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Guidance on the use of BS EN 13108, Bituminous mixtures

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Foreword

Publishing information

This Published Document is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 March 2022. 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 the committee manager.

This publication is not to be regarded as a British Standard.

Supersession

PD 6691:2021 supersedes PD 6691:2015+A1:2016, which is withdrawn.

Relationship with other publications

This Published Document gives non-contradictory, complimentary information for use in the UK with the BS EN 13108 series of standards.

Information about this document

Text introduced or altered by Corrigendum No. 1 is indicated in the text by tags C1 C1. Minor editorial corrections are not tagged.

Use of this document

As a guide, this Published Document takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice.

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

Presentational conventions

The guidance in this Published Document is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

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

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0 Introduction

0.1 Overview of BS EN 13108

[BS EN 13108](#) is based on a common format and common principles. The overall principle is to provide a way for the target composition of a mixture to be declared in a consistent way and demonstrate that, at that target composition, it has certain declared properties. Each mixture formulation needs a declaration of the properties which are being claimed, derived through a product Type Testing procedure. In the simplest case it can be just grading and binder content. In more complex situations it can include properties, such as stiffness, deformation resistance and fatigue resistance. The demonstration of performance and conformity of the mixture on an ongoing basis requires the producer to undertake factory production control. This is a quality management procedure involving defined inspection and test regimes, and conformity criteria to prove that the mixture conforms to the declared target composition within defined tolerances.

[BS EN 13108](#) offers a degree of choice in many aspects, such as target composition, types of constituents, properties, and means of specimen preparation for product type testing. In many cases, this choice is indicated by the words “in documents related to the application of a product”. For [BS EN 13108](#) to be practicably workable in the UK there needs to be consistency amongst these choices so that producers know what to declare through product type testing and purchasers know what to ask for. This Published Document gives the recommended choices for the mixtures most commonly used in the UK.

As a result of many years of practical experience, the UK has successfully specified asphalt mixtures using an empirical/recipe based approach. The European standards permit the specification of asphalt mixtures either by nominating certain performance requirements and/or by nominating target gradings and target binder contents. Where it is appropriate and practicable, the UK does specify some of the asphalt mixtures used in higher stressed applications by including performance requirements. Examples of these are stiffness to ensure heavy traffic loadings do not damage the pavement construction, and deformation resistance to minimize rutting in the upper asphalt pavement layers. These additional requirements supplement the declared target grading and target binder content.

This Published Document makes recommendations for the selection of appropriate target gradings and target binder contents along with any supplementary performance characteristics based on best construction practice and national climatic conditions in the UK at the time of writing.

The example specifications covered by [Annex B](#) to [Annex E](#) provide important requirements for the particular types of asphalt mixture. These include specific requirements for all the ingredients used in their manufacture, tables which identify boundaries for the nominated target aggregate gradings, recommended grades of bitumen, and target binder contents which take account of the differing characteristics of the aggregates used in their manufacture. The proposed target binder contents ensure that the mixture provides the appropriate characteristics to permit effective compaction during laying and adequate performance under use/trafficking.

Where appropriate to the application and as required by the use/trafficking of the pavement, suitable performance categories are identified.

[BS EN 13108](#) contains requirements only for the loose mixture, i.e. “in the back of the truck”. The requirements for the laying of asphalts are retained in [BS 594987](#), and conformity to [BS 594987](#) is essential to ensure the durability of the finished work.

NOTE Guidance on the laying of mastic asphalt is not contained in this Published Document. Advice may be obtained from the Mastic Asphalt Council.¹⁾

[BS EN 13108](#) includes provisions for the use of reclaimed asphalt in asphalt mixtures. BS EN 13108-8 provides a means of defining and classifying the properties of reclaimed asphalt to be used as a component in asphalt. This Published Document gives guidance on a means of regulating the use of reclaimed asphalt.

0.2 Assessment and verification of constancy of performance

From 1 July 2013 the Construction Products Regulation 2013 [1] was fully implemented across all EU member states. It is a requirement of [BS EN 13108](#) product standards that an asphalt product supplied in conformity with one of the parts of [BS EN 13108](#) is assessed for product type and for conformity utilizing Part 20 and Part 21. This process is now called assessment and verification of constancy of performance (AVCP) but was referred to as Evaluation of Conformity in the BS EN 13108:2006 series. The end result of the AVCP process is the CE marking of the product confirming that it meets the performance requirements as detailed in the declaration of performance.

BS EN 13108-20 identifies the way in which the performance of a mixture composition to the requirements of the product standards is to be determined. This is referred to as Type Testing.

BS EN 13108-20 calls up test methods from the BS EN 12697 series of asphalt testing standards. Separate guidance on these test methods is given in PD 6692.

BS EN 13108-21 specifies procedures to be adopted during production to ensure product constancy and conformity with declared performance. This is referred to as Factory Production Control.

Revisions to all Parts of the BS EN 13108 series have been published, dated 2016. However, the product standards, Parts 1-7 (and 9) have not received citation in the Official Journal of the European Union (OJEU) and therefore cannot be used for the purposes of CE marking.

