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Preskusi geometričnih lastnosti agregatov - 1. del: Ugotavljanje zrnivosti - Metoda sejanja

Tests for geometrical properties of aggregates - Part 1: Determination of particle size distribution - Sieving method

Prüfverfahren für geometrische Eigenschaften von Gesteinskörnungen - Teil 1: Bestimmung der Korngrößenverteilung - Siebverfahren

Essais pour déterminer les caractéristiques géométriques des granulats - Partie 1 : Détermination de la granularité - Analyse granulométrique par tamisage

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English Version

Tests for geometrical properties of aggregates - Part 1: Determination of particle size distribution - Sieving method

Essais pour déterminer les caractéristiques
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tamisage

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Gesteinskörnungen - Teil 1: Bestimmung der
Korngrößenverteilung - Siebverfahren

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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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 933-1:2021) 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 EN 933-1:2012.

In comparison with the previous edition, the following technical modifications have been made:

- a) The European foreword, the Scope, the Terms and definitions and the Test report content have been updated according to the current rules;
- b) Normative references to ISO 3310-1 and ISO 3310-2 have been deleted. The ISO standards are referenced in EN 933-2;
- c) Clauses 3 Terms and definitions and 5 Apparatus have been extended;
- d) Clause 6 Preparation of test portions has been clarified. Notes have been transformed to main text and text about recycled aggregates has been added;
- e) Clause 7 Procedure has been clarified. Text about dry sieving of lightweight aggregates has been added, notes have been transformed into main text and recommended masses to avoid overloading of sieves have been moved to an annex;
- f) In Clause 8 Calculations, the formula for dry sieving has been clarified to only apply for lightweight aggregates. Masses are expressed in grams instead of kilograms. The former subclause 8.3 about precision has been moved to an annex;
- g) In Clause 9, the list of required data has been supplemented with drying temperature;
- h) Annex A has been revised with a new title and text and has been transformed from normative Annex A to informative Annex B;
- i) Former Annex B has been transformed to new Annex A and has been provided with a new title;
- j) A new Annex C (informative) has been designed to give guidance on the maximum mass to avoid overloading of sieves;
- k) A new Annex F Precision (informative) has been added;
- l) Clause 4 Principle and Annex D have been adjusted and the Bibliography is supplemented.

prEN 933-1:2021 (E)

This document forms part of a series of tests for geometrical properties of aggregates. Test methods for other properties of aggregates are covered by the following European Standards:

- EN 932 (all parts), *Tests for general properties of aggregates*
- EN 1097 (all parts), *Tests for mechanical and physical properties of aggregates*
- EN 1367 (all parts), *Tests for thermal and weathering properties of aggregates*
- EN 1744 (all parts), *Tests for chemical properties of aggregates*
- EN 13179 (all parts), *Tests for filler aggregate used in bituminous mixtures*

The other parts of EN 933 include:

- *Part 2: Determination of particle size distribution — Test sieves, nominal size of apertures*
- *Part 3: Determination of particle shape — Flakiness index*
- *Part 4: Determination of particle shape — Shape index*
- *Part 5: Determination of percentage of crushed particles in coarse and all-in natural aggregates*
- *Part 6: Assessment of surface characteristics — Flow coefficient of aggregates*
- *Part 7: Determination of shell content — Percentage of shells in coarse aggregates*
- *Part 8: Assessment of fines — Sand equivalent test*
- *Part 9: Assessment of fines — Methylene blue test*
- *Part 10: Assessment of fines — Grading of filler aggregates (air jet sieving)*
- *Part 11: Classification test for the constituents of coarse recycled aggregate*

1 Scope

This document specifies the reference method used for type testing and in case of dispute, for determination of the particle size distribution of aggregates, by washing and dry sieving. Other methods can be used for other purposes, such as factory production control, provided that an appropriate working relationship with the reference method has been established.

This document applies to all aggregates, with an upper aggregate size D up to 90 mm, but excluding added filler aggregates.

NOTE The determination of the grading of fillers is specified in EN 933-10 [1].

Annex A specifies a test method for aggregates unsuitable for oven-drying.

Annex B specifies additional steps for preparation of the test portion for all-in aggregates with $D \geq 31,5$ mm, without washing size fractions greater than 16 mm.

