SLOVENSKI STANDARD
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Nadomešča:

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Neporušitveno preskušanje - Akustična emisija - Preskušanje tesnosti z akustično emisijo (ISO/DIS 18081:2023)

Non-destructive testing - Acoustic emission testing (AT) - Leak detection by means of acoustic emission (ISO/DIS 18081:2023)

Zerstörungsfreie Prüfung - Schallemissionsprüfung - Dichtheitsprüfung mittels Schallemission (ISO/DIS 18081:2023)

Essais non destructifs - Contrôle par émission acoustique - Détection de fuites par émission acoustique (ISO/DIS 18081:2023)

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ISO/TC **135**/SC **9** Secretariat: **SAC**

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Non-destructive testing — Acoustic emission testing (AT) — Leak detection by means of acoustic emission

Essais non destructifs — Contrôle par émission acoustique — Détection de fuites par émission acoustique

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Contents

Page

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).

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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.

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

This second edition cancels and replaces the first edition (ISO 18081:2016), which has been technically revised.

The main changes are as follows:

— xxx xxxxxxx xxx xxxx

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.

Non-destructive testing — Acoustic emission testing (AT) — Leak detection by means of acoustic emission

1 Scope

This document specifies the general principles required for leak detection by acoustic emission testing (AT). It is addressed to the application of the methodology on structures and components, where a leak flow as a result of pressure differences appears and generates acoustic emission (AE).

It describes phenomena of the AE generation and influence of the nature of fluids, shape of the gap, wave propagation and environment.

The different application techniques, instrumentation and presentation of AE results are discussed. Also included are guidelines for the preparation of application documents which describe specific requirements for the application of the acoustic emission testing.

Annex A gives procedures for some leak-testing applications.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

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

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO/TS 18173, *Non-destructive testing — General terms and definitions*

EN 1330-1, *Non-destructive testing — Terminology — Part 1: 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, *Non-destructive testing — Acoustic emission — Equipment characterisation — Part 1: Equipment description*

EN 13477-2, *Non-destructive testing — Acoustic emission — Equipment characterisation — Part 2: Verification of operating characteristics*

EN 13554, *Non-destructive testing — Acoustic emission testing — General principles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12716, ISO/TS 18173, EN 1330-1, EN 1330-2 and EN 1330-9 apply.

NOTE The definitions of leak, leakage rate, leak tightness are those defined in ISO 20484.

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

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

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

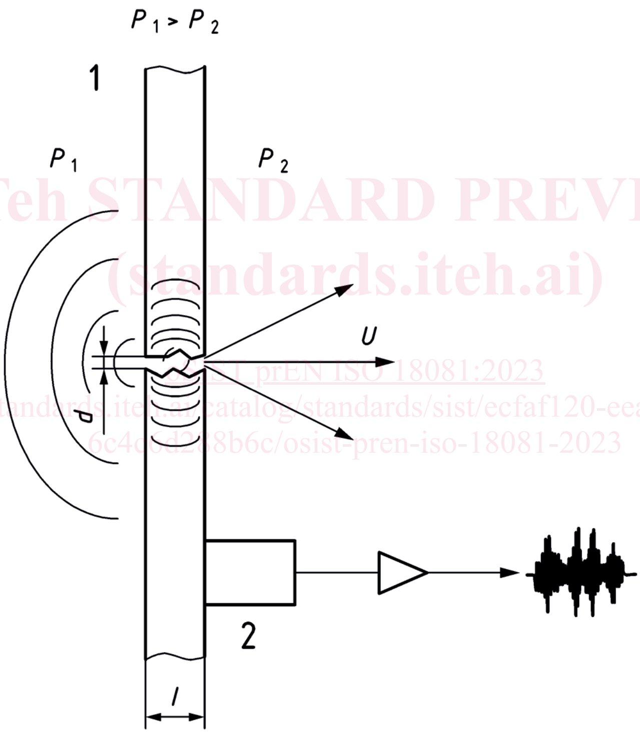
4 Qualification of test personnel

It is assumed that acoustic 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 ISO 9712.

5 Principle of acoustic emission testing

5.1 The acoustic emission phenomenon

See Figure 1.