Parts 8, 20 and 21, dated 2016, are however not harmonized and do not require citation for that purpose and therefore are available for application, and adopted in this Published Document.

Following the end of the EU exit transition period on 31 December 2020, there are different options available relating to product marks that manufacturers, and others in the supply chain, will need to apply. The rules governing these marks depend on where the product is intended to be used. Where previously these were referred to as CE marking, this is now addressed generically in the UK as Conformity Assessed (CA) Marking (see [Annex A](#)).

0.3 Mathematical nomenclature

To accord with European nomenclature protocols, the nature of mathematical notation adopted in this Published Document is that employed in the European Standard.

When denoting a decimal fraction, European notation employs a comma (,). For example, the “six point three” millimetre sieve (6.3 mm) is denoted as 6,3 mm.

¹⁾ Available at <https://masticasphaltcouncil.co.uk>

1 Scope

This Published Document gives guidance on the use of BS EN 13108:2006 and/or BS EN 13108:2016 as explained in [Annex A](#).

[Clause 1](#) to [Clause 8](#) of this Published Document give general guidance and background information on BS EN 13108:2016.

[Annex A](#) contains guidance on matters arising from the publication of BS EN 13108:2016 without Citation in the OJEU as well as some consequences of the UK's departure from the European Union in relation to Conformity Assessed Marking.

[Annex B](#) contains an example specification which gives the UK choice for specifying asphalt concrete in accordance with BS EN 13108-1:2006.

[Annex C](#) contains an example specification which gives the UK choice for specifying hot rolled asphalt in accordance with BS EN 13108-4:2006.

[Annex D](#) contains an example specification which gives the UK choice for specifying stone mastic asphalt in accordance with BS EN 13108-5:2006.

[Annex E](#) contains an example specification which gives the UK choice for specifying mastic asphalt in accordance with BS EN 13108-6:2006.

This Published Document is applicable to mixtures for use on roads and other paved areas, including airfields. As well as the recommendations for Béton Bitumineux pour chaussées Aéronautiques (BBA) in this document, additional provisions for airfields are specified elsewhere including those provided by Defence Infrastructure Organisation (DIO).²⁾

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document³⁾. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[BS 2000-49](#), *Methods of test for petroleum and its products – Determination of needle penetration of bituminous material*

[BS 594987:2015](#), *Asphalt for roads and other paved areas – Specification for transport, laying, compaction and product type testing protocols*

BS EN 1097-6, *Tests for mechanical and physical properties of aggregates. Determination of particle density and water absorption*

BS EN 1426, *Bitumen and bituminous binders – Determination of needle penetration*

BS EN ISO 9001, *Quality management systems – Requirements*

BS EN 12591:2009, *Bitumen and bituminous binders – Specifications for paving grade bitumens*

BS EN 12697 (all parts),⁴⁾ *Bituminous mixtures – Test methods*

BS EN 13043:2002, *Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas*

²⁾ Available at: <https://www.gov.uk/government/publications/specifications>

³⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

⁴⁾ This document contains specific references to Parts 2, 3, 5, 6, 8, 12, 13, 18, 20, 22, 24, 26, 30, 31, 33, 35, 37 and 43 of [BS EN 12697](#).

BS EN 13108:2006 (all parts),⁵⁾ *Bituminous mixtures – Material specifications*

BS EN 13108:2016 (all parts),⁶⁾ *Bituminous mixtures – Material specifications*

BS EN 13924-1, *Bitumen and bituminous binders – Specification framework for special paving grade bitumen*

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

For the purposes of this British Standard, the terms and definitions used in [BS EN 13108](#), including the following, apply.

3.1.1 composition

3.1.1.1 mix formulation

composition of a mixture expressed as a target composition

3.1.1.2 output target composition

expression of a mix formulation in terms of the constituent materials and the mid-point grading and soluble binder content to be found on analysis

3.1.2 mixture types in [BS EN 13108](#)

COMMENTARY ON 3.1.2

There are seven mixture-specific parts of BS EN 13108:2006.

3.1.2.1 asphalt concrete

asphalt in which the aggregate particles are continuously graded or gap-graded to form an interlocking structure

NOTE [BS EN 13108-1](#) mixtures include EME2 and BBA. BBA has been the standard asphalt surfacing used in new construction and overlay of airport pavements in France for many years, and more recently in the UK.

3.1.2.2 asphalt concrete for very thin layers

asphalt for surface courses with a thickness of 20 mm to 30 mm, in which the aggregate particles are generally gap-graded to form a stone to stone contact and to provide an open surface texture

NOTE The abbreviation “BBTM” is often used in place of this term.

3.1.2.3 soft asphalt

mixture of aggregate and soft bitumen grades

3.1.2.4 hot-rolled asphalt

dense, gap graded asphalt in which the mortar of fine aggregate, filler and high viscosity binder are major contributors to the performance of the laid material

NOTE Coated chippings are often rolled into and form part of a hot rolled asphalt (HRA) surface course – see [C.2.8.1](#) for further guidance.

