BRITISH STANDARD

BS EN
1097-4:1999

Tests for mechanical and physical properties of aggregates —

Part 4: Determination of the voids of dry compacted filler

The European Standard EN 1097-4:1999 has the status of a British Standard

ICS 91.100.15

National foreword

This British Standard is the English language version of EN 1097-4:1999. It is included in a package of European Standards declared by CEN/TC 154.

The UK participation in its preparation was entrusted by Technical Committee B/502, Aggregates, to Subcommittee B/502/6, Test methods, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 11 and a back cover.

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English version

Tests for mechanical and physical properties of aggregates – Part 4: Determination of the voids of dry compacted filler

Essais pour déterminer les caractéristiques mécaniques et physiques des granulats - Partie 4: Détermination de la porosité du filler sec compacté

Prüfverfahren für mechanische und physikalische Eigenschaften von Gesteinskörnungen - Teil 4: Bestimmung des Hohlraumgehaltes an trocken verdichtetem Füller

This European Standard was approved by CEN on 19 August 1999.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

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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of an identical text or by endorsement, at the latest by March 2000, and conflicting national standards shall be withdrawn at the latest by December 2003.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 standards for 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 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 5	Determination of the water content by drying in a ventilated oven
Part 6	Determination of particle density and water absorption
Part 7	Determination of the particle density of filler - Pyknometer method
Part 8	Determination of the polished stone value
Part 9	Method for the determination of the resistance to wear by abrasion from studded tyres: Nordic test
Part 10	Water suction height

1 Scope

This European Standard specifies the procedure for determining the voids of dry compacted filler by means of a Rigden apparatus. The test is applicable to natural and artificial fillers. It is used for example to determine their bitumen carrying capacity.

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.

EN 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 1097-7	Tests for mechanical and physical properties of aggregates - Part 7: Determination of the particle density of filler - Pyknometer method
EN 10025	Hot rolled products of non-alloy structural steels - Technical delivery conditions

3 Definitions

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

3.1 percentage air voids
volume of air filled space in the filler, expressed as a percentage of the total volume of the filler after compaction by a standard method

3.2 laboratory sample
reduced sample derived from a bulk sample for laboratory testing

3.3 test portio
sample used as a whole in a single test

3.4 test specimen
sample used in a single determination when a test method requires more than one determination of a property

3.5 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.

3.6 filler aggregate
aggregate, most of which passes a 0,063 mm sieve, which can be added to construction materials to provide certain properties

4 Principle

The filler is compacted in a standard way by using a compaction apparatus.

The volume of the compacted filler is determined using the height of the compacted filler bed. Using the known particle density of the compacted filler, the air void content of the compacted filler is calculated.

5 Apparatus

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

5.2 Ventilated drying oven, thermostatically controlled to maintain a temperature of (110 ± 5) °C.

5.3 Desiccator, filled with an appropriate amount of desiccant.

5.4 Spatula.

5.5 Compaction apparatus, made of hardened steel, conforming to EN 10025, consisting of the following elements.

NOTE: Examples of typical apparatus are shown in figures **1** and **2**.

5.5.1 Dropping block, comprising a hollow cylinder with a flat, closed bottom, with an inner diameter of (25,0 ± 1,0) mm and inner height of (65 ± 5) mm. The cylinder shall be fitted with a collar or pilot blocks to guide it along the pilot bars during the test.

5.5.2 Plunger, with a bore hole along its longitudinal axis of diameter (1,6 ± 0,1) mm over a length of 10 mm from the bottom and equal or wider above.

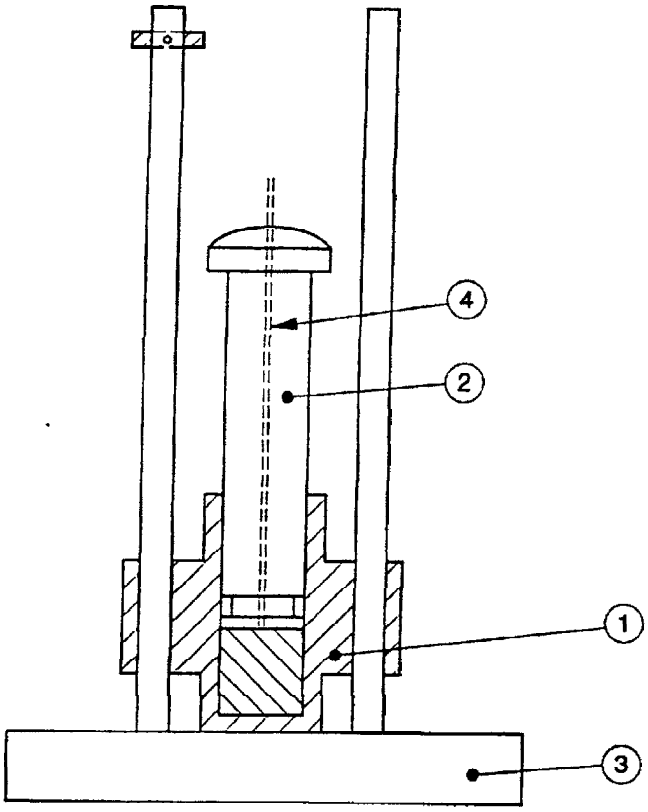
The difference in diameter between the plunger and the cylinder shall be (0,20 ± 0,05) mm.

