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**Non-destructive testing — Acoustic  
emission testing — Test method for  
damage qualification of reinforced  
concrete beams**

*Essais non destructifs — Contrôle par émission acoustique —  
Méthode d'essai pour la qualification des dommages des faisceaux de  
béton armé*



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## 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](http://www.iso.org/directives)).

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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](http://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](http://www.iso.org/members.html).

## Introduction

Acoustic emission (AE) techniques are extensively developed in concrete engineering. Concrete structures have long been referred to as maintenance-free. Recently, however, it is realized that the concrete structures can deteriorate due to many factors. In particular, heavy traffic loads result in fatigue of the concrete structures.

In order to assess the fatigue of reinforced concrete beams, one criterion to qualify the damage levels is proposed on the basis of two ratios associated with the Kaiser effect.

New AE parameters of load ratio and calm ratio are defined for qualification of the damage. It is found that the damage qualified by the two ratios are in good agreement with actual damage of the beams. This suggests that the damage of the reinforced concrete structures in service as bridges, docks and buildings be quantitatively assessed, by simply applying cyclic loading and monitoring AE activity.



# Non-destructive testing — Acoustic emission testing — Test method for damage qualification of reinforced concrete beams

## 1 Scope

This document specifies a test for damage qualification of reinforced concrete beams in services as bridges, docks and buildings.

## 2 Normative reference

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

## 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

#### **AE activity**

occurrence of AE hits or counts under stressed conditions in concrete

### 3.2

#### **Kaiser effect**

little *AE activity* (3.1) observed until the maximum load of the previous stage is surpassed when stresses are applied, removed and then reapplied to a material or a structure

### 3.3

#### **Felicity ratio**

ratio of the load at which emissions start to the previous maximum load when stresses are applied, removed and then reapplied to a material or a structure

Note 1 to entry: This shows the ratio of the degree of conformity of the *Kaiser effect* (3.2).

## 4 Requirement for the measuring system

For detection of AE signals, AE sensors shall be sensitive enough to detect AE signals generated in a concrete member, taking acoustic coupling into consideration. AE sensor shall be also robust enough against temperature change, moisture condition and mechanical vibrations in the environments. AE sensor shall be attached at proper locations to cover the target area.

In advance of the test, attenuation properties of the target structure shall be estimated, by employing the standard source. Based on this information, sensor location shall be determined in consideration with the attenuation properties.