BS EN 13108-1:2016

BSI Standards Publication

Bituminous mixtures — Material specifications

Part 1: Asphalt Concrete

bsi.

National foreword

This British Standard is the UK implementation of EN 13108-1:2016. It supersedes BS EN 13108-1:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/510/1, Asphalt products.

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Mélanges bitumineux - Spécifications pour le matériau - Partie 1: Enrobés bitumineux

Asphaltmischgut - Mischgutanforderungen - Teil 1: Asphaltbeton

This European Standard was approved by CEN on 27 February 2016.

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European foreword

This document (EN 13108-1:2016) has been prepared by Technical Committee CEN/TC 227 "Road materials", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2016, and conflicting national standards shall be withdrawn at the latest by March 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13108-1:2006.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of Regulation (EU) No 305/2011 for construction products (CPR).

For relationship with Regulation (EU) No 305/2011 see informative Annex ZA which is an integral part of this document.

Compared with EN 13108-1:2006, the following changes have been made:

a) general, empirical and fundamental approaches have been merged into one list with different properties;

b) new properties introduced (saturation tensile stiffness conditioning test, low temperature properties, fracture toughness, friction after polishing);

c) additional optional sieves for the characterization of the grading;

d) for several properties additional categories are introduced;

e) possibility to define specific conditions in documents related to the application of the product;

f) CPR reference and new Annex ZA according CPR rules.

This European Standard is one of a series of standards as listed below:

— EN 13108-1, *Bituminous mixtures — Material specifications — Part 1: Asphalt Concrete*

— EN 13108-2, *Bituminous mixtures — Material specifications — Part 2: Asphalt Concrete for Very Thin Layers (BBTM)*

— EN 13108-3, *Bituminous mixtures — Material specifications — Part 3: Soft Asphalt*

— EN 13108-4, *Bituminous mixtures — Material specifications — Part 4: Hot Rolled Asphalt*

— EN 13108-5, *Bituminous mixtures — Material specifications — Part 5: Stone Mastic Asphalt*

— EN 13108-6, *Bituminous mixtures — Material specifications — Part 6: Mastic Asphalt*

— EN 13108-7, *Bituminous mixtures — Material specifications — Part 7: Porous Asphalt*

— EN 13108-8, *Bituminous mixtures — Material specifications — Part 8: Reclaimed Asphalt*

— EN 13108-9, *Bituminous mixtures — Material specifications — Part 9: Asphalt for Ultra-Thin Layers (AUTL)*

— EN 13108-20, *Bituminous mixtures — Material specifications — Part 20: Type Testing*

— EN 13108-21, *Bituminous mixtures — Material specifications — Part 21: Factory Production Control*

Annex A (normative) details the calculation of the penetration or the softening point in mixtures containing reclaimed asphalt from the penetrations or softening points of the added binder and the recovered binder from the reclaimed asphalt.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The aim of this European Standard is to enable specification of Asphalt Concrete mixtures on a performance basis. In general, however, there are currently more empirical tests available to describe the mixtures. Depending on the experience with the combination of requirements in this European standard more or less degrees of freedom for the producer may be given.

This European Standard covers a large variety of materials for different applications, traffic and climate conditions. EN 13108-1 gives properties and listings of possible categories. It has to accommodate the road industry for all of Europe. For this reason the menu approach for properties has been chosen. The Tables represent categories that are required all over Europe. For this reason numerical values in Tables do not always obey statistical rules. Based on conditions of use specific properties and categories may be defined in documents related to the application of the product. The categories defined in those documents need to take into account the reproducibility of the test when this is given in the appropriate test method.

Care should be taken to only select those tests which are relevant to the application of the asphalt and the use of the pavement and to avoid a combination of potentially conflicting requirements.

1 Scope

This European Standard specifies requirements for mixtures of the mix group Asphalt Concrete for use on roads, airfields and other trafficked areas. Asphalt Concrete is used for surface courses, binder courses, regulating courses, and bases.

The mixtures of the mix group Asphalt Concrete are produced on the basis of hot bitumen. Mixtures utilizing bitumen emulsion and bituminous materials based on *in situ* recycling are not covered by this standard.

This European Standard includes requirements for the selection of the constituent materials. It is designed to be read in conjunction with EN 13108-20 and EN 13108-21.

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.

EN 1097-6, *Tests for mechanical and physical properties of aggregates — Part 6: Determination of particle density and water absorption*

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

EN 1427, *Bitumen and bituminous binders — Determination of the softening point — Ring and Ball method*

EN 12591, *Bitumen and bituminous binders — Specifications for paving grade bitumens*

EN 12697-3, *Bituminous mixtures — Test methods for hot mix asphalt — Part 3: Bitumen recovery: Rotary evaporator*

EN 12697-8, *Bituminous mixtures — Test methods for hot mix asphalt — Part 8: Determination of void characteristics of bituminous specimens*

EN 12697-12, *Bituminous mixtures — Test methods for hot mix asphalt — Part 12: Determination of the water sensitivity of bituminous specimens*

EN 12697-13, *Bituminous mixtures — Test methods for hot mix asphalt — Part 13: Temperature measurement*

EN 12697-16, *Bituminous mixtures — Test methods for hot mix asphalt — Part 16: Abrasion by studded tyres*

EN 12697-22, *Bituminous mixtures — Test methods for hot mix asphalt — Part 22: Wheel tracking*

EN 12697-24, *Bituminous mixtures — Test methods for hot mix asphalt — Part 24: Resistance to fatigue*

EN 12697-25, *Bituminous mixtures — Test methods for hot mix asphalt — Part 25: Cyclic compression test*

EN 12697-26, *Bituminous mixtures — Test methods for hot mix asphalt — Part 26: Stiffness*

EN 12697-31, *Bituminous mixtures — Test methods for hot mix asphalt — Part 31: Specimen preparation by gyratory compactor*

EN 12697-34, *Bituminous mixtures — Test methods for hot mix asphalt — Part 34: Marshall test*

EN 12697-41, *Bituminous mixtures — Test methods for hot mix asphalt — Part 41: Resistance to de-icing fluids*

EN 12697-43, *Bituminous mixtures — Test methods for hot mix asphalt — Part 43: Resistance to fuel*

EN 12697-44, *Bituminous mixtures — Test methods for hot mix asphalt — Part 44: Crack propagation by semi-circular bending test*

EN 12697-45, *Bituminous mixtures — Test methods for hot mix asphalt — Part 45: Saturation Ageing Tensile Stiffness (SATS) conditioning test*

EN 12697-46, *Bituminous mixtures — Test methods for hot mix asphalt — Part 46: Low temperature cracking and properties by uniaxial tension tests*

EN 12697-49, *Bituminous mixtures — Test methods for hot mix asphalt — Part 49: Determination of friction after polishing*

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

EN 13108-4:2016, *Bituminous mixtures — Material specifications — Part 4: Hot Rolled Asphalt*

EN 13108-8, *Bituminous mixtures — Material specifications — Part 8: Reclaimed asphalt*

EN 13108-20:2016, *Bituminous mixtures — Material specifications — Part 20: Type Testing*

EN 13108-21, *Bituminous mixtures — Material specifications — Part 21: Factory Production Control*

EN 13501-1:2007+A1:2009, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests*

EN 13924-1, *Bitumen and bituminous binders — Specification framework for special paving grade bitumen — Part 1: Hard paving grade bitumens*

EN 13924-2, *Bitumen and bituminous binders — Specification framework for special paving grade bitumen — Part 2: Multigrade paving grade bitumens*

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

EN ISO 11925-2, *Reaction to fire tests — Ignitability of products subjected to direct impingement of flame — Part 2: Single-flame source test (ISO 11925-2)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
pavement
structure, composed of one or more courses, to assist the passage of traffic over terrain

3.1.2
layer
element of a pavement laid in a single operation

3.1.3
course
element of a pavement constructed with a single asphalt mixture

Note 1 to entry: A course can be laid in one or more layers.

3.1.4
surface course
upper course of the pavement, which is in contact with the traffic

3.1.5
binder course
structural course of the pavement between the surface course and the base

3.1.6
regulating course
course of variable thickness applied to an existing course or surface to provide the necessary profile for a further course of consistent thickness

3.1.7
base
main structural element of a pavement

Note 1 to entry: The base can be laid in one or more courses, described as “upper” base, “lower” base.

