SLOVENSKI STANDARD
SIST EN 1097-3:1999

01-oktober-1999

Preskusi mehanskih in fizikalnih lastnosti agregatov - 3. del: Določevanje prostorninske mase in votlin v nasutem stanju

Tests for mechanical and physical properties of aggregates - Part 3: Determination of loose bulk density and voids

Prüfverfahren für mechanische und physikalische Eigenschaften von Gesteinskörnungen - Teil 3: Bestimmung von Schüttdichte und Hohlraumgehalt

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Essais pour déterminer les caractéristiques mécaniques et physiques des granulats - Partie 3: Méthode pour la détermination de la masse volumique en vrac et de la porosité intergranulaire

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Ta slovenski standard je istoveten z: **EN 1097-3:1998**

ICS:

91.100.15	Mineralni materiali in izdelki	Mineral materials and products

SIST EN 1097-3:1999 **en**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1097-3

April 1998

ICS 91.100.20

Descriptors: aggregates, tests, mechanical properties, physical properties, determination, density (mass/volume), porosity

English version

Tests for mechanical and physical properties of aggregates - Part 3: Determination of loose bulk density and voids

Essais pour déterminer les caractéristiques mécaniques et physiques des granulats - Partie 3: Méthode pour la détermination de la masse volumique en vrac et de la porosité intergranulaire

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This European Standard was approved by CEN on 25 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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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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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 European Standard forms part of a series of tests for mechanical and physical 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 933	Tests for geometrical properties of aggregates
EN 1367	Tests for thermal and weathering properties of aggregates
EN 1744	Tests for chemical properties of aggregates
prEN 13179	Tests for filler aggregate used in bituminous bound fillers

The other Parts of EN 1097 will be:

EN 1097-1	Tests for mechanical and physical properties of aggregates Part 1: Determination of the resistance to wear (micro-Deval)
prEN 1097-2	Tests for mechanical and physical properties of aggregates Part 2: Methods for the determination of resistance to fragmentation
prEN 1097-4	Tests for mechanical and physical properties of aggregates Part 4: Determination of the voids of dry compacted filler
prEN 1097-5	Tests for mechanical and physical properties of aggregates Part 5: Determination of the water content by drying in a ventilated oven
prEN 1097-6	Tests for mechanical and physical properties of aggregates Part 6: Determination of particle density and water absorption
prEN 1097-7	Tests for mechanical and physical properties of aggregates Part 7: Determination of the particle density of filler - Pyknometer method
prEN 1097-8	Tests for mechanical and physical properties of aggregates Part 8: Determination of the polished stone value
prEN 1097-9	Tests for mechanical and physical properties of aggregates Part 9: Method for the determination of the resistance to wear by abrasion from studded tyres: Nordic test
prEN 1097-10	Tests for mechanical and physical properties of aggregates Part 10: Water suction height

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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 October 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

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1 Scope

This European Standard specifies the test procedure for the determination of the loose bulk density of dry aggregate and the calculation of the voids.

The test is applicable to natural and artificial aggregates up to a maximum size of 63 mm.

A method for the determination of the apparent (bulk) density of filler in kerosene is given in annex **A**.

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
prEN 1097-6	Tests for mechanical and physical properties of aggregates - Part 6: Determination of particle density and water absorption
ISO 4788 : 1980	Laboratory glassware - Graduated measuring cylinders

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3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 loose bulk density: The quotient obtained when the mass of dry aggregate filling a specified container without compaction is divided by the capacity of that container.

3.2 voids: The air-filled spaces between the aggregate particles in the container.

3.3 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).

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

3.5 test specimen: The sample used in a single determination when a test method requires more than one determination of a property.

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3.6 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 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 dry mass of aggregates filling a specified container is determined by weighing and the corresponding loose bulk density is calculated. The percentage of voids is calculated from the loose bulk density and the particle density.

