

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

The European Standard EN 13043:2002 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN 13043:2002, including Corrigendum May 2004. It supersedes BS 63-1:1987 and BS 63-2:1987 which will be withdrawn in June 2004.

EN 13043:2002 is included in a package of new European Standards being prepared by CEN/TC 154 relating to aggregates. Although the English text versions of these European Standards will be adopted as British Standards as they become available, the existing British Standards for aggregates will be retained, but only until such time that the completed package of European Standards become available. The original group of British Standards will then be withdrawn and this will be noted in *Update Standards*.

The UK participation in its preparation was entrusted by Technical Committee B/502, Aggregates, to Subcommittee B/502/3, Bituminous bound aggregates, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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English version

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

Granulats pour mélanges hydrocarbonés et pour enduits superficiels utilisés dans la construction des chaussées, aéroports et d'autres zones de circulation

Gesteinskörnungen für Asphalt und Oberflächenbehandlungen für Straßen, Flugplätze und andere Verkehrsflächen

This European Standard was approved by CEN on 5 May 2002.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



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Foreword

This document (EN 13043:2002) has been prepared by Technical Committee CEN /TC 154, "Aggregates", the secretariat of which is held by BSI.

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 March 2003, and conflicting national standards shall be withdrawn at the latest by June 2004.

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 EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this document.

Requirements for other end uses of aggregates will be specified in the following European Standards:

prEN 12620, *Aggregates for concrete*
 EN 13139, *Aggregates for mortar*
 EN 13055-1, *Lightweight aggregates - Part 1: Lightweight aggregates for concrete, mortar and grout*
 prEN 13055-2, *Lightweight aggregates -Part 2 Lightweight aggregates for unbound and bound applications*
 prEN 13242, *Aggregates for unbound and hydraulic bound materials for use in civil engineering work and road construction*
 EN 13383-1, *Armourstone Part 1: Specification*
 prEN 13450, *Aggregates for railway ballast*

Annex A is informative and annex B is normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the properties of aggregates and filler aggregates obtained by processing natural or manufactured or recycled materials for use in bituminous mixtures and surface treatments for roads, airfields and other trafficked areas. This standard does not cover the use of reclaimed bituminous mixtures.

It provides for the evaluation of conformity of the products to this European Standard.

NOTE Aggregates used in construction should comply with all the requirements of this European Standard. As well as familiar and traditional natural and manufactured aggregates Mandate M/125 "Aggregates" included recycled aggregates and some materials from new or unfamiliar sources. Recycled aggregates are included in the standards and new test methods for them are at an advanced stage of preparation. For unfamiliar materials from secondary sources, however, the work on standardisation has only started recently and more time is needed to define clearly the origins and characteristics of these materials. In the meantime such unfamiliar materials when placed on the market as aggregates must comply fully with this standard and national regulations for dangerous substances (see Annex ZA of the standard) depending upon their intended use. Additional characteristics and requirements may be specified on a case by case basis depending upon experience of use of the product, and defined in specific contractual documents.

NOTE 2 Properties for lightweight aggregates are specified in prEN 13055-2.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 196-2:1994	<i>Methods of testing cement — Part 2: Chemical analysis of cement.</i>
EN 196-6	<i>Methods of testing cement — Part 6: Determination of fineness.</i>
EN 196-21	<i>Methods of testing cement — Part 21: Determination of the chloride, carbon dioxide and alkali content of cement.</i>
EN 459-2	<i>Building lime — Part 2: Test methods.</i>
EN 932-3	<i>Tests for general properties of aggregates — Part 3: Procedure and terminology for simplified petrographic description.</i>
EN 932-5	<i>Tests for general properties of aggregates — Part 5: Common equipment and calibration.</i>
EN 933-1:1997	<i>Tests for geometrical properties of aggregates — Part 1: Determination of particle size distribution – Sieving method.</i>
EN 933-3	<i>Tests for geometrical properties of aggregates — Part 3: Determination of particle shape of aggregates - Flakiness index.</i>
EN 933-4	<i>Tests for geometrical properties of aggregates — Part 4: Determination of particle shape of aggregates - Shape index.</i>
EN 933-5	<i>Tests for geometrical properties of aggregates — Part 5: Determination of percentage of crushed and broken surfaces in coarse aggregate particles.</i>
EN 933-6:2001	<i>Tests for geometrical properties of aggregates — Part 6: Assessment of surface characteristics – Flow coefficient of aggregates.</i>
EN 933-9	<i>Tests for geometrical properties of aggregates — Part 9: Assessment of fines - Methylene blue test.</i>
EN 933-10	<i>Tests for geometrical properties of aggregates — Part 10: Determination of fines - Grading of fillers (air jet sieving).</i>