3.1.2.5 stone mastic asphalt

gap-graded asphalt mixture with bitumen as a binder, composed of a coarse crushed aggregate skeleton bound with a mastic mortar

⁵⁾ This document contains specific references to Parts 1, 4, 5 and 6 of BS EN 13108:2006.

⁶⁾ This document contains references to Parts 7, 8, 20 and 21 of BS EN 13108:2016.

3.1.2.6 mastic asphalt

voidless asphalt with bitumen as a binder in which the volume of filler and binder fills the volume of the remaining voids in the mix

NOTE Unlike other asphalt mixtures mastic asphalt does not require mechanical compaction but is spread and levelled by means of a hand float or appropriate specialist machine.

3.1.2.7 porous asphalt

asphalt designed to have a very high content of interconnected voids for use in sustainable drainage systems (SuDS), airfields and other specialist applications which are outside the scope of this document

3.1.3 measuring properties

COMMENTARY ON 3.1.3

[BS EN 13108](#) makes a distinction between requirements based on tests considered to be pure engineering properties, which are described as performance-based, and those based on more simulative tests, which are called performance-related.

Virtually all of the tests used in the UK to measure properties of asphalt in standards and contracts are performance-related. The only common exception to this is the indirect tensile stiffness modulus (ITSM) test which, along with all methods for measuring stiffness, is classed as performance-based.

3.1.3.1 performance-based requirement

fundamental engineering property that predicts performance and appears in primary performance prediction relationships

NOTE Performance-based requirements are based on methods such as the triaxial test for deformation resistance. Such test methods tend to be more complex and expensive.

3.1.3.2 performance-related requirement

characteristic that has been found to correlate with a fundamental engineering property that predicts performance

NOTE Performance-related requirements are based on methods such as wheel tracking tests. Such test methods tend to be more practical.

3.1.4 types of specification

COMMENTARY ON 3.1.4

In line with the distinction between the empirical and the fundamental approach, and performance-based and performance-related test methods, BS EN 13108-1:2006 offers two ways of defining the composition and properties in a mixture: empirical specification and fundamental specification. The other parts of BS EN 13108:2006 use the empirical approach. This Published Document follows established UK practice, is state-of-the-art at the time of publication, and gives recommendations only for empirical specifications.

3.1.4.1 empirical specification

specification that uses a combination of requirements for composition and constituent materials together with performance-related requirements

3.1.4.2 fundamental specification

specification that uses performance-based requirements linked to limited prescription of composition and constituent materials, offering a greater degree of freedom

3.2 Abbreviated terms

For the purposes of this Published Document the following abbreviated terms apply.

AC	asphalt concrete
AVCP	assessment and verification of constancy of performance
BBA	Béton Bitumineux pour chaussées Aéronautiques
BBTM	Béton Bitumineux Très Minces
CA	Conformity Assessed (marking)
DBM	Dense Bituminous Macadam
DoP	Declaration of Performance
EME2	Enrobés à module élevé Class 2
FPC	factory production control
HRA	hot rolled asphalt
ITSM	indirect tensile stiffness modulus
ITSR	indirect tensile strength ratio
MA	mastic asphalt
MCHW 1	Manual of Contract Documents for Highway Works – Vol. 1
OCL	operational compliance level
PA	porous asphalt
PSV	Polished Stone Value
RA	reclaimed asphalt
SMA	stone mastic asphalt
SuDS	sustainable drainage systems
VFB	voids filled with binder
VMA	voids in the mineral aggregate
SATS	saturation ageing tensile stiffness (conditioning test)

NOTE 1 Abbreviations used in mixture descriptions (Designation) are given in 8.2.

NOTE 2 DBM is no longer used in this document but is still commonly used, for example DBM50, in other national documents such as Design Manual for Roads & Bridges⁷⁾ where it refers to AC dense 40/60.

3.3 Symbols

For the purposes of this Published Document, the following symbols apply.

$B_{\min}$	the density corrected measure of binder content which is used for CA Marking and is provided in the producer's Declaration of Performance (DoP)
B_{act}	the actual target binder content used for mixture production.

⁷⁾ Available at: <https://standardsforhighways.co.uk/dmrb>

4 Constituent materials

4.1 General

COMMENTARY ON 4.1

Clause 4 of each part of [BS EN 13108](#) covers constituent materials. The general presumption is that all constituent materials conform to a European Standard or European Technical Assessment.

[BS EN 13108](#) recognizes that some constituents, such as fibres and pigments, might not be covered by standards and, in those cases, evidence of satisfactory use should be demonstrated. This evidence should be included in the product type testing documentation for the appropriate mixture formulation.

4.2 Binder

4.2.1 Paving grade bitumen

4.2.1.1 General

Paving grade bitumen should be specified in accordance with BS EN 12591:2009.

NOTE The selection of the grade of binders for use with mixtures is included in the example specifications in [Annex B](#) to [Annex E](#) of this Published Document.

4.2.1.2 Blending of paving grade bitumen

Paving grade bitumen should be blended on the production plant subject to the following recommendations.