3.1.8
asphalt
homogenous mixture typically of coarse and fine aggregates, filler aggregate and bituminous binder which is used in the construction of a pavement

Note 1 to entry: Asphalt can include one or more additives to enhance the laying characteristics, performance or appearance of the mixture.

3.1.9
natural asphalt
naturally occurring mixture of bitumen and finely divided mineral matter which is found in well-defined surface deposits and which is processed to remove unwanted components such as water and vegetable matter

Note 1 to entry: Natural asphalt is described in EN 13108–4.

3.1.10
Asphalt Concrete
asphalt in which the aggregate particles are continuously graded or gap-graded to form an interlocking structure

3.1.11
mix formulation
composition of a single mixture expressed as a target composition

Note 1 to entry: A target composition is expressed in one of two ways (see 3.1.12 and 3.1.13).

3.1.12
input target composition
expression of the mix formulation in terms of the constituent materials, the grading curve and the percentage of binder added to the mixture

Note 1 to entry: This will usually be the result of a laboratory mix design and validation.

3.1.13
output target composition
expression of the mix formulation in terms of the constituent materials and the mid-point grading and soluble binder content to be found on analysis

Note 1 to entry: This will usually be the result of a production validation.

3.1.14
additive
constituent material that can be added in small quantities to influence specific properties of the mixture

Note 1 to entry: For example additives are used to influence the affinity of binder to aggregate, and the mechanical properties when using inorganic and organic fibres and polymers. They are also used to influence the colour of the mixture.

3.1.15
conflicting requirements
combination of requirements or properties which are impracticable to fulfil in their entirety

Note 1 to entry: This can occur by combining specific requirements for the composition and constituent materials together with more performance related tests. These are also relevant when two or more performance or test parameters are selected which measure similar properties using conflicting test methods resulting in a lack of clarity and consistency in the characteristics of the mixture.

3.1.16
premixed binder
bitumen which is blended on the site of the asphalt mixing plant, with an additive before or during the addition of the binder to the plant mixer, which in the case of a continuous plant, will be before or during the delivery of the binder to the mixing zone of the drier drum

3.1.17
category
defined level of a property of an asphalt mixture

Note 1 to entry: The designation of a category is expressed with a symbol and a numerical value representing the level.

EXAMPLE $B_{\text{min } 4,0}$ means that the minimum binder content shall be 4,0 %.

Note 2 to entry: Defined categories for each property are listed in EN 13108–1.

3.1.18
class
range of levels defined by a minimum and a maximum value

3.2 Symbols and abbreviations

AC general designation of Asphalt Concrete

AC *D* designation of Asphalt Concrete followed by an indication of *D*, the upper sieve size of the aggregate in the mixture, in millimetres (mm)

EXAMPLE AC 6 Asphalt Concrete with an upper sieve size of the aggregate of 6 mm.

4 Requirements for constituent materials

4.1 General

Only constituent materials with established suitability shall be used. For all constituent materials the properties relevant to the performance of the mixture shall be made available.

The establishment of suitability shall result from one or more of the following:

— European Standard;

— European Technical Assessment;

— specifications for materials based on a demonstrable history of satisfactory use in asphalt; evidence shall be based on research and/or the evidence of satisfactory practical use. In documents related to the application of the product details for the assessment of this proof may be defined.

There can be technical limitations regarding the future recycling possibilities. Also traceability of the nature of constituent materials can affect the potential for future recycling.

4.2 Binder

4.2.1 General

The binder shall be a paving grade bitumen, a polymer modified bitumen, a hard paving grade bitumen, a multigrade bitumen or a blend of one of them with natural asphalt. The paving grade bitumen shall conform to EN 12591, the modified bitumen to EN 14023, the hard paving grade bitumen to EN 13924-1 and the multigrade bitumen to EN 13924-2. When natural asphalt is used, it shall conform to EN 13108-4:2016, Annex B.

Premixed binders that are not covered by EN 12591, EN 14023 or EN 13924-1 and EN 13924-2 may be used provided that information is given as stated in 4.1, and that the base bitumen is conforming to EN 12591, EN 14023 or EN 13924-1 and EN 13924-2. The use of these binders may be defined in documents related to the application of the product.

4.2.2 Selection of binder

4.2.2.1 General

Depending on the conditions of use, the type and grade of bitumen and the amount and category of natural asphalt may be defined in documents related to the application of the product.

The type and grade of the bitumen and the amount and category of natural asphalt shall be declared in the Type Test report.

NOTE EN 14023 for modified bitumen is a framework for classification and is only meant to characterize the modified bitumen. The modified bitumen specifications are not performance based. The same applies to multigrade bitumen according to EN 13924–2.

When an additive is used to lower the production temperature of the Asphalt Concrete and thereby changes relevant properties of the binder at temperatures representative for the climatic conditions in the place of use, evidence shall be provided to show what the influence of the additive is on the performance of the mix. This proof shall be based on research or evidence of satisfactory performance according to 4.1.

4.2.2.2 Surface courses with reclaimed asphalt

When using more than 10 % by mass of the total mixture of reclaimed asphalt from mixtures in which only paving grade bitumen has been used and when the binder added to the mixture is a paving grade bitumen and the grade of the bitumen is selected, the following requirements may be defined in documents related to the application of the product.

The penetration and/or the softening point of the binder in the resulting mixture, calculated from the penetrations and/or the softening points of the added binder and the recovered binder from the reclaimed asphalt, shall meet the penetration and/or softening point requirements of the specified grade. The calculation shall be performed according to Annex A (normative). In some cases the binder of the reclaimed asphalt can be so hardened that a very soft bitumen has to be chosen to fulfil these requirements. In such cases an alternative grade to that calculated according to Annex A (normative) may be defined.

When using reclaimed asphalt from mixtures in which a modified bitumen and/or an additive has been used, and/or the mixture itself contains a modified bitumen or an additive, the amount of reclaimed asphalt may be limited in documents related to the application of the product to a maximum of 10 % by mass of the total mixture.

NOTE 1 The choice for this specification depends on the choice of requirements within this European Standard. For more performance designed mixes there might be no need to apply the pen and/or softening point rule. (However, the pen or softening point rule is only valid for paving grade bitumen.)

NOTE 2 When applying a recipe approach to the mixture, using too great a proportion of modified bitumen or additive could lead to an incorrect decision in respect to the addition of the new bitumen.

4.2.2.3 Regulating courses, binder courses and bases with reclaimed asphalt

When using more than 20 % by mass of the total mixture of reclaimed asphalt from mixtures in which only paving grade bitumen has been used and when the binder added to the mixture is a paving grade bitumen and the grade of the bitumen is selected, the following requirements may be defined in documents related to the application of the product.

The penetration and/or the softening point of the binder in the resulting mixture, calculated from the penetrations and/or the softening points of the added binder and the recovered binder from the reclaimed asphalt, shall meet the penetration and/or softening point requirements of the selected grade. The calculation shall be executed according to Annex A (normative). In some cases the binder of the recovered asphalt can be so hardened that a very soft bitumen has to be chosen to fulfil these requirements. In such cases an alternative grade to that calculated according to Annex A (normative) may be defined.

When using reclaimed asphalt from mixtures in which a modified bitumen and/or an additive has been used, and/or the mixture itself contains a modified bitumen or an additive, the amount of reclaimed asphalt for regulating courses, binder courses and base courses may be limited in documents related to the application of the product to a maximum of 20 % by mass of the total mixture.

NOTE 1 The choice for this specification depends on the choice of requirements within this standard. For performance designed mixes there might be no need to apply the pen and/ or softening point rule. (However, the pen or softening point rule is only valid for paving grade bitumen).

NOTE 2 When applying a recipe approach to the mixture, using too great a proportion of modified bitumen or additive could lead to an incorrect decision in respect to the addition of the new bitumen.

4.3 Aggregates

4.3.1 Coarse aggregate

Coarse aggregate shall conform to EN 13043 as appropriate for the intended use.

4.3.2 Fine aggregate

Fine aggregate shall conform to EN 13043 as appropriate for the intended use.

4.3.3 All-in aggregates

All-in aggregate shall conform to EN 13043 as appropriate for the intended use.

4.3.4 Added filler

Added filler shall conform to EN 13043 as appropriate for the intended use and may include materials such as cement, limestone and hydrated lime. Based on the experience in the place of use the type and amount of added filler may be defined in documents related to the application of the product.

NOTE The expression "as appropriate for the intended use" in 4.3.1 to 4.3.4 means that the selection of the requirements and the particular category depends on a number of conditions. These conditions include traffic density, climatic conditions, the construction of the course in which the mixture will be used, and economic considerations.