The plunger shall be provided with a circumferential groove about 5 mm from its lower end to accommodate filler that works up the side of the cylinder while in use. This groove shall be 2 mm to 3 mm wide and 1 mm to 2 mm deep.

The mass of the plunger shall be (350 ± 1) g and the mass of the dropping block with plunger shall be (875 ± 25) g.

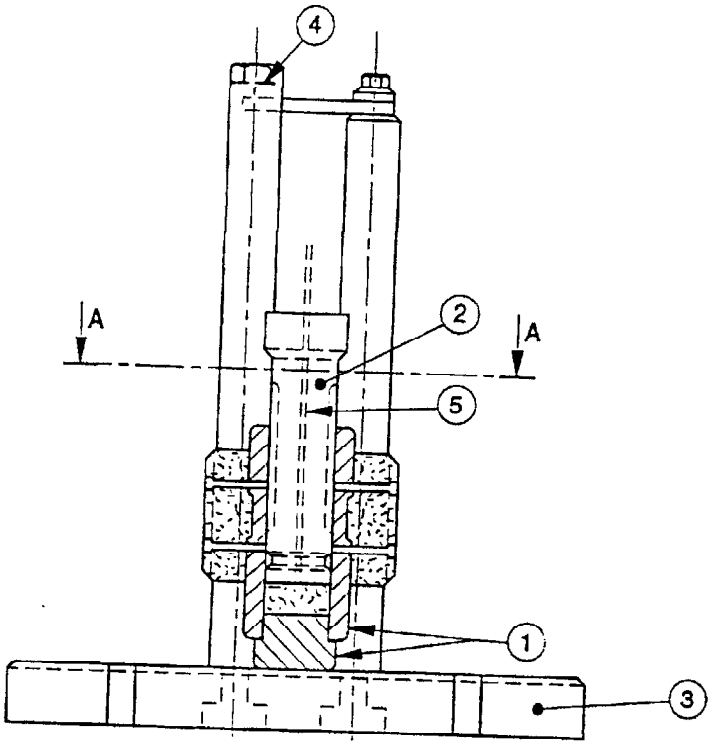
NOTE: For newly manufactured apparatus, the following dimensions should be used.

a) Dropping block	-	inner diameter of	(25,4 ± 0,1) mm;
	-	inner height of	(63,0 ± 0,1) mm;
b) Mass of dropping block with plunger			(875 ± 10) g.

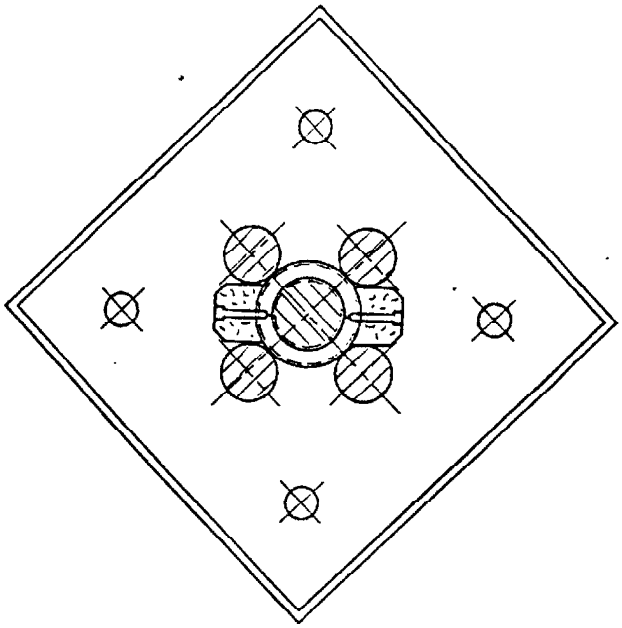


1. Dropping block
2. Plunger
3. Base plate
4. Tare boring

Figure 1: Typical compaction apparatus



1. Dropping block
2. Plunger
3. Base plate
4. Grooves for depth calliper
5. Tare boring



Cross-section A - A

Figure 2: Typical four bar compaction apparatus

5.5.3 Base plate (solid), rectangular with a minimum length of 150 mm, and minimum width of 100 mm, or circular with a minimum diameter of 140 mm, and a minimum height of 20 mm. Two (see figure 1) or four (see figure 2) upright pilot bars shall be mounted on the base plate to allow the dropping block and plunger to fall freely.

