



**NSAI**  
Standards

Irish Standard  
I.S. EN 12390-11:2015

# Testing hardened concrete - Part 11: Determination of the chloride resistance of concrete, unidirectional diffusion

**I.S. EN 12390-11:2015**

*Incorporating amendments/corrigenda/National Annexes issued since publication:*

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

*This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):*

*NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.*

*This document is based on:*

EN 12390-11:2015

*Published:*

2015-08-19

*This document was published  
under the authority of the NSAI  
and comes into effect on:*

2015-09-07

ICS number:

91.100.30

NOTE: If blank see CEN/CENELEC cover page

NSAI  
1 Swift Square,  
Northwood, Santry  
Dublin 9

T +353 1 807 3800  
F +353 1 807 3838  
E standards@nsai.ie  
W NSAI.ie

Sales:  
T +353 1 857 6730  
F +353 1 857 6729  
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

## National Foreword

I.S. EN 12390-11:2015 is the adopted Irish version of the European Document EN 12390-11:2015, Testing hardened concrete - Part 11: Determination of the chloride resistance of concrete, unidirectional diffusion

This document does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with this document does not of itself confer immunity from legal obligations.**

*In line with international standards practice the decimal point is shown as a comma (,) throughout this document.*

This page is intentionally left blank

EUROPEAN STANDARD

**EN 12390-11**

NORME EUROPÉENNE

EUROPÄISCHE NORM

August 2015

ICS 91.100.30

Supersedes CEN/TS 12390-11:2010

English Version

## Testing hardened concrete - Part 11: Determination of the chloride resistance of concrete, unidirectional diffusion

Essais pour béton durci - Partie 11 : Détermination de la résistance du béton à la pénétration des chlorures, diffusion unidirectionnelle

Prüfung von Festbeton - Teil 11: Bestimmung des Chloridwiderstandes von Beton - Einseitig gerichtete Diffusion

This European Standard was approved by CEN on 19 June 2015.

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-CENELEC 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-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

## EN 12390-11:2015 (E)

## Contents

Page

European foreword .....	3
Introduction .....	5
1 Scope .....	6
2 Normative references .....	6
3 Term, definitions symbols and abbreviated terms.....	6
3.1 Terms and definitions .....	6
3.2 Symbols and abbreviated terms .....	7
4 Principle .....	8
5 Reagents and apparatus .....	8
5.1 Reagents .....	8
5.2 Apparatus .....	9
6 Preparation of specimens .....	10
6.1 Preparing sub-specimens .....	10
6.2 Conditioning and preparation of profile specimen for chloride testing .....	11
7 Procedure .....	13
7.1 Exposure conditions .....	13
7.2 Exposure method.....	14
7.3 Exposure period.....	14
7.4 Determination of initial chloride content ( $C_i$ ) .....	14
7.5 Profile grinding .....	15
7.6 Chloride analysis .....	16
8 Regression procedure and expression of results .....	16
9 Test report .....	19
10 Precision .....	19
Annex A (informative) Diffusion coefficients .....	21
Annex B (informative) Core test specimen .....	22
Annex C (informative) Typical equipment and procedure for vacuum saturation .....	23
Annex D (normative) Immersion method for large specimens.....	25
Annex E (informative) Guidance on the test procedure .....	26
Annex F (informative) Examples for calibration of the calculation procedure for regression analysis .....	28
Bibliography .....	33

## European foreword

This document (EN 12390-11:2015) has been prepared by Technical Committee CEN/TC 104 "Concrete and related products", the secretariat of which is held by DIN.

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 February 2016 and conflicting national standards shall be withdrawn at the latest by February 2016.

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 12390-11:2010.

In comparison to CEN/TS 12390-11:2010, the following changes have been made:

- In Clause 2, the normative references have been updated;
- In Clause 8, a minimum value of the coefficient of determination has been added and further guidance on the calculations has been added;
- In Clause 9, a graph and details of points included and excluded plus the coefficient of determination have been added;
- In Clause 10, Table 3 has been added;
- A new Annex E (informative) "Guidance on test procedure" has been added;
- A new Annex F (informative) "Examples for calibration of the calculation procedure for regression analysis" has been added;
- The Bibliography has been reviewed;
- The standard has been revised editorially.

The drafting of this European Standard was delegated to CEN/TC 51(CEN/TC104)/JWG12/TG5.

This test method is one of a series concerned with testing concrete. At the behest of CEN, RILEM reviewed chloride testing methods [1] and this European Standard is based on their recommendations. In addition, this European Standard draws on recommendations from the EU-project "Chlortest" 5<sup>th</sup> Framework Programme (GRD1-2002-71808/G6RD-CT-2002-00855) [2] immersion test recommendation as well as the Nordtest Method NT Build 443 Concrete, hardened: Accelerated Chloride penetration [3].

The series EN 12390, *Testing hardened concrete* includes the following parts:

- *Part 1: Shape, dimensions and other requirements of specimens and moulds*
- *Part 2: Making and curing specimens for strength tests*
- *Part 3: Compressive strength testing of specimens*
- *Part 4: Compressive strength - Specification of testing machines*
- *Part 5: Flexural strength of test specimens*

**EN 12390-11:2015 (E)**

- *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* (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 the secant modulus of elasticity in compression*

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, 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**

Steel reinforced concrete structures exposed to the ingress of chloride, either from seawater or other sources, need to be durable for at least the intended working life. The possibility of reinforcement corrosion is significantly increased as the chloride level at the embedded reinforcement increases. For this reason the chloride diffusivity or penetrability of the concrete is an important property to measure and this European Standard sets out a test method that may be applied to specimens cast or core specimens to assess the potential chloride resistance properties of a concrete mix.

Specifications regarding the test procedure with core specimens are given in Annex B.

**NOTE** This test method takes a minimum of 119 d comprising a minimum age of the specimen prior to testing of 28 d, a minimum of one day to prepare and condition the specimen and then 90 d to expose the specimen to the chloride solution.

**EN 12390-11:2015 (E)****1 Scope**

This European Standard is a method for determining the unidirectional non-steady state chloride diffusion and surface concentration of conditioned specimens of hardened concrete. The test method enables the determination of the chloride penetration at a specified age, e.g. for ranking of concrete quality by comparative testing. Since resistance to chloride penetration depends on the ageing, including the effects of continual hydration, then the ranking may also change with age.

The test procedure does not apply to concrete with surface treatments such as silanes and it may not apply to concrete containing fibres (see E.1).

**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*

EN 14629, *Products and systems for the protection and repair of concrete structures - Test methods - Determination of chloride content in hardened concrete*

**3 Term, definitions symbols and abbreviated terms**

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

**3.1 Terms and definitions****3.1.1****as-cast surface**

surface of a concrete element exposed in the construction works to a chloride environment

**3.1.2****chloride content**

amount of acid-soluble chloride expressed in percent by mass of concrete

**3.1.3****chloride penetration**

ingress of chlorides into concrete due to exposure to external chloride sources

**3.1.4****diffusion**

movement of molecules or ions under a concentration gradient, that is movement from a zone of high concentration to a zone with a lower concentration

**3.1.5****diffusion coefficient**

proportionality between the molecular flux (e.g. rate of flow of chloride ions) and the concentration gradient in the diffusion equation

Note 1 to entry: In this European Standard Fick's Law is adopted.

Note 2 to entry: See Annex A.

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

- 
- Looking for additional Standards? Visit Intertek Inform Infostore
  - Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation
-