

Tests for mechanical and physical properties of aggregates —

Part 6: Determination of particle density and water absorption

The European Standard EN 1097-6:2000, with the incorporation of amendment A1:2005, has the status of a British Standard

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National foreword

This British Standard is the official English language version of EN 1097-6:2000, including Corrigendum December 2002 and including amendment A1:2005, which is included in a package of new European Standards being prepared by CEN/TC 154 relating to aggregates. Although the English language versions of these European Standards will be adopted as British Standards as they become available, the existing British Standards for aggregates will be retained, but only until such time that the completed package of European Standards becomes available. The original group of British Standards will then be withdrawn and this will be noted in *Update Standards*.

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English version

**Test for mechanical and physical properties of aggregates —
Part 6: Determination of particle density and water absorption
(includes amendment A1:2005)**

Essais pour déterminer les caractéristiques mécaniques et physiques des granulats — Partie 6: Détermination de la masse volumique réelle et du coefficient d'absorption d'eau (inclut l'amendement A1:2005)

Prüfverfahren für mechanische und physikalische Eigenschaften von Gesteinskörnungen — Teil 6: Bestimmung der Rohdichte und der Wasseraufnahme (enthält Änderung A1:2005)

This European Standard was approved by CEN on 18 August 2000; amendment A1:2005 was approved by CEN on 11 August 2005.

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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 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2003, and conflicting national standards shall be withdrawn at the latest by December 2003.

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.

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
EN 13179	Tests for filler aggregate used in bituminous mixtures

The other parts of EN 1097 will be:

- Part 1: Determination of the resistance to wear (micro-Deval)
- Part 2: Methods for the determination of resistance to fragmentation
- Part 3: Determination of loose bulk density and voids
- Part 4: Determination of the voids of dry compacted filler
- Part 5: Determination of water content by drying in a ventilated oven
- Part 7: Determination of the particle density of filler - Pyknometer method
- Part 8: Determination of the polished stone value
- Part 9: Determination of the resistance to wear by abrasion from studded tyres: Nordic test
- Part 10: Water suction height

Foreword to amendment A1

This European Standard (EN 1097-6:2000/A1:2005) has been prepared by Technical Committee CEN/TC 154 "Aggregates", the secretariat of which is held by BSI.

This Amendment to the European Standard EN 1097-6:2000 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2006, and conflicting national standards shall be withdrawn at the latest by April 2006.

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1 Scope

This European Standard specifies methods for the determination of the particle density and water absorption of aggregates. The first five methods are applicable to normal aggregates with a sixth method for lightweight aggregates.

The principal methods specified are:

- a) a wire basket method for aggregates passing a 63 mm sieve but retained on a 31,5 mm sieve;
- b) pyknometer methods for aggregates passing a 31,5 mm sieve but retained on a 0,063 mm sieve.

NOTE 1 The wire basket method may be used as an alternative to the pyknometer method for aggregates between 4 mm and 31,5 mm. In case of dispute, the pyknometer method described in clause 8 should be used as the reference method.

NOTE 2 The wire basket method can also be used for single aggregate particles retained on a 63 mm sieve.

A method for the determination of pre-dried particle density of dense aggregates is specified in annex A.

NOTE 3 As the absorption of dense aggregates is low, pre-dried particle density can be determined directly in water. This method is different to the determination of particle density on an oven dried basis.

A modified version of the wire-basket method suitable for determining the particle density and water absorption of coarse aggregates saturated to constant mass is specified in annex B.

For lightweight aggregates, a modified version of the pyknometer test specified in annex A is specified in annex C.

2 Normative references

This European Standard incorporates by dated or 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 (including amendments).

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

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply:

3.1

test portion

sample used as a whole in a single test.

3.2

particle density on an oven dried basis

ratio of the oven dried mass of a sample of aggregate to the volume it occupies in water including both internal sealed voids and water accessible voids.

3.3

apparent particle density

ratio of the oven dried mass of a sample of aggregate to the volume it occupies in water including any internal sealed voids but excluding water accessible voids.

3.4

particle density on a saturated and surface-dried basis

ratio of the combined mass of a sample of aggregate and the mass of water in the water accessible voids to the volume it occupies in water including both internal sealed voids and water accessible voids when present.

3.5

pre-dried particle density

$\frac{A_1}{V_1}$ ratio of the pre-dried mass of a sample of aggregate to the volume it occupies in water including any internal sealed voids but excluding water accessible voids $\frac{A_1}{V_1}$

NOTE The volume is determined as the volume of the particles inclusive of both internal sealed voids and water accessible voids.

