

Aggregates for concrete

ICS 91.100.15; 91.100.30

National foreword

This British Standard is the UK implementation of EN 12620:2002+A1:2008, incorporating corrigendum May 2004. It supersedes BS EN 12620:2002 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by **A1** ~~A1~~.

EN 12620:2002 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 becomes 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 The original group of British Standards will then be withdrawn and this will be noted in *Update Standards*.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/502/2, Aggregates for concrete including those for roads and other pavements.

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

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

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 7 October 2002

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Amendments/corrigenda issued since publication

| Amd. No. | Date | Comments |
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| 15333 Corrigendum No. 1 | 17 August 2004 | Implementation of CEN corrigendum May 2004, replacement in Clause 1 of Note 1, correction to Figure ZA.1 and Figure ZA.3 |
| | 30 June 2008 | Implementation of CEN amendment A1:2008 |
| | | |
| | | |

English Version

Aggregates for concrete

Granulats pour béton

Gesteinskörnungen für Beton

This European Standard was approved by CEN on 1 August 2002 and includes Corrigendum 1 issued by CEN on 26 May 2004 and Amendment 1 approved by CEN on 16 February 2008.

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 CEN 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 CEN Management Centre has the same status as the official versions.

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Foreword

This document (EN 12620:2002+A1:2008) 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 October 2008 and conflicting national standards shall be withdrawn at the latest by October 2008.

This document includes Amendment 1, approved by CEN on 2008-02-16.

This document supersedes EN 12620:2002.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** and **A1**.

The modifications of the related CEN Corrigendum have been implemented at the appropriate places in the text and are indicated by the tags **AC** and **AC**.

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.

A1 This amendment introduces clauses for recycled aggregates. The clauses call up new test methods, prEN 933-11, EN 1744-5, EN 1744-6 and EN 1367-4. These standards are at an advanced stage of preparation. **A1**

Annexes A, B, E, F and G are informative. Annexes C, D and H are normative.

This standard includes a Bibliography.

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

| | |
|--------------|--|
| EN 13043 | Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas |
| 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 |
| EN 13139 | Aggregates for mortar |
| prEN 13242 | Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction |
| EN 13383-1 | Armourstone - Part 1: Specification |
| prEN 13450 | Aggregates for railway ballast |

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies the properties of aggregates and filler aggregates obtained by processing natural, manufactured or recycled materials and mixtures of these aggregates for use in concrete. It covers aggregates having an oven dried particle density greater than $2,00 \text{ Mg/m}^3$ ($2\,000 \text{ kg/m}^3$) for all concrete, including concrete in conformity with EN 206-1 and concrete used in roads and other pavements and for use in precast concrete products. **A1** It also covers recycled aggregate with densities between $1,50 \text{ Mg/m}^3$ ($1\,500 \text{ kg/m}^3$) and $2,00 \text{ Mg/m}^3$ ($2\,000 \text{ kg/m}^3$) with appropriate caveats and recycled fine aggregate (4 mm) with appropriate caveats. **AC**

It also specifies that a quality control system is in place for use in factory production control and it provides for the evaluation of conformity of the products to this European Standard.

This standard does not cover filler aggregates to be used as a constituent in cement or as other than inert filler aggregates for concrete.

AC NOTE 1 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. **AC**

NOTE 2 Properties for lightweight aggregates are specified in **A1** EN 13055-1:2002 **A1**.

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).

A1 *deleted text* **A1**

A1 EN 196-2:2005, *Methods of testing cement — Part 2: Chemical analysis of cement* **A1**

EN 932-3, *Tests for general properties of aggregates — Part 3: Procedure and terminology for simplified petrographic description*

EN 932-5, *Tests for general properties of aggregates — Part 5: Common equipment and calibration*

EN 933-1, *Tests for geometrical properties of aggregates — Part 1: Determination of particle size distribution - Sieving method*

EN 933-3, *Tests for geometrical properties of aggregates — Part 3: Determination of particle shape — Flakiness index*

EN 933-4, *Tests for geometrical properties of aggregates — Part 4: Determination of particle shape — Shape index*

EN 933-7, *Tests for geometrical properties of aggregates — Part 7: Determination of shell content — Percentage of shells in coarse aggregates*

EN 933-8, *Tests for geometrical properties of aggregates — Part 8: Assessment of fines — Sand equivalent test*

EN 933-9, *Tests for geometrical properties of aggregates — Part 9: Assessment of fines — Methylene blue test*

EN 933-10, *Tests for geometrical properties of aggregates — Part 10: Assessment of fines — Grading of fillers (air jet sieving)*

prEN 933-11, *Tests for geometrical properties of aggregates — Part 11: Classification test for the constituents of coarse recycled aggregates*

EN 1097-1, *Tests for mechanical and physical properties of aggregates — Part 1: Determination of the resistance to wear (micro-Deval)*

EN 1097-2:1998, *Tests for mechanical and physical properties of aggregates — Part 2: Methods for the determination of resistance to fragmentation*

EN 1097-3, *Tests for mechanical and physical properties of aggregates — Part 3: Determination of loose bulk density and voids*

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

EN 1097-8:1999, *Tests for mechanical and physical properties of aggregates — Part 8: Determination of the polished stone value*

EN 1097-9, *Tests for mechanical and physical properties of aggregates — Part 9: Determination of the resistance to wear by abrasion from studded tyres — Nordic test*

EN 1367-1:2007, *Tests for thermal and weathering properties of aggregates — Part 1: Determination of resistance to freezing and thawing*

EN 1367-2, *Tests for thermal and weathering properties of aggregates — Part 2: Magnesium sulfate test*

EN 1367-4, *Tests for thermal and weathering properties of aggregates — Part 4: Determination of drying shrinkage*

EN 1744-1:1998, *Tests for chemical properties of aggregates — Part 1: Chemical analysis*

EN 1744-5, *Tests for chemical properties of aggregates — Part 5: Determination of acid soluble chloride salts*

EN 1744-6, *Tests for chemical properties of aggregates — Part 6: Determination of the influence of recycled aggregate extract on the initial setting time of cement*

ISO 565:1990, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

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 re-cycled

3.2

natural aggregate

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

3.3

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 may be produced by combining coarse and fine aggregate.

3.4**manufactured aggregate**

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

3.5**recycled aggregate**

aggregate resulting from the processing of inorganic material previously used in construction

3.6**filler aggregate**

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

NOTE See 3.12 for the definition of "fines".

3.7**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).

3.8**fine aggregate**

designation given to the smaller aggregate sizes with D less than or equal to 4 mm

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.

3.9**coarse aggregate**

designation given to the larger aggregate sizes with D greater than or equal to 4 mm and d greater than or equal to 2 mm

3.10**natural graded 0/8 mm aggregate**

designation given to natural aggregate of glacial and/or fluvial origin with D less than or equal to 8 mm

NOTE This aggregate can also be produced by blending processed aggregate.

3.11**batch**

production quantity, a delivery quantity, a partial delivery quantity (railway wagon-load, lorry-load, ship's cargo) or a stockpile produced at one time under conditions that are presumed uniform

NOTE With a continuous process the quantity produced during a specified period should be treated as a batch.

3.12**fines**

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

3.13**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.

3.14**grading**

particle size distribution expressed as the percentages by mass passing a specified set of sieves

4 Geometrical requirements

4.1 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 clause 4 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 8 a value of say 55 for the flakiness index corresponds to F_{55} (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.

4.2 Aggregate sizes

All aggregates shall be described in terms of aggregate sizes using the designations d/D except for aggregates added as fillers which shall be specified as filler aggregate and shall comply with the grading requirements specified in 4.3.

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

Aggregate sizes shall have D/d 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) | — |
| — | — | 6,3 (6) |
| 8 | 8 | 8 |
| — | — | 10 |
| — | 11,2 (11) | — |
| — | — | 12,5 (12) |
| — | — | 14 |
| 16 | 16 | 16 |
| — | — | 20 |
| — | 22,4 (22) | — |
| 31,5 (32) | 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.

4.3 Grading

4.3.1 General

The grading of the aggregate, when determined in accordance with EN 933-1, shall comply with the requirements of 4.3.1 to 4.3.6 as appropriate to its aggregate size d/D .

NOTE When aggregates of significantly different density are blended caution is necessary to avoid segregation.

When assessing aggregates 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 4.3.2 to 4.3.6 for tolerances on producers' declared typical gradings.

4.3.2 Coarse aggregates

All coarse aggregates shall comply with the general grading requirements specified in Table 2 appropriate to their size designation d/D and the selected categories from Table 2.

Table 2 — General grading requirements

| Aggregate | Size | Percentage passing by mass | | | | | Category G^d |
|--------------------|----------------------------------|----------------------------|------------------------|----------------------|--------------------|------------------|--------------------------|
| | | $2D$ | $1,4D^{a\&b}$ | D^c | d^b | $d/2^{a\&b}$ | |
| Coarse | $D/d \leq 2$ or $D \leq 11,2$ mm | 100 100 | 98 to 100 98 to 100 | 85 to 99 80 to 99 | 0 to 20 0 to 20 | 0 to 5 0 to 5 | $G_C85/20$ $G_C80/20$ |
| | $D/d > 2$ and $D > 11,2$ mm | 100 | 98 to 100 | 90 to 99 | 0 to 15 | 0 to 5 | $G_C90/15$ |
| Fine | $D \leq 4$ mm and $d = 0$ | 100 | 95 to 100 | 85 to 99 | – | – | G_F85 |
| Natural graded 0/8 | $D = 8$ mm and $d = 0$ | 100 | 98 to 100 | 90 to 99 | – | – | $G_{NG}90$ |
| All-in | $D \leq 45$ mm and $d = 0$ | 100 | 98 to 100 | 90 to 99 | – | – | G_A90 |
| | | 100 | 98 to 100 | 85 to 99 | – | – | G_A85 |

^a Where the sieves calculated are not exact sieve numbers in the ISO 565:1990 R 20 series then the next nearest sieve size shall be adopted.

^b For gap graded concrete or other special uses additional requirements may be specified.

^c The percentage passing D may be greater than 99 % by mass but in such cases 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 set 2 intermediate between d and D . Sieves with a ratio less than 1,4 times the next lower sieve may be excluded.

^d Other aggregate product standards have different requirements for categories.

For graded coarse aggregates where:

- a) $D > 11,2$ mm and $D/d > 2$; or
- b) $D \leq 11,2$ mm and $D/d > 4$,

the following additional requirements (i) and (ii) shall apply for the percentage passing the mid-size sieve:

- i) all gradings shall comply with the overall limits given in Table 3;

- ii) the producer shall document and, on request, declare the typical grading passing the mid-size sieve and tolerances selected from the categories in Table 3.

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

| <i>D/d</i> | Mid-size sieve mm | Overall limits and tolerances at mid-size sieves (percentage passing by mass) | | Category G_T |
|------------|-------------------|---|---|----------------|
| | | Overall limits | Tolerances on producer's declared typical grading | |
| < 4 | $D/1,4$ | 25 to 70 | ± 15 | G_T15 |
| ≥ 4 | $D/2$ | 25 to 70 | $\pm 17,5$ | $G_T17,5$ |

Where the mid-size sieve calculated as above is not an exact sieve size in the ISO 565:1990/R20 series then the nearest sieve in the series shall be used.
 NOTE Overall limits and tolerances for the most common product sizes are illustrated in annex A.