EN 1097-1	<i>Tests for mechanical and physical properties of aggregates — Part 1: Determination of the resistance to wear (micro-Deval).</i>
EN 1097-2:1998	<i>Tests for mechanical and physical properties of aggregates — Part 2: Methods for the determination of resistance to fragmentation.</i>
EN 1097-3:1998	<i>Tests for mechanical and physical properties of aggregates — Part 3: Determination of loose bulk density and voids.</i>
EN 1097-4	<i>Tests for mechanical and physical properties of aggregates — Part 4: Determination of the voids of dry compacted filler.</i>
EN 1097-5	<i>Tests for mechanical and physical properties of aggregates — Part 5: Determination of water content by drying in a ventilated oven.</i>
EN 1097-6:2000	<i>Tests for mechanical and physical properties of aggregates — Part 6: Determination of particle density and water absorption.</i>
EN 1097-7	<i>Tests for mechanical and physical properties of aggregates — Part 7: Determination of the particle density of filler — Pyknometer method.</i>
EN 1097-8:1999	<i>Tests for mechanical and physical properties of aggregates — Part 8: Determination of the polished stone value.</i>
EN 1097-9	<i>Tests for mechanical and physical properties of aggregates — Part 9: Determination of the resistance to wear by abrasion from studded tyres — Nordic test.</i>
EN 1367-1:1999	<i>Tests for thermal and weathering properties of aggregates — Part 1: Determination of resistance to freezing and thawing.</i>
EN 1367-2	<i>Tests for thermal and weathering properties of aggregates — Part 2: Magnesium sulphate test.</i>
EN 1367-3	<i>Tests for thermal and weathering properties of aggregates — Part 3: Boiling test for "Sonnenbrand" basalt.</i>
EN 1367-5	<i>Tests for thermal and weathering properties of aggregates — Part 5: Determination of resistance to thermal shock.</i>
EN 1744-1:1998	<i>Tests for chemical properties of aggregates — Part 1: Chemical analysis.</i>
prEN 1744-4:2001	<i>Tests for chemical properties of aggregates — Part 4: Determination of water susceptibility of fillers for bituminous mixtures.</i>
prEN 12697-11:2000	<i>Bituminous mixtures – Test methods for hot mix asphalt — Part 11: Determination of the compatibility between aggregate and bitumen.</i>
EN 13179-1	<i>Tests for filler aggregate for bituminous mixtures — Part 1: Delta ring and ball test.</i>
EN 13179-2	<i>Tests for filler aggregate for bituminous mixtures — Part 2: Bitumen number.</i>
ISO 565:1990	<i>Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings.</i>

3 Terms and definitions

For the purposes of this European Standard the following terms and definitions apply.

3.1

aggregate

granular material used in construction. Aggregate may be natural, manufactured or recycled



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3.2

natural aggregate

aggregate from mineral sources which has been subjected to nothing more than mechanical processing

3.3

manufactured aggregate

aggregate of mineral origin resulting from an industrial process involving thermal or other modification

3.4

recycled aggregate

aggregate resulting from processing of inorganic material previously used in construction

3.5

aggregate size

designation of aggregate in terms of lower (d) and upper (D) sieve sizes expressed as d/D

NOTE This designation accepts the presence of some particles which are retained on the upper sieve (oversize) and some which pass the lower sieve (undersize). The lower sieve size (d) can be zero.

3.6

coarse aggregate

designation given to the larger aggregate sizes with D less than or equal to 45 mm and d greater than or equal to 2 mm

3.7

fine aggregate

designation given to the smaller aggregate sizes with D less than or equal to 2 mm and containing particles which mostly are retained on a 0,063 mm sieve

NOTE Fine aggregate can be produced from natural disintegration of rock or gravel and/or by the crushing of rock or gravel or processing of manufactured aggregate.

3.8

fines

particle size fraction of an aggregate which passes the 0,063 mm sieve

3.9

filler aggregate

aggregate, most of which passes a 0,063 mm sieve, which can be added to construction materials to provide certain properties

3.10

mixed filler

filler aggregate of mineral origin, which has been mixed with calcium hydroxide

3.11

added filler

filler aggregate of mineral origin, which has been produced separately

3.12

all-in aggregate

aggregate consisting of a mixture of coarse and fine aggregates

NOTE It can be produced without separating into coarse and fine fractions or it can be produced by combining coarse and fine aggregate.

