BS EN 13383-1:2013

BSI Standards Publication

Armourstone

Part 1: Specification

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National foreword

This British Standard is the UK implementation of EN 13383-1:2013. It supersedes BS EN 13383-1:2002 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/502, Aggregates.

A list of organizations represented on this committee 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.

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Foreword

This document (EN 13383-1:2013) 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of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by February 2015.

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

This document supersedes EN 13383-1:2002.

The most significant technical changes that have been made include:

— the removal of the previous minimum density requirement and a change in the method of declaring density;

— inclusion of a new coarse grading (32/90mm) and a new light grading (15 kg to 120 kg) and guidance on the declaration of non-standard heavy gradings;

— inclusion of a new category for resistance to wear $M_{DE}15$, to take account of the fact that very few armourstone sources meet the highest quality category $M_{DE}10$;

— requirements for sample preparation for the Micro-Deval test has been moved from EN 13383-1 to EN 13383-2.

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

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

Requirements for initial type testing and factory production control (previously specified in a normative annex to this standard) are now given in a new standard EN 16236 on *Evaluation of conformity of aggregates*.

EN 13383 *Armourstone* consists of the following parts:

Part 1: Specifications

Part 2: Test methods

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

EN 12620, *Aggregates for concrete*
EN 13043, *Aggregates for bituminous mixtures and surface dressings for roads, airfields and other trafficked areas*
EN 13055, *Lightweight aggregates*
EN 13139, *Aggregates for mortar*
EN 13242, *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction*
EN 13450, *Aggregates for railway ballast*

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece,

Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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.

A list of the source materials that have been considered and are within the scope of this European Standard is given in Annex A (normative).

Requirements for the evaluation of conformity of the products to this European Standard are given in EN 16236.

It incorporates a general requirement that armourstone shall not release any dangerous substances in excess of the maximum permitted levels specified in a relevant European Standard for the material or permitted in the national regulations of the member state of destination.

Armourstone used in construction should comply with all the requirements of this European Standard. The standard includes specific requirements for natural armourstone, and armourstone made of blast furnace and steel making slag armourstone. For materials from some other secondary sources, however, work is ongoing and the requirements are incomplete. In the meantime, such materials, when placed on the market as armourstone, should comply fully with this European Standard but may also be required to conform to specific relevant additional requirements at the place of 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.

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.

Requirements for the declaration of the potential of armourstone to release regulated dangerous substances are currently under development. Until such time as these are finalised, attention should be paid to requirements at the place of use.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

EN 1097-1:2011, *Tests for mechanical and physical properties of aggregates — Part 1: Determination of the resistance to wear (micro-Deval)*

EN 1367-2:2009, *Tests for thermal and weathering properties of aggregates — Part 2: Magnesium sulfate test*

EN 1744-1:2009+A1:2012, *Tests for chemical properties of aggregates — Part 1: Chemical analysis*

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

EN 1926:2006, *Natural stone test methods — Determination of uniaxial compressive strength*

EN 13383-2:2013, *Armourstone — Part 2: Test methods*

EN 16236, *Evaluation of conformity of aggregates — Initial Type Testing and Factory Production Control*

3 Terms and definitions

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

3.1
armourstone
coarse aggregates used in hydraulic structures and other civil engineering works

Note 1 to entry: Armourstone can be natural, manufactured or recycled.

3.2
natural armourstone
armourstone from mineral sources which has been subjected to nothing more than 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 or mineral material previously used in construction

3.5
armourstone grading
armourstone designation with a nominal lower and upper limit

Note 1 to entry: 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 90 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 1 to entry: Fragments are all armourstone pieces falling below the extreme lower limit (see Annex B.1)

3.12
category
level of a property of armourstone expressed as a range of values or a limiting value

Note 1 to entry: There is no relationship between the categories of different properties.

3.13
effective mean mass, M_{em}
average mass of armourstone, excluding fragments

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.

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.

When a property is not required, a “No requirement” category may be used.

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

NOTE Where conformity with a category is based on a value of a property being less than or equal to a given value, conformity with a more severe category (lower value) automatically confers conformity with all less severe categories (higher values). Similarly for categories based on the property being greater than or equal to a given value, conformity with a more severe (higher value) automatically confers conformity with all less severe categories (lower values).

Sampling shall be carried out as specified in EN 13383-2:2013, Clause 4.

4.2 Gradings

4.2.1 Coarse gradings

The particle size distribution of coarse gradings shall be determined in accordance with EN 13383-2:2013, Clause 5. shall conform to:

a) Table 1 for categories $CP_{32/90}$, $CP_{45/125}$, $CP_{63/180}$, $CP_{90/250}$, $CP_{45/180}$, and $CP_{90/180}$; or

b) as declared by the producer for category $CP_{Declared}$.

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

Grading mm	**32/90**	**45/125**	**63/180**	**90/250**	**45/180**	**90/180** [c]
Category	$CP_{32/90}$	$CP_{45/125}$	$CP_{63/180}$	$CP_{90/250}$	$CP_{45/180}$	$CP_{90/180}$
Sieve size mm	**Cumulative 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 [a]
125	98 to 100	90 to 100	-	0 to 50	-	-
90	90 to 100	-	0 to 50	0 to 15	-	0 to 20 [a]
63	-	0 to 50	0 to 15	-	0 to 50	-
45	0 to 50	0 to 15	-	0 to 5 [b]	0 to 15	0 to 5 [b]
31,5	0 to 15	-	0 to 5 [b]	-	-	-
22,4	-	0 to 5 [b]	-	-	0 to 5 [b]	-
16	0 to 5 [b]	-	-	-	-	-

[a] The fraction between the 90 mm and 180 mm sieves of the 90/180 mm grading shall be ≥ 80 % by mass.
[b] Fragments.
[c] See Annex F.

4.2.2 Light gradings

The mass distribution of light gradings shall be determined in accordance with EN 13383-2:2013, Clause 6.