For single size coarse aggregates where:

- a) $D > 11,2$ mm and $D/d \leq 2$; or
- b) $D \leq 11,2$ mm and $D/d \leq 4$,

there shall be no requirements additional to those specified in Table 2.

4.3.3 Fine aggregate

Fine aggregates shall comply with the general grading requirements specified in Table 2 appropriate to their upper sieve size D .

The following additional requirements shall be applied to control the variability of the fine aggregate.

The producer shall document and, on request, declare the typical grading for each fine aggregate size produced. Typical grading is expressed as the percentage by mass of aggregate passing through the sieve sizes specified in Table 4.

NOTE Recommendations for the classification of coarseness of the fine aggregate are given in annex B (Tables B.1 and B.2)

Fine aggregates in regular satisfactory use for most applications shall comply with the requirements specified in Table 4. When specified for special uses and cases where the variability of grading is reduced, the grading tolerances shall be applied in accordance with annex C.

Table 4 — Tolerances on producer's declared typical grading for general use fine aggregates

| Sieve size mm | Tolerances in percentages passing by mass | | |
|--------------------|---|-----------|-----------|
| | 0/4 | 0/2 | 0/1 |
| 4 | $\pm 5^a$ | — | — |
| 2 | — | $\pm 5^a$ | — |
| 1 | ± 20 | ± 20 | $\pm 5^a$ |
| 0,250 | ± 20 | ± 25 | ± 25 |
| 0,063 ^b | ± 3 | ± 5 | ± 5 |

^a Tolerances of ± 5 are further limited by the requirements for the percentage passing *D* in Table 2.

^b In addition to the tolerances stated the maximum value of the fines content for the category selected from Table 11 applies for the percentage passing the 0,063 mm sieve.

4.3.4 Natural graded 0/8 mm aggregate

Natural graded 0/8 mm aggregate shall comply with the general grading requirements specified in Table 2.

The following additional requirements shall be applied to control the variability of natural graded 0/8 mm aggregate:

- a) the producer shall document and, on request, declare the typical grading for each aggregate produced;
- b) gradings shall comply with the tolerances given in Table 5.

Table 5 — Tolerances on producer's declared typical grading for natural graded 0/8 mm aggregate

| Sieve size mm | Tolerances Percentages passing by mass |
|------------------|---|
| 8 | ± 5 |
| 2 | ± 10 |
| 1 | ± 10 |
| 0,250 | ± 10 |
| 0,125 | ± 3 |
| 0,063 | ± 2 |

4.3.5 All-in aggregate

All-in aggregate shall be supplied as a mixture of coarse and fine aggregate with $D \leq 45$ mm and $d = 0$ and shall comply with the general grading requirements for the category selected from Table 2.

All-in aggregates shall also comply with the requirements for the percentage passing the two intermediate sieves specified in Table 6 appropriate to their aggregate size.

Table 6 — Grading requirements for all-in aggregates

| Aggregate size mm | | Overall limits of the sieves indicated below (Percentage passing by mass) | |
|----------------------|----------------------|---|-----------|
| Basic set plus set 1 | Basic set plus set 2 | 40 ± 20 | 70 ± 20 |
| | | For the sieve mm | |
| - | 0/6,3 | 1 | 4 |
| 0/8 | 0/8 | 1 | 4 |
| - | 0/10 | 1 | 4 |
| 0/11,2 (11) | - | 2 | 5,6 (5) |
| - | 0/12,5 (12) | 2 | 6,3 (6) |
| - | 0/14 | 2 | 8 |
| 0/16 | 0/16 | 2 | 8 |
| - | 0/20 | 2 | 10 |
| 0/22,4 (22) | - | 2 | 11,2 (11) |
| 0/31,5 (32) | 0/31,5 (32) | 4 | 16 |
| - | 0/40 | 4 | 20 |
| 0/45 | - | 4 | 22,4 (22) |

NOTE Figures in parentheses can be used to provide simplified descriptions of aggregate sizes.

4.3.6 Filler aggregate

The grading of filler aggregate determined in accordance with EN 933-10 shall conform to the limits specified in Table 7.

Table 7 — Grading requirements for filler aggregate

| Sieve size mm | Percentage passing by mass | |
|------------------|---|---|
| | Overall range for individual results | Producer's maximum declared range ^a |
| 2 | 100 | — |
| 0,125 | 85 to 100 | 10 |
| 0,063 | 70 to 100 | 10 |

^a Declared grading range on the basis of the last 20 values (see Table H.1, line 1). 90 % of the results shall be within this range, but all the results shall be within the overall grading range (see column 2 above).

4.3.7 Special use aggregate

When special aggregate gradings are required for a particular end use of the concrete, special grading envelopes shall be defined using the R 20 series of sieves specified in ISO 565:1990 and incorporating the appropriate sieves from 0,063 mm; 0,125 mm; 0,250 mm; 0,500 mm; 1 mm; 2 mm; 4 mm; 8 mm; 16 mm; 31,5 mm and 63 mm.

4.4 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 8 according to the particular application or end use.

Table 8 — Categories for maximum values of flakiness index

| Flakiness Index | Category <i>FI</i> |
|-----------------|-------------------------------|
| ≤ 15 | <i>FI</i> ₁₅ |
| ≤ 20 | <i>FI</i> ₂₀ |
| ≤ 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 9 according to the particular application or end use.

Table 9 — Categories for maximum values of shape index

| Shape Index | Category <i>SI</i> |
|----------------|-------------------------------|
| ≤ 15 | <i>SI</i> ₁₅ |
| ≤ 20 | <i>SI</i> ₂₀ |
| ≤ 40 | <i>SI</i> ₄₀ |
| ≤ 55 | <i>SI</i> ₅₅ |
| > 55 | <i>SI</i> _{Declared} |
| No requirement | <i>SI</i> _{NR} |

4.5 Shell content of coarse aggregate

When required, the shell content of coarse aggregate, determined in accordance with EN 933-7, shall be declared in accordance with the relevant category specified in Table 10 according to the particular application or end use.

Table 10 — Category for maximum value of shell content of coarse aggregates

| Shell content % | Category SC |
|--------------------|------------------------|
| ≤ 10 | SC ₁₀ |
| > 10 | SC _{Declared} |
| No requirement | SC _{NR} |

4.6 Fines content

The fines content, determined in accordance with EN 933-1, shall be declared in accordance with the relevant category specified in Table 11. The fines content of filler aggregate shall comply with the requirements of Table 7.

Table 11 — Categories for maximum values of fines content

| Aggregate | 0,063 mm sieve Percentage passing by mass | Category <i>f</i> |
|------------------------------------|---|------------------------------|
| Coarse aggregate | ≤ 1,5 | <i>f</i> _{1,5} |
| | ≤ 4 | <i>f</i> ₄ |
| | > 4 | <i>f</i> _{Declared} |
| | No requirement | <i>f</i> _{NR} |
| Natural graded 0/8 mm aggregate | ≤ 3 | <i>f</i> ₃ |
| | ≤ 10 | <i>f</i> ₁₀ |
| | ≤ 16 | <i>f</i> ₁₆ |
| | > 16 | <i>f</i> _{Declared} |
| | No requirement | <i>f</i> _{NR} |
| All-in aggregate | ≤ 3 | <i>f</i> ₃ |
| | ≤ 11 | <i>f</i> ₁₁ |
| | > 11 | <i>f</i> _{Declared} |
| | No requirement | <i>f</i> _{NR} |
| Fine aggregate | ≤ 3 | <i>f</i> ₃ |
| | ≤ 10 | <i>f</i> ₁₀ |
| | ≤ 16 | <i>f</i> ₁₆ |
| | ≤ 22 | <i>f</i> ₂₂ |
| | > 22 | <i>f</i> _{Declared} |
| | No requirement | <i>f</i> _{NR} |

4.7 Fines quality

The harmfulness of the fines in fine aggregate, including filler aggregate, shall be assessed in accordance with annex D.

5 Physical requirements

5.1 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 clause 5 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 12 a value of say 60 for the Los Angeles coefficient corresponds to LA_{60} (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.

5.2 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 12 according to the particular application or end use.

Table 12 — Categories for maximum values of Los Angeles coefficients

| Los Angeles coefficient | Category <i>LA</i> |
|-------------------------|-------------------------------|
| ≤ 15 | <i>LA</i> ₁₅ |
| ≤ 20 | <i>LA</i> ₂₀ |
| ≤ 25 | <i>LA</i> ₂₅ |
| ≤ 30 | <i>LA</i> ₃₀ |
| ≤ 35 | <i>LA</i> ₃₅ |
| ≤ 40 | <i>LA</i> ₄₀ |
| ≤ 50 | <i>LA</i> ₅₀ |
| > 50 | <i>LA</i> _{Declared} |
| No requirement | <i>LA</i> _{NR} |

Where required, the impact value determined in accordance with EN 1097-2:1998, clause 6, shall be declared in accordance with the relevant category specified in Table 13 according to the particular application or end use.

Table 13 — Categories for maximum values of resistance to impact

| Impact value % | Category SZ |
|-------------------|------------------------|
| ≤ 18 | SZ ₁₈ |
| ≤ 22 | SZ ₂₂ |
| ≤ 26 | SZ ₂₆ |
| ≤ 32 | SZ ₃₂ |
| > 32 | SZ _{Declared} |
| No requirement | SZ _{NR} |

5.3 Resistance to wear of coarse aggregate

When required the resistance to wear of coarse aggregate (micro-Deval coefficient, M_{DE}) shall be determined in accordance with EN 1097-1. The micro-Deval coefficient shall be declared in accordance with the relevant category specified in Table 14 according to the particular application or end use.

Table 14 — Categories for maximum values of resistance to wear

| micro-Deval coefficient | Category M_{DE} |
|-------------------------|----------------------|
| ≤ 10 | M_{DE10} |
| ≤ 15 | M_{DE15} |
| ≤ 20 | M_{DE20} |
| ≤ 25 | M_{DE25} |
| ≤ 35 | M_{DE35} |
| > 35 | $M_{DEDeclared}$ |
| No requirement | M_{DENR} |

5.4 Resistance to polishing and abrasion of coarse aggregate to be used for surface courses

5.4.1 Resistance to polishing (polished stone value - PSV)

When required the resistance to polishing of coarse aggregate to be used for surface courses (polished stone value – PSV) shall be determined in accordance with EN 1097-8.

The resistance to polishing shall be declared in accordance with the relevant category specified in Table 15.

Table 15 — Categories for minimum values of resistance to polishing

| Polished stone value | Category PSV |
|------------------------------------|-------------------------|
| ≥ 68 | PSV ₆₈ |
| ≥ 62 | PSV ₆₂ |
| ≥ 56 | PSV ₅₆ |
| ≥ 50 | PSV ₅₀ |
| ≥ 44 | PSV ₄₄ |
| Intermediate values and those < 44 | PSV _{Declared} |
| No requirement | PSV _{NR} |

5.4.2 Resistance to surface abrasion (aggregate abrasion value - AAV)

When required the resistance to surface abrasion (aggregate abrasion value - AAV), shall be determined in accordance with EN 1097-8:1999, annex A.

