
Kamen za obloge pri vodnih zgradbah in drugih gradbenih delih - 1. del:
Specifikacija

Armourstone - Part 1: Specification

Wasserbausteine - Teil 1: Anforderungen

Enrochements - Partie 1 : Spécifications

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English version

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This European Standard was approved by CEN on 25 March 2002.

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

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

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Foreword

This document EN 13383-1:2002 has been prepared by Technical Committee CEN/TC 154 "Aggregates", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by June 2004.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

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

This standard forms part of a series of standards for armourstone, the other part being:

EN 13383-2 *Armourstone - Part 2: Test methods.*

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

- prEN 12620 *Aggregates for concrete.*
 prEN 13043 *Aggregates for bituminous mixtures and surface dressings for roads.*
 EN 13055 *Lightweight aggregates.*
 prEN 13139 *Aggregates for mortar.*
 prEN 13242 *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction.*
 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the properties of aggregates obtained by processing natural, manufactured or recycled materials and mixtures of these materials for use as armourstone.

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

NOTE 1 The requirements in this European Standard are based upon experience with armourstone types with an established pattern of use. Care should be taken when considering the use of armourstone from sources with no such pattern of use, e.g., recycled armourstone and armourstone arising from certain industrial by-products. Such armourstone, which should comply with all the requirements of this European Standard, could have other characteristics not included in Mandate M 125 that do not apply to the generality of armourstone types with an established pattern of use and when required, provisions valid at the place of use can be used to assess their suitability.

NOTE 2 Finer aggregates than specified in this European Standard are used in hydraulic structures. For such aggregates European Standards for other end uses of aggregates should be applied.

2 Normative references

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

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

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

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

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

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

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

prEN 1744-3, *Tests for chemical properties of aggregates — Part 3: Preparation of eluates by leaching of aggregates.*

EN 1926:1999, *Methods of test for natural stones — Determination of compressive strength.*

EN 13383-2:2002, *Armourstone — Part 2: Test methods.*

3 Terms and definitions

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

3.1

armourstone

coarse aggregates used in hydraulic structures and other civil engineering works

3.2**natural armourstone**

armourstone from mineral sources which has only been subjected to mechanical processing

3.3**manufactured armourstone**

armourstone of mineral origin resulting from an industrial process involving thermal or other modification excluding concrete armour units

3.4**recycled armourstone**

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

3.5**armourstone grading**

armourstone designation with a nominal lower and upper limit

NOTE

This designation accepts the presence of undersize and oversize pieces of armourstone.

3.6**nominal lower limit**

mass or sieve size in a grading below which the armourstone pieces are considered to be undersized

3.7**nominal upper limit**

mass or sieve size in a grading above which the armourstone pieces are considered to be oversized

3.8**coarse grading**

designation of grading with a nominal upper limit defined by a sieve size between and including 125 mm and 250 mm

3.9**light grading**

designation of grading with a nominal upper limit defined by a mass between and including 25 kg and 500 kg

3.10**heavy grading**

designation of grading with a nominal upper limit defined by a mass of more than 500 kg

3.11**fragment**

armourstone piece in the finest fraction of coarse gradings or the lightest fraction of light and heavy gradings for which the particle size distribution or mass distribution requirements apply

NOTE

For further information on grading, see annex A.

3.12**category**

level of a property of armourstone expressed as a range of values or a limiting value

NOTE

There is no relationship between the categories of different properties.

4 Geometrical requirements**4.1 General**

The necessity for testing and declaring all properties in this clause is limited according to the particular application at end use or origin of the armourstone. 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 7 the percentage by number of pieces of armourstone with less than 50 % crushed or broken surfaces of say 7 corresponds to RO_7 (Declared value).

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

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

Sampling shall be carried out as specified in EN 13383-2:2002, clause 4.

4.2 Gradings

4.2.1 Coarse gradings

The particle size distribution of coarse gradings shall be determined in accordance with EN 13383-2:2002, clause 5 and shall conform to:

- a) Table 1 for categories $CP_{45/125}$, $CP_{63/180}$, $CP_{90/250}$, $CP_{45/180}$, and $CP_{90/180}$; or
- b) as declared by the producer for category CP_{Declared} .

The mean distribution shall be obtained by calculating the arithmetic mean of the percentages passing each specified sieve.