4.4 Reclaimed asphalt

The use and the amount of reclaimed asphalt and the mix group and/or the courses from which the reclaimed asphalt has been or will be derived may be defined in documents related to the application of the product.

The properties of reclaimed asphalt declared in accordance with EN 13108-8 shall conform to requirements that may be selected appropriate for the intended use.

NOTE The expression "appropriate for the intended use" means that the selection of the requirements and the particular category depends on a number of conditions. These conditions include traffic density, climatic conditions, the construction of the course in which the mixture will be used, and economic considerations.

The upper sieve size *D* of the aggregate in the reclaimed asphalt shall not exceed the upper sieve size *D* of the mixture. The aggregate properties of the reclaimed asphalt or of the mixed aggregates from the reclaimed asphalt with the other aggregates shall fulfil the requirements for aggregate defined in documents related to the application of the mixture.

When required, the amount of reclaimed asphalt, the mix group and/or the courses from which the reclaimed asphalt has been or will be derived shall be declared in the Type Test report.

4.5 Additives

The nature and properties of all additives shall be declared and they shall conform to the requirements referred to in 4.1. For specific applications and based on the experience in the place of use the amount of additives may be defined in documents related to the application of the product.

NOTE Chemical and organic additives can be used for example, to reduce production temperatures by influencing the viscosity of the binder. This might have an effect on other relevant mixture properties.

5 Requirements for the mixture

5.1 General

The mix formulation shall be declared in the Type Test report according to EN 13108-20, including:

— the target percentages passing the specified sieves. The target grading shall be declared for the sieves as defined in 5.2.2.1 or 5.2.2.2;

— the target binder content and where relevant, the binder content from reclaimed asphalt and/or binder content in natural asphalt;

— and the percentage(s) of additive(s).

The target binder content comprises the total of added binder (including any additives in solution in the binder), binder in reclaimed asphalt and binder in natural asphalt.

At the target composition the mixture shall conform to the appropriate requirements in accordance with this European Standard.

The test results in accordance with EN 13108-20:2016, 7.5, shall be made available.

5.2 Composition, grading, binder content

5.2.1 Composition

The grading shall be expressed in percentages by mass of total aggregate. The binder and additive content shall be expressed in percentages by mass of the total mixture. The percentages passing the sieves, with the exception of the sieve 0,063 mm shall be expressed to 1 %. The binder content, the percentage passing sieve 0,063 mm and any additive content shall be expressed to 0,1 %. Where appropriate the additive content shall be expressed to 0,01 %.

5.2.2 Grading

5.2.2.1 General grading requirements

The requirements for the overall grading limits of the target composition are given in Tables 1 and 2 for the sieves 1,4 *D*, *D*, 2 mm and 0,063 mm. The target composition shall be within these overall limits. See also 5.6 for conflicting requirements.

The sieves to be used shall be either basic sieve set plus set 1 or basic sieve set plus set 2, according to EN 13043. A combination of sieve sizes from set 1 and set 2 shall not be permissible.

The target grading according to 5.1 shall be declared for the sieves 1,4 *D*, *D*, 2 mm and 0,063 mm, as a minimum. In documents related to the application of the product it may be defined that the target grading shall be further declared for a maximum of three characteristic sieves between *D* and 2 mm and a maximum of three characteristic sieves between 2 mm and 0,063 mm.

NOTE When this approach is chosen there are no further prescribed requirements for the grading on any other characteristic sieves (see also 5.6 for conflicting requirements).

When required to be declared, those characteristic sieves shall be chosen from the lists identified in 5.2.2.2.

Table 1 — General grading requirements of target composition — Basic sieve set plus set 1

D	**4**	**5 (5,6)**	**8**	**11 (11,2)**	**16**	**22 (22,4)**	**32 (31,5)**
Sieve mm	**Percentage passing by mass**						
1,4 *D*[a]	100	100	100	100	100	100	100
D	90 to 100	90 to 100	90 to 100	90 to 100	90 to 100	90 to 100	90 to 100
2	50 to 85	15 to 72	10 to 72	10 to 60	10 to 50[b]	10 to 50[b]	10 to 65
0,063	5,0 to 17,0	2,0 to 15,0	2,0 to 13,0	2,0 to 12,0	0 to 12,0	0 to 11,0	0 to 11,0

[a] Where the sieve calculated as 1,4 *D* is not an exact number in the basic set plus set 1 series then the next nearest sieve in the set shall be adopted.

[b] For application on airfields the maximum percentage passing 2 mm may be increased to 60 %.

Table 2 — General grading requirements of target composition — Basic sieve set plus set 2

D	**4**	**6 (6,3)**	**8**	**10**	**12 (12,5)**	**14**	**16**	**20**	**32 (31,5)**
Sieve mm	**Percentage passing by mass**								
1,4 *D*[a]	100	100	100	100	100	100	100	100	100
D	90 to 100	90 to 100	90 to 100	90 to 100	90 to 100	90 to 100	90 to 100	90 to 100	90 to 100
2	50 to 85	15 to 72	10 to 72	10 to 60	10 to 55	10 to 50[b]	10 to 50[b]	10 to 50[b]	10 to 65
0,063	5,0 to 17,0	2,0 to 15,0	2,0 to 13,0	2,0 to 12,0	2,0 to 12,0	0 to 12,0	0 to 12,0	0 to 11,0	0 to 11,0

[a] Where the sieve calculated as 1,4 D is not an exact number in the basic set plus set 2 series then the next nearest sieve in the set shall be adopted.

[b] For application on airfields the maximum percentage passing 2 mm may be increased to 60 %.

5.2.2.2 Grading envelope

The grading requirements as given in 5.2.2.1 may further be defined in documents related to the application of the product. (see 5.6 for conflicting requirements). When required, the grading requirements for the target composition shall be expressed in terms of a grading envelope by selection of maximum and minimum values for the percentages passing the sieves 1,4 *D*; *D*; a characteristic sieve between *D* and 2 mm, 2 mm, a characteristic sieve between 2 mm and 0,063 mm and 0,063 mm.

D and the characteristic sieve between *D* and 2 mm shall be selected from the following sieves:

— basic sieve set plus set 1: 4 mm; 5,6 mm; 8 mm; 11,2 mm; 16 mm; 22,4 mm, 31,5 mm;

— basic sieve set plus set 2: 4 mm; 6,3 mm; 8 mm; 10 mm; 12,5 mm; 14 mm; 16 mm; 20 mm, 31,5 mm.

The characteristic sieve between 2 mm and 0,063 mm shall be selected from the following sieves: 1 mm; 0,5 mm; 0,25 mm and 0,125 mm.

When defined in documents related to the application of the product, the requirements for the grading envelope may also include the percentages passing a maximum of two additional characteristic sieves between *D* and 2 mm and a maximum of two additional characteristic sieves between 2 mm and 0,063 mm, selected from the same list of sieves as for the characteristic sieves.

The target composition of the mixture shall be within this grading envelope. The ranges between the maximum and minimum values for the grading envelope shall be selected as a single value within the

given limits from Table 3. The percentage passing the sieves *D*, 2 mm and 0,063 mm, of the selected grading envelope shall not exceed the maximum and minimum values in Table 1 or Table 2.

Table 3 — Ranges between maximum and minimum percentage values for the selected grading envelope

Sieve mm	**Ranges for grading envelope**
D	10
Characteristic sieve between *D* and 2	10 to 30[a]
Any additional characteristic sieves between *D* and 2	10 to 30[a]
2	5 to 25[a]
Characteristic sieve between 2 and 0,063	4 to 25[a]
Any additional characteristic sieves between 2 and 0,063	4 to 25[a]
0,063	2,0 to 12,0[a]

[a] Value to be selected within the given minimum and maximum value (both included).

In the case of a single point target grading meeting the requirements of Table 1 or Table 2, the use of the minimum range values in Table 3 is not required.

5.2.3 Minimum binder content

The minimum binder content may be defined in documents related to the application of the product and shall be selected to the nearest 0,1 %, between values of 3,0 % and 8,0 % for a mixture in which the aggregate density is assumed to be equal to 2,65 Mg/m^3.

The selected minimum binder content shall be expressed as B_{minx} where x is the minimum binder content in %.

The minimum binder content of the mixture shall be corrected by multiplying by the factor:

$$\alpha = \frac{2{,}650}{\rho} \tag{1}$$

where

ρ is the weighted mean of the particle density of the aggregates at the target grading, in megagrams per cubic metre (Mg/m^3), determined according to EN 1097–6

The appropriate particle density according to EN 1097-6 shall be declared in the type test report.