The mass distribution shall conform to:

a) Table 2 for categories $LMA_{15/120}$, $LMA_{5/40}$, $LMA_{10/60}$, $LMA_{40/200}$, $LMA_{60/300}$ and $LMA_{15/300}$; or

b) Table 3 for categories $LMB_{15/120}$, $LMB_{5/40}$, $LMB_{10/60}$, $LMB_{40/200}$, $LMB_{60/300}$ and $LMB_{15/300}$; or

c) the mass distribution and, where appropriate, the average mass (excluding fragments) 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**	**15 to 120**	**40 to 200**	**60 to 300**	**15 to 300**
Category	$LMA_{5/40}$	$LMA_{10/60}$	$LMA_{15/120}$	$LMA_{40/200}$	$LMA_{60/300}$	$LMA_{15/300}$
Average mass (excluding fragments), M_{em} kg	10 to 20	20 to 35	35 to 60	80 to 120	120 to 190	45 to 135
Reference mass kg	**Cumulative percentage (by mass) of stones lighter than reference mass**					
450	-	-	-	-	97 to 100	97 to 100
300	-	-	-	97 to 100	70 to 100	70 to 100
200	-	-	97 to 100	70 to 100	-	-
120	-	97 to 100	70 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 10	0 to 2 [a]	-	0 to 10
10	-	0 to 10	-	-	-	-
5	0 to 10	-	0 to 2 [a]	-	-	-
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**	**15 to 120**	**40 to 200**	**60 to 300**	**15 to 300**
Category	$LMB_{5/40}$	$LMB_{10/60}$	$LMB_{15/120}$	$LMB_{40/200}$	$LMB_{60/300}$	$LMB_{15/300}$
Reference mass kg	**Cumulative percentage (by mass) of stones lighter than reference mass**					
450	-	-	-	-	97 to 100	97 to 100
300	-	-	-	97 to 100	70 to 100	70 to 100
200	-	-	97 to 100	70 to 100	-	-
120	-	97 to 100	70 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 10	0 to 2 [a]	-	0 to 10
10	-	0 to 10	-	-	-	-
5	0 to 10	-	0 to 2 [a]	-	-	-
3	-	-	-	-	-	0 to 2 [a]
2	-	0 to 2 [a]	-	-	-	-
1,5	0 to 2 [a]	-	-	-	-	-

[a] Fragments.

4.2.3 Heavy gradings

The mass distribution of heavy gradings shall be determined in accordance with EN 13383-2:2013, Clause 6.

The mass distribution shall conform to:

a) Table 4 for categories $HMA_{300/1000}$, $HMA_{1000/3000}$, $HMA_{3000/6000}$, $HMA_{6000/10000}$, and $HMA_{10000/15000}$; or

b) Table 5 for categories $HMB_{300/1000}$, $HMB_{1000/3000}$, $HMB_{3000/6000}$, $HMB_{6000/10000}$, and $HMB_{10000/15000}$; or

c) the mass distribution and, where appropriate, the average mass (excluding fragments) 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	$HMA_{300/1000}$	$HMA_{1000/3000}$	$HMA_{3000/6000}$	$HMA_{6000/10000}$	$HMA_{10000/15000}$
Average mass (excluding fragments), M_{em} kg	540 to 690	1 700 to 2 100	4 200 to 4 800	7 500 to 8 500	12 000 to 13 000
Reference mass kg	**Cumulative percentage (by mass) of stones lighter than reference 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 [a]	-	-	-
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	$HMB_{300/1000}$	$HMB_{1000/3000}$	$HMB_{3000/6000}$	$HMB_{6000/10000}$	$HMB_{10000/15000}$
Reference mass kg	**Cumulative percentage (by mass) of stones lighter than reference 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 [a]	-	-	-
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 13383-2:2013, Clause 7.

NOTE Guidance on the determination of shape information required for design is given in Annex F.

4.3.2 Coarse gradings

The percentage of pieces of armourstone with a length to thickness ratio greater than 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.

4.3.3 Light gradings

The percentage of pieces of armourstone with a length to thickness ratio greater than 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.

4.3.4 Heavy gradings

The percentage of pieces of armourstone with a length to thickness ratio greater than 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
> 20	> 20	> 5	$LT_{Declared}$
No requirement	No requirement	No requirement	LT_{NR}

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. When examining pieces of armourstone, surfaces arising from discontinuities in the rock formation such as bedding planes or joints shall be included in the percentage of broken surfaces.

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	RO_5
> 5	$RO_{Declared}$
No requirement	RO_{NR}

NOTE Guidance on the selection of *RO* category is given in Annex F.

5 Physical requirements

5.1 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 5 shall be carried out to determine appropriate physical properties.

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. For example, in Table 9 a value of a micro-Deval coefficient of less than or equal to 40 corresponds to $M_{DE}40$.

When a property is not required, a “No requirement” category may be used.

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

NOTE Where conformity with a category is based on a value of a property being less than or equal to a given value, conformity with a more severe category (lower value) automatically confers conformity with all less severe categories (higher values). Similarly for categories based on the property being greater than or equal to a given value, conformity with a more severe (higher value) automatically confers conformity with all less severe categories (lower values).

Sampling shall be carried out as specified in EN 13383-2:2013, Clause 4.

5.2 Particle density

The particle density of at least 10 pieces of armourstone (excluding fragments), shall be determined in accordance with EN 13383-2:2013, Clause 8.

Using the results, the average particle density (in Mg/m^3) of the pieces of armourstone tested shall be declared to 2 decimal places.

Using the results, the minimum particle density (in Mg/m^3) of any piece of armourstone shall be declared to 2 decimal places.

5.3 Resistance to breakage

The resistance to breakage of armourstone (excluding fragments) shall be determined by testing compressive strength in accordance with EN 1926:2006, Annex A.

Each specimen shall be prepared from a separate piece of armourstone.

The number of specimens to be tested and the test results shall conform to the relevant requirements (or the producer's declaration for category $CS_{Declared}$) specified in Table 8 for the selected category.

Table 8 — Categories of resistance to breakage requirements

Mean compressive strength of 9 specimens after striking out the lowest value from 10 specimens MPa	**Compressive strength of no more than 2 specimens out of 10** MPa	**Category** *CS*
≥ 80	< 60	CS_{80}
≥ 60	< 40	CS_{60}
< 60	No requirement	$CS_{Declared}$
No requirement	No requirement	CS_{NR}

NOTE Block integrity is also of particular importance. Guidance on block integrity is given in Annex C.

5.4 Resistance to wear

When required, the resistance to wear of armourstone (excluding fragments), determined in accordance with EN 1097-1:2011, Clause 7, shall conform to the relevant requirement (or the producer's declaration for category M_{DE}Declared) specified in Table 9 for the selected category.

Table 9 — Categories for resistance to wear requirements

micro-Deval coefficient	Category M_{DE}
≤ 10 ≤ 15 ≤ 20 ≤ 30 > 30	M_{DE}10 M_{DE}15 M_{DE}20 M_{DE}30 M_{DE}Declared
No requirement	M_{DE}NR

NOTE Guidance on the selection of wear categories is given in Annex F.

The test portion shall be prepared in accordance with EN 1097-1:2011, Clause 6. Where suitable aggregate from a source representative of the armourstone is not available, the test portion shall be prepared in accordance with EN 13383-2:2013, 4.7.

5.5 Requirement associated with grouting

Armourstone intended for use in a layer to be grouted with bituminous or cement mortar shall not be covered with observable clayey or other adhesive soil.

5.6 Colour

Natural variation in colour supplied from a quarry (or distinct part of a quarry) with an established pattern of supply shall not be grounds for rejection of any material.

