BS EN 12390-19:2023

BSI Standards Publication

Testing of hardened concrete — Determination of electrical resistivity

Documents
Document Sharing Hub

Full document details: BS EN 12390-19:2023

National foreword

This British Standard is the UK implementation of EN 12390-19:2023.

The UK participation in its preparation was entrusted to Technical Committee B/517/1, Concrete production and testing.

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

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 18383 2

ICS 91.100.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2023.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS EN 12390-19:2023

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12390-19

February 2023

ICS 91.100.30

English Version

Testing of hardened concrete - Determination of electrical resistivity

Essais pour béton durci - Détermination de la résistivité électrique

Prüfung von Festbeton - Teil 19: Bestimmung des elektrischen Widerstands

This European Standard was approved by CEN on 9 January 2023.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

© 2023 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN 12390-19:2023 E

Documents
Document Sharing Hub

Full document details: BS EN 12390-19:2023

Contents

Page

European foreword ... 3
Introduction ... 4
1 Scope ... 5
2 Normative references ... 5
3 Terms, definitions and symbols ... 5
3.1 Terms and definitions ... 5
3.2 Symbols ... 7
4 Principle ... 7
5 Apparatus ... 8
5.1 Resistivity meter ... 8
5.2 Data logger ... 9
5.3 Electrodes ... 9
5.4 Sponges ... 9
5.5 Wetting liquid at the sponge/concrete interface ... 10
6 Preparation of test specimens ... 10
6.1 Minimum number of specimens/readings to obtain a test result for a concrete ... 10
6.2 Test specimen preparation ... 11
7 Test procedure volumetric method (reference method) ... 11
7.1 Determination of the volumetric resistance ... 11
7.2 *Two-electrode* arrangement ... 13
8 Test procedure surface method ... 13
8.1 Measurements ... 13
8.2 Calculation of resistivity ... 15
8.2.1 General ... 15
8.2.2 Volumetric method ... 15
8.2.3 Surface method ... 15
9 Test report ... 16
10 Precision ... 17
Annex A (informative) Determination of the precision of the equipment ... 18
Bibliography ... 19

Documents
Document Sharing Hub
Full document details: BS EN 12390-19:2023

European foreword

This document (EN 12390-19:2023) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, Subcommittee SC1 “Concrete - Specification, performance, production and conformity”, the secretariat of which is held by SN.

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 August 2023, and conflicting national standards shall be withdrawn at the latest by August 2023.

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

A list of all parts in the EN 12390 series can be found on the CEN website.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

AVA Documents
Document Sharing Hub

Full document details: BS EN 12390-19:2023

Introduction

This test method is one of a series concerned with testing hardened concrete.

This document is based on current national standards and in particular the Spanish standard UNE PNE 83988 Part 1 and Part 2.

Resistivity is a property that quantifies how strongly a given material opposes the flow of electric current. Resistivity is the electrical resistance of a unit volume (e.g. 1 m^3) of a concrete. It is the inverse of conductivity, and it is obtained from the ratio between the voltage drop and the current (Ohm's law).

The resistivity of a water-saturated concrete is mainly a function of the pore size distribution and the connectivity/tortuosity of the pore system. It also depends on the pore solution composition, which is strongly affected by the cement type, additions, w/c ratio, aggregate type and the degree of hydration of the cement.

Resistivity is also dependent on temperature and for quality control testing, the temperature of the concrete specimens should be held within a defined range for comparable results.

The document is applied to water saturated concretes because the resistivity is affected by the degree of water saturation. A reduction in the moisture content increases the resistivity. Loss of continuity of the pore system by drying can have more impact on the resistivity value than a change in the volume of capillary porosity because drying can produce changes of more than one order of magnitude while a change in capillary porosity can be reflected in changes of two or three times.

In this document a 4-electrode arrangement is recommended as it avoids the voltage drop produced by the concrete/electrode interfacial resistance. This interfacial resistance can appear when using only two electrodes placed on parallel faces of the specimen, electrodes which apply the current and measure the voltage at the same geometrical point. If two electrodes are used, calibration is recommended with the 4 electrodes arrangement described in this document.

The measured resistivity is also affected by the electrical frequency of testing ([1], [2], [3], [4]) and so the measured resistivity could be increased by reducing the electrical frequency. In addition, for the same electrical frequency, the measured resistivity is dependent on the specific pattern of the electrical field across the specimen. Notwithstanding these differences, where the electrical resistivity is determined in the same conditions, in a frequency range where the electrode polarization phenomena are independent of its variation, changes in resistivity reflect changes occurring in the concrete.

An electrically conductive or porous aggregate also influences the magnitude of concrete resistivity. This should be considered when establishing threshold values as it prevents a comparison of resistivity values between concretes if the aggregates show a difference of half an order of magnitude (higher or lower) of resistivity. The same effect of decreasing the measured resistivity is produced when metallic or electricity conducting fibres or particles, are present.

Documents
Document Sharing Hub
Full document details: BS EN 12390-19:2023

1 Scope

This document describes two methods for measuring the electrical resistivity of concrete in water saturated conditions: the volumetric method (see 3.1.3), which is the reference method, and the surface method (see 3.1.4). The document gives the procedure to calibrate the surface method by means of the reference-volumetric method. Both methods give the same resistivity result, provided the provisions of the present document (using the Form Factor (F_f) for equivalence between them) are followed.

NOTE The volumetric method is applicable to cast specimens or cores, while the surface method is suitable for use on cast specimens, cores and on construction sites, but not all of these applications are covered in this document.

The method can be applied to the normal range of concretes covered by current standards. It does not cover concretes containing metallic components or made with porous aggregates.

The use of resistivity to assess the potential for corrosion of reinforcement in existing structures is not specified in this document.

The use of resistivity to test cores taken from an existing structure, which require pre-conditioning by water saturation, is not covered in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 12390-2, *Testing hardened concrete - Part 2: Making and curing specimens for strength tests*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp/ui

3.1.1
electrical resistance
$\boldsymbol{R_e}$
voltage drop divided by current (in Ohm)

$$R_e = \frac{U}{I} \tag{1}$$

where

U is the difference in voltage drop before and after the application of the current between the voltage electrode; and

I is current circulating through the current electrodes

Documents
Document Sharing Hub
Full document details: BS EN 12390-19:2023