NOTE For normal weight aggregates with water absorption less than about 1,5 % the pre-dried particle density method as defined in EN 1097–6:2013, Annex A, is applicable for aggregates passing the 63 mm test sieve and retained on the 0,063 mm test sieve. EN 1097–6:2013, Annex G, is applicable to aggregates passing the 31,5 mm test sieve including the 0/0,063 mm size fraction.

Based on experience in the place of use for certain specific aggregates with particular granulometric characteristics the corrected minimum binder content may be adjusted appropriately. The adjustment shall be defined in documents related to the application of the product.

5.3 Properties

5.3.1 Specimens

For application of this European Standard specimens shall be in accordance with EN 13108-20:2016, 6.5.

5.3.2 Void content requirements

5.3.2.1 Void content

The range of categories of minimum and maximum void contents is defined in Table 4.

The void content shall be determined in accordance with EN 12697-8 using the conditions defined in EN 13108-20:2016, D.2. The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1.

In documents related to the application of the product, categories or classes for the void content may be defined when appropriate as maximum and minimum categories selected from Table 4.

Table 4 — Void content, V_{min} and/or V_{max}

Void content %	Minimum void content %	Maximum void content %
	Category V_{min}	Category V_{max}
0,5	$V_{min\ 0,5}$	–
1,0	$V_{min\ 1,0}$	–
1,5	$V_{min\ 1,5}$	–
2,0	$V_{min\ 2,0}$	$V_{max\ 2,0}$
2,5	$V_{min\ 2,5}$	$V_{max\ 2,5}$
3,0	$V_{min\ 3,0}$	$V_{max\ 3,0}$
3,5	$V_{min\ 3,5}$	$V_{max\ 3,5}$
4,0	$V_{min\ 4,0}$	$V_{max\ 4,0}$
4,5	$V_{min\ 4,5}$	$V_{max\ 4,5}$
5,0	$V_{min\ 5,0}$	$V_{max\ 5,0}$
5,5	$V_{min\ 5,5}$	$V_{max\ 5,5}$
6,0	$V_{min\ 6,0}$	$V_{max\ 6,0}$
6,5	–	$V_{max\ 6,5}$
7,0	–	$V_{max\ 7,0}$
8,0	–	$V_{max\ 8,0}$
9,0	–	$V_{max\ 9,0}$
10,0	–	$V_{max\ 10,0}$
11,0	–	$V_{max\ 11,0}$
12,0	–	$V_{max\ 12,0}$
13,0	–	$V_{max\ 13,0}$
14,0	–	$V_{max\ 14,0}$
No requirement	$V_{min\ NR}$	$V_{max\ NR}$

5.3.2.2 Voids filled with binder

The percentage of voids filled with binder shall be determined according EN 12697-8 using the conditions defined in EN 13108-20:2016, D.2, based on the samples prepared and tested according to 5.3.2.1.

The range of categories of minimum and maximum percentage of voids filled with binder is defined in Tables 5 and 6. In documents related to the application of the product categories for the minimum and/or maximum percentage of voids filled with binder selected from Tables 5 and 6 may be defined.

Table 5 — Minimum voids filled with binder, VFB_{min}

Minimum voids filled with binder %	Category VFB_{min}
50	$VFB_{min\ 50}$
55	$VFB_{min\ 55}$
60	$VFB_{min\ 60}$
65	$VFB_{min\ 65}$
70	$VFB_{min\ 70}$
72	$VFB_{min\ 72}$
75	$VFB_{min\ 75}$
78	$VFB_{min\ 78}$
82	$VFB_{min\ 82}$
85	$VFB_{min\ 85}$
88	$VFB_{min\ 88}$
No requirement	$VFB_{min\ NR}$

Table 6 — Maximum voids filled with binder, VFB_{max}

Maximum voids filled with binder %	Category VFB_{max}
50	$VFB_{max\ 50}$
53	$VFB_{max\ 53}$
56	$VFB_{max\ 56}$
59	$VFB_{max\ 59}$
62	$VFB_{max\ 62}$
65	$VFB_{max\ 65}$
68	$VFB_{max\ 68}$
71	$VFB_{max\ 71}$
74	$VFB_{max\ 74}$
77	$VFB_{max\ 77}$
80	$VFB_{max\ 80}$
83	$VFB_{max\ 83}$
86	$VFB_{max\ 86}$
89	$VFB_{max\ 89}$
93	$VFB_{max\ 93}$
97	$VFB_{max\ 97}$
No requirement	$VFB_{max\ NR}$

5.3.2.3 Voids in mineral aggregate

The percentage of voids in mineral aggregate shall be determined according to EN 12697-8 using the conditions defined in EN 13108-20:2016, D.2, based on the samples prepared and tested according to 5.3.2.1.

The range of categories of minimum percentage of voids in mineral aggregate is defined in Table 7.

In documents related to the application of the product, categories for the minimum percentage of voids in mineral aggregate selected from Table 7 may be defined.

Table 7 — Minimum voids in mineral aggregate, VMA_{min}

Minimum voids in mineral aggregate %	Category VMA_{min}
8	$VMA_{min\ 8}$
10	$VMA_{min\ 10}$
12	$VMA_{min\ 12}$
14	$VMA_{min\ 14}$
16	$VMA_{min\ 16}$
18	$VMA_{min\ 18}$
No requirement	$VMA_{min\ NR}$

5.3.2.4 Void content at 10 gyrations

The minimum void content after 10 gyrations shall be determined in accordance with EN 12697-31 using the conditions defined in EN 13108-20:2016, D.2.

The range of categories of minimum void content after compaction by 10 gyrations is defined in Table 8.

In documents related to the application of the product, categories for the minimum void content at 10 gyrations selected from Table 8 may be defined.

Table 8 — Minimum void content at 10 gyrations, $V10G_{min}$

Minimum void content at 10 gyrations %	Category $V10G_{min}$
9,0	$V10G_{min\ 9,0}$
11,0	$V10G_{min\ 11,0}$
14,0	$V10G_{min\ 14,0}$
No requirement	$V10G_{min\ NR}$

5.3.3 Water sensitivity

The water sensitivity expressed as an Indirect Tensile Strength Ratio or Compression strength ratio shall be determined in accordance with EN 12697-12 using the conditions defined in EN 13108-20:2016, D.3.

The range of categories of water sensitivity of specimens is defined in Table 9.

In documents related to the application of the product, categories for the minimum water sensitivity selected from Table 9 may be defined.

Table 9 — Minimum water sensitivity, $ITSR_{min}$ or i/C_{min}

Minimum Water sensitivity %	Category $ITSR_{min}$	Category i/C_{min}
90	$ITSR_{min90}$	i/C_{min90}
85	$ITSR_{min85}$	i/C_{min85}
80	$ITSR_{min80}$	i/C_{min80}
75	$ITSR_{min75}$	i/C_{min75}
70	$ITSR_{min70}$	i/C_{min70}
65	$ITSR_{min65}$	i/C_{min65}
60	$ITSR_{min60}$	i/C_{min60}
No requirement	$ITSR_{minNR}$	i/C_{minNR}

5.3.4 Resistance to abrasion by studded tyres

The resistance to abrasion by studded tyres shall be determined in accordance with EN 12697-16, method A using the conditions defined in EN 13108-20:2016, D.4.

The range of categories of resistance to abrasion by studded tyres of specimens is defined in Table 10.

In documents related to the application of the product, categories for resistance to abrasion by studded tyres selected from Table 10 may be defined.

Table 10 — Maximum abrasion value, $Abr_{A\ max}$

Maximum abrasion value ml	Category $Abr_{A\ max}$
20	$Abr_{A\ max20}$
24	$Abr_{A\ max24}$
28	$Abr_{A\ max28}$
32	$Abr_{A\ max32}$
36	$Abr_{A\ max36}$
40	$Abr_{A\ max40}$
45	$Abr_{A\ max45}$
50	$Abr_{A\ max50}$
No requirement	$Abr_{A\ max\ NR}$

5.3.5 Resistance to permanent deformation

5.3.5.1 Permanent deformation by wheel-tracking test

The resistance to permanent deformation, in terms of rut depth and wheel-tracking slope, shall be determined in accordance with EN 12697-22 using the conditions defined in EN 13108-20:2016, D.6.

