



# SLOVENSKI STANDARD

## SIST EN 1367-4:2008

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Tests for thermal and weathering properties of aggregates - Part 4: Determination of drying shrinkage

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Prüfverfahren für thermische Eigenschaften und Verwitterungsbeständigkeit von Gesteinskörnungen - Teil 4: Bestimmung der Trockenschwindung

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Essais pour déterminer les propriétés thermiques et l'altérabilité des granulats - Partie 4: Détermination du retrait au séchage

**Ta slovenski standard je istoveten z: EN 1367-4:2008**

### ICS:

91.100.15	Mineralni materiali in izdelki	Mineral materials and products
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**SIST EN 1367-4:2008**

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**Tests for thermal and weathering properties of aggregates - Part  
4: Determination of drying shrinkage**

Essais pour déterminer les propriétés thermiques et  
l'altérabilité des granulats - Partie 4: Détermination du  
retrait au séchage

Prüfverfahren für thermische Eigenschaften und  
Verwitterungsbeständigkeit von Gesteinskörnungen - Teil 4:  
Bestimmung der Trockenschwindung

This European Standard was approved by CEN on 4 February 2008.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

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 CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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## Foreword

This document (EN 1367-4:2008) 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 September 2008, and conflicting national standards shall be withdrawn at the latest by September 2008.

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

This document supersedes EN 1367-4:1998.

Testing in accordance with this standard is intended to provide information to assist in judging the performance of aggregates subject to weathering action. This standard is intended to identify aggregates with high moisture sensitivity which in concrete may cause excessive cracking, deflection and loss of durability. This test may not be suitable for lightweight aggregates.

This European Standard is one of a series of tests for thermal and weathering properties of aggregates as listed below.

EN 1367-1, Tests for thermal and weathering properties of aggregates - Part 1: Determination of resistance to freezing and thawing

EN 1367-2, Tests for thermal and weathering properties of aggregates - Part 2: Magnesium sulfate test

EN 1367-3, Tests for thermal and weathering properties of aggregates - Part 3: Boiling test for "Sonnenbrand basalt"

EN 1367-5, Tests for thermal and weathering properties of aggregates - Part 5: Determination of resistance to thermal shock

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 1097, Tests for mechanical and physical properties of aggregates

EN 1744, Tests for chemical properties of aggregates

EN 13179, Tests for filler aggregate used in bituminous mixtures

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

## EN 1367-4:2008 (E)

## 1 Scope

This standard describes the reference method used for type testing and in cases of dispute, for determining the effect of aggregates on the drying shrinkage of concrete. For other purposes, in particular factory production control, other methods may be used provided an appropriate working relationship with the reference method has been established.

This standard is based on the testing of concretes of fixed mix proportions and aggregates of 20 mm maximum size.

NOTE 1 Guidance on the use of larger size is given in Annex A. Precision data is not available for variations in size and for variations in the water content of the test concrete.

NOTE 2 In those cases where the drying shrinkage of a source of coarse aggregate only or a source of fine aggregate (sand) only are required, the other component to be used should be, respectively, a fine or coarse aggregate of known low shrinkage.

NOTE 3 Aggregates with high water demand and/or porosity may in a concrete with a fixed water content result in a mix with insufficient workability to allow full compaction of the test specimens. This is likely to occur with aggregates combinations having a composite water absorption value greater than 3,5% or oven-dried particle densities less than 2,45 Mg/m<sup>3</sup> (e.g. for recycled aggregates). In such instances a variation of the method (without precision data) may be carried out by one of the following changes to the concrete mix:

(a) use of aggregates in the saturated and surface dry condition.

(b) use of water-reducing admixture.

A note on the details of any modification to the mix design should be included with the test report.

## 2 Normative references

The following referenced documents are indispensable for the application 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 197-1 *Cement - Part 1: Composition, specifications and conformity criteria for common cements*

EN 932-1, *Tests for general properties of aggregates - Part 1: Methods for sampling*

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*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 3.1

#### **laboratory sample**

sample intended for laboratory testing

NOTE The laboratory sample is generally the penultimate stage in a multi-stage sampling procedure.

**3.2****subsample**

sample obtained from sampling increments or a bulk sample by means of a sample reduction procedure

**3.3****test portion**

sample used as a whole in a single test

**4 Principle**

The aggregate under test is mixed with cement and water and cast into prisms of specified dimensions. The prisms are subjected to wetting followed by drying at  $(110 \pm 5) ^\circ\text{C}$  and the change in length from the wet to the dry state is determined. The excess drying shrinkage of the concrete is attributed to the aggregate, and is expressed as the average change in length of the prisms, as a percentage of their final dry lengths.

