SLOVENSKI STANDARD
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Neporuġitveno preskuġanje - Akustiļ na emisija - Karakterizacija opreme - 2. del: Verifikacija lastnosti delovanja

Non-destructive testing - Acoustic emission - Equipment characterisation - Part 2: Verification of operating characteristic

Zerstörungsfreie Prüfung - Schallemissionsprüfung - Gerätecharakterisierung - Teil 2: Überprüfung der Betriebskenngrößen

Essais non destructifs - Emission acoustique - Caractérisation de l'équipement - Partie 2: Vérifications des caractéristiques de fonctionnement

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ICS:

19.100	Neporušitveno preskušanje	Non-destructive testing

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EUROPEAN STANDARD
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Non-destructive testing - Acoustic emission - Equipment characterisation - Part 2: Verification of operating characteristic

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This European Standard was approved by CEN on 28 December 2000.

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 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 Management Centre has the same status as the official versions.

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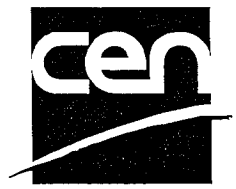

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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by July 2001, and conflicting national standards shall be withdrawn at the latest by July 2001.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association . This European Standard is considered to be a supporting standard to those application and product standards which in themselves support an essential safety requirement of a New Approach Directive and which make normative reference to this European Standard.

This standard about "Non destructive testing - Acoustic emission - Equipment characterisation" consists of the following parts:

Part 1: Equipment description

Part 2: Verification of operating characteristics

Part one of this standard gives a description of the main components of an AE monitoring system.

Part two of this standard gives methods and acceptance criteria for verifying the electronic performance of an AE monitoring system. These methods and acceptance criteria are used to routinely check and verify the performance of an AE monitoring system composed of one or more channels during it's life time.

Annex A is informative.

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, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This part of the standard specifies methods for routine verification of the performance of an AE equipment comprising one or more sensing channels. It is intended for use by operators of the equipment. Verification of the measurement characteristics is recommended after purchase of equipment, modifications or use under extraordinary conditions.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions 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 13477-1:2001, *Non-destructive testing - Acoustic emission - Equipment characterisation - Part 1: Equipment description*

3 Terms and definitions

For the purposes of this standard the definitions of EN 1330-1, EN 1330-2, EN 1330-9, EN 13477-1:2001 and IEC 60050 International Electrotechnical Vocabulary apply.

4 Required test equipment

The following minimum test equipment is required:

- Test block;
- Hsu-Nielsen source;
- Sweep function/variable pulse signal generator;
- Random noise generator;
- Dual channel storage oscilloscope;
- Variable attenuator, graduated in decibels;
- Multimeter;
- RMS voltmeter;
- DC Power supply.

4.1 Test set-up

The test set-up is shown in Figure 1. The test signal is fed into the preamplifier (or the main amplifier when the preamplifier is integral with the sensor). The dynamic range and frequency response of the test equipment shall be significantly better than the AE monitoring equipment under examination.

Different test signals shall be used depending on the characteristic under examination.

Testing an external parameter channel shall require a DC signal generator.

4.2 Test signal waveforms

The following types of test signals shall be used to verify the operating characteristics of the AE measurement system:

a) Continuous sinewave
This type of test signal shall be used to measure the frequency response and gain of the measurement system.

b) Noise signal
In this type of test signal the amplitude and frequency change stochastically. It shall be used to verify the response to continuous AE.

c) Triangular gated sinewave
This type of wave simulates an AE burst signal, see Figure 2. It is defined by the following characteristics:

A = amplitude

R = rise-time

D = duration

f = carrier frequency

d) Rectangular gated sinewave
This type of signal is defined by the characteristics A, D and f, see Figure 3.

Note Various gated sinewaves are used to verify the measured AE burst signal characteristics, e.g. detection threshold, peak amplitude, rise time, duration, energy, ringdown count, see 7.3 and 7.4.

e) Pulse
This test signal shall be used to check the measurement of Delta t and the overload behaviour of the preamplifier, see Figure 4. It is defined by the characteristics A and D.
The rise-time shall be significantly less than the reciprocal of the "cut-off" frequency of the AE measurement system.

f) Repetitive signals
This is a series of transient signals. It is described by the type of transient used and the repetition frequency (typically 1 Hz to 1 kHz) and is used to verify the signal processing rate, see 7.6.

5 Verification of sensor sensitivity

The following procedure allows rapid comparison of the sensitivity of sensors. Damage to sensors can result from e.g., mechanical shock, exposure to high temperature, a corrosive environment, water ingress, a damaged connector or cable.

