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Interested committees:

Title: Draft BS EN 17555-1 Aggregates for construction works. Part 1: Characteristics.

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

June 2021

ICS 91.100.15

Will supersede EN 12620:2002+A1:2008, EN
13043:2002, EN 13139:2002, EN
13242:2002+A1:2007

English Version

Aggregates for construction works - Part 1: Characteristics

Granulats pour travaux de construction - Partie 1 :
caractéristiques

Gesteinskörnungen für Bauwerke - Teil 1:
Produktnorm

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 154.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CEN 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-CENELEC Management Centre has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 17555-1:2021) has been prepared by Technical Committee CEN/TC 154 “Aggregates”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede the following set of standards:

- EN 12620:2002+A1:2008,
- EN 13043:2002, together with EN 13043:2002/AC:2004,
- EN 13139:2002, together with EN 13139:2002/AC:2004, and
- EN 13242:2002+A1:2007.

The most significant technical changes compared to EN 12620:2002+A1:2008, EN 13043:2002, together with EN 13043:2002/AC:2004, EN 13139:2002, together with EN 13139:2002/AC:2004, and EN 13242:2002+A1:2007 include:

- a) unification and clarifications of the scope statement;
- b) unification and improvement of definitions for aggregate families and other matters which were common across the four main aggregate standards EN 12620, EN 13043, EN 13139 and EN 13242, i.e. for coarse, fine, all-in aggregates, natural graded aggregates, grit and added fillers;
- c) updating and improving references to supporting test methods;
- d) consolidation of classes for characteristics, including:
 - a. merging of classes which were common across the four main aggregate standards: EN 12620, EN 13043, EN 13139 and EN 13242;
 - b. addition of classes to respond to requests from Member States;
 - c. addition of intermediate classes to provide a more uniform sequence;
- e) with regard to aggregates (not including added filler):
 - a. unification of overall limits for graded coarse aggregates at mid-size sieves;
 - b. removal of clauses referring to tolerances on grading;
 - c. deletion of classes (and replacement with a simple level declaration) for proportions of constituents of recycled aggregates and for water absorption linked to freeze thaw resistance;
 - d. addition of new classes for the following: grading, particle shape, crushed particles, fines content, sand equivalent value; methylene blue value; shell content, lightweight contaminators, resistance to fragmentation, resistance to wear, resistance to abrasion from studded tyres, total sulfur content, water soluble sulfate content of recycled aggregates, effect of organic contaminators on the rate of setting and hardening of concrete mortar and hydraulically bound mixtures – recycled aggregates, resistance to weathering – magnesium sulfate soundness;

- e. introduction of aggregate proxy characteristics and classes for the following; susceptibility to attrition; resistance to weathering – water absorption; water soluble sulfate content of coarse natural aggregates; resistance to freezing and thawing in the presence of salt;
 - f. formal addition of characteristics and some classes for the fine fraction of aggregates not including added filler. These are identical to the equivalent tests for added fillers and previously were just cross referenced to filler tests;
 - g. removal of simple petrographic description from the characteristics and inclusion instead under the marking labelling and packaging clause;
- f) with regard to added fillers:
- a. addition of new classes for total sulfur content, harmful fines, water content, volume of voids and change of the softening point, carbonate content of filler of limestone origin, loss on ignition;
 - b. removal of the clause relating to specific surface area of added filler;
 - c. introduction of a new characteristic and classes for carbonate content of composite filler;
- g) restructuring of all clauses to be in line with the requirements of the Construction Product Regulations;
- h) introduction of revised AVCP clauses and tables, although minimum test frequencies are almost unchanged.

Provisions for other types of aggregates and their intended uses are specified in the following European Standards:

- prEN 13055:2021, *Lightweight aggregates*
- prEN 13383-1:2021, *Armourstone — Part 1: Characteristics*
- prEN 13450-1:2021, *Aggregates for railway ballast — Part 1: Characteristics*

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

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

1 Scope

This document specifies the characteristics of aggregates, i.e. aggregates without added fillers (see 3.1.1 a) and added fillers (see 3.1.1 b), for uses, either with or without high safety requirements, for:

- a) concrete for buildings, roads and other civil engineering works,
- b) bituminous mixtures and surface treatments for roads, airfields and other trafficked areas,
- c) mortars, renders and screeds, e.g. masonry mortar, floor/screed mortar, surfacing of internal walls (plastering mortar), rendering of external walls, special bedding materials, repair mortar and grouts for buildings, roads and civil engineering works;
- d) unbound and hydraulically bound materials for civil engineering works and road constructions.

With regard to the material source and production process, this document covers natural aggregate (see 3.1.2), manufactured aggregate (see 3.1.3), recycled aggregates (see 3.1.4), and mixtures of these materials.