Annex C provides guidance for maximum mass on sieves to avoid overloading.

Annex D provides an example of test data sheet.

Annex E provides a sheet for graphical presentation of test results.

Annex F gives precision data.

Annex A is normative and Annexes B, C, D, E and F are informative.

WARNING – The use of this part of EN 933 can involve hazardous materials, operations and equipment (such as dust, noise and heavy lifts). It does not purport to address all of the safety or environmental problems associated with its use. It is the responsibility of users of this document to take appropriate measures to ensure the safety and health of personnel and the environment prior to application of the standard, and fulfil statutory and regulatory requirements for this purpose.

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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 932-2, *Tests for general properties of aggregates — Part 2: Methods for reducing laboratory samples*

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

EN 933-2, *Tests for geometrical properties of aggregates — Part 2: Determination of particle size distribution — Test sieves, nominal size of apertures*

3 Terms and definitions

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:

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

3.1

aggregate

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

3.2

aggregate size

d/D

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

Note 1 to entry: This designation accepts the presence of some particles which will be retained on the upper sieve (oversize) and some which will pass the lower sieve (undersize).

3.3

test portion

d_0/D_0

sample used as a whole in a single test

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3.4

constant mass

mass determined by successive weighings during drying performed at least 1 h apart and not differing by more than 0,1 %

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Note 1 to entry: In many cases, constant mass can be achieved after a test portion has been dried for a pre-determined period in a specified oven (see 5.3) at (110 ± 5) °C. Test laboratories can determine the time required to achieve constant mass for specific types and sizes of sample dependent upon the drying capacity of the oven used.

4 Principle

The test consists of washing, dividing and separating a material into several particle size classifications of decreasing sizes by means of a series of sieves.

Successive steps are: initial washing to remove most of the fines in the test sample, drying, and dry sieving to separate the test sample into several size fractions of decreasing sizes. This is done by means of a series of selected sieves.

The mass of the particles retained on the various sieves is related to the initial dry mass of the test sample. The cumulative percentages passing each sieve are then calculated.

5 Apparatus

Unless otherwise stated, all apparatus shall conform to the general requirements of EN 932-5.

5.1 Test sieves, conforming to EN 933-2.

NOTE In the following parts of the standard, sieve is used as a short form of test sieve.

5.2 Tightly fitting pan and lid, for the sieves.

5.3 **Ventilated oven**, capable of maintaining a temperature of $(110 \pm 5) ^\circ\text{C}$ or $(40 \pm 5) ^\circ\text{C}$, or other suitable equipment for drying the aggregates, which does not cause any particle size breakdown.

5.4 Washing equipment.

5.5 **Balances or scales**, accurate to $\pm 0,1 \%$ of the test portion mass.

5.6 Trays, brushes.

5.7 **Sieve shaker**, with such sieving action that the criterion for adequate separation of the test portion in 7.2 is met in a reasonable time, (optional).

5.8 **Equipment for reducing laboratory samples**, as specified in EN 932-2.

6 Preparation of test portions

Reduce samples in accordance with EN 932-2 to produce the required number of test portions.

Samples containing substantial amounts of fines shall be moistened before reduction, to minimize segregation and loss of dust.

The size of each test portion shall be not less than specified in Table 1.

Table 1 — Minimum size of test portions

| Upper aggregate size <i>D</i> mm | Normal weight aggregates kg | Lightweight aggregates litres |
|-------------------------------------|--------------------------------|----------------------------------|
| 90 | 80 | - |
| 32 | 10 | 2,1 |
| 16 | 2,6 | 1,7 |
| 8 | 0,6 | 0,8 |
| ≤ 4 | 0,2 | 0,3 |

For other *D* values below 90 mm, the minimum test portion mass may be interpolated from the masses, using the following formula: $M = (D/10)^2$

where *M* = minimum mass of test portion, in kg

D = upper aggregate size, in mm

For aggregates with particle density higher than 3,00 Mg/m³ (see EN 1097-6), the minimum test portion masses shall be corrected. The correction shall be based on the density ratio, in order to produce a test portion of approximately the same volume as those for aggregates of normal density.

For lightweight aggregates complying with EN 13055 [4], the volume column shall be used to choose the appropriate minimum size of test portions. The volumes for other aggregate sizes may be interpolated.