The grades used for blending should not be harder than 30/45 nor softer than 160/220, and should conform to BS EN 12591:2009.

Measures for ensuring consistency of proportioning of the blend should be included in plant quality management systems. These should include evidence of type tests carried out on a laboratory blend of the bitumen to demonstrate conformity to BS EN 12591:2009.

The quality assurance/management systems should also include the steps to be taken to demonstrate the continuing adequacy of the process following significant changes being made to those parts of the plant involved in the process of bitumen blending.

No grades of bitumen harder than 70/100 should be produced by blending in the mixer.

4.2.2 Hard paving grade bitumen

Hard paving grade bitumen conforming to BS EN 13924 should only be used in EME2 base and binder course mixtures and mastic asphalt.

4.2.3 Polymer modified bitumen

Selection of an appropriate polymer modified binder should be agreed between the bitumen supplier, asphalt producer and the specifier as appropriate.

NOTE Polymer modified bitumen is covered by a framework specification in BS EN 14023. Since this is not a performance specification, product-type testing of the asphalt mixture may be used to demonstrate which grades are acceptable.

4.2.4 Natural asphalt

Natural asphalt should be specified in accordance with BS EN 13108-4:2006, Annex B.

NOTE Natural asphalt may be blended with paving grade bitumen or hard grade bitumen in the production of HRA and mastic asphalt.

4.3 Aggregates

All aggregate requirements should be specified in accordance with BS EN 13043 as appropriate to the intended use, which means that the detail depends on traffic, climate and the economics of local geology.

NOTE 1 Detailed recommendations for categories of all relevant properties are given in PD 6682-2.

BS EN 13043 requirements for shape, fines content, etc., are included in the example specifications in [Annex B](#) to [Annex E](#) of this Published Document; in general, the grading requirements for asphalt mixtures should be determined on the finished mixture and specific requirements on constituent materials are not appropriate, with the exception of fine aggregate for HRA.

NOTE 2 The recommendations of PD 6682-2 are followed, where relevant, in this Published Document.

4.4 Reclaimed asphalt (RA)

COMMENTARY ON 4.4

BS EN 13108-8 is a specification for the definition and classification of the properties of RA, principally for the purposes of its sale and purchase. It is, however, convenient to use these classifications as a way of defining the quality of RA as a feedstock for asphalt mixtures.

This has been done in the example specifications for asphalt mixtures in [Annex B](#) to [Annex E](#) of this Published Document, which reflect the current practice.

The properties classified in BS EN 13108-8 are:

- a) size of asphalt particles;*
- b) size of aggregate in RA;*
- c) content of foreign matter (contamination); and*
- d) binder hardness, expressed as one of mean penetration, mean softening point or mean viscosity of the recovered binder.*

Feedstock for asphalt plants in the UK has traditionally been defined as the RA (direct from source) and has been fully or partly processed to make it suitable for inclusion in the asphalt plant.

4.4.1 General

The BS EN 13108-8 classifications should be used to define the RA at any stage between the raw planed or excavated material, and a fully processed feedstock for a mixing plant.

4.4.2 Requirements in BS EN 13108 in relation to RA

There are no definitive requirements in BS EN 13108-8 in relation to RA.

The individual mixture parts of [BS EN 13108](#) contain two requirements for RA:

- a) the upper sieve size D of the aggregate in the reclaimed asphalt should not exceed the upper sieve size D of the mixture; and
- b) the aggregate properties of the reclaimed asphalt or of the mixed aggregates from the reclaimed asphalt with the other aggregates should fulfil the requirements for aggregate defined in documents related to the application of the mixture.

NOTE BS EN 13108-8 does, however, allow for additional requirements to be defined and specified appropriate to the intended use. BS EN 13108-8 is written as a means of classifying the properties of RA in a standard way in order to facilitate such specification.

4.4.3 Limiting the amount of reclaimed asphalt

[BS EN 13108](#) covers the possibility of limiting the amount of RA permitted to be added to the mixture; in line with current UK practice, the following limits should apply:

- a) mastic asphalt, 10%;
- b) all other surface course, 20%; and
- c) all other materials, 50%.

NOTE Criteria for RA feedstock up to these limiting values are given in [4.4.4](#).

4.4.4 Criteria for adoption in the UK

For the purposes of specification, the following criteria given in [Table 1](#) based on application and addition rate should be applied.

Table 1 — RA addition rates and requirements

Application	RA addition rate and requirements			
	≤10%	11-20%	≤20%	21-50%
Surface course				
Base /& binder course				
Penetration (min.)	P ₁₅	P ₁₅	P ₁₅ ^{A)}	P ₁₅ ^{A)}
Determination of recovered aggregate properties ^{B)}	—	PSV AAV	—	—
Contamination	F ₅	F ₁	F ₅	F ₅
Combined binder Pen calculation	No	Yes	No ^{E)}	Yes
Assessment of feedstock homogeneity				
Penetration (standard deviation) ^{C)}	No	Yes	No	Yes
Grading (standard deviation) ^{D)}	No	Yes	No	No
Feedstock sample frequency (BS EN 13108-8:2016, Table 1)	Level Y (1:1000t)	Level X (1:500t)	Level Z (1:2000t)	Level Z (1:2000t)

^{A)} P₁₅ is a general case, but reliable and consistent feedstock of harder reclaimed material might be suitable by agreement with the client.