Aggregates covered in this document are:

- a) aggregates without added fillers, including coarse aggregates (see 3.1.8), grit (see 3.1.11), fine aggregates (see 3.1.12), all-in aggregates (see 3.1.13), natural graded aggregates (see 3.1.14); and
- b) added fillers (see 3.1.15).

Coarse aggregates covered in this document are single sized coarse aggregates (see 3.1.9) and graded coarse aggregates (see 3.1.10).

Added fillers covered in this document are natural fillers (see 3.1.16), manufactured fillers (see 3.1.18), mixed fillers (see 3.1.19), composite fillers (see 3.1.20) and recycled fillers (see 3.1.21). Natural fillers include fillers of limestone origin (see 3.1.17).

This document does not cover:

- natural and manufactured aggregates, having oven-dried particle density less than or equal to $2,00 \text{ Mg/m}^3$, as they are already specified in prEN 13055:2021,
- recycled aggregates, with particle densities less than $1,50 \text{ Mg/m}^3$,
- aggregates with a nominal upper size greater than 90 mm,
- armourstone, as this is specified in prEN 13383-1:2021,
- aggregates for railway ballast, as these are specified in prEN 13450-1:2021,
- use of aggregates contained within reclaimed bituminous mixtures, as the reclaimed asphalt for use as a constituent of bituminous mixtures is already specified in EN 13108-8:2016,
- use of aggregates as soil,
- use of aggregates in earthworks, as these are specified in EN 16907-2:2018.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 196-2:2013, *Method of testing cement - Part 2: Chemical analysis of cement*

EN 459-2:—,¹ *Building lime — Part 2: Test methods*

prEN 932-3:2021, *Tests for general properties of aggregates — Part 3: Procedure and terminology for simplified petrographic description*

prEN 933-1:2021, *Tests for geometrical properties of aggregates — Part 1: Determination of particle size distribution — Sieving method*

EN 933-3:2012, *Tests for geometrical properties of aggregates - Part 3: Determination of particle shape - Flakiness index*

EN 933-4:2008, *Tests for geometrical properties of aggregates - Part 4: Determination of particle shape - Shape index*

prEN 933-5:2021, *Tests for geometrical properties of aggregates — Part 5: Determination of percentage of crushed and broken surfaces in coarse aggregate particles*

prEN 933-6:2021, *Tests for geometrical properties of aggregates — Part 6: Assessment of surface characteristics — Flow coefficient of aggregates*

EN 933-7:1998, *Tests for geometrical properties of aggregates - Part 7: Determination of shell content - Percentage of shells in coarse aggregates*

EN 933-8:2012+A1:2015, *Tests for geometrical properties of aggregates - Part 8: Assessment of fines - Sand equivalent test*

prEN 933-9:2021, *Tests for geometrical properties of aggregates — Part 9: Assessment of fines — Methylene blue test*

EN 933-10:2009, *Tests for geometrical properties of aggregates - Part 10: Assessment of fines - Grading of filler aggregates (air jet sieving)*

prEN 933-11:2021, *Tests for geometrical properties of aggregates — Part 11: Classification test for the constituents of coarse recycled aggregate*

prEN 1097-1:2021, *Tests for mechanical and physical properties of aggregates — Part 1: Determination of the resistance to wear (micro-Deval)*

EN 1097-2:2020, *Tests for mechanical and physical properties of aggregates - Part 2: Methods for the determination of resistance to fragmentation*

EN 1097-4:2008, *Tests for mechanical and physical properties of aggregates - Part 4: Determination of the voids of dry compacted filler*

¹ To be published. Stage at the time of publication: EN 459-2:2021.

EN 1097-5:2008, *Tests for mechanical and physical properties of aggregates - Part 5: Determination of the water content by drying in a ventilated oven*

prEN 1097-6:2021, *Tests for mechanical and physical properties of aggregates — Part 6: Determination of particle density and water absorption*

prEN 1097-7:2021, *Tests for mechanical and physical properties of aggregates - Part 7: Determination of the particle density of filler — Pyknometer method*

EN 1097-8:2020, *Tests for mechanical and physical properties of aggregates - Part 8: Determination of the polished stone value*

EN 1097-9:2014, *Tests for mechanical and physical properties of aggregates - Part 9: Determination of the resistance to wear by abrasion from studded tyres - Nordic test*

EN 1097-10:2014, *Tests for mechanical and physical properties of aggregates - Part 10: Determination of water suction height*

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

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

EN 1367-3:2001,² *Tests for thermal and weathering properties of aggregates - Part 3 : Boiling test for "Sonnenbrand basalt"*

EN 1367-4:2008, *Tests for thermal and weathering properties of aggregates - Part 4: Determination of drying shrinkage*

EN 1367-5:2011, *Tests for thermal and weathering properties of aggregates - Part 5: Determination of resistance to thermal shock*

