SLOVENSKI STANDARD
SIST EN 13554:2004

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Neporuġitveno preskuġanje ï Akustiļ na emisija ï Sploġna naļ ela

Non-destructive testing - Acoustic emission - General principles

Zerstörungsfreie Prüfung - Schallemissionsprüfung - Allgemeine Grundlagen

Essais non destructifs - Emission acoustique - Principes généraux

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

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Contents

Foreword

This document EN 13554:2002 has been prepared by Technical Committee CEN/TC 138 "Non-destructive testing", the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by October 2002, and conflicting national standards shall be withdrawn at the latest by October 2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the general principles required for the acoustic emission (AE) testing of industrial structures, components, and different materials under stress and for harsh environment, in order to provide a defined and repeatable performance. It includes guide lines for the preparation of application documents, which describe the specific requirements for the application of the AE method.

Unless otherwise specified in the referencing documents, the minimum requirements of this standard are applicable.

2 Normative references

This European Standard incorporates by dated or undated reference, provision from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 1330-1, *Non destructive testing - Terminology - Part 1: List of general terms.*

EN 1330-2, *Non destructive testing - Terminology - Part 2: Terms common to the non destructive testing methods.*

EN 1330-9, *Non destructive testing - Terminology - Part 9: Terms used in Acoustic Emission testing.*

EN 473, *Non-destructive testing – Qualification and certification of NDT personnel - General principles.*

EN 13477-2, *Non-destructive testing – Acoustic emission – Equipment characterisation – Part 2: Verification of operating characteristic.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions of EN 1330-1, EN 1330-2 and EN 1330-9 apply.

4 Personnel qualification

It is assumed that emission testing is performed by qualified and capable personnel. In order to prove this qualification, it is recommended to certify the personnel in accordance with EN 473 or equivalent.

NOTE For pressure equipment see directive 97/23/EC, annex I, 3.1.3 : " For pressure equipment in categories III and IV, the personnel must be approved by a third-party organization recognized by a Member State."

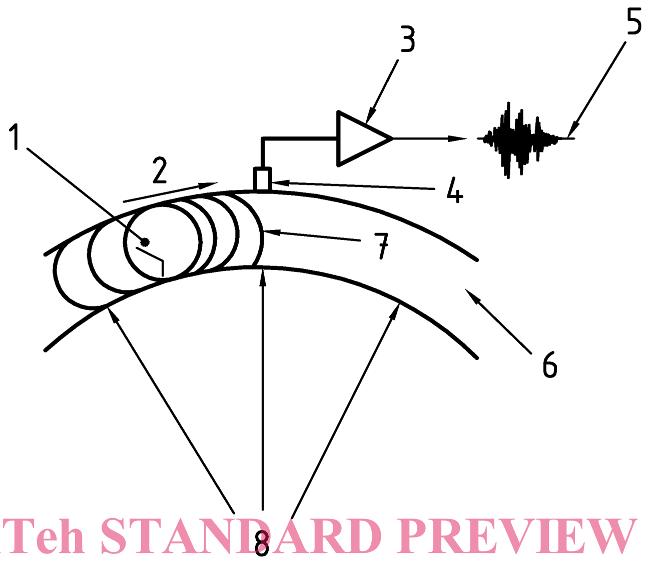
5 Principle of the acoustic emission method

5.1 The acoustic emission (AE) phenomenon

Acoustic emission is a physical phenomenon occurring within materials, and the term Acoustic Emission is used to define the spontaneous elastic energy released within a material or by a process, in the form of transient elastic waves.

The application of load or harsh environment in a material produces internal modifications such as crack growth, local plastic deformation, corrosion and phase changes which are generally accompanied by the emission of elastic waves in materials. These waves therefore contain information on the internal behaviour of the material.

The waves are detected by the use of a suitable sensor that converts the surface movements of the material into an electric signal. These signals are processed by appropriate instrumentation to detect, characterize and locate the AE sources. Figure 1 shows the schematic principle of AE.



Key

1	Growing discontinuity	5	Signal out
2	Surface waves	6	Section view of the component material
3	Preamplifier	7	Wave packet
4	AE sensor	8	Applied load inducing stress

Figure 1 - Schematic principle of Acoustic Emission and its detection

5.2 Advantages and features of AE

The AE method has the following features:

— it is a *passive* detection method that monitors the *dynamic* response on the material to the applied load;

— it allows detection of sources, depending of the materials properties, up to several meters distance;

— it allows a 100 % monitoring;

— it is sensitive to defect growth and changes in the material structure rather than to the presence of static defects;

— it is non invasive;

— it offers a dynamic real time monitoring of any discontinuity that grows under the applied stress;

— it can be applied to monitor the structures during operating conditions;

— it can be used to prevent catastrophic failure of structures and control the effects of the application of load;

— it is capable of locating a growing discontinuity in the structure under test by the use of remotely installed sensors.

The AE method can be applied only if the materials in the structures or components are adequately stressed.

The difference between AE and most NDT methods stems from the above features. It is the *material itself* that releases the energy in consequence of structural degradation due to different source mechanisms. This is different to detecting existing geometrical discontinuities in a static condition.

AE is a method which points out the presence and location of an evolving degradation process under a given stimulus.

5.3 Limitations of AE

Limitations of the AE method are:

— non growing discontinuities generally will not generate AE signals;

— subsequent application of load to the same stress level will only identify discontinuities which are still active (this is a reversible phenomenon known as Kaiser effect);

— it is sensitive to the presence of process noise.

Prior to performing an AE test, it is very important to check for the presence of potential noise sources. Noise sources should be removed or action taken to insure they do not reduce the effectiveness of the AE examination.

6 Applications of the acoustic emission method

AE it is applied at different phases of product life:

— manufacturing;

— acceptance test;

— initial proof test;

— requalification tests;

— in service monitoring;

— leak detection.

It is applied to:

— pressure equipment;

— pipe systems;

— storage tanks;

— structures;

— components;

— machinery.

These examples concern predominantly metallic materials but this method applies also to composites, ceramics, concrete, etc.

7 Instrumentation

The AE instrumentation shall fulfil the requirements of EN 13477-2 and the performance shall be checked periodically in accordance with this standard.

7.1 AE sensors

Detection is the most important part of an AE chain because any problem here (poor acoustical coupling, bad installation, incorrect frequency selection, cable mismatching, etc.) affects the rest of the measurements and hence the results.

7.1.1 AE sensor selection

The sensors are normally of the resonant type, i.e., one frequency dominates the response, sensors with different resonant frequencies are available.

The choice of the sensor and the operating frequency depends upon:

— the purpose of examination;

— the requirements of the referencing standard or specification;

— type and shape of structure or component;

— operating temperature and surface condition of the structure or component (insulation, painting, coating, surface corrosion etc.);

— environment;

— material properties;

— background noise;

— attenuation;

— material thickness.

The signal waveform from the sensor is affected by multiple path propagation and multiple waves modes that are generated in the material. An example of a typical AE burst signal is shown in Figure 2.