3.13

grading

particle size distribution expressed as the percentage by mass passing a specified number of sieves

3.14

undersize

that part of the aggregate passing the smaller of the limiting sieves used in the aggregate size description

3.15**oversize**

that part of the aggregate retained on the larger of the limiting sieves used in the aggregate size description

3.16**category**

level of a property of an aggregate expressed as a range of values or a limiting value

NOTE There is no relationship between the categories of different properties.

4 Requirements for coarse and fine aggregate**4.1 Geometrical requirements****4.1.1 General**

The necessity for testing and declaring all properties specified in this clause shall be limited according to the particular application at end use or origin of the aggregate. When required, the tests specified in 4.1 shall be carried out to determine appropriate geometrical properties.

NOTE 1 When the value of a property is required but not defined by specified limits the value should be declared by the producer as an XX_{Declared} category, e.g., In Table 6 a value of say 30 g/kg corresponds to MB_F 30 (Declared value).

NOTE 2 When a property is not required, a "No requirement" category can be used.

NOTE 3 Guidance on selection of appropriate categories for specific applications can be found in national provisions in the place of use of the aggregate.

4.1.2 Aggregate sizes

All aggregates shall be described in terms of aggregate sizes using the designations d/D and shall comply with the grading requirements specified in 4.1.3.

Aggregate sizes shall be specified using the sieve sizes given in Table 1 comprising the basic set, or the basic set plus set 1, or the basic set plus set 2. A combination of sieve sizes from set 1 and set 2 is not permissible.

Aggregate sizes shall be separated by a ratio between the upper sieve size D and the lower sieve size d of not less than 1,4.

Table 1 — Sieve sizes for specifying aggregate sizes

Basic set mm	Basic set plus set 1 mm	Basic set plus set 2 mm
0	0	0
1	1	1
2	2	2
4	4	4
-	5,6 (5)	-
8	-	6,3 (6)
-	8	8
-	-	10
-	11,2 (11)	-
-	-	12,5 (12)
16	-	14
-	16	16
-	-	20
31,5 (32)	22,4 (22)	-
-	31,5(32)	31,5 (32)
-	-	40
-	45	-
63	63	63

NOTE Rounded sizes shown in parentheses can be used as simplified descriptions of aggregate sizes.

NOTE For special end use in surface treatments a sieve size of 2,8 mm can be used in set 2.

4.1.3 Grading

The grading of aggregate sizes specified in accordance with 4.1.2, shall be determined in accordance with EN 933-1:1997 and shall conform to the requirements of Table 2 as appropriate to its aggregate size d/D .

Combinations of two or more than two adjacent aggregate sizes or all-in aggregates are permitted.

NOTE Aggregate supplied as a mixture of different sizes or types should be uniformly blended. When aggregates of significantly different density are blended caution is necessary to avoid segregation.

When assessing production within a system of factory production control at least 90 % of gradings, taken on different batches within a maximum period of 6 months, shall fall within the limits specified in 4.1.3.1 and 4.1.3.2 for tolerances on producers' declared typical gradings.

Table 2 — General grading requirements

Aggregate	Size mm	Percentage passing by mass					Category <i>G</i>
		$2 D$	$1,4 D^a$	D^b	d	$d/2^a$	
Coarse	$D > 2$	100	100	90 to 99	0 to 10	0 to 2	$G_{C90/10}$
		100	98 to 100	90 to 99	0 to 15	0 to 5	$G_{C90/15}$
		100	98 to 100	90 to 99	0 to 20	0 to 5	$G_{C90/20}$
		100	98 to 100	85 to 99 ^c	0 to 15	0 to 2	$G_{C85/15}$
		100	98 to 100	85 to 99 ^c	0 to 20	0 to 5	$G_{C85/20}$
		100	98 to 100	85 to 99 ^c	0 to 35	0 to 5	$G_{C85/35}$
Fine	$D \leq 2$	100	-	85 to 99	—	—	G_F85
All-in	$D \leq 45$ and $d = 0$	100 100	98 to 100 98 to 100	90 to 99 85 to 99	—	—	G_A90 G_A85
^a Where the sieves calculated as $1,4 D$ and $d/2$ are not exact sieve numbers in the ISO 565:1990, R20 series then the next nearest sieve size shall be adopted. ^b If the percentage retained on D is < 1 % by mass the producer shall document and declare the typical grading including the sieves D , d , $d/2$ and sieves in the basic set plus set 1 or basic set plus 2 intermediate between d and D . ^c For single size coarse aggregates d/D , where $D/d < 2$, of the categories $G_{C85/15}$, $G_{C85/20}$ and $G_{C85/35}$, the value of the percentage passing by mass at D may be lowered by 5 % according to the particular application or end use.							