EN 1367-6:2008, *Tests for thermal and weathering properties of aggregates - Part 6: Determination of resistance to freezing and thawing in the presence of salt (NaCl)*

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

EN 1744-4:2005, *Tests for chemical properties of aggregates - Part 4: Determination of water susceptibility of fillers for bituminous mixtures*

EN 1744-5:2006, *Tests for chemical properties of aggregates - Part 5: Determination of acid soluble chloride salts*

EN 1744-6:2006, *Tests for chemical properties of aggregates - Part 6: Determination of the influence of recycled aggregate extract on the initial setting time of cement*

EN 13179-1:2013, *Tests for filler aggregate used in bituminous mixtures - Part 1: Delta ring and ball test*

EN 13179-2:2000, *Tests for filler aggregate used in bituminous mixtures — Part 2: Bitumen number*

² As impacted by EN 1367-3:2001/AC:2004.

3 Terms, definitions, symbols and abbreviated terms

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Terms and definitions

3.1.1

aggregate

granular material of natural, manufactured or recycled origin used in construction, and including:

- a) aggregates without added fillers, and
- b) added fillers

3.1.2

natural aggregate

aggregate from mineral sources that has been subjected to nothing more than mechanical processing and sometimes washing

3.1.3

manufactured aggregate

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

Note 1 to entry: Manufactured aggregates (not including added filler) are of different types, including those, namely air-cooled blast furnace slags, steel slags and foundry cupola furnace slags, for which this standard defines application of specific test methods to cover some essential characteristics.

3.1.4

recycled aggregate

aggregate resulting from the processing of mineral material either previously used in construction or from the processing of the residues of material production

Note 1 to entry: Recycled aggregates can also be obtained from production residues e.g. crushed unused concrete.

3.1.5

aggregate size

designation of aggregate in terms of lower (d) and upper (D) sieve sizes expressed as d/D , where $d/D < 0,72$

Note 1 to entry: Sieve sizes are selected from those in EN 933-2:2020.

Note 2 to entry: This designation accepts the presence of some particles which are retained on the upper sieve (oversize) and some which pass the lower sieve (undersize).

3.1.6

grading

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

Note 1 to entry: The grading classes are designated as $G_n X/Y$ ($n = C, CA, G$ or GA) or as $G_n X$ ($n = F, NG$ or A) in which:

n : type of grading defined below:

C = coarse;

CA = coarse aggregates for bituminous mixtures only;

G = grit;

GA = grit for bituminous mixtures only;

F = fine;

NG = natural graded;

A = all-in;

X :minimum percentage by mass passing the upper (D) sieve size;

Y :maximum percentage by mass passing the lower (d) sieve size.

3.1.7

fines

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

3.1.8

coarse aggregate

designation given to the larger aggregate sizes with D greater than 4 mm and less than 90mm and d greater than or equal to 1 mm

3.1.9

single sized coarse aggregate

designation given to coarse aggregate where either

$D > 11,2$ mm and $D/d \leq 2$ or

$D \leq 11,2$ mm and $D/d \leq 4$

3.1.10

graded coarse aggregate

designation given to coarse aggregate where either

$D > 11,2$ mm and $D/d > 2$ or

$D \leq 11,2$ mm and $D/d > 4$

3.1.11

grit

designation given to the aggregate sizes with D less than or equal to 4 mm and d greater than or equal to 1 mm

3.1.12

fine aggregate

designation given to the smaller aggregate sizes with D less than or equal to 4 mm and d equal to 0

3.1.13**all-in aggregate**

processed aggregate consisting of a mixture of coarse and fine aggregates with D greater than 4 mm and d equal to 0

Note 1 to entry: It can be produced without separating into coarse and fine fractions or it can be produced by combining coarse and fine aggregates.

3.1.14**natural graded aggregate**

designation given to natural aggregate sizes of glacial and/or fluvial origin with D less than or equal to 8 mm and d equal to 0

3.1.15**added filler**

aggregate, at least 70% of which passes the 0,063 mm sieve, that has been produced separately, which can be added to construction materials to provide their performances required for certain end uses

Note 1 to entry: Added filler is sometimes described as 'filler aggregate'.

3.1.16**natural filler**

added filler from mineral sources that has been subjected to nothing more than mechanical processing

3.1.17**filler of limestone origin**

added filler produced from limestone, dolomitised limestone or dolomite

3.1.18**manufactured filler**

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

Note 1 to entry: Manufactured added fillers are of different types, including those, namely fly ashes, for which this standard defines application of specific test methods to cover some essential characteristics. .

3.1.19**mixed filler**

added filler comprising natural or manufactured filler mixed with calcium hydroxide

3.1.20**composite filler**

added filler comprising filler of limestone origin mixed with fly ash

3.1.21**recycled filler**

added filler resulting from the processing of mineral material either previously used in construction or obtained from the residues of material production

3.1.22**particle size fraction**

fraction of an aggregate passing the larger of two sieves and retained on the smaller

Note 1 to entry: The lower limit can be zero.