Test equipment preamplifier and cable used shall be controlled to ensure reproducibility of results.

5.1 Uses

The specific objective of the procedure for checking sensors are:

- warning of degrading response;
- determining when a sensor is no longer suitable for use;
- checking sensors that are known to have been exposed to high-risk conditions;

- creating matched sets of sensors to achieve uniform performance;

- verifying sensors quickly and reliably in the field and assisting trouble shooting when a channel shows a fault.

5.2 Test block

This can take different forms, e.g., a metallic plate, a plexiglass rod. Once chosen, the dimensions, construction material, Hsu-Nielsen source position, sensor mounting position and usage shall be controlled to ensure reproducibility of results.

The surface in contact with the sensor shall be flat and smooth. The test block shall be isolated acoustically from the work bench to avoid interference from external noise sources.

5.3 Procedure

For verification of a sensor sensitivity a reference preamplifier and cable shall be used.

Mount the sensor on the test block using an appropriate couplant. Be sparing with the couplant, e.g., approximately 0,1 cm^3 of silicone grease is adequate for most types of sensor.

Press the sensor firmly down onto the test block to ensure a good coupling. Take care the attachment cannot be perturbed during the test. The use of a constant force device is recommended.

Using the Hsu-Nielsen source make a minimum of 3 lead breaks at the prescribed position on the test block. In each case record the signal amplitude in units of dB_{AE}, on the test record card. If the difference between the lowest and highest readings is more than 3 dB, repeat the procedure until a set of 3 "good" breaks has been made. Before proceeding to the next sensor, clear away the couplant from the previous test.

The test temperature and lead diameter shall be recorded.

A suitable format for test records is shown in annex A.

The above-described procedure does not exclude any other qualified method.

5.4 Noise level of sensor and preamplifier combination

The noise level of the sensor and preamplifier combination shall be measured with the sensor unmounted, see 6.2.1. The noise level is measured in specified units and shall not normally vary by more than 3 dB from sensor to sensor. The measured value shall be reported in the test record card (see annex A).

6 Verification of preamplifier performance

The following procedure applies to voltage preamplifiers. Verification involves measuring:

- electronic noise (peak and/or RMS);

- gain;

- frequency response and bandwidth;

- maximum voltage output.

6.1 Test Set-up

Perform a physical examination of the preamplifier to identify any obvious mechanical damage, paying particular attention to cables and connectors. The preamplifier power supply shall be at the prescribed voltage. Good measurement practice requires:

- correct impedance matching throughout ;
- avoidance of ground loops ;
- avoidance of sources of electromagnetic interference.

Input and output signals shall be compared. A continuous sinewave signal shall be used for the input, see 4.2.

6.2 Measurement of preamplifier characteristics

6.2.1 Measurement of electronic noise

The input termination of the preamplifier shall be specified. The output shall be decoupled from the supply voltage where appropriate.

The peak value of the electronic noise may be determined using an oscilloscope.

Typical voltage and timebase settings, using a 40 dB preamplifier, are 2 mV/div. and 2 ms/div. respectively.

The peak noise is the maximum signal voltage in a specified time frame. Alternatively the electronic noise can be characterised using an RMS voltmeter with a specified time constant.

The noise level referred to the preamplifier input is specified in μV_{peak} and μV_{RMS}.

6.2.2 Gain

The ratio of the measured output to input voltage determines the gain. It shall be assessed with the output voltage at 50% of the saturation level and at the centre frequency of the preamplifier bandwidth.

6.2.3 Bandwidth

The bandwidth shall be characterised by the – 3 dB points on the frequency response curve. The low frequency and high frequency "roll-off" shall be measured in dB per octave.

6.2.4 Dynamic range

The dynamic range is the ratio of the largest signal peak output (without distortion) to the peak electronic noise. It shall be specified in dB given by:

Dynamic Range (dB) = 20 log (V_{peak} (signal)/V_{peak} noise).

7 Verification of the signal conditioning and measurement system

7.1 Overview

Verification of the acoustic emission (AE) measurement system shall be performed by comparing the measured values of the AE parameters and external parameters with the actual values read from the calibrated test instruments.

The characterisation of the AE measurement system shall be performed using different test signals. The recommended test signal and the frequency, dynamic range and tolerance of measurement shall be given.

In the event that the AE measurement system and/or the preamplifier are fitted with frequency filters, the AE parameters shall be measured within the filter bandwidth. If the filter is changed, the gain shall be checked and adjusted accordingly.

Before proceeding to verify the measured AE parameters, the detection threshold shall be checked. The minimum value of test signal used shall normally be not less than 20 dB above the detection threshold.