The purchaser should advise the supplier of any preference for a particular general colour for the armourstone.

6 Chemical requirements

6.1 General

The necessity for testing and declaring all properties 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 This clause generally applies to natural and manufactured armourstone. However, some recycled materials could have other chemical characteristics that do not apply to the generality of armourstone with an established pattern of use and when required, provisions valid at the place of use can be used to assess its suitability.

Sampling shall be carried out as specified in EN 13383-2:2013, Clause 4.

6.2 Impurities

Armourstone shall not contain any foreign matter such as scrap metal, wood and plastic in a quantity that will cause damage to the structure or the environment in which it is used (see EN 16236:2013, Table 3).

6.3 Water soluble constituents

When a determination of water soluble constituents is required, an eluate shall be prepared from a representative sample of armourstone as specified in EN 1744-3. Where suitable aggregate representative of the armourstone is

not available, the test portion shall be obtained by crushing, using a laboratory jaw crusher, at least six separate pieces of armourstone for which the masses do not differ by more than 25 %.

7 Durability requirements

7.1 General

The necessity for testing for 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 7 shall be carried out to determine appropriate durability properties.

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. For example, in Table 13 a value of a percentage loss of mass of less than or equal to 30 corresponds to MS_{30}.

When a property is not required, a “No requirement” category may be used.

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

NOTE Where conformity with a category is based on a value of a property being less than or equal to a given value, conformity with a more severe category (lower value) automatically confers conformity with all less severe categories (higher values). Similarly for categories based on the value of a property being greater than or equal to a given value, conformity with a more severe (higher value) automatically confers conformity with all less severe categories (lower values).

Sampling shall be carried out as specified in EN 13383-2:2013, Clause 4.

7.2 Constituents which affect the durability of blastfurnace and steel slags

7.2.1 Dicalcium silicate disintegration of air-cooled blastfurnace slag

When required, air-cooled blast-furnace slag armourstone (excluding fragments) tested in accordance with EN 1744-1:2009+A1:2012, 19.1, shall be free from dicalcium silicate disintegration.

7.2.2 Iron disintegration of air-cooled blastfurnace slag

When required, air-cooled blastfurnace slag armourstone (excluding fragments) tested in accordance with EN 1744-1:2009+A1:2012, 19.2, shall be free from iron disintegration.

7.2.3 Disintegration of steel slag

When required, the disintegration of steel slag armourstone shall be tested in accordance with EN 13383-2:2013, Clause 10.

The sample for testing shall consist of 20 pieces of slag (excluding fragments).

The disintegration of steel slags shall conform to the relevant requirements (or the producer's declaration for category $DS_{Declared}$) specified in Table 10 for the selected category.

Table 10 — Categories for disintegration of steel slag

Disintegration of steel slag **Loss of mass or formation of cracks**	**Category** *DS*
Maximum four pieces show > 0,5 % loss of mass and maximum one piece shows > 20 % loss of mass or cracks	DS_A
Maximum four pieces show > 1,0 % loss of mass and maximum one piece shows > 20 % loss of mass or cracks	DS_B
Other values declared by the producer	$DS_{Declared}$
No requirement	DS_{NR}

For categories DS_A and DS_B of Table 10, if one of the 20 pieces shows either cracks or more than 20 % loss of mass, another 20 pieces of steel slag shall be tested. None of these additional pieces shall show either cracks or more than 20 % loss of mass.

7.3 Water absorption as a screening test for resistance to freezing and thawing and to salt crystallization

When required, the water absorption of armourstone (excluding fragments) shall be determined in accordance with EN 13383-2:2013, Clause 8. At least 10 Pieces of armourstone shall be tested and the average absorption declared.

If the average water absorption is not greater than the value selected as category $WA_{0,5}$ specified in Table 11, the armourstone shall be assumed to be resistant to freezing and thawing and to salt crystallization.

Table 11 — Categories for water absorption

Water absorption Percentage by mass	**Category** *WA*
Average absorption $\leq$ 0,5	$WA_{0,5}$

7.4 Resistance to freezing and thawing

When required, the resistance to freezing and thawing of armourstone (excluding fragments) shall be determined in accordance with EN 13383-2:2013, Clause 9. The resistance to freezing and thawing shall conform to the relevant requirements (or the producer's declaration for category $FT_{Declared}$) specified in Table 12 for the selected category. 10 pieces of armourstone shall be tested initially.

If one of the tested pieces shows more than 0,5 % loss of mass or formation of open cracks, another 10 pieces of armourstone shall be tested.

NOTE 1 The pieces tested in conformity with 7.3 and showing maximum 0,5 % water absorption are excluded from further testing.

NOTE 2 Guidance on how to specify the resistance of armourstone to freezing and thawing is given in Annex D.

Table 12 — Categories for resistance to freezing and thawing

Freezing and thawing **Loss of mass or formation of open cracks**	**Category** *FT*
Maximum of one of the initially tested pieces and none of the additionally tested pieces shows more than 0,5 % loss of mass or formation of open cracks.	FT_A
Other value declared by the producer	$FT_{Declared}$
No requirement	FT_{NR}

7.5 Resistance to salt crystallization

When required, the resistance to salt crystallization of armourstone (excluding fragments) shall be determined in accordance with EN 1367-2:2009, Clause 9. The resistance to salt crystallization shall conform to the relevant requirement (or the producer's declaration for category $MS_{Declared}$) specified in Table 13 for the selected category. Where suitable aggregate representative of the armourstone is not available, the test portion shall be obtained by crushing, using a laboratory jaw crusher, at least six separate pieces of armourstone for which the masses do not differ by more than 25 %.

Table 13 — Categories for resistance to salt crystallization

Magnesium sulfate value Percentage loss of mass	**Category** *MS*
≤ 25	MS_{25}
> 25	$MS_{Declared}$
No requirement	MS_{NR}

NOTE Guidance on how to specify the resistance of armourstone to salt crystallization is given in Annex D.

7.6 Sonnenbrand

When required, the presence of signs of Sonnenbrand in armourstone (excluding fragments) from volcanic rock sources like some basalts, shall be determined in accordance with EN 13383-2:2013, Clause 10. The presence of signs of Sonnenbrand shall conform to the relevant requirement (or the producer's declaration for category $SB_{Declared}$) specified in Table 14 for the selected category.

20 pieces of armourstone shall be tested initially. If one piece shows signs of Sonnenbrand, another 20 pieces of armourstone shall be tested.

Table 14 — Categories for signs of Sonnenbrand

Signs of Sonnenbrand	Category *SB*
Maximum of one piece of the initially tested pieces and none of the additionally tested pieces shows signs of Sonnenbrand	SB_A
Other value declared by the producer	$SB_{Declared}$
No requirement	SB_{NR}

8 Evaluation of conformity

The conformity of the product with the requirements of this standard shall be demonstrated by initial type testing and factory production control in accordance with EN 16236.