The resistance to surface abrasion shall be declared in accordance with the relevant category specified in Table 16.

Table 16 — Categories for maximum values of resistance to surface abrasion

| Aggregate abrasion value | Category AAV |
|---|--|
| ≤ 10 ≤ 15 ≤ 20 Intermediate values and those > 20 | AAV ₁₀ AAV ₁₅ AAV ₂₀ AAV _{Declared} |
| No requirement | AAV _{NR} |

5.4.2 Resistance to abrasion from studded tyres

When required the resistance to abrasion from studded tyres (Nordic abrasion value - A_N), shall be determined in accordance with EN 1097-9. Resistance to abrasion from studded tyres, shall be declared in accordance with the relevant category specified in Table 17.

Table 17 — Categories for maximum values of resistance to abrasion from studded tyres

| Nordic abrasion value | Category A_N |
|--|---|
| ≤ 7 ≤ 10 ≤ 14 ≤ 19 ≤ 30 Intermediate values and those > 30 | A_N7 A_N10 A_N14 A_N19 A_N30 $A_NDeclared$ |
| No requirement | A_NNR |

5.5 Particle density and water absorption

When required the particle density and water absorption shall be determined in accordance with EN 1097-6 and the results declared on request stating the means of determination and the calculations used.

5.6 Bulk density

When required the bulk density shall be determined in accordance with EN 1097-3 and the results declared on request.

5.7 Durability

5.7.1 Freeze/thaw resistance of coarse aggregate

If frost resistant aggregates are required for concrete used in an environment subject to freezing and thawing, the resistance to freezing determined in accordance with EN 1367-1 or EN 1367-2 shall be declared in accordance with the relevant category specified in Table 18 or Table 19.

NOTE Guidance on the use of aggregates in an environment that is subject to freezing and thawing is given in annex F. Advice on the use of the water absorption value as a screening test for freeze/thaw resistance is given in F.2.3.

Table 18 — Categories for maximum values of freeze-thaw resistance

| Freeze-thaw Percentage loss of mass ^a | Category <i>F</i> |
|---|------------------------------|
| ≤ 1 | <i>F</i> ₁ |
| ≤ 2 | <i>F</i> ₂ |
| ≤ 4 | <i>F</i> ₄ |
| > 4 | <i>F</i> _{Declared} |
| No requirement | <i>F</i> _{NR} |
| ^a In extreme situations of cold weather and/or salt or de-icing salt saturation, then tests using a salt solution or urea as detailed in [A1] EN 1367-1:2007 [A1], annex B, may be more appropriate. The limits in this table would not apply. | |

Table 19 — Categories for maximum magnesium sulfate soundness

| Magnesium sulfate value Percentage loss of mass | Category <i>MS</i> |
|--|-------------------------------|
| ≤ 18 | <i>MS</i> ₁₈ |
| ≤ 25 | <i>MS</i> ₂₅ |
| ≤ 35 | <i>MS</i> ₃₅ |
| > 35 | <i>MS</i> _{Declared} |
| No requirement | <i>MS</i> _{NR} |

5.7.2 Volume stability - drying shrinkage

Where disruptive shrinkage cracking of concrete occurs due to the properties of the aggregate, the drying shrinkage associated with aggregates to be used in structural concrete shall, when required, not exceed 0,075 % when tested in accordance with EN 1367-4 [A1] (in the case of recycled aggregate, see also Annex A) [A1] and the results declared.

[A1] NOTE 1 [A1] This requirement does not apply to positions where drying out never occurs, mass concrete surfaced with air entrained concrete, or to structural elements symmetrically and heavily reinforced and not exposed to the weather.

[A1] NOTE 2 Volume stability - expansion. In very rare circumstances, it is possible that recycled aggregate can contain expansive material such as un-slaked lime. Currently it is not possible to give requirements as no test methods are available. [A1]

5.7.3 Alkali-silica reactivity

When required the alkali-silica reactivity of aggregates shall be assessed in accordance with the provisions valid in the place of use and the results declared.

NOTE Guidance on the effects of alkali-silica reactivity, is given in annex G.

5.8 Classification of the constituents of coarse recycled aggregates

The proportions of constituent materials in coarse recycled aggregate shall be determined in accordance with prEN 933-11 and shall be declared in accordance with the relevant categories specified in Table 20.

Table 20 — Categories for constituents of coarse recycled aggregates

| Constituent | Content Percentage by mass | Category |
|-------------|---------------------------------------|--------------------------------|
| Rc | ≥ 90 | <i>Rc</i> ₉₀ |
| | ≥ 80 | <i>Rc</i> ₈₀ |
| | ≥ 70 | <i>Rc</i> ₇₀ |
| | ≥ 50 | <i>Rc</i> ₅₀ |
| | < 50 | <i>Rc</i> _{Declared} |
| | No requirement | <i>Rc</i> _{NR} |
| Rc + Ru | ≥ 95 | <i>Rcu</i> ₉₅ |
| | ≥ 90 | <i>Rcu</i> ₉₀ |
| | ≥ 70 | <i>Rcu</i> ₇₀ |
| | ≥ 50 | <i>Rcu</i> ₅₀ |
| | < 50 | <i>Rcu</i> _{Declared} |
| | No requirement | <i>Rcu</i> _{NR} |
| Rb | ≤ 10 | <i>Rb</i> ₁₀₋ |
| | ≤ 30 | <i>Rb</i> ₃₀₋ |
| | ≤ 50 | <i>Rb</i> ₅₀₋ |
| | > 50 | <i>Rb</i> _{Declared} |
| | No requirement | <i>Rb</i> _{NR} |
| Ra | ≤ 1 | <i>Ra</i> ₁₋ |
| | ≤ 5 | <i>Ra</i> ₅₋ |
| | ≤ 10 | <i>Ra</i> ₁₀₋ |
| X + Rg | ≤ 0,5 | <i>XRg</i> _{0,5-} |
| | ≤ 1 | <i>XRg</i> ₁₋ |
| | ≤ 2 | <i>XRg</i> ₂₋ |
| | Content cm ³ /Kg | |
| FL | ≤ 0,2 ^a | <i>FL</i> _{0,2-} |
| | ≤ 2 | <i>FL</i> ₂₋ |
| | ≤ 5 | <i>FL</i> ₅₋ |

^a The ≤ 0,2 category is intended only for special applications requiring high quality surface finish.

where, according to prEN 933-11:

| Constituent | Description |
|-------------|--|
| Rc | Concrete, concrete products, mortar Concrete masonry units |
| Ru | Unbound aggregate, natural stone Hydraulically bound aggregate |
| Rb | Clay masonry units (i.e. bricks and tiles) Calcium silicate masonry units Aerated non-floating concrete |
| Ra | Bituminous materials |
| FL | Floating material in volume |
| X | Other: Cohesive (i.e. clay and soil) Miscellaneous: metals (ferrous and non-ferrous), non-floating wood, plastic and rubber Gypsum plaster |
| Rg | Glass |

Ⓐ1

6 Chemical requirements

6.1 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 clause 6 shall be carried out to determine appropriate chemical 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 Ⓐ1 Table 21 Ⓐ1 a value of say 1,2 percent by mass for the acid-soluble sulfate content of air-cooled blastfurnace slag corresponds to $AS_{1,2}$ (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.

NOTE 4 Guidance on the effects of chemical constituents in aggregates, including alkali-silica reactivity and lightweight organic contaminants related to the durability and surface properties of the concrete in which they are incorporated, is given in annex G.

6.2 Chlorides

When required the water-soluble chloride ion content of aggregates for concrete shall be determined in accordance with EN 1744-1:1998, clause 7, and shall, on request, be declared by the producer.

NOTE If the water-soluble chloride ion content of the combined aggregate is known to be 0,01 % or lower (e.g. for aggregates extracted from most inland quarries) this value can be used in the calculation of the chloride content of concrete.

Ⓐ1 The acid-soluble chloride ion content of recycled aggregates for concrete shall be determined in accordance with EN 1744-5, and shall, on request, be declared by the producer. Ⓐ1

6.3 Sulfur containing compounds

6.3.1 Acid-soluble sulfate

When required the acid-soluble sulfate content of the aggregates and filler aggregates for concrete determined in accordance with EN 1744-1:1998, clause 12, shall be declared in accordance with the relevant category specified in \square_{A1} Table 21 \square_{A1} .

\square_{A1} Table 21 \square_{A1} — Categories for maximum values of acid-soluble sulfate content

| Aggregate | Acid soluble sulfate content Percentage by mass | Category AS |
|--|--|---|
| Aggregates other than air-cooled blastfurnace slag | $\leq 0,2$ | AS _{0,2} |
| | $\leq 0,8$ > 0,8 | AS _{0,8} AS _{Declared} |
| | No requirement | AS _{NR} |
| Air-cooled blastfurnace slag | $\leq 1,0$ | AS _{1,0} |
| | > 1,0 | AS _{Declared} |
| | No requirement | AS _{NR} |

6.3.2 Total sulfur

When required the total sulfur content of the aggregates and filler aggregates, determined in accordance with EN 1744-1:1998, clause 11, shall not exceed:

- 2 % S by mass for air-cooled blastfurnace slag;
- 1 % S by mass for aggregates other than air-cooled blastfurnace slag.

Special precautions are necessary if pyrrhotite, (an unstable form of iron sulfide FeS), is present in the aggregate. If this mineral is known to be present, a maximum total sulfur content of 0,1 % as S shall apply.

6.3.3 \square_{A1} Water soluble sulfate content of recycled aggregates

When required, the water soluble sulfate content of recycled aggregates determined in accordance with EN 1744-1, shall be declared in accordance with the relevant category specified in Table 22.

Table 22 — Categories for maximum values of water-soluble sulfate content of recycled aggregates

| Water-soluble sulfate content Percentage by mass | Category SS |
|---|-------------------|
| $\leq 0,2$ | SS _{0,2} |
| No requirement | SS _{NR} |

\square_{A1}

6.4 Other constituents

6.4.1 Constituents which alter the rate of setting and hardening of concrete

Aggregates and filler aggregates that contain organic or other substances in proportions that alter the rate of setting and hardening of concrete shall be assessed for the effect on stiffening time and compressive strength in accordance with EN 1744-1:1998, 15.3.

The proportions of such materials shall be such that they do not:

- a) increase the stiffening time of mortar test specimens by more than 120 min;
- b) decrease the compressive strength of mortar test specimens by more than 20 % at 28 days.

The presence of organic matter shall be determined in accordance with EN 1744-1:1998, 15.1 (determination of humus content). If the results indicate a high humus content, the presence of fulvo acids shall be determined in accordance with EN 1744-1:1998, 15.2. If the supernatant liquid in these tests is lighter than the standard colours the aggregates shall be considered to be free from organic matter.

NOTE 1 Some inorganic compounds which discolour the supernatant liquid in the humus content test do not adversely affect the setting and hardening of concrete.

