



BSI Standards Publication

Testing hardened concrete

Part 9: Freeze-thaw resistance with de-icing salts — Scaling

National foreword

This Published Document is the UK implementation of CEN/TS 12390-9:2016. It supersedes DD CEN/TS 12390-9:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/516/12, Sampling & Testing.

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

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English Version

**Testing hardened concrete - Part 9: Freeze-thaw
resistance with de-icing salts - Scaling**

Essais sur béton durci - Partie 9: Résistance au gel
dégel-dégel en présence de sels de déverglaçage
(écaillage)

Prüfung von Festbeton - Teil 9: Frost- und Frost-
Tausalz-Widerstand - Abwitterung

This Technical Specification (CEN/TS) was approved by CEN on 25 April 2016 for provisional application.

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European foreword

This document (CEN/TS 12390-9:2016) has been prepared by Technical Committee CEN/TC 51 “Cement and building limes”, the secretariat of which is held by NBN.

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 CEN/TS 12390-9:2006.

The following technical modifications have been made in this new edition:

- In Clause 2, the normative references have been updated;
- In Clauses 5, 6 and 7, (for all test methods), a prescription measuring the CO₂ content of the air in the storage room has been introduced;
- In Annex A, the alternative applications have been strictly specified;
- In Annex B, a technical specification has been introduced;
- In the Bibliography, the references have been updated.

EN 12390, *Testing hardened concrete*, is currently composed with the following parts:

- *Part 1: Shape, dimensions and other requirements for specimens and moulds;*
- *Part 2: Making and curing specimens for strength tests;*
- *Part 3: Compressive strength of test specimens;*
- *Part 4: Compressive strength — Specification for testing machines;*
- *Part 5: Flexural strength of test specimens;*
- *Part 6: Tensile splitting strength of test specimens;*
- *Part 7: Density of hardened concrete;*
- *Part 8: Depth of penetration of water under pressure;*
- *Part 9: Freeze-thaw resistance — Scaling — Complementary element [Technical Specification];*
- *Part 10: Determination of the relative carbonation resistance of concrete [Technical Specification];*
- *Part 11: Determination of the chloride resistance of concrete, unidirectional diffusion;*
- *Part 13: Determination of secant modulus of elasticity in compression.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: 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.

Introduction

Concrete structures exposed to the effects of freezing and thawing need to be durable to have an adequate resistance to this action and, in cases such as road construction, to freezing and thawing in the presence of de-icing agents. It is desirable, especially in the case of new constituents or new concrete compositions, to test for such properties. This also applies to concrete mixes, concrete products, precast concrete, concrete members or concrete *in situ*.

There are two types of concrete deterioration when a freeze–thaw attack occurs, scaling and internal structural damage. Test methods on internal structural damage are described in the CEN Technical Report CEN/TR 15177, *Testing the freeze-thaw resistance of concrete — Internal structural damage*.

Many different test methods have been developed. No single test method can completely reproduce the conditions in the field in all individual cases. Nevertheless, any method should at least correlate to the practical situation and give consistent results. Such a test method may not be suitable for deciding whether the resistance is adequate in a specific instance but will provide data of the resistance of the concrete to freeze–thaw-attack and freeze–thaw-attack in the presence of de-icing agents.

If the concrete has inadequate resistance then the freeze–thaw attack can lead to two different types of damage, namely to scaling (surface weathering) and to internal structural damage. This part of this standard covers only testing for scaling resistance.

This Technical Specification has one reference method and two alternative methods. For routine testing either the reference method or one of the two alternative methods may be used with the agreement of the parties involved. In case of doubt, and if there is no such agreement, the reference method is used.

The testing methods may be used for comparative testing or for assessment against fixed acceptance criteria. The application of limiting values will require the establishment of the correlation between laboratory results and field experience. Due to the nature of the freeze–thaw action, such correlation would have to be established in accordance with local conditions, reflected in the national application documents.

1 Scope

This Technical Specification describes the testing of the freeze-thaw scaling resistance of concrete both with water and with sodium chloride solution. It can be used either to compare new constituents or new concrete compositions against a constituent or a concrete composition that is known to give adequate performance in the local environment or to assess the test results against some absolute numerical values based on local experiences.

Extrapolation of test results to assess different concretes, i.e. new constituents or new concrete compositions, requires an expert evaluation.

NOTE In some cases the test methods may not be suitable for testing special concretes e.g. high strength concrete or permeable concrete. In these cases the result needs to be treated with caution. Also, the testing methods included in this document may not identify aggregates that are subject to occasional 'pop-outs'.

There is no established correlation between the results obtained by the three test methods. All tests will clearly identify poor and good behaviour, but they differ in their assessment of marginal behaviour. The application of different acceptance limits for test results enables assessment for different degrees of exposure severity. In case of justified modifications of the test parameters, precautions might apply. Some alternative applications are described in Annex A.

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 12390-2, *Testing hardened concrete - Part 2: Making and curing specimens for strength tests*

ISO 5725 (all parts), *Accuracy (trueness and precision) of measurement methods and results*

3 Terms and definitions

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

3.1

freeze-thaw resistance

resistance against alternating freezing and thawing in the presence of water alone

3.2

freeze-thaw resistance with de-icing salt

resistance against alternating freezing and thawing in the presence of de-icing salt

3.3

scaling

loss of material at the testing surface of concrete due to freeze-thaw attack

3.4

internal structural damage

cracks inside concrete which cannot be seen on the surface, but which lead to an alteration of concrete properties, e. g. reduction of the dynamic modulus of elasticity