The maximum dropping height of (102,0 ± 1,0) mm shall be indicated by a stop on the pilot bars, preferably in combination with spacers to keep the pilot bars exactly parallel.

During compaction the apparatus shall be securely clamped or screwed onto a sturdy, non-flexible and even base (e.g., a concrete cube or pillar).

The apparatus shall be dry; the use of lubricants is not permitted.

5.6 Vernier depth calliper or dial gauge, for measuring the height of the compacted filler.

NOTE: The vernier depth calliper can be accommodated in grooves (i) in the upper ends of two pilot bars and a tare boring in the plunger. The dial gauge can be clamped on the crossarm of a stand, on which the dropping block with plunger (empty for zero value setting) is placed for height measurement.

The accuracy of the depth calliper or dial gauge shall be at least 0,01 mm.

5.7 Balance, accuracy 0,01 g.

5.8 Filter paper, (20 ± 5) g/m^2 in mass and (25,0 ± 1,0) mm in diameter.

5.9 Test sieve, 0,125 mm size and suitable receiver.

6 Preparation of test portion

Reduce the size of the laboratory sample in accordance with EN 932-2. The test portion before drying shall have a minimum mass of 150 g. Dry the test portion at (110 ± 5°) C to constant mass and leave it to cool down in the desiccator for at least 90 min.

Check the test portion for the presence of lumps and, if present, pulverise them carefully with a spatula. Mix the pulverised lumps.

Dry sieve the filler using the 0,125 mm sieve. Retain all of the particles which pass the sieve.

7 Procedure

Determine the particle density of the filler in accordance with EN 1097-7. Carry out the determination of voids using three separate test specimens.

Insert a filter paper and the plunger into the empty cylinder and set the zero height of the cylinder with filter paper and plunger with the depth gauge calliper or dial gauge. Weigh the dropping block without the plunger, but with one filter paper, to an accuracy of 0,01 g and record the mass (m_o). Remove the filter paper from the cylinder.

Place (10 ± 1) g of filler into the dropping block cylinder and spread evenly by gently tapping the dropping block on the table. Put the filter paper on the filler and carefully insert the plunger into the cylinder, taking care that the filler does not work up the side of the cylinder. Carefully press the plunger to compact the filler.

Position the dropping block with filler and plunger over or between the pilot bars on the base plate. Raise the dropping block to the upper stop (the touch shall be as light as possible) and let it fall freely to the base. Repeat the procedure 100 times at intervals of approximately 1 s.

NOTE: Automatic compaction is possible if it complies with the requirements specified above.

After 100 impacts, read the height (h) of the compacted filler to the nearest 0,01 mm, either by placing the depth calliper on the pilot bars or by taking the dropping block off the pilot bars and placing it under the dial gauge. Take the dropping block off the pilot bars (if not previously done) and carefully remove the plunger from the cylinder without disturbing the compacted bed of filler.

Weigh the cylinder with the filler and filter paper (m_1) with an accuracy of 0,01 g and determine the mass of the compacted filler $m_2 = (m_1 - m_0)$ g.

After each test, clean the apparatus thoroughly. Carry out the determination of m_2 and h in triplicate and use a new amount of filler for every determination.

8 Calculation and expression of results

Calculate the voids from the individual values of m_2 and h with an accuracy of 0,1 % in accordance with the following equation:

$$v = \left(1 - \frac{4 \times 10^3 \times m_2}{\pi \times \alpha^2 \times \rho_f \times h}\right) \times 100$$

where:

v is the voids, in percent;
m_2 is the mass of the compacted filler, in grams;
α is the inner diameter of the dropping block cylinder, in millimetres;
ρ_f is the particle density of the filler, in megagrams per cubic metre;
h is the height of the compressed filler, in millimetres.

Calculate the voids of the filler as the mean of the three determinations, and round off to 1 %.

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

9 Test report

9.1 Required data

The test report shall include the following information:

a) reference to this European Standard;
b) the voids of the filler;
c) the brand name or type/source of the filler;
d) the name and location of the sample source;
e) the date of the determination.

9.2 Optional data

The test report can include the following information:

a) a description of the sample;
b) a description of the sampling procedure;
c) the values of m_2, h and v of three individual determinations.

Annex A (informative)

Precision

Repeatability ***r*** and reproducibility ***R*** have been determined by a Dutch proficiency scheme, which started in 1978, as follows:

Repeatability (*r*): 4,5 %

Reproducibility (*R*): 5 %

Annex B (informative)

Bibliography

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