3.6

water absorption

increase in mass of a sample of oven dried aggregate due to the penetration of water into the water accessible voids.

3.7

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 $(110 \pm 5) ^\circ\text{C}$. 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

Particle density is calculated from the ratio of mass to volume. The mass is determined by weighing the test portion in the saturated and surface dried condition and again in the oven-dried condition. Volume is determined from the mass of the water displaced, either by mass reduction in the wire-basket method or by weighings in the pycnometer method.

NOTE 1 Due to the influence on the absorption, no artificial heating of the test portion should be applied before testing. However, if such material is used, this fact should be stated in the report.

NOTE 2 For porous aggregates, the values of absorption and density depend on the size fractions which are tested. For this reason, the determined values are referenced to the size fractions actually tested.

If the aggregate consists of a number of different size fractions, it is necessary to separate the sample into fractions 0,063 mm to 4 mm, 4 mm to 31,5 mm and 31,5 mm to 63 mm, before preparing the test portion. The percentage of each fraction shall be stated in the test report.

5 Materials

Water, boiled and cooled before use.

NOTE Fresh tap water and demineralised water are both suitable. The water should be free from any impurity (for example dissolved air) that could significantly affect its density. Dissolved air can also be removed by applying a vacuum.

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 Ventilated oven, thermostatically controlled to maintain a temperature of $(110 \pm 5) ^\circ\text{C}$.

6.2.2 Balance, accurate to 0,1 % of the mass of the test portion

The capacity of the balance shall be suitable to allow the wire basket containing the sample to be suspended and weighed in water.

6.2.3 Water bath, thermostatically controlled, capable of being maintained at $(22 \pm 3) ^\circ\text{C}$

6.2.4 Thermometer, accurate to 0,1 $^\circ\text{C}$.

6.2.5 Test sieves, 0,063 mm, 4 mm, 31,5 mm and 63 mm, with apertures as specified in EN 933-2.

6.2.6 Trays, of suitable size which can be heated in a ventilated oven without change in mass.

6.2.7 Dry soft absorbent cloths

6.2.8 Washing equipment.

6.2.9 Timer.

6.3 Special apparatus for the wire-basket method (see clause 7, A.3, and B.2)

6.3.1 Wire basket, or perforated container of suitable size to allow suspension from the balance. The basket or container shall be resistant to corrosion.

6.3.2 Watertight tank, containing water at $(22 \pm 3) ^\circ\text{C}$ in which the basket may be freely suspended with a minimum clearance of 50 mm between the basket and the sides of the tank.

NOTE A watertight tank can be used instead of a water bath specified in **6.2.3**.

6.4 Special apparatus for pyknometer method for aggregate particles between 4 mm and 31,5 mm (see clause 8)

Pyknometer, consisting of a glass flask or other suitable vessel with volume between 1 000 ml and 5 000 ml, constant to 0,5 ml for the duration of the test.

NOTE The required volume of the pyknometer should be chosen to suit the size of the test portion. Two smaller pyknometers can be used instead of one large one, by summing the weighings before the calculation is carried out.

6.5 Special apparatus for pyknometer method for aggregate particles between 0,063 mm and 4 mm (See clause 9)

6.5.1 Pyknometer, consisting of a glass flask or other suitable vessel with volume between 500 ml and 5000 ml, constant to 0,5 ml for the duration of the test.

NOTE The required volume of the pyknometer is to be chosen to suit the size of the test portion.

6.5.2 Metal mould, in the form of a frustum of a cone (40 ± 3) mm at the top, (90 ± 3) mm at the bottom and (75 ± 3) mm high. The metal shall have a minimum thickness of 0,8 mm.

6.5.3 Metal tamper, of mass (340 ± 15) g and having a flat circular tamping face of diameter (25 ± 3) mm, for use with the metal mould.

6.5.4 Funnel, plain glass (alternative to use of the metal mould and tamper).

6.5.5 Shallow tray, of non-water absorbing material having a plane bottom of area not less than 0,1 m² and an edge of not less than 50 mm in height.

6.5.6 Warm air supply, such as a hair dryer.

6.6 Special apparatus for the pyknometer method for aggregate particles between 0,063 mm and 31,5 mm (see A.4)

Pyknometer, consisting of a glass flask with a volume between 250 ml and 2 000 ml, constant to 0,5 ml for the duration of the test, and a corresponding glass funnel.

