SLOVENSKI STANDARD
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Preskusi lastnosti agregatov zaradi termiļnih in vremenskih vplivov - 6. del: Odpornost proti zmrzovanju in tajanju ob prisotnosti soli (NaCl)

Tests for thermal and weathering properties of aggregates - Part 6: Determination of resistance to freezing and thawing in the presence of salt (NaCl)

Prüfverfahren für thermische Eigenschaften und Verwitterungsbeständigkeit von Gesteinskörnungen - Teil 6: Beständigkeit gegen Frost-Tau-Wechsel in der Gegenwart von Salz (NaCl)

Essais pour déterminer les propriétés thermiques et l'altérabilité des granulats - Partie 6: Résistance au gel-dégel au contact du sel

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 1367-6:2008) 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of an identical text or by endorsement, at the latest by January 2009, and conflicting national standards shall be withdrawn at the latest by January 2009.

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 European Standard is one Part in the EN 1367 series of European Standards under the general title *Tests for thermal and weathering properties of aggregates*. The other parts are:

Part 1: Determination of resistance to freezing and thawing
Part 2: Magnesium sulphate test
Part 3: Boiling test for “Sonnenbrand basalt"
Part 4: Determination of drying shrinkage
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.

1 Scope

This European Standard specifies a method of assessing the frost resistance of an aggregate when it is subjected to the cyclic action of freezing and thawing in the presence of 1 % solution of NaCl in de-ionized or distilled water.

The results of this test provide a means for assessing an aggregate's resistance to this form of weathering in areas where frequent freeze-thaw cycling occurs with seawater sprays or abundant de-icers conditions, and where result values of EN 1367-1 test method do not describe correctly aggregate performance in extreme conditions.

This European Standard gives the option to control the thawing sequence either by immersion in water or by using air circulation in the low temperature cabinet to obtain the required reference temperature.

This test method is applicable to coarse aggregates or to coarse aggregates' fractions of all-in materials. This method is not appropriate for lightweight aggregates covered by EN 13055 or aggregates which can not be submitted to 110 °C oven drying.

2 Normative references

The following referenced documents are indispensable for the application of this document. 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 933-1, *Tests for geometrical properties of aggregates — Part 1: Determination of particle size distribution — Sieving method*

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 purpose of this document, the following terms and definitions apply.

3.1
constant mass
successive weighings of the test specimen, after drying it, of at least 1 h apart, not differing by more than 0,1 %

NOTE In many cases constant mass can be achieved after a test specimen has been dried for a pre-determined period in a ventilated drying oven at (110 ± 5) °C.

3.2
reference temperature
temperature of the test specimen measured at the reference temperature measuring point

3.3
reference temperature measuring point
temperature at the centre of the covered can, filled with a test specimen and 1 % NaCl solution and situated in the centre of the cooled area of the low temperature cabinet

4 Principle

The frost resistance of the aggregate is determined by subjecting it to the cyclic action of freezing and thawing in the presence of salt (NaCl). The aggregate is soaked at atmospheric pressure and stored in 1 % NaCl solution for thorough absorption of the solution (see 8.1) and exposed to freezing under 1 % NaCl solution (see 8.2).

Three test specimens of a single sized aggregate, having been soaked in 1 % NaCl solution at atmospheric pressure, are subjected to 10 freeze-thaw cycles. This involves cooling to -17,5 ºC under the 1 % NaCl solution and then thawing to 20 ºC. After completion of the freeze-thaw cycles, the freeze-thaw resistance of the aggregate, as measured by the proportion of aggregate passing through the d/2 sieve as sieved from the test specimen, is considered separately for each test specimen and then expressed as a mean percentage by mass.

5 Apparatus

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

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

5.3 **Balance**, readable to ± 0,1 g, of sufficient capacity.

5.4 **Low temperature cabinet**, (upright or chest) with air circulation. The cabinet shall be automatically controlled to adhere to the temperature curve shown in Figure 1. The test specimen temperature in the thawing phase may be controlled by either air circulation or immersion in water. Any manual method of control may be used, provided the correct temperature curve for the reference temperature measuring point, as shown in Figure 1, is adhered to.

5.5 **Cans**, made from corrosion-resistant sheet metal, with a thickness of about 0,6 mm, having a nominal capacity of 2 000 ml, an internal diameter of 120 mm to 140 mm, and an internal height of 170 mm to 220 mm. Cans shall be covered with lids.

5.6 **Test sieves**, conforming to EN 933-2.

5.7 **1 % NaCl solution**, made by mixing 20,0 g of NaCl of analytical grade in 1 980 g of de-ionized or distilled water and making up to 2 000 g of the solution.

6 Sampling

Sampling shall be carried out in accordance with EN 932-1.

7 Test specimens

7.1 General

The preferred size fraction of the test specimen shall be within the range 8 mm (d) to 16 mm (D). If the product size is smaller than 8 mm, a size fraction of 4 mm to 8 mm may be used.

Three individual test specimens shall be used. The test specimens shall be obtained in accordance with EN 932-2 by sample reduction. Particles retained on “D” sieve or passing “d” sieve shall be removed.

7.2 Mass of test specimens

The quantities for each of the three individual test specimens are specified in Table 1. Deviations of ± 5 % are permissible.