3.1.23**oversize**

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

3.1.24**undersize**

part of the aggregate passing the lower of the limiting sieves used in aggregate size description

3.1.25**product family**

group of products produced by one manufacturer for which the assessment results for one or more characteristics from any one product within the range are valid for all other products within this range

3.2 Symbols and abbreviated terms

For the purposes of this document, the following symbols and abbreviations apply:

Symbol/Acronym	Meaning:
A	Change in the initial setting time
AAV	Aggregate Abrasion Value
A_N	Resistance against abrasion from studded tires (Nordic Abrasion value)
AS	Acid-soluble sulfate content
$AVCP$	Assessment for Verification of Constancy of Performance
BN	Bitumen Number (of added filler)
C	(Percentage of) Crushed particles
CC_f	Carbonate Content of composite filler
CC_l	Carbonate Content of filler of limestone origin
d	lower sieve size designation in mm
D	upper sieve size designation in mm
d/D	Aggregate size designation
E_{CS}	Flow coefficient of fine aggregates
f	Fines content
F	Freeze thaw resistance
F_{EC}	Freeze thaw resistance in the presence of salt (extreme conditions)
FI	Flakiness Index
G_n X/Y	Grading (for “n”, “X” and “Y” see 3.1.6)
I	Percentage passing the 5 mm sieve after thermal shock
Ka	Calcium hydroxide content (of mixed filler)
LA	Los Angeles coefficient
L_i	Loss on ignition
MB, MB_A	Methylene Blue value

Symbol/Acronym	Meaning:
MB_F	Methylene Blue value of filler
M_{DE}	Micro-Deval coefficient
m_{LPC}	Lightweight contaminators
MS	Magnesium Sulfate soundness
PSV	Polished stone value
Q	Swelling of a Marshall specimen
S	Total sulfur content
SC	Shell content
SE_{10}, SE_4	Sand equivalent value
SI	Shape Index
SS	Water-soluble sulfate content
SZ	Impact value
v	voids content of dry compacted filler (Rigden)
V	Volume Stability
V_{LA}	Absolute loss of Los Angeles coefficient after thermal shock
V_{SZ}	Absolute loss of impact value after thermal shock
WC	Water Content (of added filler)
WS	Water Solubility (of filler)
$\Delta_{R\&B}$	Delta Ring and Ball (softening point)

Symbol		Constituent of recycled aggregate	Additional description
<i>Rc</i>		concrete	dense and cured (hardened) mix of fine and coarse aggregates with attached mortar of concrete
		concrete products, concrete blocks	concrete slabs, concrete pavers, roller compacted concrete, concrete bricks, core floor slabs, concrete roofing tiles, etc.
		concrete mortar	cured concrete mortar
<i>Ru</i>	<i>Rn</i>	natural stone	stone from mineral sources that has been subjected to nothing more than mechanical processing and sometimes washing
	<i>Rh</i>	hydraulically bound mixtures - not concrete	lean concrete, sand cement, stabilized coarse aggregates, ternary mixture
		comparable materials	screed floor of cement mortar
	<i>Rs</i>	materials from metallurgical industry	ferrous- and non-ferrous slags
<i>Rb</i>	Consisting of ...		
		1. elements of baked clay	bricks, pottery, roof tiles, vitrified clay pipe, expanded clay, pavers
		2. ceramic products	ceramic products (tiles, sanitary elements, plinths)
		3. lightweight concrete	concrete with lightweight grains (expanded clay), aerated concrete, cellcrete
		4. masonry mortar	mortar from joints in masonry, surface render
		5. elements of calcium silicate	sand-limestone
		6. other comparable materials	oven stone, shells and other
<i>Ra</i>		hydrocarbon mixtures	asphalt, mastic asphalt, lean asphalt, cement asphalt aggregate
<i>Rg</i>		Glass	glass, regardless of origin
<i>X</i>	Consisting of ...		
		1. cohesive materials	clay and soil
		2. roofing bitumen and bitumen sheets materials	bitumen roofing and bitumen- and bituminous sheets
		3. plastic, rubber	PVC, HDPE, LDPE, rubber, polystyrene, polycarbonate, formica, and other plastics
		4. wood, organic materials	all organic materials
		5. metals	all metals
		6. gypsum	gypsum blocks and -plaster
		7. materials from thermal processes	coal, black carboniferous slate, lignite, coal residues
		8. other contaminants (not limited)	insulation, fiberboard and other materials
<i>FL</i>		particles with density $\leq 1\,000\text{ kg/m}^3$	all floating materials on water

4 Characteristics

4.1 Aggregates (not including added fillers)

4.1.1 Particle size, shape and density

4.1.1.1 Grading

4.1.1.1.1 Coarse aggregates

The grading of coarse aggregates shall be determined in accordance with prEN 933-1:2021.