Key

1 fluid

2 AE sensor

P_1 pressure on side of fluid

P_2 pressure on side of sensor

d main dimension of leak orifice

I wall thickness

U leaking fluid

Figure 1 — Schematic principle of acoustic emission and its detection

The continuous acoustic emission in the case of a leak, in a frequency range, looks like an apparent increase in background noise, depending on pressure.

5.2 Influence of different media and different phases

The detectability of the leak depends on the fluid type and its physical properties. These will contribute to the dynamic behaviour of the leak flow (laminar, turbulent) (see Table 1).

Table 1 — Influence of the different parameters on the AE activity

Sub-clause	Parameter	Higher activity	Lower activity
5.2	Test media	gas	liquid
		two phase	
	Viscosity	low	high
	Type of flow	turbulent	laminar
	Fluid velocity	high	low
5.3	Pressure difference	high	low
5.4	Shape of leak	crack like	hole
	Length of leak path	long	short
	Surface of leak path	rough	smooth

In contrast to turbulent flow, the laminar flow in general does not produce detectable acoustic emission signals.

Acoustic signals in conjunction with a leakage are generated by the following:

— turbulent flow of the escaping gas or liquid;

— fluid friction in the leak path;

— cavitations, during two-phase flow (gas coming out of solution) through a leaking orifice;

— the pressure surge generated when a leakage flow starts or stops;

— backwash of particles against the surface of equipment being monitored;

— gaseous or liquid jet (verification source);

— pulsating bubbles;

— explosion of bubbles;

— shock-bubbles on the walls;

— vaporization of the liquid (flashing).

The frequency content of cavitation may comprise from several kHz to several MHz.

Cavitation results in a burst emission whose energy is at least one order of magnitude higher than that caused by turbulence.

The relative content in gas or air strongly influences the early stage of cavitation.

The acoustic waves generated by leaks can propagate by the walls of the structure as well as through any fluids inside.

Acoustic waves are generated by vibration at ultrasonic frequencies of the molecules of the fluid. The vibrations are produced by turbulence and occur in the transition between a laminar and a turbulent flow within the leak path and as these molecules escape from an orifice.

The acoustic waves produced by the above mentioned factors are used for leak detection and location.

5.3 Influence of pressure differences

The pressure difference is the primary factor affecting leak rate. However, the presence of leak paths may depend on a threshold value of fluid temperature or pressure.

Pressure-dependent leaks and temperature-dependent leaks have been observed, but in extremely limited number.

Pressure-dependent or temperature-dependent leaks denote a condition where no leakage exists until a threshold pressure or temperature is reached. At this point, the leakage appears suddenly and may be detectable.

When the pressure or temperature is reversed, the leakage follows the prescribed course to the critical point at which leakage drops to zero.

Temperature and pressure are not normally applied in the course of leak testing for the purpose of locating such leaks. Instead, they are used to force existing discontinuities to open, so as to start or increase the leakage rate to point of detection.

An example of this effect is the reversible leakages at seals below the service temperature and/or service pressure.

Sound waves emitted by a leak will normally have a characteristic frequency spectrum depending on the pressure difference and shape of the leak path.

Therefore the detectability of the leak depends on the frequency response of the sensor and this shall be taken into account when selecting the instrumentation.

5.4 Influence of geometry of the leak path

The AE intensity from a natural complex leak path (e.g. pinhole corrosion, fatigue or stress corrosion cracks) is generally greater than that produced by leakage from an artificial source, such as a drilled hole used for verification.

The main parameters defining the complexity are the cross section, length and surface roughness of the leak path.

5.5 Influence of wave propagation

Acoustic emission signals are the response of a sensor to sound waves generated in solid media. These waves are similar to the elastic waves propagated in air and fluids but are more complex because solid media are also capable of resisting shear force.

Waves that encounter a change in media in which they are propagating may change directions or reflect. In additions to reflection, the interface causes the wave to diverge from its original line of flight or refract in the second medium. Also the mode of the wave may be changed in the reflection and/or refraction process.

An incident wave upon an interface between two media will reflect or refract such that directions of the incident, reflected and refracted waves all lie in the same plane. This plane is defined by the line along which the incident wave is propagating and the normal to the interface.

The following factors are important to acoustic emission testing:

a) wave propagation has the most significant influence on the form of the detected signals;

b) wave velocity is key to computed source location;

c) wave attenuation governs the maximum sensor spacing that is acceptable for effective detection.