^{B)} Where specified for the asphalt mixture. To be tested on a representative sample from each feedstock unless the properties of the original aggregate can be satisfactorily determined from records.

^{C)} Binder penetration has been selected from the properties included in [BS EN 13108-8:2016, 5.4](#).

^{D)} Applies to HRA surface course mixtures up to and including 35% stone content in recognition of the effect of fine aggregate grading on these mixtures. Standard deviation limits should be set by the producer as a minimum on the 2mm and 0.25mm sieves to confirm that the variation is not significantly greater than that for gradings with no RA.

^{E)} It is recommended that combined binder properties are calculated for addition rates >10%

4.4.5 Combined binder properties in the mixture

In cases where more than 10% for surface course mixtures, and 20% for other mixtures, by mass of the total mixture of RA is added to the mixture, the properties of the total binder in the mixture (calculated from the combination of the properties of the fresh binder and the properties determined on the recovered binder from the RA) should conform to the grade specification for the mixture.

[BS EN 13108](#) gives the option of carrying out this calculation on either penetration or softening point; in line with current UK practice the penetration method should be adopted.

NOTE Additional requirements are called up in the product standards when the binder from the RA or the binder for the mixture is modified. BS EN 13108-8 requires the producer to declare the feedstock binder type, i.e. paving grade or modified, and the properties. The determination of recovered binder softening point in addition to penetration might assist where historical records are not available.

4.4.6 Binder recovered from mixtures containing RA

[7.3.6.2](#) contains recommendations for the testing of mixtures containing RA to be followed in accordance with this clause.

4.5 Additives

If the specifier has requirements for additives these should be included in the specification, in accordance with [BS EN 13108](#).

NOTE 1 Small quantities of additives can be used to enhance the laying characteristics, performance or appearance of asphalt, for example:

- *affinity of binder to aggregate;*
- *control of binder drainage from the hot mixture;*
- *colour of the mixture;*
- *workability;*
- *fuel resistance;*
- *toughness.*

This list is not exhaustive.

NOTE 2 Additives used to reduce the production temperature of asphalt are dealt with in [6.5](#) of this Published Document.

5 Mixture composition

5.1 General

BS EN 13108, Parts 1 to 7, require that:

- a) the mixture formulation is declared in the type test report according to BS EN 13108-20;
- b) at the target composition, the mixture conforms to the selected requirements;
- c) the grading is expressed in percentages by mass of total aggregate;
- d) the binder and additive content is expressed in percentages by mass of total mixture;
- e) the percentages passing the sieves, with the exception of the sieve 0,063 mm, is expressed to 1%;
- f) the binder content and the percentage passing sieve 0,063 mm is expressed to 0,1%;
- g) any additive content is expressed to 0,1% but where appropriate to 0,01%;
- h) in the case of stone mastic asphalt to BS EN 13108-5:2006 the angularity of the fine aggregates to be used and their ratio may be selected.

5.2 Grading and sieves

5.2.1 Sieves

COMMENTARY ON 5.2.1

The sieves used in the UK are basic sieve set “plus set 2” conforming to BS EN 13043. Detailed guidance on this can be found in PD 6682-2.

The range of sieves, both coarse and fine, to be used in asphalt specifications in the UK is: 0,063 mm; 0,125 mm; 0,250 mm; 0,500 mm; 1 mm; 2 mm; 4 mm; 6,3 mm; 10 mm; 14 mm; 20 mm; 31,5 mm; and 40 mm.

NOTE 1 Whilst BS EN 933-1 suggests the need to use the full series for each grading determination on aggregates, for the purposes of determining the grading of asphalt mixtures it is not necessary to use sieves other than those used in [BS EN 13108](#), as shown in the example specifications in the annexes of this Published Document.

NOTE 2 [BS EN 13108](#), Parts 1 to 7, specifically disallow the combination of sieves from “plus set 2” and “plus set 1”.

5.2.2 Grading

Mandatory sieves used for mixtures in [BS EN 13108](#) mixture specifications generally follow the same form:

1.4 D This is the sieve which governs the amount of oversize permitted

D This is the “nominal” sieve which is used in the product description

2 mm This is the sieve separating coarse from fine aggregate

0,063 mm This is the sieve determining filler content in the mixture

These are the minimum requirements for specifying asphalt mixtures with the exception of hot-rolled asphalt. In addition, “characteristic” sieves may be specified between *D* and 2 mm (coarse sieves) and 2 mm and 0,063 mm (fine sieves). The number of these sieves is limited by each part of [BS EN 13108](#) and is summarized below.

Some standards place restrictions on the sieves that can be selected for “characteristic” fine sieves.