The results obtained shall be evaluated against the classification criteria for the relevant grading, for:

- a) single sized coarse aggregates, as given in Table 1, and
- b) graded coarse aggregates, as given in Tables 1 and 2.

The performance shall be expressed as a grading class in accordance with the provisions of Table 1 or Tables 1 and 2.

Table 1 — Grading classes for coarse aggregates

Size mm	Percentage passing by mass					Class $G_n X/Y$
	$2D$	$1,4D$	D	d	$d/2$	
$D > 4$ $d \geq 1$	100	98 to 100	90 to 99	0 to 15	0 to 5	$G_C 90/15$
	100	98 to 100	90 to 99	0 to 20	0 to 5	$G_C 90/20$
	100	98 to 100	85 to 99	0 to 15	0 to 5	$G_C 85/15$
	100	98 to 100	85 to 99	0 to 20	0 to 5	$G_C 85/20$
	100	98 to 100	80 to 99	0 to 15	0 to 5	$G_C 80/15$
	100	98 to 100	80 to 99	0 to 20	0 to 5	$G_C 80/20$
	100	98 to 100	80 to 99	0 to 35	0 to 5	$G_C 80/35$
	100	98 to 100	85 to 99	0 to 35	0 to 5	$G_C 85/35$
	100	98 to 100	X to 99	0 to Y	0 to 5	G_C StatedX/Y
	100	100	90 to 99	0 to 10	0 to 2	$G_{CA} 90/10$
	100	98 to 100	85 to 99	0 to 15	0 to 2	$G_{CA} 85/15$
	100	98 to 100	80 to 99	0 to 15	0 to 2	$G_{CA} 80/15$
	100	98 to 100	X to 99	0 to Y	0 to 2	G_{CA} StatedX/Y

Table 2 — Overall levels for graded coarse aggregates at mid-size sieves

D/d	Mid-size sieve mm	Overall threshold levels for percentage passing mid-size sieve Percentage passing by mass
< 4	$D/1,4$	20 to 80
≥ 4	$D/2$	20 to 70

4.1.1.1.2 Grit

The grading of grits shall be determined in accordance with prEN 933-1:2021.

The results obtained shall be evaluated against the classification criteria for the relevant grading in Table 3.

The performance shall be expressed as a class in accordance with the provisions of Table 3.

Table 3 — Grading classes for grits

Size	Percentage passing by mass					Class
mm	$2D$	$1,4D$	D	d	$d/2$	$G_n X/Y$
$D \leq 4$ $d \geq 1$	100	98 to 100	90 to 99	0 to 10	0 to 2	$G_{GA} 90/10$
	100	98 to 100	X to 99	0 to Y	0 to 2	$GG_{Stated} X/Y$
	100	98 to 100	90 to 99	0 to 10	0 to 5	$G_G 90/10$
	100	95 to 100	85 to 99	0 to 15	0 to 5	$G_G 85/15$
	100	98 to 100	85 to 99	0 to 20	0 to 5	$G_G 85/20$
	100	98 to 100	85 to 99	0 to 35	0 to 5	$G_G 85/35$
	100	98 to 100	80 to 99	0 to 20	0 to 5	$G_G 80/20$
	100	95 to 100	X to 99	0 to Y	0 to 5	$GG_{Stated} (95) X/Y$
	100	98 to 100	X to 99	0 to Y	0 to 5	$GG_{Stated} (98) X/Y$

4.1.1.1.3 Fine aggregates

The grading of fine aggregates shall be determined in accordance with prEN 933-1:2021.

The results obtained shall be evaluated against the classification criteria for the relevant grading in Table 4.

The performance shall be expressed as a class in accordance with the provisions of Table 4.

Table 4 — Grading classes for fine aggregates

Size	Percentage passing by mass			Class
mm	$2D$	$1,4D$	D	$G_F X$
$D \leq 4$ $d = 0$	100	98 to 100	85 to 99	$G_F 85$
	100	98 to 100	80 to 99	$G_F 80$
	100	98 to 100	X to 99	$G_F \text{ Stated } X$

4.1.1.1.4 All-in aggregates

The grading of all-in aggregates shall be determined in accordance with prEN 933-1:2021.

The results obtained shall be evaluated against the classification criteria for the relevant grading, as given in Tables 5 and 6.

The performance shall be expressed as a class in accordance with the provisions of Table 5.

Table 5 — Grading classes for all-in aggregates

Size	Percentage passing by mass			Class
mm	$2D^a$	$1,4D$	D	$G_A X$
$D > 4$ $d = 0$	100	98 to 100	90 to 99	$G_A 90$
	100	98 to 100	85 to 99	$G_A 85$
	100	98 to 100	80 to 99	$G_A 80$
	100	-	75 to 99	$G_A 75$
	100	-	70 to 99	$G_A 70$
	100	-	X to 99	$G_A \text{ Stated } X$

^a For aggregate sizes where D is greater than 63 mm (e.g. 80 mm and 90 mm), only the oversize limit related to the $1,4 D$ sieve applies.