4.1.3.1 Coarse aggregate

When required for graded coarse aggregates d/D , where $D \geq 2d$, the following additional requirements shall apply for the percentage passing the mid-size sieve:

- all gradings shall conform to the overall limits given in Table 3;
- the producer shall document and declare the typical grading passing the mid-size sieve and tolerances selected from the categories in Table 3.

For single size coarse aggregate d/D where $D < 2d$ there shall be no requirement additional to those specified in Table 2.

Table 3 — Overall limits and tolerances for coarse aggregate grading at mid-sieve size

<i>D/d</i>	Mid-size sieve ^a mm	Overall limits and tolerances at mid-size sieves Percentage passing by mass		Category <i>G</i>
		Overall limits	Tolerances on producer's declared typical grading	
< 4	<i>D/1,4</i>	25 to 80	15	<i>G</i> _{25/15}
		20 to 70	15	<i>G</i> _{20/15}
4	<i>D/2</i>	20 to 70	17,5	<i>G</i> _{20/17,5}
No requirement				<i>G</i> _{NR}
^a Where the mid-size sieves calculated as above are not an exact sieve size in the ISO 565:1990, R20 series then the nearest sieve in the series shall be used.				

4.1.3.2 Fine aggregate and all-in aggregate

When required fine aggregate and all-in aggregate 0/*D* shall conform to the general grading requirements specified in Table 2 appropriate to their upper size sieve *D*.

The following additional requirements shall apply to control the variability of the fine aggregate and all-in aggregate 0/*D* with *D* ≥ 8 mm.

The producer shall document and declare the typical grading for each fine aggregate or all-in aggregate with *D* ≥ 8 mm produced. The tolerances shall conform to the requirements specified in Table 4.

Table 4 — Tolerances on producer's declared typical grading for fine aggregate and all-in aggregate 0/*D* with *D* ≥ 8 mm

Sieve size mm	<i>D</i>	<i>D/2</i>	0,063	Category <i>G</i> _{TC}
Tolerances	5 ^a	10	3 ^b	<i>G</i> _{TC10}
Percentage passing by mass	5 ^a	20	3 ^b	<i>G</i> _{TC20}
	No requirement	No requirement	No requirement	<i>G</i> _{TCNR}
^a Except for categories <i>G</i> _{A90} and <i>G</i> _{A85} tolerances of 5 are further limited by the requirements for the percentage passing <i>D</i> in Table 2 (<i>G</i> _{A90} , <i>G</i> _{A85}). ^b Except for category <i>f</i> ₃ (fines content ≤ 3 %).				

4.1.4 Fines content

When required the fines content, determined in accordance with EN 933-1:1997, shall be expressed in accordance with the relevant category specified in Table 5.

Table 5 — Categories for maximum values of fines content

Aggregate	Percentage passing 0,063 mm sieve	Category f
Coarse	$\leq 0,5$ ≤ 1 ≤ 2 ≤ 4 > 4	$f_{0,5}$ f_1 f_2 f_4 f_{Declared}
	No requirement	f_{NR}
Fine	≤ 3 ≤ 10 ≤ 16 ≤ 22 > 22	f_3 f_{10} f_{16} f_{22} f_{Declared}
	No requirement	f_{NR}

4.1.5 Fines quality

When the fines content in the fine aggregate, or in the all-in aggregate 0/ D with $D = 8$ mm, is not greater than 3 %, no further testing is required.

When a further evaluation of fines quality is required the following shall apply.

If the fines content of fine aggregate is between 3 % and 10 % by mass, the harmful fines (e.g., swelling of clay) of the 0/0,125 mm fraction shall be determined as the methylene blue value (MB_F) in accordance with EN 933-9. The methylene blue value shall be declared in accordance with the relevant category specified in Table 6.

If the fines content is greater than 10 % by mass, it shall satisfy the relevant requirements for filler aggregate specified in clause 5.