9 Designation and description

9.1 Designation

Armourstone shall be identified in the following terms:

a) source and producer - if the material has been rehandled in a depot both source and depot shall be given;

b) type of armourstone (see Annex A);

c) designation of the grading.

9.2 Additional information for the description of armourstone

The necessity for other information depends on the situation and end use.

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

10 Marking and labelling

The delivery ticket shall contain at least the following information:

a) designation;

b) date of despatch;

c) serial number of the ticket;

d) number of this European Standard.

It can be a requirement of the supply agreement to have additional information included on the delivery ticket.

NOTE For CE marking and labelling see ZA.3 in Annex ZA.

Annex A
(normative)

Source materials considered in the development of EN 13383-1 and their status in respect of the scope of this European Standard

The source types listed in this annex have been considered in the preparation of this European Standard. Their status within the standard is indicated in Table A. Source materials not described here are outside the scope of EN 13383-1.

Sources with no history of use as armourstone are outside the scope of the standard and cannot be used as armourstone in conformity with this standard and are therefore gray shaded in Table A.1.

Sources with positive history of use and no identification of the need for additional requirements are fully within the scope of the standard.

Sources with a positive history of use and where the need for additional requirements has been identified are provisionally within scope pending the inclusion of suitable test methods and requirements.

In all cases there is an obligation to control the potential release of regulated dangerous substances (RDS) in accordance with Member State requirements at the place of use.

The information in this annex is based on a comprehensive survey of the use of armourstone from secondary sources in European member states undertaken between 2000 and 2005 and subsequent corrections identified by CEN/TC 154. CEN/TC 154 intends to keep this inventory under continual review. Any relevant information to assist in the updating of this annex including any proposal for the inclusion of new source types should be submitted to the secretariat of CEN/TC 154.

In situations where the need for additional requirements has been identified, such materials, when placed on the market as aggregates, shall comply fully with this European Standard but may also be required to comply with specific relevant additional requirements at the place of 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.

Under an extension to its Mandate, CEN/TC 154 is currently developing requirements for the declaration of the potential of aggregates to release regulated dangerous substances under Essential Requirement 3. It is anticipated that the source classifications in this annex will be used as the basis of families for the collation of data and the development of source specific requirements for regulated dangerous substances. Any input to this process should be made through the secretariat of CEN/TC 154.

Table A.1 — Inventory list with classification codes and status for source materials for EN 13383-1 armourstone

Nr.	Source	Sub-nr.	Specific material	History of use	Special requirements in standard	Additional requirements identified for inclusion [a]
P	Natural aggregates	P	All petrographic types included in EN 932-3	Yes	Yes	No
A	Construction and demolition recycling industries	A1	Reclaimed asphalt	No	-	-
		A2	Crushed concrete	Yes	No	Yes
		A3	Crushed bricks, masonry	No	–	–
		A4	Mix of A1, A2 and A3	Yes (A2 and A3)	No	Yes
B	Municipal solid waste incineration industry	B1	Municipal incinerator bottom ash [b] (excluding fly ash) (MIBA)	No	–	–
		B2	Municipal incinerator fly ash (MIFA)	No	–	–
C	Coal power generation industry	C1	Coal fly ash	No	–	–
		C2	Fluidized bed combustion fly ash (FBCFA)	No	–	–
		C3	Boiler slag	No	–	–
		C4	Coal bottom ash	No	–	–
		C5	Fluidized bed combustion bottom ash (FBC bottom ash)	No	–	–
D	Iron and steel industry	D1	Granulated blast furnace slag (GBS) (vitrified)	No	–	–
		D2	Air-cooled blast furnace slag (ABS) (crystallized)	Yes	Yes	No
		D3	Basic oxygen furnace slag (converter slag, BOS)	Yes	Yes	No
		D4	Electric arc furnace slag (from carbon steel production, EAF C)	Yes	Yes	No
		D5	Electric arc furnace slag (from stainless/high alloy steel production, EAF S)	No	–	–
		D6	Ferrochromium slag	No	–	–

Table A.1 — *(continued)*

Nr.	Source	Sub-nr.	Specific material	History of use	Special requirements in standard	Additional requirements identified for inclusion [a]
E	Non ferrous metal industry	E1	Copper slag	Yes	No	No
		E2	Molybdenum slag	No	–	–
		E3	Zinc slag	No	–	–
		E4	Phosphorus slag	Yes	No	No
F	Foundry industry	F1	Foundry sand	No	–	–
		F2	Foundry cupola furnace slag	No	–	–
G	Mining and quarry industry	G1	Red coal shale	No	–	–
		G2	Refuse from hard coal mining (black coal shale)	Yes	No	No
		G3	Pre-selected all-in from quarry/mining	No	–	–
		G4	Spent oil shale	No	–	–
H	Maintenance dredging works	H1	Dredge spoil sand	No	–	–
		H2	Dredge spoil clay	No	–	–
I	Miscellaneous	I1	Excavated soil	No	–	–
		I2	Paper sludge ash	No	–	–
		I3	Sewage sludge incineration ash (municipal)	No	–	–
		I4	Biomass ash	No	–	–
		I5	Crushed glass	No	–	–
		I6	Expanded clay	No	–	–

