INTERNATIONAL STANDARD

ISO 16836

First edition
2019-01

Non-destructive testing — Acoustic emission testing — Measurement method for acoustic emission signals in concrete

Essais non destructifs — Contrôle par émission acoustique — Méthode de mesure pour les signaux d'émission acoustique dans le béton

Reference number
ISO 16836:2019(E)

© ISO 2019



COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

 © ISO 2019 – All rights reserved

Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Detection of AE waves **2**
5 Measuring system **3**
5.1 General 3
5.2 Sensor 3
5.3 Amplifier 4
5.4 Filter 4
6 Signal analysis and AE parameters **4**
7 Setup and measurement **6**
7.1 Sensor setup 6
7.2 Environmental noises 6
7.3 Measurement 7
7.4 System inspection 7
7.5 Storage of data 7
8 Test report **7**
Annex A (informative) **Recommended types of sensors to be used in concrete** **8**
Bibliography **9**

© ISO 2019 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 135, *Non-destructive testing*, Subcommittee SC 9, *Acoustic emission testing*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2019 – All rights reserved

Introduction

Acoustic emission (AE) techniques have been investigated in concrete engineering for more than a half century. Nowadays, results of AE research are put to practical use for infrastructures, not only concrete structures, but also masonry structures.

Concrete structures can deteriorate due to heavy traffic loads, fatigue, chemical reactions and unpredictable disasters, although concrete structures have long been referred to as maintenance-free. Eventually, retrofit and rehabilitation of the structures are in heavy demand all over the world. It results in the need for the development of advanced and effective inspection techniques prior to repair work. In this regard, AE techniques have been extensively studied in concrete engineering.

Focusing on crack detection and damage evaluation, it is known that AE techniques are prospectively applicable to concrete and concrete structures. Therefore, basic aspects on the measurement method for AE signals in concrete are prescribed. AE is an inspection technique, by which elastic waves due to cracking and damage in concrete are detected. Since AE phenomena are to be observed under in-service conditions, AE measurement can be conducted not only in a laboratory, but also on site.

© ISO 2019 – All rights reserved

Non-destructive testing — Acoustic emission testing — Measurement method for acoustic emission signals in concrete

1 Scope

This document establishes a measurement method for acoustic emission signals in concrete.

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.

ISO 12713, *Non-destructive testing — Acoustic emission inspection — Primary calibration of transducers*

ISO 12714, *Non-destructive testing — Acoustic emission inspection — Secondary calibration of acoustic emission sensors*

ISO 12716, *Non-destructive testing — Acoustic emission inspection — Vocabulary*

ISO/TR 13115, *Non-destructive testing — Methods for absolute calibration of acoustic emission transducers by the reciprocity technique*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12716 and the following apply.

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

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

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

3.1
acoustic emission
AE
transient elastic waves generated by the release of energy within a material

3.2
AE signal
electrical signal detected at a sensor, which is converted through the detection of *AE wave* (3.3) (elastic wave)

3.3
AE wave
wave that can be detected in the form of *hits* (3.5) on one or more *channels* (3.4)

3.4
channel
one line of *AE signal* (3.2) detected by *AE* (3.1) sensor and processed by the other devices

© ISO 2019 – All rights reserved

3.5
hit
given *AE* (3.1) *channel* (3.4) that has detected and processed one AE transient

3.6
event
group of *AE* (3.1) *hits* (3.5) received from a single source by two or more *channels* (3.4), of which spatial coordinates can be located

3.7
array
spatial arrangement of *AE* (3.1) sensors for spatially locating AE sources

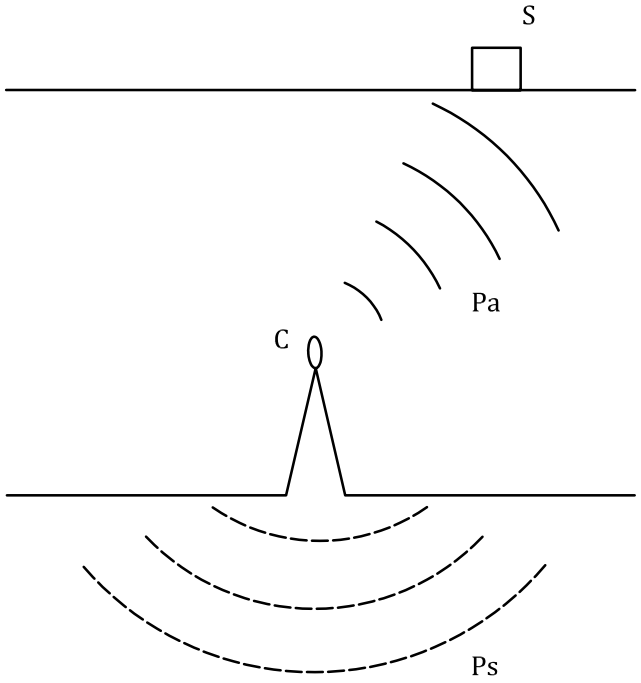
3.8
attenuation
observed loss of a signal as it travels through a medium

3.9
noise
signal produced by causes other than *AE* (3.1) phenomena

Note 1 to entry: Elimination of noises is essential for effective detection of *AE signals* (3.2).

4 Detection of AE waves

Microscopic fracture in concrete takes place with the release of stored strain energy as nucleating micro-cracks and generating elastic waves. These waves due to crack nucleation are referred to as AE waves, which propagate inside a material and are detected by an AE sensor as shown in Figure 1.



Key
S detection of AE waves by an AE sensor
Pa propagation of AE waves
C nucleation of a crack
Ps propagation of sound waves in air

Figure 1 — Detection of AE waves

© ISO 2019 – All rights reserved