



BSI Standards Publication

# Tests for thermal and weathering properties of aggregates

Part 7: Determination of resistance to freezing and thawing of Lightweight aggregates

**National foreword**

This British Standard is the UK implementation of EN 1367-7:2014.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

## Tests for thermal and weathering properties of aggregates - Part 7: Determination of resistance to freezing and thawing of Lightweight aggregates

Essais pour déterminer les propriétés thermiques et  
l'altérabilité des granulats - Partie 7: Détermination de la  
résistance au gel-dégel des granulats légers

Prüfverfahren für thermische Eigenschaften und  
Verwitterungsbeständigkeit von Gesteinskörnungen - Teil 7:  
Bestimmung des Widerstandes von leichten  
Gesteinskörnungen gegen Frost-Tau-Wechsel

This European Standard was approved by CEN on 16 February 2014.

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## Foreword

This document (EN 1367-7:2014) 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of an identical text or by endorsement, at the latest by October 2014, and conflicting national standards shall be withdrawn at the latest by October 2014.

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.

EN 1367 "Tests for thermal and weathering properties of aggregates" consists of the following parts:

- *Part 1: Determination of resistance to freezing and thawing*
- *Part 2: Magnesium sulfate test*
- *Part 3: Boiling test for "Sonnenbrand Basalt"*
- *Part 4: Determination of drying shrinkage*
- *Part 5: Determination of resistance to thermal shock*
- *Part 6: Determination of resistance to freezing and thawing in the presence of salt (NaCl)*
- *Part 7: Determination of resistance to freezing and thawing of Lightweight Aggregates (the present document)*
- *Part 8: Determination of resistance to disintegration of Lightweight 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 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*

NOTE This document supersedes the test methods described in EN 13055-1:2002, Annex C and EN 13055-2:2004, Annex B.

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

## 1 Scope

This European Standard specifies the reference test method used for type testing, and in case of dispute, for determining the resistance to freezing and thawing of lightweight aggregates (LWA) in accordance with EN 13055. For other purposes, in particular for factory production control, other methods may be used provided that an appropriate working relationship with the reference method has been established. The test is applicable to LWA with particle size not less than 4 mm and up to a maximum size of 32 mm.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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*

EN 13055-1, *Lightweight aggregates - Part 1: Lightweight aggregates for concrete, mortar and grout*

EN 13055-2, *Lightweight aggregates - Part 2: Lightweight aggregates for bituminous mixtures and surface treatments and for unbound and bound applications*

## 3 Terms and definitions

For the purpose of this document, the terms and definitions given in EN 13055-1, EN 13055-2 and the following apply.

**3.1**  
**test specimen**  
sample used as in single determination when a test method requires more than one determination of a property

**3.2**  
**constant mass**  
mass determined by successive weighings performed 1 h apart and not differing by more than 0,1 %

Note 1 to entry: 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  $(110 \pm 5)$  °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

Three test specimens of lightweight aggregates, having been soaked in water at atmospheric pressure, are subjected to 20 freeze–thaw cycles. This involves cooling down to  $-17,5$  °C in air and then thawing in a water bath at about 20 °C. After completion of the freeze–thaw cycles, the loss of mass of the lightweight aggregates is recorded.

## 5 Apparatus and materials

- 5.1 All apparatus, unless otherwise stated, shall conform to the general requirements of EN 932-5.
- 5.2 Ventilated drying oven, with forced circulation of adequate capacity. The oven shall be capable of being maintained at  $(110 \pm 5) ^\circ\text{C}$ .
- 5.3 Balance, capable of weighing test specimens up to 400 g with an accuracy of  $\pm 0,04$  g and test specimens above 400 g with an accuracy of 0,1 g.
- 5.4 Low temperature cabinet, (upright or chest) with air circulation. The cabinet shall be capable of being maintained at  $(-17,5 \pm 2,5) ^\circ\text{C}$ .
- 5.5 Test sieves, conforming to EN 933-2 shall be used.
- 5.6 Water, distilled or deionised.
- 5.7 Container, made from corrosion resistant material with a base area of approximate  $0,02 \text{ m}^2$  and a height not less than 0,1 m.
- 5.8 Grid, of a suitable size and aperture to prevent the lightweight aggregates floating out of the container and to prevent any loss of whole aggregates.
- 5.9 Water bath, thermostatically controlled to maintain a temperature of  $(20 \pm 3) ^\circ\text{C}$ .

## 6 Sampling

Sampling and sample reduction shall be carried out in accordance with EN 932-1 and EN 932-2.

