

Tests for mechanical and physical properties of aggregates —

Part 5: Determination of the water content by drying in a ventilated oven

The European Standard EN 1097-5:1999 has the status of a
British Standard

ICS 91.100.15

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English version

Test for mechanical and physical properties of aggregates — Part 5: Determination of the water content by drying in a ventilated oven

Essais pour déterminer les caractéristiques
mécaniques et physiques des granulats —
Partie 5: Détermination de la teneur en eau par
séchage en étuve ventilée

Prüfverfahren für mechanische und physikalische
Eigenschaften von Gesteinskörnungen —
Teil 5: Bestimmung des Wassergehaltes durch
Ofentrocknung

This European Standard was approved by CEN on 11 June 1999.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
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of an identical text or by endorsement, at the latest by January 2000, and conflicting national standards shall be withdrawn at the latest by December 2003.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 Standard forms part of a series of tests for mechanical and physical properties of aggregates. Test methods for other properties of aggregates are 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 6, *Determination of particle density and water absorption.*

Part 7, *Determination of the particle density of filler — Pycnometer 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.*

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1 Scope

This European Standard specifies a procedure for determining the water content of aggregates by drying in a ventilated oven.

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*

3 Terms and definitions

For the purposes of this standard the following terms and definitions apply.

3.1

aggregate size

designation of aggregate in terms of lower (*d*) and upper (*D*) sieve sizes. 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

test portion

sample used as a whole in a single test

3.3

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

The oven-drying method provides a measure of the total free water present in a test portion of aggregate. The water can be from the surface of the aggregate and from water accessible pores within the aggregate particles.

A test portion is weighed and then placed in a ventilated drying oven at a temperature of $(110 \pm 5)^\circ\text{C}$. Successive weighings are used to determine the constant mass of the dried test portion. At all stages of handling and preparation before the start of the test, the laboratory sample and subsequent test portion are protected from loss or gain of water.

The water content is determined as the difference in mass between the wet and the dry mass and is expressed as a percentage of the dry mass of the test portion.

A variation on the method for use with lightweight aggregates is specified in annex A.

5 Apparatus

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

5.2 Container, large enough to store the test portion before testing. The container shall be non-corrodible and closed so as to prevent the loss of water.

NOTE 1 The following may be suitable:

- a) watch glasses with clips;
- b) petri dishes or tins with lids;
- c) plastic sacks or bags with suitable closures.

NOTE 2 Long term storage of the test portion in a plastic sack or bag should be avoided.

5.3 Heat resistant stirrer, such as a knife or spatula.

5.4 Balance, of suitable capacity, with an accuracy of 0,02 % of the mass of the test portion.

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

NOTE The air movements within the oven induced by a ventilation system should not cause the loss of fine particles.

5.6 Desiccator with desiccant. As an alternative to the desiccator a closed cabinet containing desiccant may be used for the cooling stage.

NOTE Silica gel with colour indicator and calcium chloride are suitable desiccants.

5.7 Tray(s), heat resistant and of sufficient size and number to suit the test portion.

NOTE For small test portions, tins and watch glasses can be suitable.

6 Preparation of test portion

The laboratory sample shall be reduced as specified in EN 932-2 to produce a test portion.

Calculate the minimum mass of the test portion from the value of the upper (*D*) sieve size, in millimetres (see 3.1) as follows:

- if $D \geq 1,0$ mm, the minimum mass (in kilograms) shall be $0,2 D$;
- if $D < 1,0$ mm, the minimum mass shall be 0,2 kg.

Immediately after preparing the test portion, place it in a clean and dry container (see 5.1.1) unless the determination is carried out straight away.

7 Procedure

Clean and dry sufficient tray(s) to contain the test portion during drying. Weigh and record the mass of the tray(s) (M_2).

Spread the test portion out on the tray(s).

NOTE 1 For efficient drying, the layer thickness (in millimetres) should not be more than twice the upper (D) sieve size. Aggregates of 1 mm or less should have a layer thickness of not more than 2 mm. If an aggregate contains a high proportion of fines, the thickness can be reduced further as necessary.

Weigh the tray(s) containing the moist test portion and determine the mass of the test portion (M_1) by subtracting the mass of the trays (M_2).

Place the tray(s) in the oven at $(110 \pm 5)^\circ\text{C}$ until constant mass has been achieved.

To establish whether constant mass (M_3) has been achieved, proceed as follows with each tray:

Cool the tray to room temperature in a desiccator, and determine the mass of the test portion (M_{di}) by subtracting the mass of the tray (M_2).