Table 2 — Characteristic sieves

Part	Mixture	Maximum number of “characteristic” sieves	
		between <i>D</i> and 2 mm	between 2 mm and 0,063 mm
1	Asphalt concrete	2	2
2	Asphalt concrete for very thin layers	2	1
4	Hot-rolled asphalt	see note	
5	Stone mastic asphalt	2	1
6	Mastic asphalt	1	1

NOTE Given the history of use of HRA in the UK, BS EN 13108-4:2006 defines what sieves are to be used. This follows the same principle as the other mixture types in [BS EN 13108](#) and Part 4 defines the “characteristic” coarse and fine sieves to be used.

[Annex B](#) to [Annex E](#) give recommended grading envelopes, including characteristic sieves, for the grading values selected for each sieve for the commonly used mixture types in the UK. These requirements are in accordance with those of [BS EN 13108](#).

5.3 Binder content

5.3.1 General

The binder contents in the example specifications in this Published Document are those which are determined as part of the mixture formulation process and are required as actual soluble binder contents on analysis of the finished mixture. This binder content is designated as the B_{act} target value and is that used in [Annex B](#) to [Annex E](#). This follows historical practice in the UK.

B_{min} is a density corrected measure of binder content which is used for the purposes of CA Marking and is explained in greater detail in 5.3.2. A consideration of UK mixtures and aggregates indicated

that specification of mixtures using $B_{\min}$ alone could be detrimental for some mixtures, as some of the denser aggregates in practice needed higher binder contents to ensure adequate durability.

The selection of the appropriate target binder content for the particular mixture takes account of a number of important factors. These include the handling and laying characteristics of the mixture and the anticipated performance in the pavement. As already stated, two of the factors which significantly affect the target binder content selected for mixtures are the relative density of the combined aggregates, and the surface characteristics and the mineralogical nature of the particular type(s) of aggregate used.

5.3.2 Calculation of $B_{\min}$

COMMENTARY ON 5.3.2

[BS EN 13108](#) requires the application of a correction factor based on the density of the aggregate in the mixture. The principle is that the binder content category in the standard is based on an aggregate density in the mixture of 2,650 megagrams per cubic metre (Mg/m^3).

If the aggregate is denser than $2,650 \text{ Mg}/\text{m}^3$ the actual binder content in the true mixture is reduced proportionally, or if the aggregate is less dense it is increased with the intention of providing the same binder volume in all mixtures regardless of aggregate density.

To convert a B_{act} target value within this Published Document back to a $B_{\min}$ declared value from [BS EN 13108](#), the following formula is used:

$$B_{\min \text{ declared}} = \frac{\rho_b \times B_{\text{act target}}}{2,650} \quad (1)$$

where:

ρ_b is the mean particle density of the aggregate mixture, in Mg/m^3 , determined in accordance with BS EN 1097-6 and [5.3.2](#) of this Published Document.

WORKED EXAMPLE

An asphalt mixture contains a single source of coarse and fine aggregate with a percentage of added limestone filler as follows.

Aggregate	Percentage in mixture at target Apparent particle density composition (%)	
		(Mg/m^3)
Coarse	60	2,78
Fine	33	2,76
Inherent filler	2	2,72
Added filler	5	2,70

The weighted average aggregate particle density is therefore:

$$\frac{(60 \times 2,78) + (33 \times 2,76) + (2 \times 2,72) + (5 \times 2,70)}{100} = 2,77$$

The target binder content of the asphalt mixture is 6,0% (B_{act}). Using Equation (1) the back-corrected binder content $B_{\min}$, declared for CA marking purposes, can be calculated as follows:

$$B_{\min} = 6,0 \times \frac{2,78}{2,65} = 6,3\% \quad (2)$$

NOTE 1 For the convenience of the recipients of CA marking, B_{act} can also be declared in the CA marking information sheet, identified as "additional information".

NOTE 2 For recipe mixtures, if experience with a particular aggregate combination indicates that a higher or lower target binder content than that stated in the example specifications in [Annex B](#) to [Annex E](#) is required, and this does not compromise the laying or measured characteristics of the mixture, then the appropriate target binder content can be used for product-type testing of the mixture.

The correction factor is not applicable to slag aggregates, and provision is made for these in the annexes of this Published Document in terms of compacted bulk density.

5.3.3 Aggregate particle density

The mean particle density of the aggregate mixture should be calculated as the weighted mean of the apparent particle density of the coarse, fine and filler aggregate(s) comprising the mixture.

For fine aggregate the apparent density should be determined on material passing the 2 mm sieve retained 0,063 mm.

For coarse aggregate the following guidance is provided.

- a) Where the water absorption of the passing 14 mm retained 10 mm fraction does not exceed WA_{24} , then the apparent density of this fraction may be used for the entire coarse aggregate from that source.
- b) Where the water absorption of the passing 14 mm retained 10 mm fraction exceeds WA_{24} , then the apparent density of the following individual coarse fractions should be used (2 to 6,3 mm, 6,3 to 10 mm, 10 to 14 mm, 14 to 20 mm, 20 to 31,5 mm and 31,5 to 40 mm).