## 7 Test specimens

### 7.1 General

Three individual test specimens shall be used. The test specimens shall be obtained in accordance with EN 932-2 by sample reduction. Particles of oversize ( $>D$ ) and undersize ( $<d$ ) shall be removed.

### 7.2 Size of test specimens

The quantities for each of the three individual test specimens shall be chosen according to the upper size of the aggregates as shown in Table 1. Deviations of  $\pm 5 \%$  in the volume of test specimens are permissible.

**Table 1 — Test specimen volumes required**

Maximum aggregate size (mm)	Approximate volume of the test specimen (l)
8	0,5
16	1,0
32	1,5

### 7.3 Preparation of test specimens

Wash the test specimens on the lower (*d*) test sieve. Dry the test specimens to constant mass. Allow to cool to ambient temperature and weigh immediately ( $M_1$ , see Clause 9).

Weighing shall be carried out to the following accuracies:

- Test specimens up to 400 g: to  $\pm 0,04$  g.
- Test specimens above 400 g: to  $\pm 0,1$  g.

## 8 Procedure

### 8.1 Soaking

Store the test specimens at atmospheric pressure for  $(240 \pm 15)$  min in the containers specified in 5.7 at  $(20 \pm 3)$  °C in distilled or deionised water, ensuring that the water covers the test specimens by at least 10 mm. In order to prevent the test specimens floating, the specimens are kept submerged by a grid as specified in 5.8.

### 8.2 Freezing in air and thawing in water

Remove the test specimens from the containers and allow them to drain on a sieve with a maximum size of 2 mm for about 1 min. Then place them back into the containers spreading them out evenly.

Place the containers in the low temperature cabinet, ensuring that the heat is extracted as uniformly as possible from all sides of all test specimens. The distance between each container, and between the containers and the sidewalls of the cabinet, shall not be less than 50 mm. After placing the containers in the cabinet, hold the air temperature in the cabinet at  $(-17,5 \pm 2,5)$  °C.

The containers with the test specimens shall remain in the cabinet for minimum of 240 min.

After completion of the freezing cycle, remove the containers from the cabinet, add water to the containers with the test specimens and store for at least 60 min in a water bath at a temperature of  $(20 \pm 3)$  °C. In order to prevent the test specimens floating, the specimens are kept submerged by a grid as specified in 5.8.

Pour off the water from the containers carefully and allow the test specimens to drain for about 1 min. Then start the next freezing cycle. In total 20 freeze–thaw cycles shall be performed.

If it is necessary to interrupt the test, the test specimens should remain in the cabinet at  $(-17,5 \pm 2,5)$  °C.

On completion of the 20th freezing and thawing cycle, pour the contents of each container into a sieve having an aperture size that is half the lower size sieve used to prepare the test specimen (e.g. in case of the 8 mm to 16 mm fraction, pour into a test sieve of 4 mm aperture size). Wash and sieve the test specimen on the specified sieve by hand. Dry the residue remaining on the sieve at  $(110 \pm 5)$  °C to constant mass, cool at ambient temperature and weigh immediately ( $M_2$ , see Clause 9).

## 9 Calculation and expression of results

Calculate the loss in mass ( $FL_i$ ) of each test specimen in accordance with the following formula:

$$FL_i = [(M_1 - M_2)/M_1] \times 100$$

where



$FL_i$  is the percentage loss in mass of the test specimen;

$M_1$  is the initial dry mass of the test specimen before freeze–thaw cycling, in grams;

$M_2$  is the final dry mass of the test specimen after freeze–thaw cycling, that is retained on the specified sieve, in grams.  
Express  $FL_i$  to the nearest 0,01 %.

Calculate  $FL$  as the mean of the three individual test results to the nearest 0,1 %.

## 10 Test report

### 10.1 Mandatory data

The test report shall include the following information:

- reference to this European Standard;
- identification of the test sample, including identification of the source, aggregate size and date of sampling;
- sample reception date if different from sampling date;
- identification of the laboratory;
- percentage of mass loss after freezing and thawing  $FL$ , expressed to the nearest 0,1 %;
- deviations from the reference method, if any.

### 10.2 Optional data

The test report can include the following information:

- date of test;
- reference to the chosen sampling procedure;
- reference to the chosen sample reduction procedure;
- percentage of the mass loss after freezing and thawing of the individual test specimens  $FL_i$ , expressed to the nearest 0,01 %.

## Bibliography

- [1] EN 1097-5, *Tests for mechanical and physical properties of aggregates - Part 5: Determination of the water content by drying in a ventilated oven*



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