Table 6 — Overall limits for all-in aggregate at intermediate sieves

Sieve size mm	Overall threshold limits at intermediate sieves Percentage passing by mass			
	$D/2$	4 mm	2 mm	1 mm
$D \leq 10$	50 to 90	—	—	20 to 60
$10 < D < 32$	50 to 90	—	20 to 60	—
$D \geq 32$	50 to 90	20 to 60	—	—

4.1.1.1.5 Natural graded aggregates

The grading of natural graded aggregates shall be determined in accordance with prEN 933-1:2021.

The results obtained shall be evaluated against the classification criteria for the relevant grading in Table 7.

The performance shall be expressed as a class in accordance with the provisions of Table 7.

Table 7 — Grading classes for natural graded aggregates

Size	Percentage passing by mass			Class
mm	$2D$	$1,4D$	D	$G_n X$
$D \leq 8$ $d = 0$	100	98 to 100	90 to 99	$G_{NG} 90$
	100	98 to 100	X to 99	$G_{NG} \text{ Stated } X$

4.1.1.2 Particle shape

4.1.1.2.1 Flakiness index

The flakiness index of coarse aggregates and the coarse fraction of all-in and natural graded aggregates shall be determined in accordance with EN 933-3:2012.

The results obtained shall be evaluated against the criterion for the respective class in Table 8.

The performance shall be expressed as a class in accordance with Table 8.

Table 8 — Classes for flakiness index

Values of Flakiness Index	Class FI
0 to 10	$FI 10$
0 to 15	$FI 15$
0 to 20	$FI 20$
0 to 25	$FI 25$
0 to 30	$FI 30$
0 to 35	$FI 35$
0 to 40	$FI 40$
0 to 45	$FI 45$
0 to 50	$FI 50$
0 to X, where $X > 50$	$FI_{\text{Stated } X}$

4.1.1.2.2 Shape index

The shape index of coarse aggregates and the coarse fraction of all-in and natural graded aggregates shall be determined in accordance with EN 933-4:2008.

The results obtained shall be evaluated against the criterion for the respective class in Table 9.

The performance shall be expressed as a class in accordance with Table 9.

Table 9 — Classes for shape index

Values of Shape Index	Class <i>SI</i>
0 to 15	<i>SI 15</i>
0 to 20	<i>SI 20</i>
0 to 25	<i>SI 25</i>
0 to 30	<i>SI 30</i>
0 to 35	<i>SI 35</i>
0 to 40	<i>SI 40</i>
0 to 45	<i>SI 45</i>
0 to 50	<i>SI 50</i>
0 to 55	<i>SI 55</i>
0 to X, where X > 55	<i>SI_{Stated} X</i>

4.1.1.2.3 Angularity

The angularity of fine aggregates, and of the fine fraction of all-in and natural graded aggregates shall be determined as the flow coefficient in accordance with prEN 933-6:2021, Clause 8.

The results obtained shall be evaluated against the criterion for the respective class in Table 10.

The performance shall be expressed as a class in accordance with Table 10.

Table 10 — Classes for angularity

Values of Flow coefficient	Class <i>E_{CS}</i>
38 to 60	<i>E_{CS} 38</i>
35 to 60	<i>E_{CS} 35</i>
30 to 60	<i>E_{CS} 30</i>
X to 60, where X < 30	<i>E_{CS Stated} X</i>

4.1.1.3 Particle density**4.1.1.3.1 Particle density of aggregates not including added filler**

The particle density of aggregates shall be determined in accordance with prEN 1097-6:2021

The performance shall be expressed as a level in Mg/m³, stating the means of determination.

4.1.1.3.2 Particle density of fine fraction of aggregates not including added filler

If the fines content of fine aggregates, all-in aggregates and natural graded aggregates is greater than 10 % by mass, the fraction 0 mm to 0,125 mm shall be separated and the particle density determined for this size fraction in accordance with prEN 1097-7:2021.

The performance shall be expressed as a level in Mg/m³.

4.1.2 Percentage of crushed particles

The percentages of crushed particles, totally crushed particles and totally rounded particles of coarse aggregates, all-in aggregates and natural graded aggregates and grit shall be assessed, either:

- a) without testing (WT), where the aggregates are obtained from crushing of massive rock or slag; or
- b) based on determination of the percentages of crushed particles, totally crushed particles and totally rounded particles in accordance with prEN 933-5:2021.

In case b), the results obtained shall be evaluated against the criterion for the respective class in Table 11.