6 Performance properties

6.1 General

A key element of [BS EN 13108](#) is the ability of specifiers to set requirements for asphalt performance based on a wide range of tests in the BS EN 12697 series. This is achieved by calling up performance classes. Specifiers are restricted to those performance classes given in the relevant part of [BS EN 13108](#). The modification of [BS EN 12697](#) tests to produce different values for inclusion in specifications is not permitted.

Further guidance on each of the test methods in the BS EN 12697 series, including those called up in [BS EN 13108](#), is available in PD 6692.

6.2 Conflicting requirements

BS EN 13108-1 to BS EN 13108-7 contain limitations to prevent over-specification by the combination of inappropriate and unnecessarily onerous combinations of requirements. Referred to as conflicting requirements, these limitations have been applied in this Published Document.

6.3 Properties covered by BS EN 12697 test methods

[Table 3](#) to [Table 5](#) provide guidance on properties and performance classes depending on their anticipated use in UK specifications referred to as “frequently specified”, “occasionally specified” and those “which should not be used”.

This guidance is provided for asphalt concrete, stone mastic asphalt, hot rolled asphalt and mastic asphalt mixtures. Cells without ticks indicate that the property should not be included in UK specifications for that mixture type. This is because the relevant part of BS EN 13108:2006 does not itself include Performance Classes for that property and therefore cannot be used by the producer for the purpose of Conformity Assessed marking.

Table 3 — *Properties frequently specified in the UK*

Property	1. AC	4. HRA	5. SMA	6. MA	Guidance
Void content	✓	✓	✓		The requirement for a maximum void content is generally adopted for dense base and binder course mixtures as a surrogate measure for achieved compaction. There are difficulties in accurately determining the inherent voids content of the thinner surface courses. Minimum voids content may be specified for designed dense base and binder course mixtures as part of the design process to ensure the mixture is not at risk of losing interparticle integrity through the use of an excessively high bitumen content.
Permanent deformation (wheeltrack)	✓	✓	✓		This test is applicable to mixtures for use generally within the top 100 mm of pavements on sites where trafficking by commercial vehicles, including public service vehicles, is high volume and/or slow moving. The risk of permanent deformation in the wheeltrack zones is highest in the summer when the upper asphalt layers in the pavement are at their hottest.
Stiffness	✓	✓			The specification of minimum stiffness requirements applied to base and binder mixture types used in heavily trafficked pavements. The specification of maximum stiffness values is generally not recommended.
Indentation				✓	The indentation test carried out in accordance with BS EN 12697-20 is used to determine the resistance to indentation under static loads.

Table 4 — *Properties occasionally specified in the UK with specific applications*

Property	1. AC	4. HRA	5. SMA	6. MA	Guidance
Binder volume		✓			Only performance-related HRA surface course mixtures should be produced using the method for determining the quantity of binder in the mixture required by BS EN 13108-4:2006, 5.2.4 (see C.2.5.1.4.1 of this Published Document).
Voids filled with binder (VFB)	✓		✓		The requirements specified in the BS EN 13108 series are not generally adopted in the UK, other than for some asphalt concrete mixtures on airfield applications. This property should not be specified for use in other applications.
Voids in mineral aggregate (VMA)	✓				The requirements specified in the BS EN 13108 series are not generally adopted in the UK, other than for some asphalt concrete mixtures on airfield applications. This property should not be specified for use in other applications.

Table 4 — *Properties occasionally specified in the UK with specific applications (continued)*

Property	1. AC	4. HRA	5. SMA	6. MA	Guidance
Binder drainage			✓		The stone-dependent gap-graded nature of SMA has the potential to result in binder drainage during storage and transportation, and this should be addressed in the design of the materials; for example, by the inclusion of a polymer modified bitumen or drainage inhibitors, such as cellulose fibres. As such it should not be necessary for specifiers to include a requirement for binder drainage and generally this property should not be specified.
Water sensitivity	✓	✓	✓		There may be specific applications or mixture types where water sensitivity is appropriate. However, it is generally recommended that this property should not be specified.
Fatigue	✓				Fatigue testing is available as an option in the design procedures for EME2 and airfield BBA mixtures, see Annex B . For all other asphalt mixtures fatigue testing is not considered necessary and this property should not be specified.
Marshall properties	✓				Marshall test properties specified in BS EN 13108-1:2006, 5.3.2 , are only for use on airfields. These properties should not be specified for use in other applications.
Fuel resistance	✓	✓	✓	✓	The BS EN 13108 series requirements apply only to airfields. However, the test method in BS EN 12697-43 might be useful in assessing the suitability of asphalt mixtures for highway applications where fuel may be spilled, e.g. laybys, emergency areas, bus stops, tunnels and other hardstandings.
De-icer resistance	✓	✓	✓	✓	The BS EN 13108 series requirements apply only to airfields. This property should not be specified for use in other applications.
Fracture toughness					There are few applications where fracture toughness is appropriate. Use should generally be restricted to surface course mixtures.