The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1 where the range between the upper and lower limits selected shall be 2 % based on compaction degree and 3 % based on void content.

The void content of the specimens shall be specified in accordance with EN 13108-20:2016, D.2.

The ranges of categories of resistance to permanent deformation of specimens are defined in one of the Tables 11, 12, 13 or 14. A combination of a requirement from Table 13 and Table 14 is not allowed.

In documents related to the application of the product, categories for the resistance to permanent deformation selected from Tables 11, 12, 13 or 14 may be defined.

Table 11 — Large size device[a], maximum proportional rut depth, P_{max}

Large size device[a], maximum proportional rut depth %	**Category P_{max}**
5,0	$P_{max5,0}$
7,5	$P_{max7,5}$
10,0	$P_{max10,0}$
15,0	$P_{max15,0}$
20,0	$P_{max20,0}$
No requirement	$P_{max\ NR}$
[a] For designed axle loads ≥ 13 Mg.	

Table 12 — Small size device[a], procedure B, conditioning in air, maximum wheel tracking slope, $WTS_{AIR\ max}$

Small size device[a], procedure B, conditioning in air, maximum wheel tracking slope mm per 10^3 load cycle	**Category $WTS_{AIR\ max}$**
0,03	$WTS_{AIR\ max\ 0,03}$
0,04	$WTS_{AIR\ max\ 0,04}$
0,05	$WTS_{AIR\ max\ 0,05}$
0,06	$WTS_{AIR\ max\ 0,06}$
0,07	$WTS_{AIR\ max\ 0,07}$
0,08	$WTS_{AIR\ max\ 0,08}$
0,09	$WTS_{AIR\ max\ 0,09}$
0,10	$WTS_{AIR\ max\ 0,10}$
0,15	$WTS_{AIR\ max\ 0,15}$
0,30	$WTS_{AIR\ max\ 0,30}$
0,40	$WTS_{AIR\ max\ 0,40}$
0,50	$WTS_{AIR\ max\ 0,50}$
0,60	$WTS_{AIR\ max\ 0,60}$
0,80	$WTS_{AIR\ max\ 0,80}$
1,00	$WTS_{AIR\ max\ 1,00}$
No requirement	$WTS_{AIR\ max\ NR}$

[a] For designed axle loads < 13 Mg.

Table 13 — Small size device[a], procedure B, conditioning in air, maximum proportional rut depth, $PRD_{AIR\ max}$

Small size device[a], procedure B, conditioning in air, maximum proportional rut depth %	**Category $PRD_{AIR\ max}$**
3,0	$PRD_{AIR\ max\ 3,0}$
4,0	$PRD_{AIR\ max\ 4,0}$
5,0	$PRD_{AIR\ max\ 5,0}$
6,0	$PRD_{AIR\ max\ 6,0}$
7,0	$PRD_{AIR\ max\ 7,0}$
9,0	$PRD_{AIR\ max\ 9,0}$
11,0	$PRD_{AIR\ max\ 11,0}$
13,0	$PRD_{AIR\ max\ 13,0}$
16,0	$PRD_{AIR\ max\ 16,0}$
20,0	$PRD_{AIR\ max\ 20,0}$
25,0	$PRD_{AIR\ max\ 25,0}$
No requirement	$PRD_{AIR\ max\ NR}$

[a] For designed axle loads < 13 Mg.

Table 14 — Small size device[a], procedure B, conditioning in air, maximum rut depth, $RD_{AIR\ max}$

Small size device[a], procedure B, conditioning in air, maximum rut depth mm	Category $RD_{AIR\ max}$
1,0	$RD_{AIR\ max\ 1,0}$
1,5	$RD_{AIR\ max\ 1,5}$
2,0	$RD_{AIR\ max\ 2,0}$
2,5	$RD_{AIR\ max\ 2,5}$
3,0	$RD_{AIR\ max\ 3,0}$
3,5	$RD_{AIR\ max\ 3,5}$
4,0	$RD_{AIR\ max\ 4,0}$
4,5	$RD_{AIR\ max\ 4,5}$
5,0	$RD_{AIR\ max\ 5,0}$
5,5	$RD_{AIR\ max\ 5,5}$
6,5	$RD_{AIR\ max\ 6,5}$
7,0	$RD_{AIR\ max\ 7,0}$
8,0	$RD_{AIR\ max\ 8,0}$
9,0	$RD_{AIR\ max\ 9,0}$
10,0	$RD_{AIR\ max\ 10,0}$
No requirement	$RD_{AIR\ max\ NR}$

[a] For designed axle loads < 13 Mg.

5.3.5.2 Resistance to permanent deformation in tri-axial compression test

The resistance to permanent deformation, in terms of the creep rate in tri-axial compression, f_C, shall be determined in accordance with EN 12697-25 using the conditions defined in EN 13108-20:2016, D.7.

The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1 where the range between the upper and lower limits selected shall be 2 % based on compaction degree and 3 % based on void content.

The void content of the specimens shall be specified in accordance with EN 13108-20:2016, D.2.

The range of categories of resistance to permanent deformation of specimens is defined in Table 15.

In documents related to the application of the product, categories for the resistance to permanent deformation selected from Table 15 may be defined.

Table 15 — Maximum creep rate, $f_{C\ max}$

Maximum creep rate f_C ***Microstrain/loading cycle***	**Category $f_{C\ max}$**
0,2	$f_{C\ max\ 0,2}$
0,4	$f_{C\ max\ 0,4}$
0,6	$f_{C\ max\ 0,6}$
0,8	$f_{C\ max\ 0,8}$
1,0	$f_{C\ max\ 1,0}$
1,2	$f_{C\ max\ 1,2}$
1,4	$f_{C\ max\ 1,4}$
1,6	$f_{C\ max\ 1,6}$
2,0	$f_{C\ max\ 2,0}$
4,0	$f_{C\ max\ 4,0}$
6,0	$f_{C\ max\ 6,0}$
8,0	$f_{C\ max\ 8,0}$
10,0	$f_{C\ max\ 10,0}$
12,0	$f_{C\ max\ 12,0}$
14,0	$f_{C\ max\ 14,0}$
16,0	$f_{C\ max\ 16,0}$
No requirement	$f_{C\ max\ NR}$

5.3.6 Stiffness

The stiffness shall be determined in accordance with EN 12697-26 using the conditions defined in EN 13108-20:2016, D.8.

The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1, where the range between the upper and lower limits selected shall be 2 % based on compaction degree and 3 % based on void content.

The void content of the specimens shall be specified in accordance with EN 13108-20:2016, D.2.

The ranges of categories of stiffness are defined in Table 16 and/or Table 17.

In documents related to the application of the product categories or classes for the stiffness, selected from Table 16 and/or Table 17 may be defined.

Table 16 — Minimum stiffness, S_{min}

Minimum stiffness MPa	Category S_{min}
21 000	S_{min} 21 000
17 000	S_{min} 17 000
14 000	S_{min}14 000
11 000	S_{min} 11 000
9 000	S_{min} 9 000
7 000	S_{min} 7 000
5 500	S_{min} 5 500
4 500	S_{min} 4 500
3 600	S_{min} 3 600
2 800	S_{min} 2 800
2 200	S_{min} 2 200
1 800	S_{min} 1 800
1 500	S_{min} 1 500
No requirement	S_{min} NR

Table 17 — Maximum stiffness, S_{max}

Maximum stiffness MPa	Category S_{max}
30 000	S_{max} 30 000
25 000	S_{max} 25 000
21 000	S_{max} 21 000
17 000	S_{max} 17 000
14 000	S_{max} 14 000
11 000	S_{max} 11 000
9 000	S_{max} 9 000
7 000	S_{max} 7 000
No requirement	S_{max} NR

5.3.7 Resistance to fatigue

The resistance to fatigue shall be determined in accordance with EN 12697-24 using the conditions defined in EN 13108-20:2016, D.9.

The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1 where the range between the upper and lower limits selected shall be 2 % based on compaction degree and 3 % based on void content.

The void content of the specimens shall be specified in accordance with EN 13108-20:2016, D.2.

The ranges of categories of resistance to fatigue are defined in Table 18 and Table 19. A combination of a requirement from Table 18 and Table19 is not allowed.

In documents related to the application of the product categories for the resistance to fatigue, selected from Table 18 or Table 19 may be defined.

