

RATIFIED EUROPEAN TEXT

EN933-7:1998

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EUROPEAN STANDARD

EN 933-7

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 1998

ICS

Descriptors: aggregates, tests, geometrical characteristics, determination, percentage, gravel

English version

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

Essais pour déterminer les propriétés géométriques des
granulats - Partie 7: Détermination de la teneur en
éléments coquilliers - Pourcentage des coquilles dans les
gravillons

Prüfverfahren für geometrische Eigenschaften von
Gesteinkörnungen - Teil 7: Bestimmung des
Muschelschalengehaltes - Prozentsatz von Muschelschalen
in groben Gesteinkörnungen

This European Standard was approved by CEN on 15 February 1998.

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

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 154 "Aggregates", the secretariat of which is held by BSI.

This standard forms part of a series of tests for geometrical properties of aggregates. Test methods for other properties of aggregates will be covered by Parts of the following European Standards:

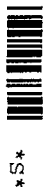
EN 932 Tests for general properties of aggregates
EN 1097 Tests for mechanical and physical properties of aggregates
EN 1367 Tests for thermal and weathering properties of aggregates
EN 1744 Tests for chemical properties of aggregates
A European Standard "Tests for filler aggregate used in bituminous mixtures" is in course of preparation.

The other parts of EN 933 will be:

Part 1: Determination of particle size distribution - Sieving method
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: Assessment of surface characteristics - Percentage of crushed and broken surfaces in coarse aggregates
Part 6: Assessment of surface characteristics - Flow coefficient of 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 fillers (air jet sieving)

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 September 1998, and conflicting national standards shall be withdrawn at the latest by December 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.



1 Scope

This European Standard specifies a method for the determination of shell content of coarse aggregates. It applies to gravel or mixed aggregate containing gravel.

The test method specified in this part of this European Standard is applicable to particle size fractions d_i/D_i where $D_i \leq 63$ mm and $d_i \geq 4$ mm.

NOTE: For aggregate sizes with $D > 63$ mm and/or $d < 4$ mm the test may be carried out on particle size fractions d_i/D_i where $D_i \leq 63$ mm and $d_i \geq 4$ mm.

2 Normative references

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

prEN 932-2	Tests for general properties of aggregates Part 2: Methods for reducing laboratory samples
prEN 932-5	Tests for general properties of aggregates Part 5: Common equipment and calibration
EN 933-1	Tests for geometrical properties of aggregates Part 1: Determination of particle size distribution - Sieving method
EN 933-2	Tests for geometrical properties of aggregates Part 2: Determination of particle size distribution - Test sieves, nominal size of apertures

3 Definitions

For the purposes of this European Standard the following definitions apply.

3.1 aggregate size: A designation of aggregate in terms of lower (d) and upper (D) sieve sizes.

NOTE: 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).

3.2 particle size fraction d_i/D_i : Fraction of an aggregate passing the larger (D_i) of two sieves and retained on the smaller (d_i).

NOTE: The lower limit may be zero.

3.3 test portion: The sample used as a whole in a single test.

3.4 constant mass: Successive weighings after drying at least 1 h apart not differing by more than 0,1 %.

NOTE: 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 may determine the time required to achieve constant mass for specific types and sizes of sample dependent upon the drying capacity of the oven used.

3.5 shell: The hard outer casing of a testaceous animal.

4 Principle

The test consists of sorting by hand shells and shell fragments from a test portion of coarse aggregate.

The shell content is determined as the proportion of the mass of shells and shell fragments to the mass of the test portion. The shell content, SC , is expressed as a percentage.

5 Apparatus

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

5.1 Test sieves, of nominal size of apertures in accordance with EN 933-2.

5.2 Tightly fitting pan and lid, for the sieves.

5.3 Ventilated oven, thermostatically controlled to maintain a temperature of (110 ± 5) °C or equipment for drying the aggregate which does not cause any particle size breakdown.

5.4 Balances or scale, of suitable capacity, readable to $\pm 0,1$ % of the mass to be weighed.

5.5 Trays.

5.6 Brushes.

5.7 Sieving machine, optional.

6 Preparation of test portion

The sample shall be reduced in accordance with the requirements of prEN 932-2.

Dry the sample at (110 ± 5) °C to constant mass. Weigh and record the mass as M_o .

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Sieve on appropriate test sieves, agitating with sufficient vigour to ensure complete separation of particles greater than 4 mm. Discard the particles retained on the 63 mm test sieve and those passing the 4 mm test sieve.

