hand laying is necessary is given in [6.4](#).*

The laying operation shall be controlled and carried out by those trained in asphalt laying.

*NOTE 2 Guidance on competencies of asphalt paving gangs for highways is in the National Highways Sector Scheme 16 [5].*

### 6.2 Laying in adverse conditions

#### COMMENTARY ON 6.2

*Materials laid in adverse conditions are unlikely to provide the same serviceability and durability as those laid in ideal conditions, so all reasonable steps to avoid or prevent the effects of adverse conditions*

*should be taken and declared by the installer as part of the quality plan in the National Highways Sector Scheme 16 [5].*

*The following factors, which affect the rate of cooling of asphalt layers and hence the time available for compaction, should also be declared and put into a quality plan, and working practices adjusted accordingly:*

- *thicker layers cool more slowly, and binder course and base layers of 60 mm or more thickness provide adequate time for compaction under most weather conditions. Thinner layers need more care and the details should be clear and declared by the installer in the quality plan (see National Highways Sector Scheme 16 [5] for further guidance);*
- *wind speed has a greater effect on the rate of cooling than ambient temperature;*
- *ambient temperature should be taken into consideration but is of less significance than wind speed; and*
- *the time available for compaction is also dependent on the type of binder in the mixture and the temperature of the mixture as it is laid.*

### 6.2.1 Wet weather

Laying shall not be carried out if standing water is present on the surface to be covered.

*NOTE Laying should be avoided as far as is practicable during heavy rain. If wet weather is likely to be prolonged, laying should be suspended.*

### 6.2.2 Low temperatures

Laying shall be carried out with due regard to ambient weather conditions so that materials can be properly compacted. The asphalt shall not be laid on any surface which is frozen or covered with ice or snow. Laying shall cease when the air temperature reaches 0 °C on a falling thermometer, except in calm dry conditions, when laying shall cease if the air temperature reaches –3 °C on a falling thermometer.

*NOTE 1 When the surface on which asphalt is to be laid is dry and free from ice, laying may proceed at air temperatures at or above –1 °C on a rising thermometer, and only if compaction can be substantially completed before the asphalt cools below the temperature given in [Table 4](#) or [Table A.1](#), as appropriate.*

*NOTE 2 Further guidance is given in Transport and Road Research Laboratory Research Report 4 [3] and Manual of Contract Documents for Highway Works – Volume 1 [2].*

### 6.2.3 Wind chill

When laying chipped HRA surface courses (see [Clause 7](#)) in windy and/or cold conditions, the delivery vehicles and paving train shall be coordinated to minimize delays between discharging material into the paver, laying, application of coated chippings and initial rolling of the coated chippings into the freshly-laid surface course asphalt.

*NOTE 1 The embedment and adhesion of coated chippings is affected by surface chilling of asphalt, which occurs quickly in windy conditions, particularly if it is also cold. The guidance given in [6.2.2](#), Note 1, should be taken into consideration in that the decision to lay or not to lay is dependent on factors such as temperature and wind speed. This is defined in Transport and Road Research Laboratory Research Report 4 [3] and should be used by the installer.*

*NOTE 2 When chipped surface courses are to be laid in winter, some loss of chippings is likely, particularly when high rates of spread have been applied to achieve high levels of texture depth. The risk of loss of chippings increases if the surface course is first trafficked in cold weather.*