Table 1 — Mass of test specimens

Size fraction (d to D) (mm)	Mass of test specimen (g)
8 to 16	2 000
4 to 8	1 000

7.3 Preparation of test specimens

The test specimens shall be washed according to EN 933-1 on the 8 mm sieve (or 4 mm sieve if the smaller size fraction is used). They shall be dried to constant mass at (110 ± 5) °C, according to EN 933-1 and allowed to cool to room temperature and weighed immediately (M_1) to the nearest 0,1 g.

8 Procedure

8.1 Soaking

Store the test specimens prepared in accordance with 7.3 for (24 ± 1) h in the cans at (20 ± 3) °C. Add the 1 % NaCl solution, and cover the test specimen by at least 10 mm for the full 24 h period of soaking.

8.2 Exposure to freezing under 1 % NaCl solution

Check that the 1 % NaCl solution level in each can is still at least 10 mm above the top of the test specimen and place the lids on the cans. Place the covered cans containing the test specimens in the low temperature cabinet, ensuring that the distance between the cans and the sidewalls of the cabinet is not less than 50 mm and the cans are not touching, in order that the heat is extracted from them as uniformly as possible from all sides.

Use the reference temperature measuring point (see Clause 3) to regulate the low temperature cabinet so that the reference temperature follows a temperature curve inside the limits shown in Figure 1.

NOTE If desired, more than one reference temperature measuring point may be used, distributed at different levels in the cabinet, to increase the accuracy of the temperature control.

Subject the test specimens in the cans in the low temperature cabinet to a series of 10 freeze-thaw cycles as follows:

a) Reduce the temperature from (20 ± 3) °C to (- 1,0 ± 0,5) °C in (150 ± 30) min and hold at (- 1,0 ± 0,5) °C till (360 ± 30) min from the beginning of the cycle;

b) Reduce the temperature from (- 1,0 ± 0,5) °C to reach (- 17,5 ± 2,5) °C (540 ± 30) min after the beginning of the cycle and hold at (- 17,5 ± 2,5) °C for a minimum of 240 min.

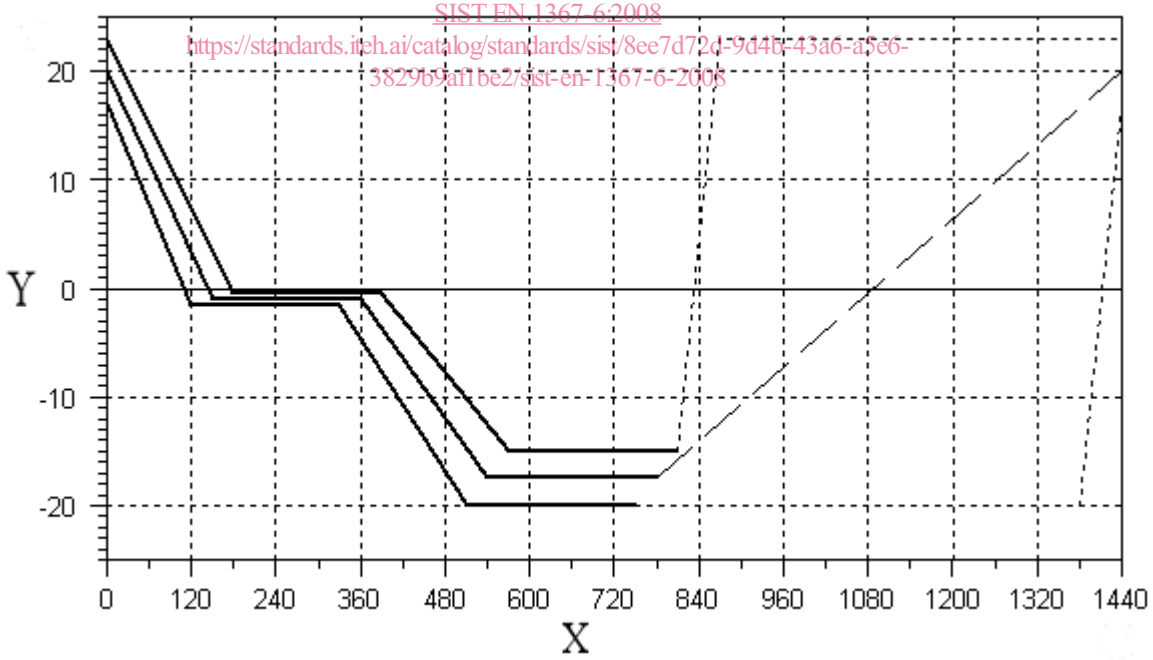
If the test needs to be interrupted, when under manual control for example at weekends, the cans shall be kept at (-17,5 ± 2,5) °C. The total interruption shall not exceed 72 h;

c) At no stage allow the temperature of the air in the cabinet to fall below - 22 °C;

d) After the completion of each freezing phase, thaw the cans by immersion in water or by using air circulation in the cabinet until the reference temperature has reached (20 ± 3) °C;

e) After the completion of each thawing phase hold the cans at (20 ± 3) °C for a maximum of 10 h and a minimum of 1 h. Each freeze-thaw cycle shall be completed within 24 h (except when interruption occurs according to 8.2 b).

On completion of the tenth cycle, pour the contents of each can into a test sieve having an aperture size that is half the lower size sieve used to prepare the test specimen (e.g. in the case of the 8 mm to 16 mm size fraction, 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 ± 5) °C to constant mass, cool to ambient temperature and weigh immediately (M_2) to the nearest 0,1 g.



Key
X Time (min)
Y Temperature (°C)

Figure 1 — Temperature curve with tolerance limits for the reference temperature measuring point(s)