Table 1 — Requirements for the particle size distribution of standard coarse gradings

Grading mm	45/125	63/180	90/250	45/180	90/180 ^a
Category	$CP_{45/125}$	$CP_{63/180}$	$CP_{90/250}$	$CP_{45/180}$	$CP_{90/180}$ ^a
Sieve size mm	Percentage passing (by mass)				
360	-	-	98 to 100	-	-
250	-	98 to 100	90 to 100	98 to 100	98 to 100
180	98 to 100	90 to 100	-	90 to 100	80 to 100 ^b
125	90 to 100	-	0 to 50	-	-
90	-	0 to 50	0 to 15	-	0 to 20 ^b
63	0 to 50	0 to 15	-	0 to 50	-
45	0 to 15	-	0 to 5 ^c	0 to 15	0 to 5 ^c
31,5	-	0 to 5 ^c	-	-	-
22,4	0 to 5 ^c	-	-	0 to 5 ^c	-

^a Grading 90/180 mm is a narrow grading designated for special applications such as gabions.
^b The fraction between the 90 mm and 180 mm sieves of the 90/180 mm grading shall be ≥ 80 % by mass.
^c Fragments.

4.2.2 Light gradings

The mass distribution of light gradings shall be determined in accordance with EN 13383-2:2002, clause 6.

The mass distribution of a bulk sample consisting of three samples from a stream of material or six samples from a static batch shall conform to:

- a) Table 2 for categories $LMA_{5/40}$, $LMA_{10/60}$, $LMA_{40/200}$, $LMA_{60/300}$ and $LMA_{15/300}$; or
- b) Table 3 for categories $LMB_{5/40}$, $LMB_{10/60}$, $LMB_{40/200}$, $LMB_{60/300}$ and $LMB_{15/300}$; or
- c) the mass distribution and, where appropriate, the average mass as declared by the producer for category LM_{Declared} .

Table 2 — Requirements for average mass (excluding fragments) and mass distribution of category A standard light gradings

Grading kg	5 to 40	10 to 60	40 to 200	60 to 300	15 to 300
Category	$LMA_{5/40}$	$LMA_{10/60}$	$LMA_{40/200}$	$LMA_{60/300}$	$LMA_{15/300}$
Average mass kg	10 to 20	20 to 35	80 to 120	120 to 190	45 to 135
Mass kg	Percentage (by mass) less than particle mass				
450	-	-	-	97 to 100	97 to 100
300	-	-	97 to 100	70 to 100	70 to 100
200	-	-	70 to 100	-	-
120	-	97 to 100	-	-	-
80	97 to 100	-	-	-	-
60	-	70 to 100	-	0 to 10	-
40	70 to 100	-	0 to 10	-	-
30	-	-	-	0 to 2 ^a	-
15	-	-	0 to 2 ^a	-	0 to 10
10	-	0 to 10	-	-	-
5	0 to 10	-	-	-	-
3	-	-	-	-	0 to 2 ^a
2	-	0 to 2 ^a	-	-	-
1,5	0 to 2 ^a	-	-	-	-

^a Fragments.

Table 3 — Requirements for mass distribution of category B standard light gradings

Grading kg	5 to 40	10 to 60	40 to 200	60 to 300	15 to 300
Category	$LMB_{5/40}$	$LMB_{10/60}$	$LMB_{40/200}$	$LMB_{60/300}$	$LMB_{15/300}$
Mass kg	Percentage (by mass) less than particle mass				
450	-	-	-	97 to 100	97 to 100
300	-	-	97 to 100	70 to 100	70 to 100
200	-	-	70 to 100	-	-
120	-	97 to 100	-	-	-
80	97 to 100	-	-	-	-
60	-	70 to 100	-	0 to 10	-
40	70 to 100	-	0 to 10	-	-
30	-	-	-	0 to 2 ^a	-
15	-	-	0 to 2 ^a	-	0 to 10
10	-	0 to 10	-	-	-
5	0 to 10	-	-	-	-
3	-	-	-	-	0 to 2 ^a
2	-	0 to 2 ^a	-	-	-
1,5	0 to 2 ^a	-	-	-	-

^a Fragments.

4.2.3 Heavy gradings

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The mass distribution of heavy gradings shall be determined in accordance with EN 13383-2:2002, clause 6.

The mass distribution of a bulk sample consisting of three samples from a stream of material or six samples from a static batch shall conform to:

- Table 4 for categories $HMA_{300/1000}$, $HMA_{1000/3000}$, $HMA_{3000/6000}$, $HMA_{6000/10000}$, and $HMA_{10000/15000}$; or
- Table 5 for categories $HMB_{300/1000}$, $HMB_{1000/3000}$, $HMB_{3000/6000}$, $HMB_{6000/10000}$, and $HMB_{10000/15000}$; or
- the mass distribution and, where appropriate, the average mass as declared by the producer for category $HM_{Declared}$.