Table 5 — *Properties which should not be used in the UK*

Property	1. AC	4. HRA	5. SMA	6. MA	Guidance
Voids at 10 gyrations	✓				The requirements specified in BS EN 13108-1:2006, 5.3.5 , are a measure of mixture workability and compactability. This property should not be specified in the UK.
Abrasion by studded tyres	✓		✓	✓	The requirement in the BS EN 13108 series is relevant only to those countries where studded tyres are used in winter. Since these are illegal in the UK, the requirement is not relevant. Therefore, this property should not be specified in the UK.

Table 5 — *Properties which should not be used in the UK (continued)*

Property	1. AC	4. HRA	5. SMA	6. MA	Guidance
Permanent deformation (triaxial) SATS	✓				Triaxial testing for deformation resistance should not be used in specifications in the UK.
Low temp. properties					The requirement for mixture SATS Durability Index was restricted to dense base and binder mixtures specified through the MCHW-1 for use on the Strategic Road Network. It is replaced by ITSr and therefore should not be specified for use.
Friction after polishing					Low temperature testing is intended for asphalt used in cold climates. Therefore, this property should not be specified in the UK.
					The delivery of satisfactory in situ friction characteristics for UK highways and other paved areas should continue to be through the combination of aggregate PSV and asphalt texture depth. Therefore, this property should not be specified in the UK.

6.4 Properties not covered by BS EN 12697 test methods

6.4.1 Coating and homogeneity

[BS EN 13108](#) requires that the material when discharged from the mixer is homogenous in appearance, with the aggregate completely coated with binder, without any evidence of balling of fine aggregate, filler or any additives that have not been effectively distributed through the mixture.

6.4.2 Reaction to fire

There is a regulatory requirement in some countries for a Euro class for reaction to fire if asphalt is to be laid in certain types of tunnel. This is not a regulatory requirement in UK.

6.4.3 Dangerous substances

Attention is drawn to the relevant regulations on dangerous substances which might be in force in the intended place of use for asphalts covered by [BS EN 13108](#). In the absence of International or European test methods, manufacturers should verify and declare the release of dangerous substances in accordance with provisions applicable in the intended place of use of the product.

6.5 Temperature

[BS EN 13108](#) provides maximum temperatures for mixtures with paving grade and hard grade bitumens. These maximum values are reproduced in the example specifications in [Annex B](#) to [Annex E](#) of this Published Document.

For mixtures containing polymer modified bitumen, different temperatures might be applicable and should be declared and documented by the manufacturer.

Since the previous edition of PD 6691, routine use of warm mix asphalt has become established in the UK. The available manufacturing technologies allow the production of asphalt at lower temperatures, whilst enabling normal compaction on site. The range of technologies available for warm mix asphalt production means that guidance on minimum and maximum production temperatures should come from the manufacturer. This information should be declared and documented by the manufacturer.

NOTE [BS 594987](#) specifies requirements on suitable minimum temperatures at delivery and for compaction. These apply to conventional hot-mix asphalt. It is advisable to seek guidance from manufacturers for Warm Mix asphalts.

7 Assessment and verification of constancy of performance

7.1 General

7.1.1 Obligations of a producer of asphalt

COMMENTARY ON 7.1.1

The demonstration of performance and conformity of asphalt mixtures is covered by:

- a) BS EN 13108-20, Type testing; and*
- b) BS EN 13108-21, Factory production control.*

These are used as part of the process of Assessment and Verification of Constancy of Performance (AVCP).

BS EN 13108-20 and BS EN 13108-21 specify the obligations of a producer of asphalt so as to be able to make a "Declaration of Performance" that the material:

- a) meets the requirements of the essential characteristics as defined in Annex ZA of the relevant product standard; and
- b) conforms to a particular specification drawn from the relevant parts of [BS EN 13108](#).

7.1.2 Product type testing

Product type testing is a procedure in which a given mixture formulation (target composition and set of constituents) is put through a series of tests to prove that it conforms to the detailed specification requirements of the applicable part of [BS EN 13108](#). In particular this involves any performance-related properties for which performance and conformity is being claimed. The result of a product type testing procedure is a type test report. This is a formal document that relates only to the formulation which has been tested and which provides proof that the formulation conforms to the relevant specification detail. Every detail and each property should be validated, even for simple recipe mixtures, although there will be fewer requirements to demonstrate.

NOTE This is similar to a combination of a technical file, a mixture design report and/or a job standard mixture trial report.

The product type test report should be made available to the purchaser of the product on demand in support of the Declaration of Performance.

7.1.3 Factory production control

Factory production control is a schedule for a quality system to verify that, at the asphalt plant, a mixture formulation which has already been type-tested is manufactured consistently. It does not include requirements for measuring performance-related properties of the asphalt, other than a requirement that the validation carried out under initial product type testing be repeated at not greater than five yearly intervals.

In summary, a mixture conforms to the European Standard if there is a valid type test for the particular mixture composition covering all of the specified requirements and if it is produced at a plant conforming fully to the requirements of factory production control.

[BS EN 13108](#) does not deal with the subject of acceptance testing as this is a contractual issue.