NOTE 2 Sugars do not affect the colour of the supernatant liquid in the humus content test or the fulvo acid test. If it is suspected that sugars or sugar type materials are present, the aggregate should be tested using the mortar specimen test (see EN 1744-1:1998, 15.3). The stiffening time and compressive strength requirements shown above should apply.

A1) When required, the presence of lightweight contaminators that alter the rate of setting and hardening of concrete shall be tested in accordance with EN 1744-1.

When required, recycled aggregates shall be assessed for the influence of water-soluble materials from the aggregates on the initial setting time of cement paste in accordance with EN 1744-6. The change in initial setting time, t_e , shall conform to the requirements of Table 23.

Table 23 — Categories for influence of water-soluble materials from recycled aggregates on the initial setting time of cement paste

| Change in initial setting time, t_e (min) | Category (A) |
|--|-----------------------|
| ≤ 10 | A10 |
| ≤ 40 | A40 |
| > 40 | A _{Declared} |
| No requirement | A _{NR} |

Two screening tests for the presence of organic matter are in common use, the sodium hydroxide test and the fulvo acid test (see EN 1744-1:1998, 15.1 and 15.2). Both tests may be applied to recycled aggregates. If the supernatant liquid in these tests is lighter than the standard colours the aggregates may be considered to be free from organic matter.

NOTE 3 Sugars do not affect the colour of the supernatant liquid in the sodium hydroxide or the fulvo acid test. If it is suspected that sugars or sugar type materials are present, the aggregate should be tested using the water extract test (see EN 1744-6). The requirements for the influence on setting time shown above should apply.

NOTE 4 Constituents of recycled aggregates that may adversely affect the rate of setting and hardening of concrete may be inorganic, and therefore not detected by the procedures given in 15.3 of EN 1744-1:1998. The procedures given in EN 1744-6 should be used for recycled aggregates. **A1**)

6.4.2 Constituents which affect the volume stability of air-cooled blastfurnace slag

6.4.2.1 Air-cooled blastfurnace slag aggregate shall be free from dicalcium silicate disintegration when tested in accordance with EN 1744-1:1998, 19.1.

6.4.2.2 Air-cooled blastfurnace slag aggregate shall be free from iron disintegration when tested in accordance with EN 1744-1:1998, 19.2.

6.5 Carbonate content Of fine aggregates for concrete pavement surface courses

When it is required to control the carbonate content in fine aggregates for use in concrete surface courses, the carbonate content shall be determined as specified in **EN 196-2:2005**, clause 5, with the test portion being prepared in accordance with EN 1744-1:1998, 12.3 and the results declared.

7 Evaluation of conformity

7.1 General

The producer shall undertake initial type tests (see 7.2) and factory production control (see annex H) to ensure that the product conforms to this European Standard and to declared values as appropriate.

7.2 Initial type tests

Initial type tests relevant to the intended end use shall be carried out to check compliance with specified requirements in the following circumstances:

- a) a new source of aggregates is to be used.
- b) there is a major change in the nature of the raw materials or in the processing conditions which may affect the properties of the aggregates.

The results of the initial tests shall be documented as the starting point of the factory production control for that material. This shall particularly include the identification of any components likely to emit radiation above normal background levels, any components likely to release polyaromatic carbons or other dangerous substances. If the content of any of these components exceeds the limits in force according to the provisions valid in the place of use of the aggregate, the results of the initial tests shall be declared.

7.3 Factory production control

The producer shall have in place a system of factory production control that complies with the requirements of annex H.

The records held by the producer shall indicate what quality control procedures are in operation during the production of the aggregate.

NOTE The form of control applied to any aggregate depends upon its intended use and the regulations relating to that use.

8 Designation

8.1 Designation and description

EN 12620 Aggregates shall be identified in the following terms:

- a) source and manufacturer – if the material has been re-handled in a depot both source and depot shall be given;
- b) type of aggregate (see EN 932-3 and for recycled aggregate: "recycled aggregate");

- c) for recycled aggregate, the constituent categorization according to Table 20;
- d) aggregate size. $\langle A_1 \rangle$

8.2 Additional information for the description of an aggregate

The necessity for other information depends on the situation and end use, for example:

- a) a code to relate the designation to the description;
- b) any other additional information needed to identify the particular aggregate.

NOTE The purchaser should inform the producer at the time of order of any special requirements associated with a particular end use and of requirements for extra information not covered in Table ZA.1a and Table ZA.1b.

9 Marking and labelling

The delivery ticket shall contain at least the following information:

- a) designation;
- b) date of dispatch;
- c) serial number of the ticket;
- d) the number of this European Standard.

NOTE For CE marking and labelling see clause ZA.3 in annex ZA.

Annex A
(informative)

Illustration of grading requirements for most commonly used sizes for graded coarse aggregates

Table A.1 — Overall limits and tolerances for coarse aggregate grading at mid-size sieves for basic set plus set 1 coarse aggregate product sizes (in millimetres)

| Ratio <i>D/d</i> | Size/ Mid size | Value of <i>d</i> | | | | | | | Overall limits and tolerances at mid-size sieves (Percentage passing by mass) | | |
|---------------------|-------------------|-------------------|----------------|------------------|--------------|-------------------|---------------|---------------|---|---|-------------|
| | | 2 | 4 | 5,6 | 8 | 11,2 | 16 | 22,4 | Overall limits | Tolerances on producer's declared typical grading | |
| | | mm | mm | mm | mm | mm | mm | mm | | G_{T15} | $G_{T17,5}$ |
| 2,8 | Size Mid-size | 2/5,6 - | 4/11,2 - | 5,6/16 11,2 | 8/22,4 16 | 11,2/31,5 22,4 | 16/45 31,5 | 22,4/63 45 | 25 to 70 | ± 15 | - |
| 4,0 | Size Mid-size | 2/8 - | 4/16 8 | 5,6/22,4 11,2 | 8/31,5 16 | 11,2/45 22,4 | 16/63 31,5 | | 25 to 70 | - | ± 17,5 |
| 5,6 | Size Mid-size | 2/11,2 5,6 | 4/22,4 11,2 | 5,6/32 16 | 8/45 22,4 | 11,2/63 31,5 | | | 25 to 70 | - | ± 17,5 |
| 8,0 | Size Mid-size | 2/16 8 | 4/31,5 16 | 5,6/45 22,4 | 8/63 31,5 | | | | 25 to 70 | - | ± 17,5 |
| 11,2 | Size Mid-size | 2/22,4 11,2 | 4/45 22,4 | 5,6/63 31,5 | | | | | 25 to 70 | - | ± 17,5 |

NOTE 1 The shaded box area indicates sizes not normally used.

NOTE 2 When a dash is shown against the mid-size there is no mid-size sieve applicable.

Table A.2 — Overall limits and tolerances for coarse aggregate grading at mid-size sieves for basic set plus set 2 coarse aggregate product sizes (in millimetres)

| Ratio D/d | Size/ Mid size | Value of d | | | | | | | Overall limits and tolerances at mid-size sieves (Percentage passing by mass) | | |
|-------------|-------------------|--------------|--------------|----------------|--------------|-----------------|---------------|-------------|--|---|-------------|
| | | 2 | 4 | 6,3 | 8 | 10 | 16 | 20 | Overall limits | Tolerances on producer's declared typical grading | |
| | | mm | mm | mm | mm | mm | mm | mm | | G_{T15} | $G_{T17,5}$ |
| 2,5 | Size Mid-size | | 4/10 - | 6,3/16 11,2 | 8/20 14 | | 16/40 31,5 | | 25 to 70 | ± 15 | - |
| 3,15 | Size Mid-size | 2/6,3 - | 4/12,5 8 | 6,3/20 14 | | 10/31,5 22,4 | | 20/63 45 | 25 to 70 | ± 15 | - |
| 4 | Size Mid-size | 2/8 - | 4/16 8 | | 8/31,5 16 | 10/40 20 | 16/63 31,5 | | 25 to 70 | - | ± 17,5 |
| 5 | Size Mid-size | 2/10 5 | 4/20 10 | 6,3/31,5 16 | 8/40 20 | | | | 25 to 70 | - | ± 17,5 |
| 8 | Size Mid-size | 2/16 8 | 4/31,5 16 | | | | | | 25 to 70 | - | ± 17,5 |
| 10 | Size Mid-size | 2/20 10 | 4/40 20 | | | | | | 25 to 70 | - | ± 17,5 |

NOTE 1 The shaded box area indicates sizes not normally used.

NOTE 2 When a dash is shown against the mid-size there is no mid-size sieve applicable.

Annex B
(informative)

Guidance on the description of coarseness/fineness of fine aggregates

Tables B.1 and B.2 are provided where specifiers wish to additionally describe the coarseness or fineness of fine aggregates. Either of the tables, but not both, can be used for such descriptions.

In Tables B.1 and B.2, coarse graded fine aggregates are denoted by the letter *C*, medium grading by *M* and fine grading by *F*.

Additionally, when Table B.1 is selected, a *P* for percentage passing the 0,500 mm sieve is added after *C*, *M* or *F* (e.g. for medium grading *MP*).

Similarly when Table B.2 is selected an *F* for fineness modulus is added after *C*, *M* or *F* (e.g. for fine grading *FF*).

Table B.1 — Coarseness or fineness based on the percentage passing the 0,500 mm sieve

| Percentage passing by mass | | |
|----------------------------|-----------|-----------|
| <i>CP</i> | <i>MP</i> | <i>FP</i> |
| 5 to 45 | 30 to 70 | 55 to 100 |

Table B.2 — Coarseness or fineness based on the fineness modulus

| Fineness modulus | | |
|------------------|------------|------------|
| <i>CF</i> | <i>MF</i> | <i>FF</i> |
| 4,0 to 2,4 | 2,8 to 1,5 | 2,1 to 0,6 |

Fineness modulus (*FM*) is used to check constancy. Where additionally required the *FM* of a delivery should be within the limits of the declared $FM \pm 0,50$ or other specified limit.

NOTE Fineness modulus (*FM*) is normally calculated as the sum of cumulative percentages by mass retained on the following sieves (mm) expressed as a percentage i.e.

$$FM = \frac{\Sigma \{(> 4) + (> 2) + (> 1) + (> 0,5) + (> 0,25) + (> 0,125)\}}{100}$$

Annex C
(normative)

Reduced grading tolerances on producer's declared typical grading for fine aggregate

Table C.1 — Reduced tolerances on producer's declared typical grading for fine aggregate

| Sieve size mm | Tolerances in percentage passing by mass | | |
|------------------|--|------|------|
| | 0/4 | 0/2 | 0/1 |
| 4 | ± 5 | - | - |
| 2 | - | ± 5 | - |
| 1 | ± 10 | ± 10 | ± 5 |
| 0,250 | ± 10 | ± 15 | ± 15 |
| 0,063 | ± 3 | ± 5 | ± 5 |
| NOTE See 4.3.3. | | | |

Annex D
(normative)

Assessment of fines

Fines shall be considered non-harmful when any of the four following conditions apply:

- a) the total fines content of the fine aggregate is less than 3 % or other value according to the provisions valid in the place of use of the aggregate;
- b) the sand equivalent value (*SE*) when tested in accordance with EN 933-8 exceeds a specified lower limit;
- c) the methylene blue test (*MB*) when tested in accordance with EN 933-9 gives a value less than a particular specified limit;
- d) equivalence of performance with known satisfactory aggregate is established or there is evidence of satisfactory use with no experience of problems.