Return the tray with the test portion to the oven for at least 1 h, cool to room temperature and repeat the determination of the mass of the test portion (M_{di}).

If M_{di} is less than 0,1 % different from M_{d1} , constant mass is assumed achieved. If the difference is 0,1 % or more, return the tray with the test portion to the oven and repeat this procedure until the difference between two successive determinations is less than 0,1 %. If more than one tray is used, M_3 is the sum of the values of M_{di} .

NOTE 2 For fine aggregates, it is permissible to aid the evaporation of water during heating by occasionally stirring. Keep the stirrer in the tray(s) until the test portion is dry to avoid the loss of solid material.

Once constant mass has been achieved, report the final value of M_{di} as M_3 .

8 Calculation and expression of results

The value of the water content (w) is the mass of water in the test portion expressed as a percentage of the mass of the dry test portion.

Calculate the water content w in accordance with the following equation:

$$w = \frac{M_1 - M_3}{M_3} \times 100$$

where:

M_1 is the mass of the test portion, in grams;

M_3 is the constant mass of the dried test portion, in grams.

Express the result to the nearest 0,1 %.

NOTE 1 A typical example of the calculation of water content is given in annex B.

NOTE 2 A statement on the precision of the test is given in annex C.

9 Test report

9.1 Required data

The test report shall include the following information:

- reference to this European Standard;
- identification of the sample;
- identification of the laboratory;
- the type and nominal size of the aggregate;
- result of the water content of test portion w .

9.2 Optional data

The test report can include the following information:

- name and location of the sample source;
- each weighing data;
- description of the sampling procedure;
- mass of the dried test portion;
- date of the test.

Annex A (normative)

Variations to the determination of the water content by drying in a ventilated oven for use with lightweight aggregates

A.1 Introduction

The determination of the water content of lightweight aggregates shall be carried out using the apparatus and procedures in accordance with this European Standard with the variations specified in this annex.

A.2 Oven temperature

The temperature of the oven and drying time shall be chosen so as not to cause a change of mass other than by loss of free water. If a temperature other than $(110 \pm 5)^\circ\text{C}$ is used or restricted drying time is used, the details shall be stated in the test report.

NOTE The appropriate oven temperature and drying time can be defined by the aggregate producer.

A.3 Preparation of test portion

For lightweight aggregates, the size of the test portion is defined using volume (litres) instead of mass, as follows:

- for $D > 8$ mm the minimum test portion volume shall be 2,0 l;
- for $D \leq 8$ mm the minimum test portion volume shall be 1,0 l.

A.4 Cooling

Instead of cooling the dried test portion to room temperature, weigh each tray and its contents immediately after removing it from the oven.

NOTE It can be necessary to protect the balance from the heat of the tray. A cork mat can be suitable.

Annex B (informative)

Example of calculation of the water content by drying in a ventilated oven

Determination of the water content by drying in a ventilated oven (using one tray)

1	Container	M_2	653,34 g
2	Mass of tray + moist test portion	$M_1 + M_2$	3574,4 g
3	Mass of tray + dry test portion	$M_{d1} + M_2$	3389,7 g
4	Second weighing of tray and dry test portion	$M_{di} + M_2$	3388,6 g
5	Difference of weighing data	(line 3 – line 4)	1,1 g
6	$\frac{(\text{line 3} - \text{line 4})}{(\text{line 3} - \text{line 1})} \times 100$		0,04 % (see note)
7	Mass of water (line 2 – line 4)	$(M_1 + M_2) - (M_3 + M_2)$	185,8 g
8	Mass of dry test portion (line 4 – line 1)	M_3	2735,2 g
9	Water content $\frac{(\text{line 7})}{(\text{line 8})} \times 100$	(mass %)	6,8 %

NOTE In line 6, 0,04 % is less than 0,1 %. Additional weighing is not required and M_{di} becomes M_3 because constant mass has been achieved.

Annex C (informative)

Precision

A precision exercise was carried out in 1988 in the United Kingdom involving 13 laboratories. The results of the exercise obtained by applying the oven dried method once to a single test portion were:

Repeatability $r_1 = 0,11 + 0,079 X$

where X is the mean value of the water content.

Definitions of r_1 and X are given in prEN 932-6.

Annex D (informative)

Bibliography

- prEN 932-6, *Tests for general properties of aggregates — Part 6: Definitions of repeatability and reproducibility.*
- ISO 6783:1982, *Coarse aggregates for concrete — Determination of particle density and water absorption — Hydrostatic balance method.*
- BS 812-109:1990, *Testing aggregates — Part 109: Methods for determination of moisture content.*

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