**Table 4 — Requirements for average mass (excluding fragments)
and mass distribution of category A standard heavy gradings**

Grading kg	300 to 1 000	1 000 to 3 000	3 000 to 6 000	6 000 to 10 000	10 000 to 15 000
Category	<i>HMA</i> _{300/1000}	<i>HMA</i> _{1000/3000}	<i>HMA</i> _{3000/6000}	<i>HMA</i> _{6000/10000}	<i>HMA</i> _{10000/15000}
Average mass kg	540 to 690	1 700 to 2 100	4 200 to 4 800	7 500 to 8 500	12 000 to 13 000
Mass kg	Percentage (by mass) less than particle mass				
22 500	-	-	-	-	97 to 100
15 000	-	-	-	97 to 100	70 to 100
10 000	-	-	-	70 to 100	0 to 10
9 000	-	-	97 to 100	-	-
6 500	-	-	-	-	0 to 5 ^a
6 000	-	-	70 to 100	0 to 10	-
4 500	-	97 to 100	-	-	-
4 000	-	-	-	0 to 5 ^a	-
3 000	-	70 to 100	0 to 10	-	-
2 000	-	-	0 to 5 ^a	-	-
1 500	97 to 100	-	-	-	-
1 000	70 to 100	0 to 10	-	-	-
650	-	0 to 5	-	-	-
300	0 to 10	-	-	-	-
200	0 to 5 ^a	-	-	-	-
^a Fragments.					

Table 5 — Requirements for mass distribution of category B standard heavy gradings

Grading kg	300 to 1 000	1 000 to 3 000	3 000 to 6 000	6 000 to 10 000	10 000 to 15 000
Category	<i>HMB</i> _{300/1000}	<i>HMB</i> _{1000/3000}	<i>HMB</i> _{3000/6000}	<i>HMB</i> _{6000/10000}	<i>HMB</i> _{10000/15000}
Mass kg	Percentage (by mass) less than particle mass				
22 500	-	-	-	-	97 to 100
15 000	-	-	-	97 to 100	70 to 100
10 000	-	-	-	70 to 100	0 to 10
9 000	-	-	97 to 100	-	-
6 500	-	-	-	-	0 to 5 ^a
6 000	-	-	70 to 100	0 to 10	-
4 500	-	97 to 100	-	-	-
4 000	-	-	-	0 to 5 ^a	-
3 000	-	70 to 100	0 to 10	-	-
2 000	-	-	0 to 5 ^a	-	-
1 500	97 to 100	-	-	-	-
1 000	70 to 100	0 to 10	-	-	-
650	-	0 to 5	-	-	-
300	0 to 10	-	-	-	-
200	0 to 5 ^a	-	-	-	-
^a Fragments.					

4.3 Shape

4.3.1 Length-to-thickness ratio

The percentage of pieces of armourstone with a length to thickness ratio greater than 3 shall be determined in accordance with EN 13383-2:2002, clause 7.

4.3.2 Coarse gradings

The percentage of pieces of armourstone with a length to thickness ratio greater than 3 of a subsample, obtained from the samples specified for the determination of particle size distribution (see 4.2.1) shall conform to the relevant requirements (or the producer's declaration for category LT_{Declared}) specified in Table 6 for the selected category, when tested as specified in 4.3.1.

4.3.3 Light gradings

The percentage of pieces of armourstone with a length to thickness ratio greater than 3 of a bulk sample as specified for the determination of the mass distribution (see 4.2) shall conform to the relevant requirements (or the producer's declaration for category LT_{Declared}) specified in Table 6 for the selected category, when tested as specified in 4.3.1.

4.3.4 Heavy gradings

The percentage of pieces of armourstone with a length to thickness ratio greater than 3 of a bulk sample as specified for the determination of the mass distribution (see 4.2.3) shall conform to the relevant requirements (or the producer's declaration for category LT_{Declared}) specified in Table 6 for the selected category, when tested as specified in 4.3.1.

Table 6 — Category for shape

Length to thickness ratio greater than 3			Category LT
Percentage by mass		Percentage by number	
Coarse gradings	Light gradings	Heavy gradings	
≤ 20	≤ 20	≤ 5	LT_A
Other value declared by the producer	Other value declared by the producer	Other value declared by the producer	LT_{Declared}
No requirement	No requirement	No requirement	LT_{NR}

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4.4 Proportion of crushed or broken surfaces

When required, the proportion of pieces of armourstone (excluding fragments), with less than 50 % crushed or broken surfaces (rounded pieces) shall conform to the relevant requirement (or the producer's declaration for category RO_{Declared}) specified in Table 7 for the selected category. The sample tested shall be the sample used for the determination of shape, see 4.3. The sample shall be examined by visual inspection and counting of pieces of armourstone.

Table 7 — Categories for crushed or broken surfaces

Pieces of armourstone with less than 50 % crushed or broken surfaces Percentage by number	Category RO
≤ 5 Other value declared by the producer	RO_5 RO_{Declared}
No requirement	RO_{NR}
<p>NOTE 1 Broken surfaces are understood to include surfaces arising from discontinuities in the rock formation such as bedding planes and joints.</p> <p>NOTE 2 Category RO_5 should only be applied to armourstone for use in structures in which rounded pieces of armourstone could lead to instability.</p>	