The compliance requirements for sand equivalent and methylene blue tests on 0/2 mm fraction shall normally be expressed with a probability of 90 %.

NOTE Precise limits cannot be universally fixed until there is further evidence using the test methods for different fine aggregates in some parts of Europe. The limits and/or categories should be established from experience of existing requirements of materials in local satisfactory use according to the provisions valid in the place of use of the aggregate.

Annex E
(informative)

Guidance on the use of aggregates in concrete

E.1 Resistance to fragmentation of coarse aggregate

E.1.1 Aggregates usually have a higher strength than concrete, and for combinations of aggregates and cement with or without admixtures, which have a satisfactory service record, the normal control strengths obtained from production concrete generally provide a sufficient guide to aggregate strength. However, if very high strength concrete is required the strength of the aggregate can need to be considered.

E.1.2 A category LA_{15} , LA_{20} or Impact SZ_{18} aggregate is generally only required in special cases (e.g. regions where studded tyres are in use or for special regional road finish requirements).

E.1.3 A category LA_{30} or Impact SZ_{22} aggregate can be required for road pavements and floor finishes which are subject to impact stresses. Aggregates with Los Angeles coefficients exceeding 40 should be assessed on the basis of experience of use.

E.2 Freezing and thawing resistance

E.2.1 The freezing and thawing resistance of concrete is related to the degree of water saturation, the constituent materials and their proportions used in concrete. The degree of air entrainment is a particularly important factor and it is therefore essential to assess the freezing and thawing resistance of concrete by testing samples of the concrete.

Annex F (informative)

Notes for guidance on the freezing and thawing resistance of aggregates

F.1 General

The susceptibility of an aggregate to damage from freezing and thawing action depends primarily on climate, end use, petrographic type and on the size distribution of the pores within the aggregate particles.

F.1.1 Climate

The severity of any damage is related to the frequency of freeze thaw cycles, the degrees of freezing and thawing and the degree of saturation of the aggregate particles.

F.1.2 End Use

Aggregates are susceptible to damage from freezing and thawing action under partially or fully saturated environmental conditions or in high humidity situations. The risk of damage is significantly increased where the aggregate is exposed to seawater or to the action of de-icing salts.

F.1.3 Petrographic type

Freezing and thawing resistance is related to the strength of the aggregate particles and to the size and distribution of the pores or other discontinuities within the particles.

F.2 Testing

F.2.1 Indicative tests

Tests that can give an indication of freeze-thaw susceptibility include either petrographical examination or one of the physical tests indicated below. Aggregates complying with the requirements of any one of these tests can be considered freeze-thaw resistant.

F.2.2 Petrographic examination

A petrographic examination of the aggregate according to the procedure specified in EN 932-3 can give an indication of the presence of weak and/or highly absorptive particles that can be susceptible to damage from freeze-thaw action. Where the presence of such particles is observed or suspected one of the physical tests given in F.2.3 and F.2.4 can be used to assess freeze-thaw resistance of the aggregate.

Susceptible aggregates derived from highly weathered rocks and some conglomerates and breccias can include for example some or all of the following:

schist, mica schist, phyllite, chalk, marl, shale, porous flint, altered porous basalt or particles loosely cemented by clay minerals.

F.2.3 Water absorption

When the water absorption of the aggregate determined in accordance with EN 1097-6 is not greater than 1 % the aggregate can be considered resistant to freeze-thaw attack. However, many satisfactory aggregates have higher absorption values.

For example some Jurassic limestones and sandstones frequently have absorption values in excess of 4 % whilst blastfurnace slags, Permian limestones, dolomites and Carboniferous sandstones frequently have absorption values in excess of 2 % but these materials can still have adequate freeze-thaw resistance.

With some aggregates containing a proportion of microporous flint aggregate sources the differentiation between satisfactory and unsatisfactory freeze-thaw durability can be better assessed by density measurements rather than water absorption.

F.2.4 Other indicative tests

Either a freeze-thaw value determined in accordance with EN 1367-1 or a magnesium sulfate value determined in accordance with EN 1367-2 can be applied to assess the freeze-thaw resistance of an aggregate. The magnesium sulfate test is considered most appropriate for situations where the aggregate may be exposed to seawater or de-icing salts.

NOTE In extreme situations of cold weather and/or salt or de-icing salt saturation, then tests using a salt solution or urea as detailed in A_1 EN 1367-1:2007 A_1 , annex B, can be more appropriate.

It is also possible to verify the freeze-thaw resistance of an aggregate by using a test on concrete.

A_1 The magnesium sulfate test is unsuitable for recycled aggregates with cement-bound fractions. A_1

F.3 Selection of category

Where a satisfactory service record for the performance of an aggregate under similar conditions of use to which intended is available, the aggregate can be deemed acceptable. In cases where a satisfactory record is not available and testing is deemed necessary, the environmental conditions, end use and climate can be used to select an appropriate category from Table F.1. The selected category can then be used in conjunction with 5.7.1 to set the required level of freeze/thaw resistance or magnesium sulfate soundness.

Table F.1 — Freeze-thaw severity category related to climate and end use

| Environmental conditions | Climate | | |
|----------------------------------|--------------------|--------------------|--------------------------|
| | Mediterranean | Atlantic | Continental ^a |
| Frost free or dry situation | Not required | Not required | Not required |
| Partial saturation, no salt | Not required | F_4 or MS_{35} | F_2 or MS_{25} |
| Saturated, no salt | Not required | F_2 or MS_{25} | F_1 or MS_{18} |
| Salt (seawater or road surfaces) | F_4 or MS_{35} | F_2 or MS_{25} | F_1 or MS_{18} |
| Airfield surfacings | F_2 or MS_{25} | F_1 or MS_{18} | F_1 or MS_{18} |

^a The Continental category could also apply to Iceland, parts of Scandinavia and to mountainous regions where severe winter weather conditions are experienced.

Annex G (informative)

Guidance on the effects of some chemical constituents of aggregates on the durability of concrete in which they are incorporated

G.1 Chlorides

G.1.1 A1 Chlorides in natural aggregates A1

Chlorides can be present in aggregates usually as sodium and potassium salts, the quantity present being largely dependent on the source of the aggregate. Such salts contribute to the total chloride and alkali content of the concrete. To minimise the risk of corrosion of embedded metal it is usual to limit the total quantity of chloride ion contributed by all the constituent materials in the concrete.

The water-soluble chloride ion content of aggregates extracted from most inland deposits is likely to be very low. Where it can be shown that the chloride content of such materials is not greater than 0,01 % this value can be used in the calculation procedure based on the maximum chloride contents of the constituent materials in the concrete.

G.1.2 A1 Chlorides in recycled aggregates

For recycled aggregates, particularly those containing hardened concrete or mortar, chlorides may be combined in the calcium aluminate and other phases. The combined chlorides are unlikely to be extracted using water in the procedures described in Clause 7 of EN 1744-1:1998 even if the sample is ground to a fine powder before extraction.

For most recycled aggregates, chloride ion contents are likely to be low. The acid-soluble chloride content, determined in accordance with EN 1744-5, will probably overestimate the availability of chlorides and this value should be used in the calculation of the chloride ion content of the concrete. This may provide an additional margin of safety. A1

G.2 Sulfates

Sulfates in aggregates can give rise to expansive disruption of the concrete. A substantial proportion of the sulfate in crystalline blast-furnace slag is encapsulated in the slag grains and therefore plays no part in the hydration reactions of cement. For this reason a higher proportion of sulfate is tolerable in slag. Under certain circumstances other sulfur compounds present in the aggregates can oxidise in the concrete to produce sulfates. These can also give rise to expansive disruption of concrete.

A1 Water-soluble sulfates in recycled aggregates determined in accordance with EN 1744-1 are essentially potentially reactive sulfates (e.g. gypsum plaster) and may also give rise to expansive disruption of concrete. A1

G.3 Alkali-silica reaction

G.3.1 A1 Alkali-silica reaction with natural aggregates A1

Certain aggregates can react with alkaline hydroxides present in the pore fluids of concrete. Under adverse conditions and in the presence of moisture this can lead to expansion and subsequent cracking or disruption of the concrete. The most common form of reaction occurs between alkalis and certain forms of silica (alkali-silica reaction). Another less common form of reaction is alkali-carbonate reaction.

In the absence of previous long-term experience of a lack of disruptive reactivity of a particular combination of cement and aggregate, it can be necessary to take one of the following precautions:

- limit the total alkali content of the concrete mix;
- use a cement with a low effective alkali content;
- use a non-reactive aggregate combination;
- limit the degree of saturation of the concrete with water.

The combination of aggregates and cement can be assessed using Regulations applying at the place of use when compliance with one of the above procedures is not possible.

Where aggregates are imported across national boundaries, the purchaser should take account of experience in the country of origin.

NOTE For further information see CEN Report CR1901 “Regional specifications and recommendations for the avoidance of alkali-silica reactions in concrete”.

G.3.2 A1 Alkali-silica reaction with recycled aggregates

The use of recycled aggregates can influence the suitability of the above precautions. In the case of recycled concrete aggregates, it will be necessary to ascertain that the original concrete does not contain reactive (or reacting) aggregate and, where the alkali content of the new concrete (or the cement therein) is being limited, the alkali content of the recycled concrete aggregates will need to be determined and taken into account. In the case of general recycled aggregates, it will be appropriate to regard the material as being a potentially reactive aggregate, unless it has been specifically established to be non-reactive. In both cases, the possibility of unpredictable compositional variability should be considered. A1

G.4 Constituents affecting the surface finish of concrete

Where appearance is an essential feature of concrete, aggregates should not contain materials in proportions that adversely affect surface quality or durability.

NOTE Since very small percentages by mass of contaminants in aggregates can have a considerable effect on concrete finishes, attention should be given to the suitability of a source for a particular end use.

The proportion of lightweight organic contaminants, determined in accordance with EN 1744-1:1998, 14.2, should not normally exceed:

- a) 0,5 % by mass of fine aggregate; or
- b) 0,1 % by mass of coarse aggregate.

Where the surface of concrete is of importance, the proportion of lightweight organic contaminants, determined in accordance with EN 1744-1:1998, 14.2, should not normally exceed:

- a) 0,25 % by mass of fine aggregate; or
- b) 0,05 % by mass of coarse aggregate.

In some situations, for example critical fair faced concrete, it can be necessary to make additional agreements on levels of lightweight organic contaminants.

Some constituents of aggregates can adversely affect the surface finish of concrete causing staining, discoloration, swelling or pop-outs if present close to the surface of the concrete. Reactive iron sulfide and lignite are two examples of materials that can affect concrete in this way.

G.5 Constituents affecting the setting and hardening of concrete

Other constituents of aggregates can adversely affect the rate of hydration of cement altering the rate of setting and hardening of concrete. Humus and sugar-type materials are two examples of substances that have such an effect. Some clay minerals also adversely affect the rate of development of strength, the strength and the durability of concrete in which they are incorporated.