If necessary further reduce the sample in accordance with prEN 932-2 to produce a test portion. Record the mass of the test portion as M_1 . The mass of the test portion shall be as specified in table 1.

Table 1: Mass of test portions

Upper aggregate size D mm	Test portion mass (minimum) kg
63	45
32	6
16	1
8	0,1

NOTE: For other aggregate sizes D , appropriate test portion masses may be interpolated from those given in table 1.

Sample reduction shall yield a test portion of mass larger than the minimum but not of an exact predetermined value.

Carry out the test on each particle size fraction d_i/D_i where $D_i \leq 2 d_i$.

Samples for which $D > 2 d$ shall first be separated into particle size fractions d_i/D_i where $D_i \leq 2 d_i$.

7 Procedure

7.1 Test portions where $D \leq 2 d$

Spread the particles of the test portion on a flat surface and separate out the shells and shell fragments by hand.

Weigh the shells and shell fragments and record their mass M_2 .

7.2 Test portion where $D > 2 d$

Separate the test portion into particle size fractions d_i/D_i where $D_i \leq 2 d_i$ by sieving in accordance with EN 933-1.

Record the mass of each particle size fraction as M_i and calculate and record the percentage by mass of each particle size fractions d_i/D_i to the test portion mass M_i as V_i .

Discard any size fraction d_i/D_i which comprises less than 10 % of M_i .

NOTE 1: Any remaining size fraction d_i/D_i which contains less than 100 particles should, if required, be recorded in the test report.

NOTE 2: Size fractions d_i/D_i which contain an excessive number of particles can be further reduced in accordance with prEN 932-2.

NOTE 3: Size fractions can be further reduced if they consist of significantly more than 200 particles.

Record the mass of particles to be tested in each remaining particle size fraction d_i/D_i as M_{ii} and sort them as specified in 7.1.

Record the mass of shell and shell fragments in each of these size fractions d_i/D_i as M_{2i} .

8 Calculation and expression of results

8.1 Test portions where $D \leq 2d$

Calculate the shell content SC in accordance with the following equation:

$$SC = (M_2/M_1) \times 100$$

where:

M_1 is the mass of the test portion, in grams;
 M_2 is the mass of the shells and shell fragments, in grams.

Record the value of SC to the nearest whole number.

8.2 Test portions where $D > 2d$

8.2.1 Size fractions not reduced

If no size fractions have been reduced calculate the shell content in accordance with the following equation:

$$SC = \frac{\sum M_{2i}}{\sum M_{1i}} \times 100$$

where:

$\sum M_{1i}$ is the sum of the masses in the size fractions tested, in grams.
 $\sum M_{2i}$ is the sum of the masses of shells and shell fragments in each of the size fractions tested, in grams.

Record the value of SC to the nearest whole number.

8.2.2 Reduced size fractions

If any size fractions have been reduced calculate the percentages by mass of shells and shell fragments in each particle size fraction and record as SC_i .

Calculate the weighted mean percentage value of the shells and shell fragments in accordance with the following equation:

$$SC = \frac{\sum(V_i SC_i)}{\sum V_i}$$

where:

- V_i is the percentage by mass of particle size fraction i in the sample tested;
- SC_i is the percentage by mass of shells and shell fragments in particle size fraction i .

Record the weighted mean percentage of shells and shell fragments to the nearest whole number.

9 Test report

9.1 Required data

The test report shall include the following information:

- a) reference to this European Standard;
- b) identification of the sample;
- c) identification of the laboratory;
- d) sample reception date.
- e) shell content SC , to the nearest whole number;
- f) where applicable, the weighted mean percentage.

9.2 Optional data

The test report may include the information:

- a) name and location of the sample source;
- b) description of the material and of the sample reduction procedure;
- c) visual description of shells (e.g., hollow or flat);
- d) mass of sample M_0 ;
- e) mass of test portion M_1 ;
- f) mass of shells and fragments M_2 ;
- g) any size fraction consisting of less than 100 particles;
- h) sampling certificate, if available;
- i) date of test.

Annex A (informative)

Example of a test data sheet

EN 933-7 Identification of the sample:	Laboratory: Date: Operator:
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$M_0 =$ g

Particle size fraction d_i/D_i where $D_i \leq 2 d_i$ mm	Mass M_1 g	Mass M_2 g	Shell content SC = $(M_2/M_1) \times 100$ (to the nearest whole number) %

NOTE: When a particle size fraction d_i/D_i has been reduced, an appropriate test data sheet should be used and the weighted mean values calculated as specified in 8.2.

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