SLOVENSKI STANDARD
SIST EN 933-6:2023

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SIST EN 933-6:2014

Preskusi geometričnih lastnosti agregatov - 6. del: Ocenjevanje značilnosti površine - Količnik sipkosti agregatov

Tests for geometrical properties of aggregates - Part 6: Assessment of surface characteristics - Flow coefficient of aggregates

Prüfverfahren für geometrische Eigenschaften von Gesteinskörnungen - Teil 6: Beurteilung der Oberflächeneigenschaften - Fließkoeffizienten von Gesteinskörnungen

Essais pour déterminer les caractéristiques géométriques des granulats - Partie 6 : Evaluation des caractéristiques de surface - Coefficient d'écoulement des granulats

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English Version

Tests for geometrical properties of aggregates - Part 6: Assessment of surface characteristics - Flow coefficient of aggregates

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This European Standard was approved by CEN on 7 November 2022.

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COMITÉ EUROPÉEN DE NORMALISATION
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Ref. No. EN 933-6:2022 E

Contents

Page

European foreword

This document (EN 933-6:2022) has been prepared by the 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of an identical text or by endorsement, at the latest by June 2023, and conflicting national standards shall be withdrawn at the latest by June 2023.

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

This document supersedes EN 933-6:2014.

In comparison with the previous edition EN 933-6:2014, the following technical modifications have been made:

a) amendment to the Scope, clarifying that the standard does not apply to lightweight aggregates;

b) amendment to the Scope according to the current rules, introducing the three annexes and adding a warning about potential hazardous materials, operations and equipment;

c) change of the dated normative references to Annex A of EN 1097-6:2013 to undated references. The references are given for the calculations of masses in 7.2.2, 7.3.1 and 8.2.2. As a consequence, new notes to 7.2.2 and 8.2.2 have been added, informing that the test method generally applies to aggregates with water absorption less than about 1,5 %;

d) rewording of Clause 5 Reference materials, using the same text structure as in EN 1097-8. The information about alternative sources of reference materials has been moved to a new Note;

e) amendment to 6.4.1, including Figure 3, to clarify the verification of aperture dimension;

f) updating of the test reports in 7.5 and 8.5 according to the current rules;

g) amendment to the expressions of numerical results in 8.3, 8.4 and Annex C, for a better precision of the final result.

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 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: Determination of percentage of crushed particles in coarse and all-in natural 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*

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

1 Scope

This document specifies the reference method used for type testing, and in case of dispute, for determining the flow coefficient of coarse and fine aggregates. 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. Examples of advanced test methods can be found in the Bibliography.

This document applies to coarse aggregate of sizes between 4 mm and 20 mm and to fine aggregate of size up to 2 mm. It does not apply to lightweight aggregates.

NOTE 1 For coarse aggregates between 4 mm and 20 mm, the flow coefficient is linked with the percentage of crushed or broken surfaces of an aggregate and can therefore be used in association with the method specified in EN 933–5. Shape and surface texture characteristics also influence the result.

NOTE 2 Experience of this test has been generally limited to natural aggregates.

Examples of test data sheets are given in informative Annexes A and C.

Annex B (informative) contains precision data.

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.

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*

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

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

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:

— ISO Online browsing platform: available at https://www.iso.org/obp/ui

— IEC Electropedia: available at https://www.electropedia.org/

3.1
aggregate size
designation of aggregate in terms of lower (d) and upper (D) sieve sizes expressed in terms as d/D

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).

3.2
constant mass
mass determined by successive weighings performed at least 1 h apart and not differing by more than 0,1 %

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 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.

3.3
laboratory sample
sample intended for laboratory testing

3.4
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)

3.5
test portion
sample used as a whole in a single test

4 Principle

The flow coefficient of an aggregate is the time, expressed in seconds, for a specified volume of aggregate to flow through a given opening, under specified conditions using a standard apparatus.

5 Reference materials

5.1 Reference coarse aggregate, from a recognized source, with a size fraction of 6,3/10 mm and a flow time E_R of (100 ± 2) s when the shutter has an opening of (42,0 ± 0,2) mm. In the various calculations, E_R shall be taken as equal to 100 s and its pre-dried particle density ρ_p shall be taken as equal to 2,70 Mg/m^3.

NOTE 1 At present, the only recognized source of reference coarse aggregate is a stock of quartzite aggregate controlled by the CEREMA, Direction territoriale Normandie Centre, Laboratoire Régional de Rouen, 10 chemin de la Poudrière, CS 90245, 76121 Le Grand-Quevilly cedex, France. lrr.dternc@cerema.fr.

NOTE 2 An alternative source of reference coarse aggregate, with the flow time E_R and the pre-dried particle density ρ_p, can be used provided that the flow coefficient of that aggregate is established in a controlled experiment carried out in at least ten laboratories, by cross testing against the CEREMA type reference coarse aggregate.

In case of dispute, the CEREMA type reference coarse aggregate shall be used.

5.2 Reference fine aggregate, from a recognized source, with a size fraction of 0,063/2 mm and a flow time E_{RS} of (32 ± 2) s. In the various calculations, E_{RS} shall be taken as equal to 32 s and its pre-dried particle density ρ_p shall be taken as equal to 2,70 Mg/m^3.