The performance shall be expressed as a class

- (i) in case a) as class *C* 90/100/0/ (WT)
- (ii) in case b) as a class in accordance with Table 11.

Table 11 — Classes for the percentage of crushed particles

Percentage of totally crushed particles by mass	Percentage of crushed particles by mass	Percentage of totally rounded particles by mass	Class <i>C</i>
90 to 100	100	0	<i>C</i> 90/100/0
30 to 100	95 to 100	0 to 1	<i>C</i> 30/95/1
30 to 100	90 to 100	0 to 1	<i>C</i> 30/90/1
45 to 100	90 to 100	0 to 1	<i>C</i> 45/90/1
-	90 to 100	0 to 3	<i>C</i> N/90/3 ^a
-	70 to 100	0 to 10	<i>C</i> N/70/10 ^a
-	50 to 100	0 to 10	<i>C</i> N/50/10 ^a
-	50 to 100	0 to 30	<i>C</i> N/50/30 ^a
-	-	0 to 50	<i>C</i> N/N/50 ^a
-	-	0 to 70	<i>C</i> N/N/70 ^a
X to 100	Y to 100	0 to Z	<i>C</i> _{Stated} X/Y/Z ^a
^a N = No minimum value for totally crushed or crushed particles			

4.1.3 Cleanliness

4.1.3.1 Fines content

The fines content of aggregates shall be determined in accordance with prEN 933-1:2021.

The results obtained shall be evaluated against the criterion for the respective class in Table 12.

The performance shall be expressed as a class in accordance with Table 12.

Table 12 — Classes for fines content

Aggregate	Value of fines content Percentage passing 0,063 mm sieve by mass	Class <i>f</i>
Coarse and grit	0 to 0,5	<i>f</i> 0,5
	0 to 1	<i>f</i> 1
	0 to 1,5	<i>f</i> 1,5
	0 to 2	<i>f</i> 2
	0 to 3	<i>f</i> 3
	0 to 4	<i>f</i> 4
	0 to X, where X > 4	<i>f</i> _{Stated X}
Natural graded 0/8 mm	0 to 3	<i>f</i> 3
	0 to 5	<i>f</i> 5
	0 to 7	<i>f</i> 7
	0 to 10	<i>f</i> 10
	0 to 16	<i>f</i> 16
	0 to X, where X > 16	<i>f</i> _{Stated X}
All-in	0 to 3	<i>f</i> 3
	0 to 5	<i>f</i> 5
	0 to 7	<i>f</i> 7
	0 to 9	<i>f</i> 9
	0 to 10	<i>f</i> 10
	0 to 11	<i>f</i> 11
	0 to 12	<i>f</i> 12
	0 to 15	<i>f</i> 15
	0 to X, where X > 15	<i>f</i> _{Stated X}
Fine	0 to 3	<i>f</i> 3
	0 to 4	<i>f</i> 4
	0 to 5	<i>f</i> 5
	0 to 6	<i>f</i> 6
	0 to 7	<i>f</i> 7
	0 to 10	<i>f</i> 10
	0 to 16	<i>f</i> 16
	0 to 22	<i>f</i> 22
	0 to X, where X > 22	<i>f</i> _{Stated X}

4.1.3.2 Harmful fines

4.1.3.2.1 General

The harmfulness of fines of fine aggregates, all-in aggregates and natural-graded aggregates may be determined using two different proxy characteristics: the sand-equivalent value and the methylene blue value. The “sand equivalent” test quantifies the relative proportions of fine dust or clay-like materials in fine aggregate by forcing the fine particles into suspension using a flocculating agent. However, the sand equivalent test does not quantify the deleterious adsorbing effect of the fine dust or clay-like minerals, which varies from one mineral to another. This is achieved instead by the methylene blue test which is based on the degree of adsorption of a dye solution of methylene blue by the particles of clay contained in a 0/2 mm fine aggregate.

4.1.3.2.2 Sand equivalent test

4.1.3.2.2.1 General

There are two methods in EN 933-8:2012+A1:2015 for determining sand equivalent value for fine aggregates, all-in aggregates and natural graded aggregates: SE_{10} and SE_4 . The SE_{10} method is carried out on the 0/2 mm size fraction and the SE_4 method is carried out on the 0/4 mm size fraction. The SE_{10} method shall be the reference method.

4.1.3.2.2.2 Sand equivalent SE_{10} method

The sand equivalent SE_{10} of fine aggregate, all-in aggregate and natural graded aggregate shall be assessed, either:

- a) without testing (WT), if the performance of fines content of these aggregates is declared, based on the assessment according to 4.1.3.1, and the value determined therein is $< 3 \%$ (by mass); or
- b) based on determination of the sand equivalent SE_{10} in accordance with EN 933-8:2012+A1:2015, Clause 8.

In case b) the results obtained shall be evaluated against the criterion for the respective class in Table 11.