Ⓐ Constituents of recycled aggregates that can adversely affect the rate of setting and hardening of concrete can be inorganic, and therefore not detected by the procedures given in 15.3 of EN 1744-1:1998. The procedures given in EN 1744-6 should be used for recycled aggregates. Ⓐ

G.6 Constituents of air-cooled blastfurnace slag

Some constituents of air-cooled blastfurnace slag can adversely affect its volume stability when used as aggregates for concrete. However, air-cooled blastfurnace slag from modern production units is less likely to be unsound in this way.

Annex H
(normative)

Factory production control

H.1 Introduction

This annex specifies a factory production control system for aggregates to ensure that they conform to the relevant requirements of this standard.

The performance of the factory production control system shall be assessed according to the principles used in this annex.

H.2 Organization

H.2.1 Responsibility and authority

The responsibility, authority and the interrelation between all personnel who manage, perform and check work affecting quality shall be defined, including personnel who need organizational freedom and authority to:

- a) initiate action to prevent the occurrence of product non-conformity;
- b) identify, record and deal with any product quality deviations.

H.2.2 Management representative for factory production control

For every aggregate producing plant the producer shall appoint a person with appropriate authority to ensure that the requirements given in this annex are implemented and maintained.

H.2.3 Management review

The factory production control system adopted to satisfy the requirements of this annex shall be audited and reviewed at appropriate intervals by management to ensure its continuing suitability and effectiveness. Records of such reviews shall be maintained.

H.3 Control procedures

The producer shall establish and maintain a factory production control manual setting out the procedures by which the requirements for factory production control are satisfied.

H.3.1 Document and data control

Document and data control shall include those documents and data that are relevant to the requirements of this standard covering purchasing, processing, inspection of materials and the factory production control system documents.

A procedure concerning the management of documents and data shall be documented in the production control manual covering procedures and responsibilities for approval, issue, distribution and administration of internal and external documentation and data; and the preparation, issue and recording of changes to documentation.

H.3.2 Sub-contract services

If any part of the operation is sub-contracted by the producer a means of control shall be established. The producer shall retain overall responsibility for any parts of the operation sub-contracted.

H.3.3 Knowledge of the raw material

There shall be documentation detailing the nature of the raw material, its source and where appropriate, one or more maps showing the location and extraction plan.

It is the producer's responsibility to ensure that if any dangerous substances are identified their content does not exceed the limits in force according to the provisions valid in the place of use of the aggregate.

A1 NOTE 1 **A1** Most of the dangerous substances defined in Council Directive 76/769/EEC are not usually present in most sources of aggregates of mineral origin. However Note in ZA. 1 of annex ZA is drawn to the attention of the aggregates producer.

A1 Additionally for recycled aggregates there shall be a documented input control of raw material to be recycled.

NOTE 2 The input control procedures for recycling should identify:

- nature of the raw material,
- source and place of origin,
- supplier and transporting agent.

NOTE 3 For recycled aggregates, the processing depot will suffice for the source. **A1**

H.4 Management of production

The factory production control system shall fulfil the following requirements:

- a) there shall be procedures to identify and control the materials.

NOTE These can include procedures for maintaining and adjusting processing equipment, inspection or testing material sampled during processing, modifying the process during bad weather, etc.

- b) there shall be procedures to identify and control any hazardous materials identified in H.3.3 to ensure that they do not exceed the limits in force according to the provisions valid in the place of use of the aggregate.
- c) there shall be procedures to ensure that material is put into stock in a controlled manner and the storage locations and their contents are identified.
- d) there shall be procedures to ensure that material taken from stock has not deteriorated in such a way that its conformity is compromised.
- e) the product shall be identifiable up to the point of sale as regards source and type.

H.5 Inspection and test

H.5.1 General

The producer shall make available all the necessary facilities, equipment and trained personnel to carry out the required inspections and tests.

H.5.2 Equipment

The producer shall be responsible for the control, calibration and maintenance of inspection, measuring and test equipment.

Accuracy and frequency of calibration shall be in accordance with EN 932-5.

Equipment shall be used in accordance with documented procedures.

Equipment shall be uniquely identified.

Calibration records shall be retained.

H.5.3 Frequency and location of inspection, sampling and tests

The production control document shall describe the frequency and nature of inspections. The frequency of sampling and the tests when required shall be carried out for the relevant characteristics as specified in Tables H.1, H.2 and H.3.

NOTE 1 Test frequencies are generally related to periods of production. A period of production is defined as a full week, month or year of production working days.

NOTE 2 The requirements for factory production control can introduce visual inspection. Any deviations indicated by these inspections can lead to increased test frequencies.

NOTE 3 When the measured value is close to a specified limit the frequency may need to be increased.

NOTE 4 Under special conditions the test frequencies can be decreased below those given in Tables H.1, H.2 and H.3. These conditions could be:

- a) highly automated production equipment;
- b) long-term experience with consistency of special properties;
- c) sources of high conformity;
- d) running a Quality Management System with exceptional measures for surveillance and monitoring of the production process.

The producer shall prepare a schedule of test frequencies taking into account the minimum requirements of Tables H.1, H.2 and H.3.

Reasons for decreasing the test frequencies shall be stated in the factory production control document.

H.6 Records

The results of factory production control shall be recorded including sampling locations, dates and times and product tested with any other relevant information, e.g. weather conditions.

NOTE 1 Some characteristics can be shared by several products, in which case the producer, based on his experience, can find it possible to apply the results of one test to more than one product. This is particularly the case when a product is the combination of two or more different sizes. The particle size distribution or the cleanliness should be checked in case the intrinsic characteristics may have changed.

Where the product inspected or tested does not satisfy the requirement laid down in the specification, or if there is an indication that it shall not do so, a note shall be made in the records of the steps taken to deal with the situation (e.g. carrying out of a new test and/or measures to correct the production process).

The records required by all the clauses of this annex shall be included.

The records shall be kept for at least the statutory period.

NOTE 2 “Statutory period” is the period of time records are required to be kept in accordance with Regulations applying at the place of production.

H.7 Control of non-conforming product

Following an inspection or test that indicates that a product does not conform the affected material shall be:

- a) reprocessed; or
- b) diverted to another application for which it is suitable; or
- c) rejected and marked as non-conforming.

All cases of non-conformity shall be recorded by the producer, investigated and if necessary corrective action shall be taken.

NOTE Corrective actions can include:

- a) investigation of the cause of non-conformity including an examination of the testing procedure and making any necessary adjustments;
- b) analysis of processes, operations, quality records, service reports and customer complaints to detect and eliminate potential causes of non-conformity;
- c) initiating preventive actions to deal with problems to a level corresponding to the risks encountered;
- d) applying controls to ensure that effective corrective actions are taken;
- e) implementing and recording changes in procedures resulting from corrective action.

H.8 Handling, storage and conditioning in production areas

The producer shall make the necessary arrangements to maintain the quality of the product during handling and storage.

NOTE These arrangements should take account of the following:

- a) contamination of product;
- b) segregation;
- c) cleanliness of handling equipment and stocking areas.

H.9 Transport and packaging

H.9.1 Transport

The producer's factory production control system shall identify the extent of his responsibility in relation to storage and delivery.

NOTE When aggregates are transported in bulk it can be necessary to cover or contain aggregates to reduce contamination.

H.9.2 Packaging

If aggregates are packaged the methods and materials used shall not contaminate or degrade the aggregate to the extent that the properties are significantly changed before the aggregate is removed from the packaging. Any precautions necessary to achieve this during handling and storage of the packaged aggregate shall be marked on the packaging or accompanying documents.

H.10 Training of personnel

The producer shall establish and maintain procedures for the training of all personnel involved in the factory production system. Appropriate records of training shall be maintained.

Table H.1 — Minimum test frequencies for general properties

| Property | | Clause | Notes/ references | Test method | Minimum test frequency |
|---|--|----------------|--|-----------------------|------------------------------------|
| 1 | Grading | 4.3.1 4.3.6 | | EN 933-1 EN 933-10 | 1 per week |
| 2 | Shape of coarse aggregate | 4.4 | Test frequency applies to crushed aggregates. Test frequency for uncrushed gravel depends on the source and may be reduced | EN 933-3 EN 933-4 | 1 per month |
| 3 | Fines content | 4.6 | | EN 933-1 | 1 per week |
| 4 | Fines quality | 4.6 | Only when required in accordance with the conditions specified in annex D. | EN 933-8 EN 933-9 | 1 per week |
| 5 | Particle density and water absorption | 5.5 | | EN 1097-6 | 1 per year |
| 6 | Alkali-silica reactivity | 5.7.3 | | ^a | When required and in case of doubt |
| 7 | Petrographic description | 8.1 | | EN 932-3 | 1 per 3 years |
| 8 | Dangerous substances ^b In particular: Emission of radioactivity Release of heavy metals Release of polyaromatic carbons | H.3.3 H.4 | ^b | ^b | When required and in case of doubt |
| ^a In accordance with the provisions valid in the place of use. ^b Unless otherwise specified, only when necessary for CE marking purposes (see annex ZA). | | | | | |

Table H.2 — Minimum test frequencies for properties specific to end use

| Property | | Clause | Notes/ references | Test method | Minimum test frequency |
|----------|---|--------|---|---|---------------------------|
| 1 | Resistance to fragmentation | 5.2 | For high strength concrete | EN 1097-2 | 2 per year |
| 2 | Resistance to wear | 5.3 | Aggregates for surface courses only | EN 1097-1 | 1 per 2 years |
| 3 | Polishing resistance | 5.4 | Aggregates for surface courses only | EN 1097-8 | 1 per 2 years |
| 4 | Resistance to surface abrasion | 5.4.2 | Aggregates for surface courses only | EN 1097-8:1999, annex A | 1 per 2 years |
| 5 | Resistance to abrasion from studded tyres | 5.4.3 | Only in regions where studded tyres are used. | EN 1097-9 | 1 per 2 years |
| 6 | Freezing and thawing | 5.7.1 | | EN 1367-1 or EN 1367-2 | 1 per 2 years |
| 7 | Chloride content | 6.2 | For marine aggregates see Table H.3 | EN 1744-1:1998, clause 7 | 1 per 2 years |
| 8 | Calcium carbonate content | 6.5 | Fine aggregate for concrete surface courses | EN 1744-1:1998, 12.3 EN 196-2:2005, clause 5 | 1 per 2 years |