Table 18 — Minimum resistance to fatigue, $\varepsilon_{6\text{-min}}$

Minimum resistance to fatigue *microstrain*	**Category** $\varepsilon_{6\text{-min}}$
310	$\varepsilon_{6\text{-min}}$ 310
260	$\varepsilon_{6\text{-min}}$ 260
220	$\varepsilon_{6\text{-min}}$ 220
190	$\varepsilon_{6\text{-min}}$ 190
160	$\varepsilon_{6\text{-min}}$ 160
130	$\varepsilon_{6\text{-min}}$ 130
115	$\varepsilon_{6\text{-min}}$ 115
100	$\varepsilon_{6\text{-min}}$100
90	$\varepsilon_{6\text{-min}}$ 90
80	$\varepsilon_{6\text{-min}}$ 80
70	$\varepsilon_{6\text{-min}}$ 70
60	$\varepsilon_{6\text{-min}}$ 60
50	$\varepsilon_{6\text{-min}}$ 50
No requirement	$\varepsilon_{6\text{-min}}$ NR

Table 19 — Resistance to fatigue, $N_{\text{macro min}}$

Minimum load cycle number until macro crack formation for $\Delta\varepsilon$ = 0,1 ‰	Minimum load cycle number until macro crack formation for $\Delta\varepsilon$ = 0,05 ‰	Category $N_{\text{macro min}}$
3 000	30 000	$N_{\text{macro min } 3/30}$
5 000	60 000	$N_{\text{macro min } 5/60}$
9 000	100 000	$N_{\text{macro min } 9/100}$
15 000	200 000	$N_{\text{macro min } 15/200}$
25 000	400 000	$N_{\text{macro min } 25/400}$
45 000	800 000	$N_{\text{macro min } 45/800}$
No requirement	No requirement	$N_{\text{macro min NR}}$

5.3.8 Saturation Ageing Tensile Stiffness conditioning test (Mixture SATS Durability Index)

The Mixture SATS Durability Index shall be determined in accordance with EN 12697-45 using the conditions defined in EN 13108-20:2016, D.17.

The range of categories of Mixture SATS Durability Index of test specimens is defined in Table 20.

In documents related to the application of the product categories for the Mixture SATS Durability Index, selected from Table 20 may be defined.

Table 20 — Mixture SATS Durability Index, MDI_{min}

Mixture SATS Durability Index %	Category MDI_{min}
100	$MDI_{\text{min}100}$
90	$MDI_{\text{min } 90}$
80	$MDI_{\text{min } 80}$
70	$MDI_{\text{min } 70}$
60	$MDI_{\text{min } 60}$
No requirement	$MDI_{\text{min NR}}$

5.3.9 Low temperature properties

The maximum failure temperature shall be determined in accordance with EN 12697-46 Thermal Stress Restrained Specimen Test (TSRST), using the conditions defined in EN 13108-20:2016, D.18.

The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1 where the range between the upper and lower limits selected shall be 2 % based on compaction degree and 3 % based on void content.

The void content of the specimens shall be specified in accordance with EN 13108-20:2016, D.2.

The range of categories of maximum failure temperature of specimens is defined in Table 21.

In documents related to the application of the product categories for the maximum failure temperature selected from Table 21 may be defined.

Table 21 — Maximum failure temperature, $TSRST_{max}$

Maximum failure temperature °C	**Category $TSRST_{max}$**
−15,0	$TSRST_{max}$ −15,0
−17,5	$TSRST_{max}$ −17,5
−20,0	$TSRST_{max}$ −20,0
−22,5	$TSRST_{max}$ −22,5
−25,0	$TSRST_{max}$ −25,0
−27,5	$TSRST_{max}$ −27,5
−30,0	$TSRST_{max}$ −30,0
No requirement	$TSRST_{max}$ NR

5.3.10 Fracture toughness

The fracture toughness shall be determined in accordance with EN 12697-44 using the conditions defined in EN 13108-20:2016, D.19.

The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1, where the range between the upper and lower limits selected shall be 2 % based on compaction degree and 3 % based on void content.

The void content of the specimens shall be specified in accordance with EN 13108-20:2016, D.2.

The range of categories of fracture toughness of specimens is defined in Table 22.

In documents related to the application of the product categories for the minimum fracture toughness selected from Table 22 may be defined.

Table 22 — Minimum fracture toughness, $K_{Ic\ min}$

Minimum fracture toughness $N/mm^{1,5}$	Category $K_{Ic\ min}$
10	$K_{Ic\ min10}$
15	$K_{Ic\ min15}$
20	$K_{Ic\ min20}$
25	$K_{Ic\ min25}$
30	$K_{Ic\ min30}$
35	$K_{Ic\ min35}$
40	$K_{Ic\ min40}$
45	$K_{Ic\ min45}$
50	$K_{Ic\ min50}$
55	$K_{Ic\ min55}$
No requirement	$K_{Ic\ minNR}$

5.3.11 Friction after polishing

The minimum friction after polishing shall be determined in accordance with EN 12697-49 using the conditions defined in EN 13108-20:2016, D.20.

The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1, where the range between the upper and lower limits selected shall be 2 % based on compaction degree and 3 % based on void content.

The void content of the specimens shall be specified in accordance with EN 13108-20:2016, D.2.

The range of categories of minimum friction after polishing of specimens is defined in Table 23.

In documents related to the application of the product categories for the minimum friction after polishing selected from Table 23 may be defined.

Table 23 — Minimum friction after polishing, FAP_{min}

Minimum friction after polishing	Category FAP_{min}
0,30	FAP_{min30}
0,32	FAP_{min32}
0,34	FAP_{min34}
0,36	FAP_{min36}
0,38	FAP_{min38}
0,40	FAP_{min40}
0,42	FAP_{min42}
0,44	FAP_{min44}
0,46	FAP_{min46}
0,48	FAP_{min48}
0,50	FAP_{min50}
No requirement	FAP_{minNR}

5.3.12 Coating and homogeneity

The material when discharged from the mixer shall be homogenous in appearance with the aggregate completely coated with binder, and there shall be no evidence of balling of fine aggregate.

5.3.13 Reaction to fire

Where subject to regulation, the manufacturer shall declare the reaction to fire class according to EN 13501-1:2007+A1:2009, Table 2, according to the test method EN ISO 11925-2.

5.3.14 Marshall values for application on airfields

The Marshall values for application on airfields shall be determined according to EN 12697-34 using the conditions defined in EN 13108-20:2016, D.10.

The ranges of categories of Marshall Stability (MS), the Marshall Flow (F) and the Marshall Quotient (Q), are defined in Tables 24, 25, 26 and 27 respectively. For Marshall Flow a minimum and maximum value may be selected, the range shall be at least 2 mm.

In documents related to the application of the product categories for the Marshall values selected from Tables 24, 25, 26 and 27 may be defined.

Table 24 — Minimum Marshall Stability, MS_{min}

Minimum Marshall Stability kN	Category MS_{min}
12,5	$MS_{min\ 12,5}$
10,0	$MS_{min\ 10,0}$
7,5	$MS_{min\ 7,5}$
5,0	$MS_{min\ 5,0}$
2,5	$MS_{min\ 2,5}$
No requirement	$MS_{min\ NR}$

Table 25 — Maximum Marshall Stability, MS_{max}

Maximum Marshall Stability kN	Category MS_{max}
22,5	$MS_{max\ 22,5}$
20,0	$MS_{max\ 20,0}$
17,5	$MS_{max\ 17,5}$
15,0	$MS_{max\ 15,0}$
12,5	$MS_{max\ 12,5}$
10,0	$MS_{max\ 10,0}$
7,5	$MS_{max\ 7,5}$
No requirement	$MSP_{max\ NR}$

Table 26 — Marshall Flow, *F*

Marshall Flow mm	Category *F*
1,0	$F_{1,0}$
1,5	$F_{1,5}$
2,0	$F_{2,0}$
3,0	$F_{3,0}$
4,0	$F_{4,0}$
5,0	$F_{5,0}$
8,0	$F_{8,0}$
No requirement	F_{NR}

Table 27 — Minimum Marshall Quotient, Q_{min}

Minimum Marshall Quotient kN/mm	Category Q_{min}
4,0	$Q_{min\ 4,0}$
3,5	$Q_{min\ 3,5}$
3,0	$Q_{min\ 3,0}$
2,5	$Q_{min\ 2,5}$
2,0	$Q_{min\ 2,0}$
1,5	$Q_{min\ 1,5}$
1,0	$Q_{min\ 1,0}$
No requirement	$Q_{min\ NR}$

5.3.15 Resistance to fuel for application on airfields

The resistance to fuel for application on airfields shall be determined according EN 12697-43 using the conditions defined in EN 13108-20:2016, D.11.