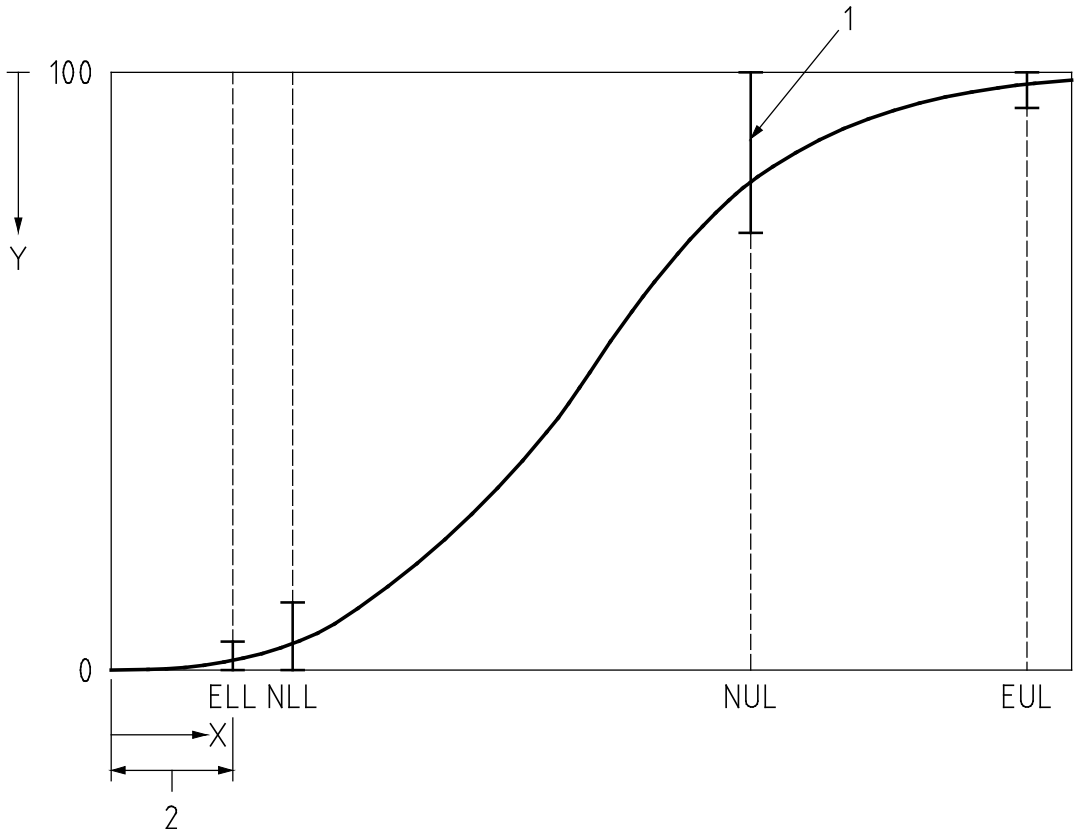
[a] Additional requirements noted in this column exclude those to control the potential release of regulated dangerous substances (RDS) in accordance with Member State requirements at the place of use.

[b] Requirements on MIBA are based on experience with grated installations.

Annex B
(informative)

Guidance on gradings

B.1 Limits of coarse, light and heavy gradings



Key

1 grading requirement

2 fragments

X mass, kilograms/sieve aperture, millimetres

Y % by mass less than (passing)

Coarse grading : a/b mm
Light and heavy grading : a to b kg

ELL : Extreme lower limit
NLL : Nominal lower limit, a
NUL : Nominal upper limit, b
EUL : Extreme upper limit

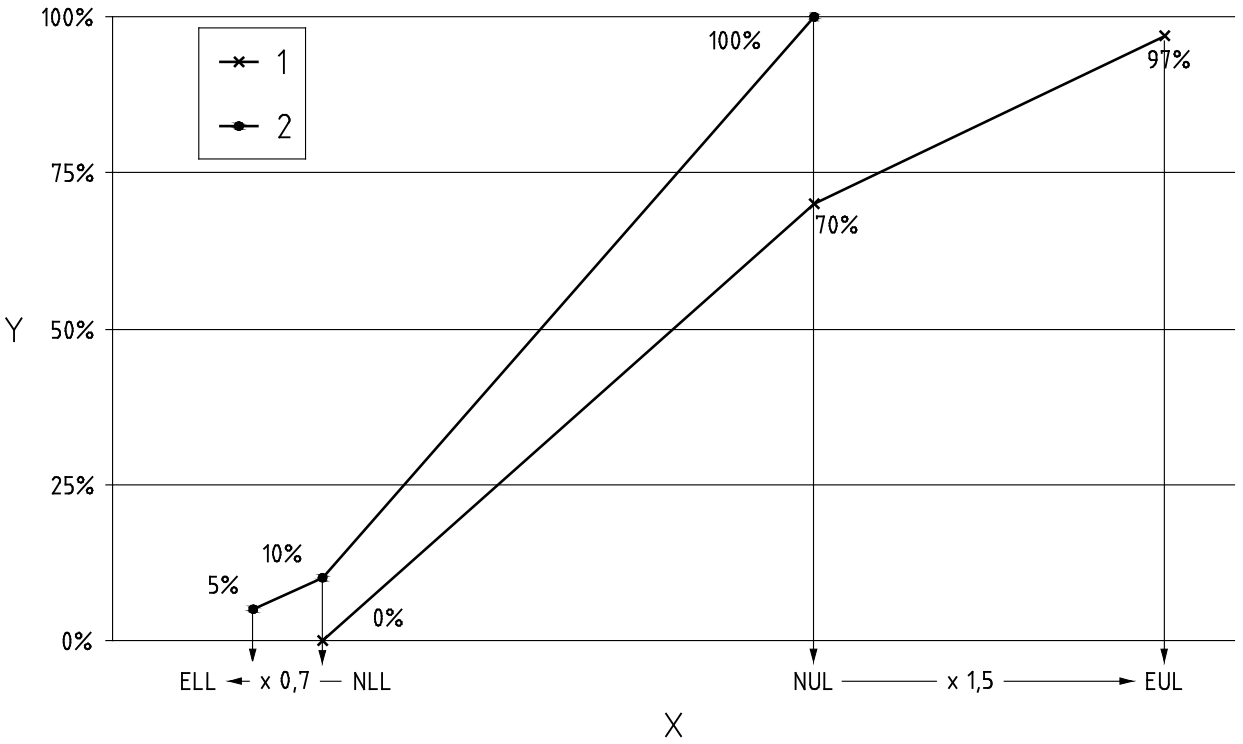
NOTE See Tables 1, 2 and 4 for values of grading requirements.

Figure B.1 — Limits of coarse, light and heavy gradings

B.2 Declaration of non-standard heavy gradings

B.2.1 General

Standard gradings should be used whenever possible. However, it is recognised that, when producing heavy gradings of armourstone, size limitations inherent in the rock mass being quarried will mean that alternative heavy gradings may give a more optimum use of the quarry yield [4]. The following approach enables non-standard heavy gradings to be determined and declared in a way that is consistent with the characteristics of the standard heavy gradings.



Keys

1 lower boundary

2 upper boundary

X mass (kg)

Y % by mass less than (passing)

Figure B.2 — Setting grading limits for non-standard gradings

B.2.2 Category B heavy gradings

Step 1: Set *NUL* and *NLL* in such a way that their mean is close to the design M_{50} (the median mass, being the mass of the piece or armourstone below which 50 % by mass of the grading lies) derived from hydraulic stability calculation, i.e. 0,5 × (*NUL*+*NLL*) ≅ M_{50}. The ratio *NUL*/*NLL* should be similar to those of standard heavy gradings of similar M_{50} (see Table 5 in Clause 4).

Step 2: Set *ELL* = 0,7 × *NLL* and *EUL* = 1,5 × *NUL* (see Figure above).

Step 3: Declare the grading as $HMB_{DeclaredNLL/NUL}$ and provide a table similar to Table 5 giving:

— the class limits *ELL*, *NLL* to definitions based on maxima of 5 % and 10 % (less than by mass) respectively and

— the class limits *NUL*, *EUL* to definitions based on minima of 70 % and 97 % (less than by mass) respectively.