The performance shall be expressed as a class

- a) in case a) as class $SE_{10} 85 / (WT)$.
- b) in case b) as a class SE_{10} in accordance with Table 13.

Table 13 — Classes for sand equivalent values SE_{10}

Sand Equivalent values	Class SE_{10}
85 to 100	SE_{10} 85
80 to 100	SE_{10} 80
75 to 100	SE_{10} 75
70 to 100	SE_{10} 70
65 to 100	SE_{10} 65
60 to 100	SE_{10} 60
55 to 100	SE_{10} 55
50 to 100	SE_{10} 50
45 to 100	SE_{10} 45
40 to 100	SE_{10} 40
35 to 100	SE_{10} 35
30 to 100	SE_{10} 30
X to 100, where $X < 30$	SE_{10} Stated X

4.1.3.2.2.3 Sand equivalent SE_4 method

The sand equivalent SE_4 value of fine aggregate, all-in aggregate and natural graded aggregate shall be assessed, either:

- without testing (WT), if the performance of fines content of these aggregates is declared, based on the assessment according to 4.1.3.1, and the value determined therein is $< 3\%$ (by mass); or
- based on determination of the sand equivalent SE_4 in accordance with EN 933-8:2012+A1:2015.

In case b), the results obtained shall be evaluated against the criterion for the respective class in Table 14.

The result shall be expressed as a class

- in case a), as class SE_4 85 / (WT)
- in case b), as a class SE_4 in accordance with Table 14.

Table 14 — Classes for sand equivalent values SE_4

Sand Equivalent values	Class SE_4
85 to 100	SE_4 85
80 to 100	SE_4 80
75 to 100	SE_4 75
70 to 100	SE_4 70
65 to 100	SE_4 65
60 to 100	SE_4 60
55 to 100	SE_4 55
50 to 100	SE_4 50
45 to 100	SE_4 45
40 to 100	SE_4 40
35 to 100	SE_4 35
30 to 100	SE_4 30
X to 100, where $X < 30$	SE_4 Stated X

4.1.3.2.3 Methylene blue test (MB , MB_A)

The methylene blue value (MB) of fine aggregates shall be assessed, either:

- without testing (WT), if the performance of fines content of these aggregates is declared, based on the assessment according to 4.1.3.1, and the value determined therein is < 3 % (by mass); or
- based on determination of the methylene blue value (MB) in accordance with EN 933-9:2009+A1:2013. The results shall be expressed as a class.

In case b), the results obtained shall be evaluated against the criterion for the respective class in Table 14.

The result shall be expressed as a class

- in case a), as class MB 1/ (WT)
- in case b), as a class MB in accordance with Table 15.

The methylene blue value (MB or MB_A) of all-in and natural-graded aggregates shall be assessed, either:

- without testing (WT), if the performance of fines content of these aggregates is declared, based on the assessment according to 4.1.3.1, and the value determined therein is < 3 % (by mass)
- based on determination of the methylene blue value (MB) in accordance with 5.1.2.

In case d), the results obtained shall be evaluated against the criterion for the respective class in Table 14.

The result shall be expressed as a class

(iii) in case c), either as class $MB\ 1 / (WT)$ or as class $MB_A\ 0,8 / (WT)$

(iv) in case d), as a class (MB or MB_A) in accordance with Table 15.

Table 15 — Classes for methylene blue values

Aggregate	Methylene Blue values	Class MB or MB_A
Fine	MB value g/kg	MB
	0 to 1	$MB\ 1$
	0 to 1,5	$MB\ 1,5$
	0 to 2	$MB\ 2$
	0 to 2,5	$MB\ 2,5$
	0 to 3	$MB\ 3$
	0 to X, where $X > 3$	$MB\ \text{Stated } X$
All-in and natural-graded	MB value g/kg	MB
	0 to 1	$MB\ 1$
	0 to 1,5	$MB\ 1,5$
	0 to 2	$MB\ 2$
	0 to 2,5	$MB\ 2,5$
	0 to 3	$MB\ 3$
	0 to X, where $X > 3$	$MB\ \text{Stated } X$
	MB_A value g/kg	MB_A
	0 to 0,8	$MB_A\ 0,8$
	0 to 1	$MB_A\ 1$
	0 to X, where $X > 1$	$MB_A\ \text{Stated } X$

4.1.3.2.4 Harmful fines of fine fraction of aggregates not including added filler

If the fines content of fine aggregates, all-in aggregates and natural graded aggregates is greater than 10 % by mass, the fraction 0 mm to 0,125 mm shall be separated and the harmful fines (e.g. swelling clay) determined for this size fraction as the methylene blue value (MB_F) in accordance with EN 933-9:2009+A1:2013, Annex A (normative).

The results obtained shall be evaluated against the criterion for the respective class in Table 16.

The performance shall be expressed as a class in accordance with Table 16.