NOTE 1 The volume of the pyknometer is to be chosen to suit the size of the test specimen.

NOTE 2 An example of a suitable pyknometer is shown in Figure 1.

6.7 Special apparatus for the determination of particle density and water absorption of coarse aggregates saturated to constant mass (see annex B)

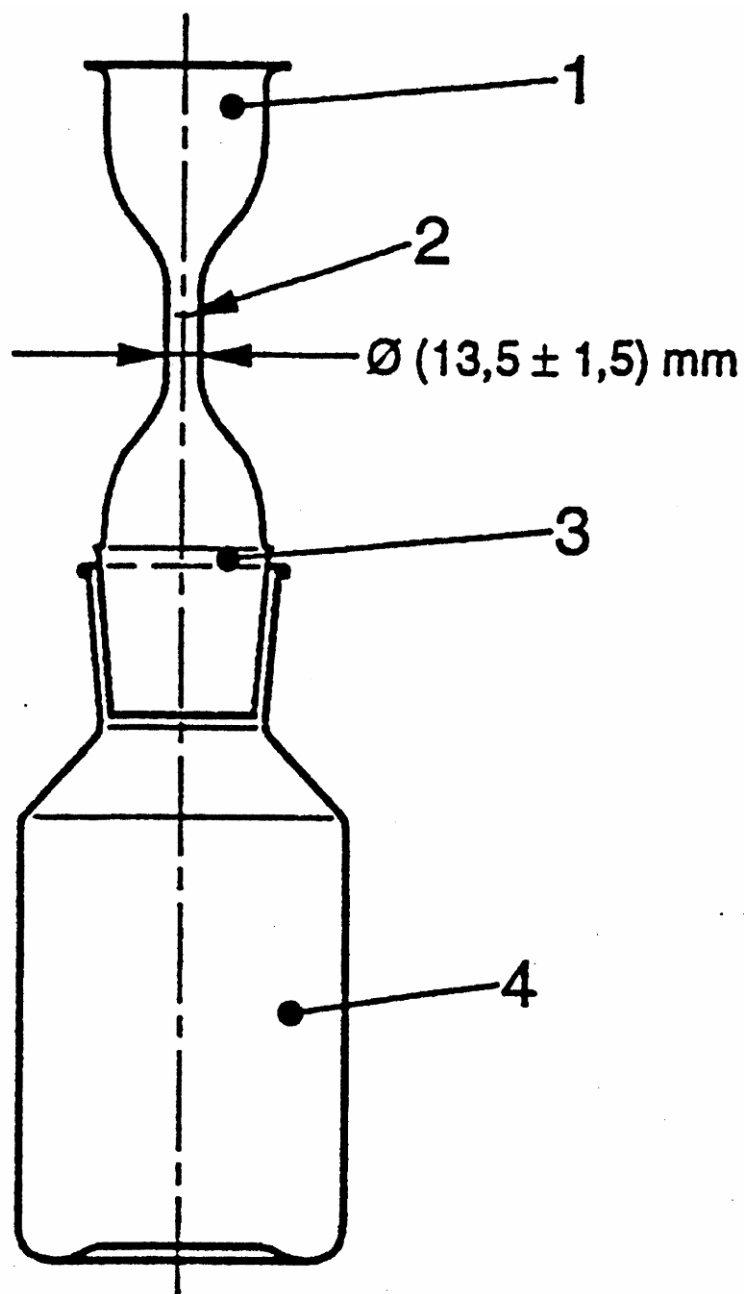
Container, of similar capacity to the wire basket specified in 6.3.1 for storage of the sample in water.

6.8 Special apparatus for the determination of particle density and water absorption of pre-dried lightweight aggregates (See annex C)

Pyknometer, consisting of a glass flask with a volume between 1 000 ml and 2 000 ml, constant to 0,5 ml for the duration of the test, and a corresponding glass funnel. If appropriate, the pyknometer shall contain a flexible grid to prevent aggregates floating,

NOTE 1 The volume of the pyknometer is to be chosen to suit the size of the test portion

NOTE 2 An example of a suitable pyknometer is given in Figure 1.



Key

- 1 Glass funnel
- 2 Mark
- 3 Ground section to fit the wide-neck flat bottom flask
- 4 Wide-neck flat bottom flask

Figure 1—Example of pyknometer