B.2.3 Category A heavy gradings

Steps 1 and 2: Set *NLL*, *NUL*, *ELL* and *EUL* as given in B.2.1 for a category B grading.

Step 3: Set the average mass (excluding fragments), M_{em}, between a lower limit of 0,8 × (*NLL* + *NUL*)/2 and an upper limit of (*NLL* + *NUL*)/2.

Step 4: Declare the grading as $HMA_{DeclaredNLL/NUL}$ and provide a table similar to Table 4 giving the range on average mass (excluding fragments) and:

— the class limits *ELL*, *NLL* to definitions based on maxima of 5 % and 10 % (less than by mass) respectively and

— the class limits *NUL*, *EUL* to definitions based on minima of 70 % and 97 % (less than by mass) respectively.

Annex C
(informative)

Guidance on block integrity

C.1 General

"Block integrity" is the name given to the property of each block or piece of armourstone indicating its wholeness or, in practical terms, its resistance to breaking apart along flaws or fissures during routine handling, placement and under wave loading in the works. The importance of block integrity increases with the size of the armourstone, becoming the most important mechanical property for heavy armourstone.

This annex provides information on methods for the control of block breakage resulting from the presence of significant flaws within pieces of armourstone.

As a result of its geological origin and the range in possible methods of extraction, pieces of armourstone may contain natural or blast-induced fissures and flaws. These planes of potential weakness sometimes arise because of veins, stylolite seams, laminations, foliation planes or unit contacts.

For smaller armourstone gradings that are mechanically size-sorted in bulk and have therefore undergone an effective strength proving process, block integrity is usually deemed acceptable and will be more closely correlated with compressive strength than for large individually size-sorted blocks.

C.2 Tests

The resistance to breakage of the mineral fabric of armourstone can be measured using intact strength tests, such as the compressive strength test specified in EN 1926. The method uses hand-sized test specimens and is objective, but gives no reliable indication of block integrity.

A destructive test is the "drop breakage test" which comprises subjecting 50 blocks to a standardised impact test by sequentially dropping the blocks from a defined height of 3 m onto a rock floor that has been prepared to give a standardised impact condition. The breakage index is assessed from mass loss measurements. This method was originally proposed in the Manual for the use of rock in coastal and shoreline engineering [5] and an updated version can be found in the 'Rock manual: the use of rock in hydraulic engineering (2^{nd} edition)' [6].

Following recent research on block integrity, an alternative test focussing on the strength of discontinuities has been proposed, known as the Full Scale Splitting Test [7] and also described in the Rock Manual 2^{nd} edition [6]. As explained in the Rock Manual, initial type testing using this method would provide armourstone designers with the information to allow for the quantification of deterioration due to breakage during the lifetime of their structures.

Subjective, visual assessment for flawed blocks is commonly used. However, this is of limited value for use in specifications because it is often not possible to detect hidden cracks within the armourstone that can lead to unexpected breakages [8]. Non-destructive test methods using acoustic velocity have been developed in France and the Netherlands. The Laboratoire Central des Ponts et Chaussées (LCPC, Paris) have developed a method for detecting different degrees of fissuring within blocks using equipment routinely employed in testing concrete quality. The method is based on NF P18-556 [9] and is used for detecting microcracking in aggregates, known as the "Index of continuity", which compares the measured velocity within a piece of rock with its theoretical velocity. However, the method for armourstone [10], requires that the continuity index derived ideally from three perpendicular measurements per block, is first calibrated against the results of drop tests for each different rock source. This objective procedure has been in operation as quality assessment for several years in France.

An appropriate method should be selected after consideration of each methodology and its cost versus any pre-existing knowledge of the homogeneity, porosity and water absorption in the batch of armourstone to be assessed. In considering homogeneity, account should be taken of the likelihood of hidden cracks, whether naturally occurring in the rock mass or induced by extraction or production techniques.

Annex D
(informative)

Guidance on the resistance of armourstone to freezing and thawing and to salt crystallization

D.1 General

In cold climates armourstone may be particularly susceptible to deterioration from cyclic ice-induced pressures due to freezing and thawing. In warm climates, armourstone can be particularly susceptible to deterioration from cyclic salt crystallization pressure that results from salt precipitation occurring after the repeated drying out of salt water. The rock's susceptibility to breakdown by these and other internal cyclic stressing mechanisms depends primarily on climate, end use, petrographic type, degree of geological weathering of the source rock, presence of unstable minerals and means of extraction, the size distribution of the pores and the flaws that can be penetrated by water.

D.2 Climate

The severity of any damage by freezing and thawing is related to the frequency of freeze-thaw cycles, the degree of freezing and thawing as indicated by the regime of temperature extremes, humidity and the degree of saturation of the armourstone.

Similarly, the damage due to salt crystallization is related to the frequency and rate of drying out as indicated by the humidity and temperature regime and the water salinity. Armourstone is most susceptible to damage when used in parts of the construction that is exposed to significant variation in the degree of saturation. For example, armourstone in permanently submerged parts of a hydraulic structure that are too deep to experience freezing conditions is least susceptible, whereas armourstone in cover layers in the inter-tidal zone is most susceptible. The severity of conditions that will promote breakdown of armourstone may be selected from Table D.1.

Table D.1 — Exposure zone and conditions

Exposure zone and conditions	**Climate**	
	Mediterranean [a]	**Atlantic and Continental** [b]
Permanently submerged zones (includes zones in freezing climates submerged below possible freezing depth)	Mild	Mild
Partial or full saturation with fresh water	Mild	Severe
Partial or full saturation with salt water	Severe	Severe

[a] The Mediterranean classification implies that freezing conditions need not be considered.
[b] Only areas with freezing climate.

D.3 Petrographic type

Engineering geologists recognise certain rock types as having particular characteristic strength ranges particular possibilities for the sizes and distributions of pores and, particular susceptibilities to geological weathering (i.e. physical and/or chemical breakdown at source). A petrographic examination and a classification of the rock type can often provide a clear indication of a high resistance to deterioration. Alternatively, signs of geological weathering, if well developed, should be grounds for assuming poor resistance to in-service weathering.

D.4 Testing and selection of specification requirements

D.4.1 Service record

Where a satisfactory service record for the long-term performance of armourstone from a homogeneous source is available and the service record is for similar conditions of use to that intended, further test requirements for resistance to freezing and thawing and to salt crystallisation are not normally necessary. If no satisfactory service record is available, the next consideration should be based on petrographic evidence, as further testing for resistance to freezing and thawing or salt crystallisation may not be necessary.

D.4.2 Petrographic examination

Results of the petrographic examination report on the armourstone sample according to the procedure specified in EN 932-3 will give an indication of the rock's main constituents, texture, anisotropy, porosity and the presence of constituents that may be of concern in particular circumstances, together with its geological weathering state and its geological name. Armourstone with unsatisfactory resistance to freeze-thaw or salt crystallization in mild and severe conditions, derived from highly-weathered or fissile rocks, some conglomerates and breccias may include some or all of the following:

— schist, mica schist, phyllite;

— chalk, marl;

— shale;

— rock loosely cemented by clay minerals.