NOTE 1 At present the only recognized source of reference fine aggregate is a siliceous Somme bay fine aggregate controlled by the CEREMA, Direction territoriale Normandie Centre, Laboratoire Régional de Rouen, 10 chemin de la Poudrière, CS 90245, 76121 Le Grand-Quevilly cedex, France. lrr.dternc@cerema.fr.

NOTE 2 An alternative source of reference fine aggregate, with the flow time E_{RS} and the pre-dried particle density ρ_p, can be used provided that the flow coefficient of that aggregate is established in a controlled experiment carried out in at least ten laboratories, by cross testing against the CEREMA type reference fine aggregate.

In case of dispute, the CEREMA type reference fine aggregate shall be used.

6 Apparatus

6.1 General

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

6.2 Apparatus for general purposes

6.2.1 Test sieves, 0,063 mm, 2 mm, 4 mm, 6,3 mm, 8 mm, 10 mm, 14 mm and 20 mm, with apertures as specified in EN 933-2.

6.2.2 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.

6.2.3 Balance, accurate to 0,1 % of the mass to be weighed.

6.2.4 Stopwatch or stopclock, to read 0,1 s.

6.3 Additional apparatus required for the determination of the flow coefficient of coarse aggregate

6.3.1 Bar sieves, conforming to EN 933-3, with apertures of 4 mm and 5 mm.

6.3.2 Container, of volume approximately 10 l.

6.3.3 Vibratory table, (Figure 1) comprising the following parts:

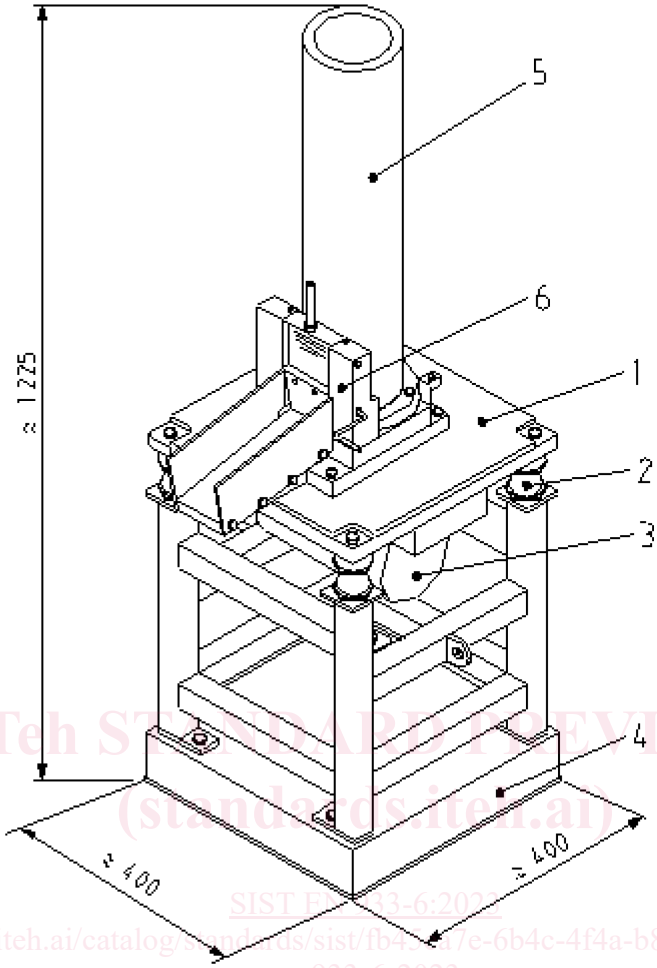
6.3.3.1 Bubble level, incorporated in the upper platform of the table and capable of setting in a horizontal position.

6.3.3.2 Four rubber suspensions, of Shore hardness (160 ± 30) N/mm joining the upper platform of the table to the support frame.

6.3.3.3 Vibrator, using unbalanced weights, fixed under the platform; with its axis of rotation horizontal and perpendicular to the axis of the flow channel. The speed of rotation shall be (2970 ± 20) revolutions/min and the amplitude (0,18 ± 0,02) mm when the flow unit is empty.

6.3.3.4 Baseplate, of mass (100 ± 10) kg, fixed under the frame.

Dimensions in millimetres



Key

1	vibratory platform	4	baseplate (see 6.3.3.4)
2	rubber suspension (see 6.3.3.2)	5	tube for test portion (see 6.3.4.1 and detail in Figure 2)
3	vibrator (see 6.3.3.3)	6	flow channel (see detail in Figure 2)

Figure 1 — Vibratory table and flow unit for coarse aggregate

6.3.4 Flow unit, of total mass (42,3 ± 0,1) kg (Figure 2) comprising the following:

6.3.4.1 Plastic tube for test portion, inside diameter (125 ± 2) mm and height (610 ± 10) mm.

6.3.4.2 Metal shutter, to adjust the height of the opening between (40 ± 1) mm and (60 ± 1) mm.

NOTE The height of the opening can be checked by using metal gauge block of a given height ± 0,1 mm.

6.3.4.3 Metal movable flap, to release the flow of material.

6.3.4.4 Metal flow channel, with a slope of (10,0 ± 0,5)°, a width of (90 ± 1) mm and fitted with plastic sides.