A1 Table H.3 — Minimum test frequencies for properties appropriate to aggregates from particular sources^a

| Property | | Clause | Notes/ references | Test method | Minimum test frequency |
|---|---|---------|---|--|--|
| 1 | Shell content | 4.5 | Coarse aggregates of marine origin | EN 933-7 | 1 per year |
| 2 | Volume stability - Drying shrinkage | 5.7.2 | | EN 1367-4 | 1 per 5 years |
| 3 | Chloride content | 6.2 | Aggregates of marine origin Recycled aggregates | EN 1744-1:1998, Clause 7 EN 1744-5 | 1 per week 2 per year |
| 4 | Sulfur containing compounds | 6.3 | Blastfurnace slag and recycled aggregates Aggregates other than air-cooled blastfurnace slag and recycled aggregates | EN 1744-1:1998, Clause 12 EN 1744-1:1998, Clause 12 | 2 per year 1 per year |
| 5 | Organic substances: - humus content - fulvo acid (when indicated humus content is high) - comparative strength test - stiffening time - lightweight organic contaminators | 6.4.1 | | EN 1744-1:1998, 15.1 EN 1744-1:1998, 15.2 EN 1744-1:1998, 15.3 EN 1744-1:1998, 14.2 | 1 per year 1 per year 1 per year 2 per year |
| 6 | Dicalcium silicate disintegration | 6.4.2.1 | Blastfurnace slag only | EN 1744-1:1998, 19.1 | 2 per year |
| 7 | Iron disintegration | 6.4.2.2 | Blastfurnace slag only | EN 1744-1:1998, 19.2 | 2 per year |
| 8 | Influence on initial setting time of cement | 6.4.1 | Recycled aggregates only | EN 1744-6 | 2 per year |
| 9 | Constituents of coarse recycled aggregates | 5.8 | Coarse recycled aggregates only | prEN 933-11 | 1 per month |
| 10 | Particle density and water absorption | 5.5 | Coarse recycled aggregates only | EN 1097-6 | 1 per month |
| 11 | Water-soluble sulfate | 6.3 | Recycled aggregates only | EN 1744-1 | 1 per month |
| ^a For recycled aggregates, the source can be considered as the processing depot. | | | | | |

Annex ZA
(informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

ZA.1 Scope and relevant characteristics

This European Standard and this annex ZA have been prepared under a mandate¹ given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard shown in this annex meet the requirements of the Mandate given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the aggregates and fillers covered by this European Standard for their intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

WARNING: Other requirements and other EU Directives, not affecting the fitness for intended uses, can be applicable to aggregates and fillers falling within the scope of this annex.

NOTE In addition to any specific clauses relating to dangerous substances contained in this standard there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive these requirements need also to be complied with when and where they apply. *Note: an informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (CREATE, accessed through <http://europa.eu.int>).*

Table ZA.1a – Scope and relevant requirement clauses

| Product: Aggregates obtained by processing natural, manufactured or recycled materials and mixtures of these aggregates as covered by the scope of this standard | | | |
|---|--|----------------------------|--------------------|
| Intended use(s): Preparation of concrete for use in buildings, roads and other civil engineering works | | | |
| Essential Characteristics | Requirement clauses in this and/or another standard(s) | Level(s) and/or class(es): | Notes |
| Particle shape, size and density | 4.2 Aggregate size | None | Designation (d/D) |
| | 4.3 Grading | None | Tolerance/category |
| | 4.4 Shape of coarse aggregate | None | Category |
| | 5.5 Particle density and water absorption | None | Declared value |
| Cleanliness | 4.5 Shell content of coarse aggregate | None | Category |
| | 4.6 Fines | None | Category |
| Resistance to fragmentation/crushing | 5.2 Resistance to fragmentation of coarse aggregate | None | Category |

¹ M125 "Aggregates", as amended.

Table ZA.1a – Scope and relevant requirement clauses (continued)

| Product: Aggregates obtained by processing natural, manufactured or recycled materials and mixtures of these aggregates as covered by the scope of this standard | | | |
|---|--|----------------------------|---------------------------|
| Intended use(s): Preparation of concrete for use in buildings, roads and other civil engineering works | | | |
| Essential Characteristics | Requirement clauses in this and/or another standard(s) | Level(s) and/or class(es): | Notes |
| Resistance to polishing/abrasion/wear | 5.3 Resistance to wear of coarse aggregate | None | Category |
| | 5.4.1 Resistance to polishing | None | Category |
| | 5.4.2 Resistance to surface abrasion | None | Category |
| | 5.4.3 Resistance to abrasion from studded tyres | None | Category |
| A1) Composition/content | 5.8 Constituents of coarse recycled aggregates | None | Categories |
| | 6.2 Chlorides | None | Declared value |
| | 6.3.1 Acid soluble sulfates | None | Category |
| | 6.3.2 Total sulfur | None | Pass/fail threshold value |
| | 6.3.3 Water-soluble sulfate content of recycled aggregates | None | Category |
| | 6.4.1 Constituents of natural aggregates which alter the rate of setting and hardening of concrete | None | Pass/fail threshold value |
| | 6.4.1 Influence on initial setting time of cement (recycled aggregates) | None | Category |
| 6.5 Carbonate content of fine aggregate for concrete pavement surface courses | None | Declared value A1 | |
| Volume stability | 5.7.2 Volume stability - drying shrinkage | None | Pass/fail threshold value |
| | 6.4.2 Constituents which affect the volume stability of air-cooled blastfurnace slag | None | Pass/fail threshold value |
| Water absorption | 5.5 Particle density and water absorption | None | Declared value |
| Dangerous substances: Emission of radioactivity (for aggregates from radioactive sources intended for use in concrete in buildings) Release of heavy metals Release of polyaromatic carbons Release of other dangerous substances | NOTE in ZA.1 above H.3.3 Knowledge of the raw material H.4 Management of the production | None | Third paragraph of ZA.3 |
| Durability against freeze-thaw | 5.7.1 Freeze/thaw resistance of coarse aggregate | None | Categories |
| Durability against alkali-silica reactivity | 5.7.3 Alkali-silica reactivity | None | Declared value |

Table ZA 1b – Scope and relevant requirement clauses

| Product: Fillers obtained by processing natural, manufactured or recycled materials and mixtures of these aggregates Intended use(s): Preparation of concrete for use in buildings, roads and other civil engineering works | | | |
|--|---|-----------------------------------|---|
| Essential Characteristics | Requirement clauses in this and/or another standard(s) | Level(s) and/or class(es): | Notes |
| Fineness/particle size and density | 4.3.6 Filler aggregate | None | Pass/fail threshold value |
| | 5.5 Particle density and water absorption | None | Declared value |
| Composition/content | 6.2 Chlorides 6.3.1 Acid soluble sulfate 6.3.2 Total sulfur | None None None | Declared value Categories Pass/fail threshold value |
| | 6.4.1 Constituents which alter the rate of setting and hardening of concrete | None | Pass/fail threshold value |
| Cleanliness | 4.6 Fines | None | Category |
| Volume stability | 5.7.2 Volume stability - drying shrinkage | None | Pass/fail threshold value |
| | 6.4.2 Constituents which affect the volume stability of air-cooled blastfurnace slag | None | Declared value |
| Release of other dangerous substances | NOTE in ZA.1 above H.3.3 Knowledge of the raw material H.4 Management of the production | | Third paragraph of ZA.3 |
| Durability against freeze-thaw | 5.7.1 Freeze/thaw resistance of coarse aggregate | None | Category |

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, producers placing their products on the market of these MSs are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option “No performance determined” (NPD) in the information accompanying the CE marking (see Clause ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

ZA.2 Procedures for attestation of conformity of aggregates and fillers

ZA.2.1 System(s) of attestation of conformity

The systems of attestation of conformity for the aggregates and fillers indicated in Table ZA.1a and Table ZA.1b, in accordance with the decision of the Commission 98/598/EC of 9 October 1998 as given in Annex 3 of the mandate M125 "Aggregates", as amended, is shown in Tables ZA.2a and ZA.2b for the indicated intended use(s):

The system of attestation of conformity for the aggregates and fillers indicated in Table ZA.1a and Table ZA.1b, in accordance with the decision of the Commission 96/579/EC of 24 June 1996 as given in Annex 3 of the mandate M125 "Aggregates", is shown in Tables ZA.2a and ZA.2b for the indicated intended use(s):

Table ZA.2a – System(s) of attestation of conformity for aggregates and fillers for uses with high safety requirements² (where third party intervention is required)

| Product(s) | Intended use(s) | Level(s) or class(es) | Attestation of conformity system(s) |
|---|---|-----------------------|-------------------------------------|
| Aggregates for concrete, mortar and grout | In buildings, roads and other civil engineering works | - | 2+ |
| Fillers for concrete mortar and grout | In buildings, the manufacturing of precast concrete products, for roads and other civil engineering works | - | 2+ |
| System 2+: See Directive 89/106/EEC (CPD) Annex III.2.(ii), First possibility, including certification of the factory production control by an approved body on the basis of initial inspection of factory and of factory production control as well as of continuous surveillance, assessment and approval of factory production control | | | |

Table ZA.2b – System(s) of attestation of conformity for aggregates and fillers for uses without high safety requirements² (where no third party intervention is required)

| Product(s) | Intended use(s) | Level(s) or class(es) | Attestation of conformity system(s) |
|--|---|-----------------------|-------------------------------------|
| Aggregates for concrete, mortar and grout | In buildings, roads and other civil engineering works | - | 4 |
| Fillers for concrete mortar and grout | In buildings, the manufacturing of precast concrete products, for roads and other civil engineering works | - | 4 |
| System 4: See Directive 89/106/EEC (CPD) Annex III.2.(ii), Third possibility | | | |

The attestation of conformity of the aggregates and fillers in Table ZA.1a and Table ZA.1b shall be based on the evaluation of conformity procedures indicated in table(s) ZA.3a and Table ZA.3b resulting from application of the clauses of this European Standard indicated therein.

² Safety requirements are defined by Member States in their national laws, regulations and administrative provisions.

**Table ZA.3a – Assignment of evaluation of conformity tasks
(for aggregates and fillers under system 2+)**

| Tasks | | Coverage of the task | Clauses to apply |
|-----------------------------|--|--|------------------|
| Tasks for the producer | Factory production control (F.P.C) | Parameters related to all relevant characteristics of Table ZA.1a or Table ZA.1b | 7.3 |
| | Initial type testing | All relevant characteristics of Table ZA.1a or Table ZA.1b | 7.2 |
| Tasks for the notified body | Certification of F.P.C on the basis of | Initial inspection of factory and of F.P.C | 7.3 |
| | | Continuous surveillance, assessment and approval of F.P.C. | 7.3 |

**Table ZA.3b – Assignment of evaluation of conformity tasks
(for aggregates and fillers under system 4)**

| Tasks | | Coverage of the task | Clauses to apply |
|------------------------|------------------------------------|--|------------------|
| Tasks for the producer | Factory production control (F.P.C) | Parameters related to all relevant characteristics of Table ZA.1a or Table ZA.1b | 7.3 |
| | Initial type testing | All relevant characteristics of Table ZA.1a or Table ZA.1b | 7.2 |

ZA.2.2 EC Declaration of conformity

For aggregates and fillers under system 2+: When compliance with the conditions of this Annex is achieved, and once the notified body has drawn up the certificate mentioned below, the producer or his agent established in the EEA shall prepare and retain a declaration of conformity, which entitles the producer to affix the CE marking. This declaration shall include:

- name and address of the producer, or his authorised representative established in the EEA, and the place of production;
- description of the product (type, identification, use, ...), and a copy of the information accompanying the CE marking;
- provisions to which the product conforms (annex ZA of this EN);
- particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc);
- the number of the accompanying factory production control certificate;
- name of, and position held by, the person empowered to sign the declaration on behalf of the producer or his authorised representative.