D.4.3 Water absorption, freeze-thaw and magnesium sulfate tests

Where the petrographic examination reports has proven inconclusive, it may be necessary to consider Table D.1 and Table D.2 in order to determine what further testing is necessary.

If the water absorption determined in accordance with EN 13383-2:2013, Clause 8 is not greater than 0,5 %, the armourstone can be considered resistant to freezing and thawing and to salt crystallisation and no further testing is required. However, many satisfactory armourstones have higher water absorption values. For example, Jurassic limestones and sandstones frequently have absorption values in excess of 4 % while Permian limestones and dolomites and carboniferous sandstones frequently have absorption values in excess of 2 % but these materials can still have adequate resistance to freeze/thaw or salt crystallisation processes.

Armourstone having water absorption values greater than 0,5 % should normally be assessed by the freeze-thaw test specified in EN 13383-2:2013, Clause 9, or by the magnesium sulphate test specified in EN 1367-2.

The magnesium sulfate test according to EN 1367-2 has been agreed as a suitable test for many aggregates. However, for armourstone, the results obtained in accordance with this test method should be taken with caution because of the narrow size range of the tested particles (10 mm to 14 mm). The small test aggregate size cannot reproduce accurately the "in-situ" salt crystallisation weathering of armourstone. The size range of the tested particles often greatly influences results.

For these reasons, the following will also be useful:

a) a petrographic examination of the armourstone specimen prior to testing;

b) a visual identification of the mode of disintegration of the specimen after the test;

c) in case of borderline test results, the standard test may be contrasted with other methods:

    1) using larger, wider and different ranges of particle sizes (e.g. 63 mm to 125 mm); and/or

    2) repeating the test with sodium sulfate, e.g. in accordance with EN 12370.

If the armourstone will be permanently submerged, no soundness test may be necessary.

Table D.1 and Table D.2 are given for guidance only, the final choice left to the purchaser/client. As further test results on armourstone performance in different environmental conditions becomes available, further classes of severity and categories of test requirements will be added to Table D.1 and Table D.2 in future versions of this European Standard.

Table D.2 — Environmental conditions

	Environmental conditions	
	Mild	**Severe**
Freeze-thaw test (6.1) applicable to Atlantic and Continental [a] conditions	Category FT_{NR}	Category FT_{A}
Magnesium sulfate test (6.2) applicable to Mediterranean [b] conditions	Category MS_{NR}	Category MS_{25}
[a] Only areas with freezing climate. [b] The Mediterranean classification implies that freezing conditions need not be considered.		

Annex E
(informative)

Properties and information which comprise the description of armourstone

E.1 Essential information

a) Name and location of quarry, or production plant and, where appropriate, depot;

b) armourstone type, e.g. crushed rock, slag;

c) simple indication of the petrographic type;

d) armourstone grading, e.g. 10 kg to 60 kg.

E.2 Other information

a) Code (where specified);

b) particle density;

c) particle size distribution or mass distribution;

d) shape:

- length-to-thickness ratio;
- crushed or broken surfaces;

e) water absorption;

f) resistance to:

- breakage;
- attrition;
- freezing and thawing;
- salt crystallization;

g) the presence of signs of Sonnenbrand;

h) freedom of air-cooled blast-furnace slag from dicalcium silicate disintegration and iron disintegration;

i) disintegration of steel slag.

Only the information listed in E.1 should be supplied for every consignment. The necessity for further details on properties given in E.2 and the frequency of testing depends on the situation and use. This extra information should be made available on request.

Annex F
(informative)

Additional information explanatory of main text of standard

F.1 Grading 90/180

Grading 90/180 mm is a narrow grading designated for special applications such as gabions. (Gabions are composite structures comprising wire mesh baskets filled with pieces of armourstone)

F.2 Crushed and broken surfaces

Subject always to national guidance, Category RO_5 should normally only be adopted where the armourstone is intended for use in structures in which rounded pieces of armourstone could lead to instability.

F.3 Resistance to attrition

Resistance to attrition requirements are only necessary where the armourstone is intended for use in cover layers which are known to be subject to attrition by sediment. Experience of use of these categories is limited, but tentative suggestions are as follows:

Category $M_{DE}10$: Extremely abrasive environment, e.g. limited armourstone movement is permitted owing to use of dynamic armour design principle; or, nearly continuous pounding of armour by shingle.

NOTE It is important to understand that few sources of rock satisfy this category.

Category $M_{DE}15$: Very highly abrasive environment, e.g. often stormy seas with attack by mixed sand and gravels;

Category $M_{DE}20$: Highly abrasive environment, e.g. occasionally stormy seas with shingle or sandy foreshore;

Category $M_{DE}30$: Moderately abrasive environment, e.g. occasional significant wave or current action of suspended sediment load.

F.4 Particle density

5.2 requires the mean and minimum particle density to be declared to assist designers in the calculation of the hydraulic stability of armourstone structures. There are no requirements included for density in relation to physical durability.

F.5 Shape

This standard provides for the determination and declaration of categories of length to thickness ratio based on the proportion of armourstones with a length to thickness ratio greater than 3. To assist designers in estimating bulk densities and layer thicknesses in completed structures using the methods set out in the ‘Rock manual: use of rock in hydraulic engineering’ [6], further information is required:

— the mean and standard deviation of the length to thickness ratios of the armourstone;

— the mean and standard deviation of the armourstone ‘blockiness’, where blockiness is the ratio of the volume of a piece of armourstone to the volume of its enclosing cuboid and is an intrinsic property related to the process of manufacturing armourstone from its rock source.

This information could be obtained during initial type testing.

Annex ZA
(informative)

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

ZA.1 Scope and relevant characteristics

This European Standard and this Annex ZA have been prepared under a mandate[1)] given to CEN by the European Commission and the European Free Trade Association.

The clauses of this and, where relevant, other European Standards 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 armourstone covered by this European Standard for its 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 armourstone falling within the scope of this annex.

NOTE 1 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 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (accessed through http://ec.europa.eu/enterprise/construction/cpd-ds/).

This annex has the same scope as Clause 1 of this standard with regard to the products covered. It establishes the conditions for the CE marking of armourstone intended for the use indicated below and shows the relevant clauses applicable (see Table ZA.1).