The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1 where the range between the upper and lower limits selected shall be 2 % based on compaction degree and 3 % based on void content.

The range of categories of resistance to fuel of specimens is defined in Table 28.

In documents related to the application of the product categories for the resistance to fuel for application on airfields selected from Table 28 may be defined.

Table 28 — Resistance to fuel, maximum loss of mass, Ci_{max}

Resistance to fuel, maximum loss of mass %	Category Ci_{max}
6	Ci_{max6}
7	Ci_{max7}
8	Ci_{max8}
9	Ci_{max9}
10	Ci_{max10}
11	Ci_{max11}
12	Ci_{max12}
13	Ci_{max13}
14	Ci_{max14}
15	Ci_{max15}
No requirement	Ci_{maxNR}

5.3.16 Resistance to de-icing fluid for application on airfields

The resistance to de-icing fluids for application on airfields shall be determined according EN 12697-41 using the conditions defined in EN 13108-20:2016, D.12.

The compaction of test specimens shall be selected from EN 13108-20:2016, Table C.1, where the range between the upper and lower limits selected shall be 2 % based on compaction degree and 3 % based on void content.

The range of categories of resistance to de-icing fluid of specimens is defined in Table 29.

In documents related to the application of the product categories for the resistance to de-icing fluid for application on airfields selected from Table 29 may be defined.

Table 29 — Minimum retained strength, β_{min}

Minimum retained strength %	Category β_{min}
100	β_{min100}
85	β_{min85}
70	β_{min70}
55	β_{min55}
No requirement	β_{minNR}

5.4 Temperature of the mixture

The maximum temperature requirements are intended to protect the integrity of the mixture. The maximum temperature applies at any place in the plant and shall be declared.

When using paving grade binder or hard grade binder, the maximum temperature, measured according to EN 12697-13, shall not exceed the limits given in Table 30.

Table 30 — Maximum temperature of the mixture

Grade of binder	Maximum temperature °C
10/20, 15/25, 20/30	200
30/45	195
35/50, 40/60	190
50/70, 70/100	180
100/150	170
160/220	165
250/330,	160
330/430	155

When using modified bitumen, multigrade bitumen, additives or premix bitumen, different maximum temperatures may be applicable. These shall then be documented and declared.

The minimum temperature of the mixture at delivery shall be declared. Depending on local conditions and for specific application the minimum temperature, measured according to EN 12697-13, may be defined in documents related to the application of the product.

5.5 Regulated dangerous substances

When required, products covered by this standard shall comply with relevant regulations on regulated dangerous substances in force in the intended place of use.

In the absence of International or European test methods, manufacturers shall verify and declare the release of dangerous substances in accordance with provisions applicable in the intended place of use of the product.

NOTE An informative database of European and national regulations on dangerous substances is available at the Construction website on EUROPA (accessed through http://ec.europa.eu/enterprise/construction/cpd-ds).

5.6 Conflicting requirements

The overall quality of an Asphalt Concrete mixture can be covered by different combinations of requirements,. The selection of requirements and the appropriate values shall be such that conflicting requirements are prevented.

To prevent conflicting requirements of mixtures the following combinations are not permissible:

— requirements for Marshall values (see 5.3.14), for voids filled with binder (see 5.3.2.2), for voids in mineral aggregate (see 5.3.2.3) and for void content at 10 gyrations (see 5.3.2.4) shall not be combined with requirements for resistance to permanent deformation (see 5.3.5);

— requirements for fatigue (5.3.7), and/or stiffness (5.3.6) and/or resistance to permanent deformation in tri-axial compression test (5.3.5.2) shall not be combined with requirements for

binder content with a percentage above 3,0 and/or additional grading requirements according 5.2.2.2, and/or with requirements for the stiffness properties of filler (4.3.4) and the angularity of fine aggregates (4.3.2);

— requirements for resistance to polishing of coarse aggregates according to EN 13043 shall not be combined with requirements for the friction after polishing of the mixture (5.3.11);

— requirements for resistance to permanent deformation based on rut depth and wheel-tracking slope in the wheel-tracking test (5.3.5.1) shall not be combined with resistance to permanent deformation in tri-axial compression test (5.3.5.2).

6 Assessment and verification of constancy of performance — AVCP

The compliance of Asphalt Concrete with the requirements of this European Standard and with the performances declared by the manufacturer in the Declaration of Performance (DoP) shall be demonstrated by:

— determination of the product type in accordance with EN 13108-20;

— factory production control by the manufacturer, including product assessment in accordance with EN 13108-21.

The result of the product type determination will, for each relevant requirement, be expressed as a numerical value. The numerical value may be presented as a category as given in the standard, a class or a value declared by the manufacturer.

The manufacturer shall always retain the overall control and shall have the necessary means to take responsibility for the conformity of the product with its declared performance(s).

For the purpose of Type Testing, Asphalt Concrete may be grouped into families as described in EN 13108-20 where it is considered that the selected property or properties is or are common to all the mixtures within that family.

7 Identification

The delivery ticket shall contain at least the following information related to identification:

— manufacturer and mixing plant;

— mix identification code;

— how to obtain the full details demonstrating conformity with this European Standard;

— designation of the mixture:

AC	*D*	surf/base/bin	Binder

where

AC is Asphalt Concrete;

D is the upper sieve size;

surf is the surface course;

base is the base course;

bin is the binder course;

binder is the binder grade or class in the final product

EXAMPLE AC 16 surf 70/100

— Asphalt Concrete with maximum aggregate size 16 mm for surface course with penetration bitumen grade 70/100.

NOTE Information concerning regulatory marking accompanies the product, but characteristics which are not necessarily part of regulatory marking, could be made available by alternative means.

Annex A
(normative)

Calculations of the penetration or the softening point of the binder of a mixture when reclaimed asphalt is used

A.1 General

These calculations shall be applied when paving grade bitumen has been used in the reclaimed asphalt and will be used as added binder. The calculation methods are only valid for paving grade bitumen.

A.2 Calculation of the penetration of the binder of a mixture

Use the following calculation:

$$a \lg pen_1 + b \lg pen_2 = (a + b) \lg pen_{\text{mix}} \quad \text{(A.1)}$$

where

pen_{mix} is the calculated penetration of the binder in the mixture containing reclaimed asphalt;

pen_1 is the penetration of the binder recovered from the reclaimed asphalt;

pen_2 is the penetration of the added binder;

a and b are the portions by mass of the binder from the reclaimed asphalt (a) and from the added binder (b) in the mixture; $a + b = 1$.

EXAMPLE $pen_1 = 20$; $pen_2 = 90$; $a = 0{,}25$ and $b = 0{,}75$

$0{,}25 \lg 20 + 0{,}75 \lg 90 = \lg pen_{\text{mix}}$

$\lg pen_{\text{mix}} = 1{,}79094$; therefore $pen_{\text{mix}} = 62$

The recovery of binder from mixtures for testing shall be performed according to EN 12697-3.

The penetrations of the added binder and the recovered binder shall be determined according to EN 1426.

A.3 Calculation of the softening point of the binder of a mixture

Use the following calculation:

$$T_{\text{R\&B mix}} = a \times T_{\text{R\&B 1}} + b \times T_{\text{R\&B 2}} \quad \text{(A.2)}$$

where

$T_{\text{R\&B mix}}$ is the calculated softening point of the binder in the mixture containing reclaimed asphalt;

$T_{\text{R\&B 1}}$ is the softening point of the binder recovered from the reclaimed asphalt;

$T_{\text{R\&B 2}}$ is the softening point of the added binder;

a and *b* are the portions by mass of binder from the reclaimed asphalt (*a*) and from the added binder (*b*) in the mixture ; $a + b = 1$.

EXAMPLE $T_{R\&B\ 1} = 62\ °C$; $T_{R\&B\ 2} = 48\ °C$; $a = 0,25$ and $b = 0,75$

$T_{R\&B\ mix} = 0,25 \times 62 + 0,75 \times 48 = 51,5\ °C$

The softening points of the added binder and the recovered binder shall be determined according to EN 1427.

Annex ZA
(informative)

Relationship of this European Standard with Regulation (EU) No. 305/2011

(When applying this standard as a harmonized standard under Regulation (EU) No. 305/2011, manufacturers and Member States are obliged by this regulation to use this annex)

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under standardization request M124 Road Construction Products given to CEN and CENELEC by the European Commission (EC) and the European Free Trade Association (EFTA).