Table 6 — Categories for maximum methylene blue (MB_F) values

MB_F -value g/kg	Category MB_F
- ≤ 10 ≤ 25 > 25	MB_{FNT}^a MB_{F10} MB_{F25} $MB_{F\text{Declared}}$
No requirement	MB_{FNR}
^a The category MB_{FNT} signifies no testing requirement	

NOTE If the fines content is greater than 3 % by mass and there is documented evidence of satisfactory use further testing can not be necessary.

4.1.6 Shape of coarse aggregate

When required the shape of coarse aggregates shall be determined in terms of the flakiness index, as specified in EN 933-3. The flakiness index shall be the reference test for the determination of the shape of coarse aggregates. The flakiness index shall be declared in accordance with the relevant category specified in Table 7 according to the particular application or end use.

Table 7 — Categories for maximum values of flakiness index

Flakiness index	Category <i>FI</i>
≤ 10	<i>FI</i> ₁₀
≤ 15	<i>FI</i> ₁₅
≤ 20	<i>FI</i> ₂₀
≤ 25	<i>FI</i> ₂₅
≤ 30	<i>FI</i> ₃₀
≤ 35	<i>FI</i> ₃₅
≤ 50	<i>FI</i> ₅₀
> 50	<i>FI</i> _{Declared}
No requirement	<i>FI</i> _{NR}

Where required, the shape index, determined in accordance with EN 933-4, shall be declared in accordance with the relevant category specified in Table 8 according to the particular application or end use.

Table 8 — Categories for maximum values of shape index

Shape index	Category <i>SI</i>
≤ 15	<i>SI</i> ₁₅
≤ 20	<i>SI</i> ₂₀
≤ 25	<i>SI</i> ₂₅
≤ 30	<i>SI</i> ₃₀
≤ 35	<i>SI</i> ₃₅
≤ 50	<i>SI</i> ₅₀
> 50	<i>SI</i> _{Declared}
No requirement	<i>SI</i> _{NR}

4.1.7 Percentage of crushed and broken surfaces in coarse aggregates

When required the content of crushed or broken particles including totally crushed particles and the percentage of totally rounded particles, determined in accordance with EN 933-5, shall be declared in accordance with the relevant category specified in Table 9.

Aggregates obtained from crushing rock shall be assumed to be category *C*_{100/0} and do not require further testing.

Table 9 — Categories for percentage of crushed and broken surfaces (including percentage of totally crushed or broken particles and totally rounded particles)

Percentage of totally crushed or broken particles by mass	Percentage of totally crushed or broken and partially crushed or broken particles by mass	Percentage of totally rounded particles by mass	Category C
90 to 100	100	0	$C_{100/0}$
30 to 100	95 to 100	0 to 1	$C_{95/1}$
30 to 100	90 to 100	0 to 1	$C_{90/1}$
-	50 to 100	0 to 10	$C_{50/10}$
-	50 to 100	0 to 30	$C_{50/30}$
-	< 50	> 30	C_{Declared}
No requirement	No requirement	No requirement	C_{NR}

4.1.8 Angularity of fine aggregate

When required, the angularity of fine aggregates determined in accordance with EN 933-6:2001, clause 8, shall be expressed in accordance with the relevant category specified in Table 10.

Table 10 — Categories for angularity of fine aggregate

Flow coefficient	Category E_{cs}
38	$E_{\text{cs}} 38$
35	$E_{\text{cs}} 35$
30	$E_{\text{cs}} 30$
< 30	$E_{\text{cs}} \text{ Declared}$
No requirement	$E_{\text{cs}} \text{ NR}$

4.2 Physical requirements

4.2.1 General

The necessity for testing and declaring all properties specified in this clause shall be limited according to the particular application at end use or origin of the aggregate. When required, the tests specified in 4.2 shall be carried out to determine appropriate physical properties.

NOTE 1 When the value of a property is required but not defined by specified limits the value should be declared by the producer as an XX_{Declared} category, e.g., in Table 11 a Los Angeles coefficient of say 55 corresponds to LA_{55} (Declared category).

NOTE 2 When a property is not required, a “No requirement” category can be used.

NOTE 3 Guidance on selection of appropriate categories for specific applications can be found in national provisions in the place of use of the aggregate.

4.2.2 Resistance to fragmentation of coarse aggregate

When required the resistance to fragmentation shall be determined in terms of the Los Angeles coefficient, as specified in EN 1097-2:1998, clause 5. The Los Angeles test method shall be the reference test for the determination of resistance to fragmentation. The Los Angeles coefficient shall be declared in accordance with the relevant category specified in Table 11 according to the particular application or end use.