5 Apparatus

All apparatus shall comply with the general requirements of prEN 932-5.

5.1 Watertight cylindrical container, made of corrosion-resistant metal. The ratio of the inside diameter of the container to its internal depth shall be between 0,5 and 0,8. The minimum capacity of the container shall be as specified in table 1. The container shall be calibrated in accordance with annex **B**.

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It shall be smooth inside, of sufficient rigidity to retain its form under rough usage and preferably fitted with handles. The top rim shall be smooth and plane and parallel to the bottom.

NOTE: When testing lightweight aggregates, the mass of the test portion may be much smaller than the mass of the container. In such cases it is permissible for a lighter non -metallic container to be used, provided it is both rigid and watertight.

Table 1: Minimum capacity of container depending on aggregate size

Upper size of aggregate (D) mm	Capacity l
Up to 4	1,0
Up to 16,0	5,0
Up to 31,5	10
Up to 63	20

5.2 Balance, of suitable capacity, accurate to 0,1 % of the mass of the test portion. For calibration (see annex **B**) the balance shall be accurate to 0,1 % of the mass of the water.

5.3 Scoops, of convenient size.

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5.4 Straight-edge, made of steel, not less than 50 mm longer than the external diameter of the container, and rigid enough so as not to deform during the levelling process.

5.5 Thermometer, (for calibration) capable of measuring the temperature of water at 20 °C to a precision of 0,5 °C.

5.6 Drying oven.

5.7 Glass plate, (for calibration) large enough to cover the container.

6 Preparation of test specimens

Three test specimens shall be obtained in accordance with prEN 932-2. The aggregate shall be dried at (110 ± 5) °C to constant mass. Each test specimen shall be 120 % to 150 % of the mass needed to fill the container.

For lightweight aggregates, where appropriate, allow the test specimens to condition to moisture equilibrium at (23 ± 5) °C and (50 ± 10) % relative humidity after drying at (110 ± 5) °C.

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7 Procedure

Weigh the empty, dry and clean container (m_1). Place the container on a horizontal surface and fill it to overflowing using the scoop. Whilst filling the container, minimize segregation by resting the scoop on the top rim. At no time shall the edge of the scoop be more than 50 mm above the rim of the container.

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Carefully remove any surplus aggregate from above the top of the container ensuring that the surface spread is even to avoid segregation. Level the surface of the aggregate with the straightedge, taking care not to compact any part of the upper surface. If this is not feasible, level the surface by hand, taking care to approximate the volume of the aggregates to the capacity of the container as far as possible.

Weigh the filled container and record its mass to 0,1 % (m_2). Three test specimens shall be tested.

8 Calculation and expression of results

The loose bulk density ρ_b is calculated for each test specimen according to the following equation:

$$\rho_b = \frac{m_2 - m_1}{V}$$

where:

ρ_b is the loose bulk density, in megagrams per cubic metre;
m_2 is the mass of the container and test specimen, in kilograms;
m_1 is the mass of the empty container, in kilograms;
V is the capacity of the container, in litres.

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Report the loose bulk density ρ_b as the mean of the three values rounded to the second decimal place for normal aggregates, and to the third decimal place for lightweight aggregates.

The percentage of voids v is the volumetric proportion of voids in the container; it is calculated according to the following equation:

$$v = \frac{\rho_p - \rho_b}{\rho_p} \times 100$$

where:

v is the percentage of voids;

ρ_b is the loose bulk density, in megagrams per cubic metre;

ρ_p is the oven dried or pre-dried particle density, in megagrams per cubic metre; as determined in accordance with prEN 1097-6 using a test portion taken from the same laboratory sample.

NOTE: A statement on the precision of the test is given in annex **C**.

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9 Test report

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The test report shall make reference to this standard, stating:

a) sample identification, nominal size, and sample description;

b) date of test;

c) loose bulk density (the three values of the test specimens and the mean value);

d) percentage of voids if relevant.