When this European Standard is cited in the Official Journal of the European Union (OJEU), under Regulation (EU) No. 305/2011, it shall be possible to use it as a basis for the establishment of the Declaration of Performance (DoP) and the CE marking, from the date of the beginning of the co-existence period as specified in the OJEU.

Regulation (EU) No. 305/2011, as amended, contains provisions for the DoP and the CE marking.

Table ZA.1 — Relevant clauses for Asphalt Concrete for use on roads, airfields and other trafficked areas

Product: Asphalt Concrete **Intended use:** For use on roads, airfields and other trafficked areas.			
Essential Characteristics	**Clauses in this and other European Standard(s) related to essential characteristics**	**Classes and/or threshold levels**	**Notes**
Adhesion of binder to aggregate	5.2.3 Target binder content	–	Declared value
	5.3.2.1 Void content	–	Declared minimum or maximum category, class or numerical value
	5.3.3 Water sensitivity	–	Declared minimum category or numerical value
	5.4 Temperature of the mixture	–	Declared maximum and minimum value

Product: Asphalt Concrete **Intended use:** For use on roads, airfields and other trafficked areas.			
Essential Characteristics	**Clauses in this and other European Standard(s) related to essential characteristics**	**Classes and/or threshold levels**	**Notes**
Stiffness	5.2.2 Target Grading	–	Declared values
	5.2.3 Target binder content	–	Declared value
	5.3.2.1 Void content	–	Declared minimum or maximum category, class or numerical value
	5.3.6 Stiffness	–	Declared minimum or maximum category, class or numerical value
	5.4 Temperature of the mixture	–	Declared maximum and minimum value
Resistance to permanent deformation	5.2.2 Target Grading	–	Declared values
	5.2.3 Target binder content	–	Declared value
	5.3.2.1 Void content	–	Declared minimum or maximum category, class or numerical value
	5.3.2.2 Voids filled with binder	–	Declared minimum or maximum category, class or numerical value
	5.3.2.3 Voids in mineral aggregate	–	Declared minimum category or numerical value
	5.3.5 Resistance to permanent deformation	–	Declared maximum category or numerical value
	5.3.14 Marshall values for application on airfields [b]	–	Declared Minimum or maximum category or numerical value
	5.4 Temperature of the mixture	–	Declared maximum and minimum value
Resistance to fatigue	5.3.2.1 Void content	-–	Declared minimum or maximum category, class or numerical value
	5.2.3 Target binder content	–	Declared value
	5.3.7 Resistance to fatigue	–	Declared minimum category or numerical value

Product: Asphalt Concrete
Intended use: For use on roads, airfields and other trafficked areas.

Essential Characteristics	Clauses in this and other European Standard(s) related to essential characteristics	Classes and/or threshold levels	Notes
	5.4 Temperature of the mixture	–	Declared minimum or minimum value
Skid resistance	5.2.2 Target Grading	–	Declared value
	5.2.3 Target binder content	–	Declared value
	5.3.2.1 Void content	–	Declared minimum or maximum category, class or numerical value
	5.3.11 Friction after polishing	–	Declared minimum category or numerical value
Resistance to abrasion	5.2.2 Target Grading	–	Declared value
	5.2.3 Target binder content	–	Declared value
	5.3.4 Resistance to abrasion by studded tyres	–	Declared maximum category or numerical value
Reaction to fire[a]	5.3.13 Fire class	$A1_{fl}$ to F_{fl}	Declared class
Durability of the above characteristics against ageing, weathering, oxidation, wear, ravelling, chemicals, wear of studded tyres, stripping, ... as relevant	All above mentioned requirements are related to durability.		
	5.3.8 Mixture SATS Durability Index	–	Declared minimum category or numerical value
	5.3.9 Low temperature property	–	Declared maximum category or numerical value
	5.3.10 Fracture toughness	–	Declared minimum category or numerical value
	5.3.15 Resistance to fuel for application on airfields[b]	–	Declared maximum category or numerical value
	5.3.16 Resistance to de-icing fluids for application on airfields[b]	–	Declared minimum category or numerical value

[a] Relevant only for Asphalt Concrete intended for uses subject to reaction to fire regulations.

[b] Only relevant for application on airfields.

ZA.2 System of Assessment and Verification of Constancy of Performance (AVCP)

The AVCP systems of Asphalt Concrete indicated in Table ZA.1, can be found in the EC legal acts adopted by the EC decision 1998/601/EC of 13 October 1998 (OJ L 287; p. 41) amended by the Commission decision 2001/596/EC of 8 January 2001 (OJ L 209; p. 33).

Micro-enterprises are allowed to treat products under AVCP system 3 covered by this standard in accordance with AVCP system 4, applying this simplified procedure with its conditions, as foreseen in Article 37 of Regulation (EU) No. 305/2011.

ZA.3 Assignment of AVCP tasks

The AVCP systems of Asphalt Concrete as provided in Table ZA.1 are defined in Tables ZA.3.1 to ZA.3.3 resulting from application of the clauses of this or other European Standards indicated therein. The content of the tasks assigned to the notified body shall be limited to those essential characteristics, if any, as provided for in Annex III of the relevant standardization request and to those that the manufacturer intends to declare.

Taking into account the AVCP systems defined for the products and the intended uses the following tasks shall be undertaken by the manufacturer and the notified body respectively for the assessment and verification of the constancy of performance of the product.

Table ZA.3.1 — Assignment of AVCP tasks for Asphalt Concrete under system 2+ and subject to reaction to fire under system 1

Tasks		Content of the task	AVCP clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which are declared.	EN 13108–21
	Determination of the product-type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product.	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which are declared except reaction to fire.	EN 13108–20
	Further testing of samples taken at factory according to the prescribed test plan.	Essential characteristics of Table ZA.1 relevant for the intended use which are declared.	EN 13108–21
Tasks for the notified product certification body	Determination of the product type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product.	Reaction to fire	EN 13501-11:2007+A1:2009, Table 2 and EN ISO 11925-2
	Initial inspection of manufacturing plant and of FPC	Parameters related to essential characteristic of Table ZA.1, relevant for the intended use which is declared, namely reaction to fire. Documentation of the FPC.	EN 13108–21
	Continuous surveillance, assessment and evaluation of FPC	Parameters related to essential characteristic of Table ZA.1, relevant for the intended use which is declared, namely reaction to fire. Documentation of FPC.	EN 13108–21
Tasks for the notified production control certification body	Initial inspection of the manufacturing plant and of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which is declared, except reaction to fire. Documentation of the FPC.	EN 13108–21
	Continuous surveillance, assessment and evaluation of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which is declared, except reaction to fire. Documentation of the FPC.	EN 13108–21

Table ZA.3.2 — Assignment of AVCP tasks for Asphalt Concrete under system 2+ and subject to reaction to fire under system 3

Tasks		Content of the task	AVCP clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which are declared.	EN 13108–21
	Determination of the product-type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product.	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which are declared except reaction to fire.	EN 13108–20
	Further testing of samples taken at factory according to the prescribed test plan.	Essential characteristics of Table ZA.1 relevant for the intended use which are declared.	EN 13108–21
Tasks for a notified testing laboratory	Determination of the product-type on the basis of type testing (based on sampling carried out by the manufacturer), type calculation, tabulated values or descriptive documentation of the product.	Reaction to fire	EN 13501-11:2007+A1:2009, Table 2 and EN ISO 11925-2
Tasks for the notified production control certification body	Initial inspection of the manufacturing plant and of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which is declared. Documentation of the FPC.	EN 13108–21
	Continuous surveillance, assessment and evaluation of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which is declared. Documentation of the FPC.	EN 13108–21

Table ZA.3.3 — Assignment of AVCP tasks for Asphalt Concrete under system 2+ and subject to reaction to fire under system 4

Tasks		Content of the task	AVCP clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which is declared.	EN 13108–21
	Determination of the product-type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product.	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which is declared.	EN 13108–20
	Further testing of samples taken at factory according to the prescribed test plan.	Essential characteristics of Table ZA.1 relevant for the intended use which is declared.	EN 13108–21
Tasks for the notified production control certification body	Initial inspection of the manufacturing plant and of FPC.	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which is declared. Documentation of the FPC.	EN 13108–21
	Continuous surveillance, assessment and evaluation of FPC.	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which is declared. Documentation of the FPC.	EN 13108–21

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