The declaration shall be accompanied by a factory production control certificate, drawn up by the notified body, which shall contain, in addition to the information above, the following:

- name and address of the notified body;
- the number of the factory production control certificate;
- conditions and period of validity of the certificate, where applicable;
- name of, and position held by, the person empowered to sign the certificate.

The above mentioned declaration shall be presented in the official language or languages of the Member State in which the product is to be used.

For aggregates and fillers under system 4: When compliance with this Annex is achieved, the producer or his agent established in the EEA shall prepare and retain a declaration of conformity (EC Declaration of conformity), which entitles the producer to affix the CE marking. This declaration shall include:

- name and address of the producer, or his authorised representative established in the EEA, and place of production;
- description of the product (type, identification, use,...), and a copy of the information accompanying the CE marking;
- provisions to which the product conforms (Annex ZA of this EN);
- particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);
- name of, and position held by, the person empowered to sign the declaration on behalf of the producer or of his authorised representative.

The above mentioned declaration shall be presented in the official language or languages of the Member State in which the product is to be used.

ZA.3 CE marking and labelling

The producer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EC and shall be shown on the accompanying label, the packaging or on the accompanying commercial documents e.g. a delivery note. The following information shall accompany the CE marking symbol:

- identification number of the certification body (only for products under system 2+);
- name or identifying mark and registered address of the producer;
- the last two digits of the year in which the marking is affixed;
- number of the certificate of factory production control certificate (if relevant);
- reference to this European Standard;
- description of the product: generic name, material, dimensions, ... and intended use;
- information on the relevant essential characteristics in Tables ZA.1a or ZA.1b as follows:
 - declared values and, where relevant, level or class/category (including "pass" for pass/fail requirements, where necessary) to declare for each essential characteristic as indicated in "Notes" in Tables ZA.1a or ZA.1b; and
 - "no performance determined" for characteristics where this is relevant.

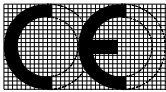
The “No performance determined” (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements.

In addition to any specific information relating to dangerous substances shown above, the product should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE European legislation without national derogations need not be mentioned.

Figures ZA.1, ZA.2, ZA.3 and ZA.4 give examples of the information to be given on the label, packaging and/or commercial documents.

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| | | |
|--|--|---|
|  01234 | | <p><i>CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.</i></p> <p><i>Identification number of the inspection body</i></p> |
| <p>Any Co Ltd, PO Box 21, B-1050</p> <p>08</p> <p>0123-CPD-0456</p> | | <p><i>Name or identifying mark and registered address of the producer</i></p> <p><i>Last two digits of the year in which the marking was affixed</i></p> <p><i>Number of the EC certificate</i></p> |
| <p>EN 12620</p> <p>Aggregates for concrete</p> | | <p><i>No. of European Standard</i></p> <p><i>Description of product and</i></p> |
| <p>Particle shape Declared value (FI)</p> <p>Particle size Designation (d/D)</p> <p>Particle density Declared value (Mg/m³)</p> <p>Cleanliness</p> <p>Fines quality Pass/fail threshold value and Category (%) (MB, SE)</p> <p>Shell content Category (e.g. SC₁₀)</p> <p>Resistance to fragmentation/crushing Category (LA₁₅)</p> <p>Resistance to polishing Category (PSV₅₆)</p> <p>Resistance to abrasion Category (AAV₁₀, A_{N30})</p> <p>Resistance to wear Category (M_{DE20})</p> <p>Composition/content</p> <p>Composition of coarse recycled aggregate Categories (Rc₉₀, XG_{0,2})</p> <p>Chlorides Declared value (% C)</p> <p>Acid soluble sulfates Category (e.g. AS_{0,2})</p> <p>Total sulfur Category (e.g. S_{NR})</p> <p>Water soluble sulfate content of recycled aggregate Category (SS_{0,2})</p> <p>Constituents which alter the rate of setting and hardening of concrete Pass/fail threshold value (Stiffening time in minutes and compressive strength S%)</p> <p>Influence of recycled aggregates on initial setting time of cement Category (A₂₅)</p> <p>Carbonate content Declared value (% CO₂)</p> | | <p><i>information on product and on regulated characteristics</i></p> |

| | | |
|--|--|----------------------|
| Volume stability | | |
| Drying shrinkage | Pass/fail threshold value | (% WS) |
| Constituents which affect the volume stability of air-cooled blastfurnace slag | Declared value | (Appearance) |
| Carbonate content | Declared value | (% CO ₂) |
| Water absorption | Declared value | (% WA) |
| Emission of radioactivity | Declared values as requested | |
| Release of heavy metals | } Threshold values valid in the place of use | |
| Release of polyaromatic carbons | | |
| Release of other dangerous substances | e.g. substance X: 0,2 µm ³ | |
| Durability against freeze-thaw | Declared value | (F or MS) |
| Durability against alkali-silica reactivity | Declared value as requested | |

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Figure ZA.1 — Example of CE marking information for aggregates for concrete under system 2+

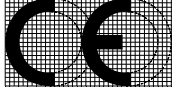
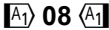
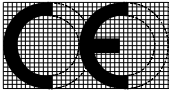
| | | | |
|---|----------------------------|--|---|
|  01234 | | | CE conformity marking, consisting of the "CE"-symbol given in directive 93/68/EEC. |
| Any Co Ltd, PO Box 21, B-1050  0123-CPD-0456 | | | Identification number of the inspection body Name or identifying mark and registered address of the producer Last two digits of the year in which the marking was affixed Number of the EC certificate |
| EN 12620 Aggregates for concrete | | | No. of European Standard Description of product and information on regulated characteristics |
| Fineness/Particle size | Declared value | (% passing by mass) | |
| Particle density | Declared value | (Mg/m ³) | |
| Composition/content | | | |
| Chlorides | Declared value | (% C) | |
| Acid soluble sulfates | Categories | (e.g. AS _{0,2}) | |
| Total sulfur | Pass/fail threshold value | (% S) | |
| Cleanliness | Pass/fail threshold values | (% passing, % by mass, MB, SE) | |
| Volume stability | | | |
| Drying shrinkage | Pass/fail threshold value | (% drying shrinkage) | |
| Constituents which affect the volume stability of air-cooled blastfurnace slag | Declared value | (visual appearance, visual cracking or disintegration) | |
| Release of other dangerous substances | X decree YY/nn (yy-mm-dd) | | |

Figure ZA.2 — Example of CE marking information for fillers under system 2+

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| | | | |
|---|---|---|--|
|  | | | <p><i>CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC</i></p> |
| <p>Any Co Ltd, PO Box 21, B-1050</p> <p>08</p> | | | <p><i>Name or identifying mark and registered address of the producer</i></p> <p><i>Last two digits of the year in which the marking was affixed</i></p> |
| <p>EN 12620</p> <p>Aggregates for concrete</p> | | | <p><i>No. of European Standard</i></p> <p><i>Description of product and</i></p> |
| <p>Particle shape</p> <p>Particle size</p> <p>Particle density</p> <p>Cleanliness</p> <p>Fines quality</p> <p>Shell content</p> <p>Resistance to fragmentation/crushing</p> <p>Resistance to polishing</p> <p>Resistance to abrasion</p> <p>Resistance to wear</p> <p>Composition/content</p> <p>Constituents of coarse recycled aggregate</p> <p>Chlorides</p> <p>Acid soluble sulfates</p> <p>Total sulfur</p> <p>Water soluble sulfate content of recycled aggregate</p> <p>Constituents which alter the rate of setting and hardening of concrete</p> <p>Influence of recycled aggregates on initial setting time of cement</p> <p>Carbonate content</p> | <p>Declared value</p> <p>Designation</p> <p>Declared value</p> <p>Pass/fail threshold value and Category</p> <p>Category</p> <p>Category</p> <p>Category</p> <p>Category</p> <p>Category</p> <p>Category</p> <p>Categories</p> <p>Declared value</p> <p>Category</p> <p>Category</p> <p>Category</p> <p>Pass/fail threshold value</p> <p>Category</p> <p>Declared value</p> | <p>(FI)</p> <p>(d/D)</p> <p>(Mg/m³)</p> <p>(%)</p> <p>(MB, SE)</p> <p>(e.g. SC₁₀)</p> <p>(LA₁₅)</p> <p>(PSV₅₆)</p> <p>(AAV₁₀, A_{N30})</p> <p>(M_{DE20})</p> <p>(Rc₉₀, XG_{0,2})</p> <p>(% C)</p> <p>(e.g. AS_{0,2})</p> <p>(e.g. S_{NR})</p> <p>(SS_{0,2})</p> <p>(Stiffening time in minutes and compressive strength S%)</p> <p>(A₂₅)</p> <p>(% CO₂)</p> | <p><i>information on product and on regulated characteristics</i></p> |

| | | |
|--|--|--------------|
| Volume stability | | |
| Drying shrinkage | Pass/fail threshold value | (% WS) |
| Constituents which affect the volume stability of air-cooled blastfurnace slag | Declared value | (Appearance) |
| Water absorption | Declared value | (% WA) |
| Emission of radioactivity | Declared values as requested | |
| Release of heavy metals | } Threshold values valid in the place of use | |
| Release of polyaromatic carbons | | |
| Release of other dangerous substances | e.g. substance X: 0,2 µm ³ | |
| Durability against freeze-thaw | Declared value | (F or MS) |
| Durability against alkali-silica reactivity | Declared value as requested | |

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Figure ZA.3 — Example of CE marking information for aggregates for concrete under system 4

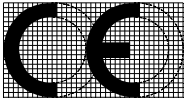
| | |
|--|---|
|  | <i>CE conformity marking, consisting of the “CE”-symbol given in directive 93/68/EEC.</i> |
| Any Co Ltd, PO Box 21, B-1050 | <i>Name or identifying mark and registered address of the producer</i> |
| A1 08 A1 | <i>Last two digits of the year in which the marking was affixed</i> |
| EN 12620 | <i>No. of European Standard</i> |
| Aggregates for concrete | <i>Description of product and information on regulated characteristics</i> |
| Fineness/Particle size | Declared value (% passing by mass) |
| Particle density | Declared value (Mg/m ³) |
| Composition/content | |
| Chlorides | Declared value (% C) |
| Acid soluble sulfates | Categories (e.g. AS _{0,2}) |
| Total sulfur | Pass/fail threshold value (% S) |
| Cleanliness | Pass/fail threshold values (% passing, % by mass, MB, SE) |
| Volume stability | |
| Drying shrinkage | Pass/fail threshold value (% drying shrinkage) |
| Constituents which affect the volume stability of air-cooled blastfurnace slag | Declared value (visual appearance, visual cracking or disintegration) |
| Release of other dangerous substances | X decree YY/nn (yy-mm-dd) |

Figure ZA.4 — Example of CE marking information for fillers under system 4

Bibliography

EN 206-1, *Concrete - Part 1: Specification, performance, production and conformity*

EN 13055-1:2002, *Lightweight aggregates - Part 1: Lightweight aggregates for concrete, mortar and grout*

CR 1901, *Regional specifications and recommendations for the avoidance of damaging alkali silica reactions in concrete*

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