The precision of the test method can be reduced if the test portion size is less than the minimum value specified. In such a case, the test portion size shall be stated in the test report (9.1).

Sample reduction shall yield a test portion size which is larger than the minimum, but not of an exact predetermined value.

Dry the test portion to constant mass at (110 ± 5) °C in the case of natural and manufactured aggregates and at (40 ± 5) °C in the case of laboratory samples containing recycled aggregates. Where necessary, the drying procedure at (40 ± 5) °C may be generalized to all types of aggregates that are sensitive to drying at 110 °C.

Allow to cool, weigh and record the mass as M_1 .

For some types of aggregate, drying at 110 °C binds particles together sufficiently strongly to prevent separation of single particles during subsequent washing and/or sieving procedures. For such aggregates the procedure given in Annex A shall be adopted.

For all-in aggregates with *D* equal to 31,5 mm or larger, the procedure described in Annex B may be used.

7 Procedure

7.1 Washing

Washing and subsequent dry sieving is necessary to ensure an accurate determination of the fines content of the test portion.

NOTE 1 Significant amounts of water-soluble constituents can influence the results when washing the test portion.

When washing can alter the physical properties of a lightweight aggregate, only dry sieving shall be used.

Place the test portion in a container and add sufficient water to cover the test portion.

NOTE 2 A storage period of 24 h under water is helpful in breaking down lumps. The use of a dispersion agent can improve the disintegration of lumps.

Agitate the sample with sufficient vigour to result in complete separation and suspension of the fines.

Wet both sides of a 0,063 mm sieve reserved for use in this test only, and fit a guard sieve (e.g. 1 mm or 2 mm) on top. Mount the sieves in such a way that the suspension passing the sieve can be run to waste or, when required, collected in a suitable vessel. Pour the contents of the container on to the top sieve. Continue washing until the water passing the 0,063 mm sieve is clear.

Care shall be taken to prevent overloading, overflowing or damaging the 0,063 mm sieve or the guard sieve. For some aggregates, it will be necessary to pour only the suspended fines from the container onto the 0,063 mm guarded sieve, continuing to wash the coarse residue in the container and decanting the suspended fines onto the guard sieve until the water passing the 0,063 mm sieve is clear.

Dry the residue retained on the 0,063 mm sieve to constant mass, at $(110 \pm 5) ^\circ\text{C}$ in the case of natural and manufactured aggregates and at $(40 \pm 5) ^\circ\text{C}$ in the case of recycled aggregates or other aggregates that are sensitive to drying at $110 ^\circ\text{C}$. Allow to cool, weigh and record as M_2 .

7.2 Sieving

Select appropriate sieves in accordance with the aggregate size d/D .

Pour the washed and dried material into the sieving column. In case of a lightweight aggregate with water sensitive physical properties pour the dry sample directly into the sieving column. The column comprises a number of sieves fitted together and arranged, from top to bottom, in order of decreasing aperture sizes with the pan and lid.

A 0,063 mm sieve shall be incorporated in the series in order to take care of the fines that remain after washing.

Shake the column. Then remove the sieves one by one, commencing with the largest aperture size opening. Shake each sieve manually ensuring no material is lost by using a pan and lid for example.

NOTE 1 Excessive dry sieving can degrade some soft and friable aggregates and affect the test result.

Transfer all the material which passes each sieve onto the next sieve in the column before continuing the operation with that sieve. Sieve overloading shall be avoided.

NOTE 2 Recommended masses to avoid overloading of sieves are indicated in Table C.1.

It is highlighted that precision is highly dependent on the loading of individual sieves. Overloaded sieves lead to degraded precision data and lightly loaded sieves lead to better precision data.

If overloading occurs, one of the following procedures shall be used:

- a) divide the fraction into smaller portions and sieve these one after the other;
- b) divide the portion of the sample passing the next largest sieve with the aid of a sample divider or by quartering, and continue the sieve analysis on the reduced test portion, making due allowance in subsequent calculations for the reductions.

The sieving process shall be considered as completed when additional sieving does not lead to a change of mass of the retained material on any sieve by more than 1,0 % by mass.

NOTE 3 A suitable time for complete sieving is one minute.