**5 Sampling**

The laboratory sample to be used for the test shall be taken in accordance with EN 932-1.

**6 Apparatus**

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

**6.1** Sample divider, of size appropriate to the maximum particle size to be handled or, alternatively, a flat shovel and a clean, hard horizontal surface, e.g. a metal tray for use in quartering.

**6.2** Test sieves, conforming to EN 933-2, appropriate to the sizes of aggregate to be tested.

**6.3** Balance, of minimum capacity 5 kg and minimum accuracy of 0,1 %.

**6.4** Single or gang moulds, suitable for casting three concrete prisms of dimensions  $(200 \pm 2)$  mm x  $(50 \pm 2)$  mm x  $(50 \pm 2)$  mm with 8 mm diameter stainless steel balls or hemispherical buttons or recessed inserts, securely fixed to the centre of the inside faces of the 50 mm x 50 mm ends of the mould.

**6.5** Vibrating table, capable of fully compacting the concrete in the moulds.

**6.6** Measuring apparatus, incorporating a dial gauge with scale divisions of 0,002 mm and having a maximum error of  $\pm 0,002$  mm in any half revolution. This gauge shall be rigidly mounted in a measuring frame and shall have a recessed end which can be located on 8 mm diameter stainless steel balls or hemispherical buttons or inserts cemented in the prisms (see 9.3). The other end of the frame shall have a similar recessed seating, which can be located upon balls in the opposite end of the prisms.

A reference alloy steel rod of low thermal expansion,  $(205 \pm 1)$  mm long, with 6 mm hemispherical ends shall be used as a standard of length against which the readings of the gauge can be tested, thus enabling corrections to be made for any changes in the dimensions of the apparatus between successive measurements of the prisms. The reference rod shall be marked so that the same end can be kept uppermost during measurements.

**NOTE** Alternative measuring devices can be used in place of the dial gauge, e.g. linear variable differential transducers, provided they are of at least equal performance and fitted with seatings compatible with the stainless steel balls or inserts as appropriate.

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**6.7** Ventilated oven, thermostatically controlled and capable of maintaining temperatures of  $(50 \pm 2) ^\circ\text{C}$  and  $(110 \pm 5) ^\circ\text{C}$ .

NOTE Different ovens for each temperature range can be used.

**6.8** Thermometer, capable of measuring the oven temperatures of  $50 ^\circ\text{C}$  and  $110 ^\circ\text{C}$  to a precision of  $0,5 ^\circ\text{C}$ .

**6.9** Desiccators, large enough to contain three concrete prisms  $200 \text{ mm} \times 50 \text{ mm} \times 50 \text{ mm}$  containing anhydrous silica gel as the desiccant.

**6.10** Trays, that are capable of being heated in the ventilated oven without damage or change in mass.

**6.11** Timing device, such that the full range of timed periods can be measured to an accuracy of  $\pm 1 \text{ min}$ .

**6.12** Mechanical mixer, capable of mixing all constituents thoroughly within the specified time limits.

NOTE Alternatively hand mixing can be used.

**6.13** Flat impervious cover sheet, of suitable size, of rubber, polythene or steel.

**7 Materials**

**7.1** Cement, conforming to type CEM 1 Class 42,5 of EN 197-1.

**7.2** Water, distilled or de-ionised.

**7.3** 8 mm diameter stainless steel balls or hemispherical buttons or inserts (see 6.4).

**8 Preparation of test subsamples**

**8.1** Reduce the laboratory samples of the coarse and fine aggregate (sand) by the procedure specified in EN 932-2 to produce subsamples that can be sieved after oven drying to give approximately 1 600 g of 10 mm to 20 mm size fraction, 800 g of 4 mm to 10 mm size fraction and 1 300 g of 0 mm to 4 mm fine aggregate (sand).

**8.2** Spread the subsamples on shallow trays and dry for at least 16 h in the oven (see 6.7) set at  $(50 \pm 2) ^\circ\text{C}$ .

**8.3** Reject all oversize material from the fine aggregate (sand) and all oversize and undersize material from each of the two coarse aggregate subsamples.



## 9 Preparation of test prisms

### 9.1 Proportioning

Cast three test prisms, using the amount of cement, aggregates and water required to make the three prisms as specified in Table 1.

**Table 1 - Masses of constituents in test prisms**

Constituent	Mass g
Cement	$550 \pm 5$
Coarse aggregate (20 mm to 4 mm) and fine aggregate (sand)	$3\,300 \pm 5$
Water	$300 \pm 5$

The coarse aggregate and fine aggregate (sand) shall comply with the limits specified in Table 2 and the grading curves shown in Figure 1.

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