1) M/125 "Aggregates"

Table ZA.1 — Scope and relevant requirement clauses

Product: Aggregates obtained by processing natural, manufactured or recycled materials and mixtures of these aggregates for use as armourstone as covered by the scope of this standard **Intended use(s):** Hydraulic protection and regulation structures			
Essential characteristics	**Requirement clauses in this and/or another standard**	**Mandated level(s) or class(es):**	**Notes**
Particle shape, size and density	4.3 Shape	None	Category
	4.2 Gradings	None	Pass/fail grading's size/mass distribution
	5.2 Average particle density	None	Declared value
	5.2 Minimum particle density	None	Declared value
Resistance to breakage	5.3 Resistance to breakage	None	Category
Resistance to wear	5.4 Resistance to wear	None	Category
Dangerous substances: Emission of radioactivity Release of heavy metals Release of polyaromatic hydocarbons Release of other dangerous substances	NOTE In ZA.1 above: EN 16236:2013, 5.3.4 Knowledge of the raw material EN 16236:2013, 5.3.5 Management of production	None None None	
Durability against weathering	7.2.1 Dicalcium silicate disintegration of air-cooled blastfurnace slag	None	Pass/fail
	7.2.2 Iron disintegration of air-cooled blastfurnace slag	None	Pass/fail
	7.2.3 Disintegration of steel slag	None	Category
Durability against freeze/thaw	7.4 Resistance to freezing and thawing	None	Category
Durability against salt crystallisation	7.5 Resistance to salt crystallisation	None	Category
Durability against "Sonnenbrand" of basalt	7.6 Sonnenbrand	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 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 armourstone

ZA.2.1 System(s) of attestation of conformity

The systems of attestation of conformity for armourstone indicated in Table ZA.1 in accordance with the decision of the Commission 98/598/EC of 9 October 1998 as amended by the Decision 2002/592/EC and 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 armourstone for uses with high safety requirements[2)] (where third party intervention is required)

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Armourstone	Hydraulic protection and regulation structures.	-	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 armourstone for uses without high safety requirements[3)] where no third party intervention is required

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Armourstone	Hydraulic protection and regulation structures.	-	4
System 4: See Directive 89/106/EEC (CPD) Annex III.2.(ii), Third possibility.			

The attestation of conformity of armourstone in Table ZA.1 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.

Table ZA.3a — Assignation of evaluation of conformity tasks (for armourstone under system 2+)

Tasks			Coverage of the task	Clauses of EN 16236 to apply
Tasks for the producer	Factory production control (F.P.C)		Parameters related to all relevant characteristics of Table ZA.1	5
	Initial type testing		All relevant characteristics of Table ZA.1	4
Tasks for the notified body	Certification of F.P.C on the basis of	Initial inspection of factory and of F.P.C	Parameters related to all relevant characteristics of Table ZA.1	5
		Continuous surveillance, assessment and approval of F.P.C.	Parameters related to all relevant characteristics of Table ZA.1	5

[2)] Safety requirements are to be defined by Member States in their national laws, regulations and administrative provisions.

[3)] Safety requirements are to be defined by Member States in their national laws, regulations and administrative provisions.

Table ZA.3b — Assignation of evaluation of conformity tasks (for armourstone under system 4)

Tasks		Coverage of the task	Clauses of EN 16236 to apply
Tasks for the producer	Factory production control (F.P.C)	Parameters related to all relevant characteristics of Table ZA.1	5
	Initial type testing	All relevant characteristics of Table ZA.1	4

ZA.2.2 EC Declaration of conformity

ZA.2.2.1 In case of products following Table ZA.3a)

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;

NOTE 1 The producer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— 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.

NOTE 2 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

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.

ZA.2.2.2 In case of products following Table ZA.3b)

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), 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/EEC 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 Table ZA.1;

— as an alternative, standard designation(s) alone or in combination with declared values as above; 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.

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

CE 0123			*CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC* *Identification number of the notified body*
Any Co Ltd, PO Box 21, B-1050 **13** **0123-CPD-0456**			*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 FPC certificate*
EN 13383-1:2013 Aggregates obtained by processing natural, manufactured or recycled materials and mixtures of these materials for use as armourstone			*Number of European Standard with dated version* *Description of product and*
Particle shape	Category	(e.g. LT_A)	*information on regulated characteristics*
Particle size	Categories	(e.g. $CP_{63/180}$, $LM_A5/40$ $HM_B300/1\ 000$)	
Particle density	Declared value	(Mg/m^3)	
Resistance to breakage	Category	(e.g. CS_{60})	
Resistance to attrition	Category	(e.g. $M_{DE}10$)	
Composition/content	Declared value	Description	
Emission of radioactivity **Release of heavy metals** **Rekease of polyarmomatic carbons** **Release of other dangerous substances**	}		
Durability against weathering			
Dicalcium silicate disintegration of air-cooled blastfurnace slag	Declared value	(Visual - Pass/ fail)	
Iron disintegration of air-cooled blastfurnace slag	Declared value	(Visual - Pass/ fail)	
Disintegration of steel slag	Category	(e.g. DS_A)	
Durability against freeze/thaw	Category	(e.g. FT_A)	
Durability against salt crystallisation	Category	(e.g. MS_{25})	
Sonnenbrand	Category	(e.g. SB_A)	

Figure ZA.1 — Example of accompanying documents under system 2+

CE			*CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.*
Any Co Ltd, PO Box 21, B-1050			*Name or identifying mark and registered address of the producer*
13			*Last two digits of the year in which the marking was affixed*
EN 13383-1:2013			*Number of European standard with dated version*
Aggregates obtained by processing natural, manufactured or recycled materials and mixtures of these materials for use as armourstone			*Description of product and*
Particle shape	Category	(e.g. LT_A)	*information on regulated characteristics*
Particle size	Categories	(e.g. $CP_{63/180}$, $LM_A5/40$ $HM_B300/1\ 000$)	
Average particle density	Declared value	(Mg/m^3)	
Minimum particle density	Declared value	(Mg/m^3)	
Resistance to breakage	Category	(e.g. CS_{60})	
Resistance to attrition	Category	(e.g. $M_{DE}10$)	
Composition/content	Declared value	Description	
Emission of radioactivity	}		
Release of heavy metals	}		
Rekease of polyarmomatic carbons	}		
Release of other dangerous substances			
Durability against weathering			
Dicalcium silicate disintegration of air-cooled blastfurnace slag	Declared value	(Visual - Pass/ fail)	
Iron disintegration of air-cooled blastfurnace slag	Declared value	(Visual - Pass/ fail)	
Disintegration of steel slag	Category	(e.g. DS_A)	
Durability against freeze/thaw	Category	(e.g. FT_A)	
Durability against salt crystallisation	Category	(e.g. MS_{25})	
Sonnenbrand	Category	(e.g. SB_A)	

Figure ZA.2 — Example of accompanying documents under system 4

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 1 European legislation without national derogations need not be mentioned.

NOTE 2 Affixing the CE marking symbol means, if a product is subject to more than one directive, that it complies with all applicable directives.

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