
**Condition monitoring and diagnostics of
machines — Ultrasound —**

**Part 1:
General guidelines**

*Surveillance des conditions et diagnostic d'état des machines —
Ultrasons —*

Partie 1: Lignes directrices générales



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 29821-1 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 5, *Condition monitoring and diagnostics of machines*.

ISO 29821 consists of the following parts, under the general title *Condition monitoring and diagnostics of machines — Ultrasound*:

— *Part 1: General guidelines*

The following part is planned:

— *Part 2: Procedures and validation*

Introduction

This part of ISO 29821 provides guidance for the condition monitoring and diagnostics of machines using airborne and structure-borne ultrasound (A&SB ultrasound). A&SB ultrasound can be used to detect abnormal performance or machine anomalies. The anomalies which are detected are high-frequency acoustic events caused by turbulent flow, ionization events, and friction, which are caused, in turn, by incorrect machinery operation, leaks, improper lubrication, worn components or electrical discharges.

A&SB ultrasound is based on measuring the high-frequency sound that is generated by turbulent flow, by friction or by the ionization created from the anomalies. The inspector therefore requires an understanding of ultrasound and how it propagates through the atmosphere and through structures as a prerequisite to the creation of an A&SB ultrasound programme.

Condition monitoring and diagnostics of machines — Ultrasound —

Part 1: General guidelines

1 Scope

This part of ISO 29821 outlines methods and requirements for carrying out condition monitoring and diagnostics of machines using airborne and structure-borne ultrasound. It provides measurement, data interpretation, and assessment criteria. This technique is typically carried out on operating machinery under a range of conditions and environments. This is a passive technique that detects acoustic anomalies produced by machines.

2 Normative references

The following referenced documents are indispensable for the application 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 2041, *Mechanical vibration, shock and condition monitoring — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041 and the following apply.

3.1

airborne and structure-borne ultrasound **A&SB ultrasound**

non-destructive test method used to inspect for airborne and structure-borne ultrasound above 20 kHz created from or through a medium

3.2

background noise

unwanted noise present in a signal which cannot be attributed to a specific cause

[ISO 13372:—^[1], 5.2]

NOTE This ultrasonic noise can emanate from the area surrounding the inspection which can cause false indications.

3.3

scanning

moving a receiving transducer or an array of transducers around a suspected source of ultrasound to verify the location

3.4

sonic reflection

airborne ultrasound reflected off a solid surface possibly indicating a false reading

3.5

stethoscope module

waveguide in the form of a rod that is coupled to a receiving transducer that receives ultrasounds by making physical contact with the subject and test equipment, for structure-borne ultrasounds

4 Principle of the airborne and structure-borne method

Airborne and structure-borne ultrasound is a physical wave that occurs within, or on the surface of, the test subject (material or machinery component) and is detected externally either close to or at a distance from the test subject. This technology is based on the detection of high-frequency sounds. Most ultrasonic instruments employed to monitor equipment detect frequencies above 20 kHz, which is above the range of human hearing (20 Hz to 20 kHz). The differences in the way low-frequency and high-frequency sounds travel helps to explain why this technology can be effective for condition monitoring. Low-frequency sounds maintain a high intensity of sound volume and travel further than high-frequency sounds. High-frequency sounds are more directional. As high-frequency sound waves propagate from the point of generation, their intensity level decreases rapidly with distance depending on the elasticity and density of the medium traversed, which helps to identify the origin of a sound source.

Airborne ultrasound is propagated through an atmosphere (air or gas) and detected with an ultrasonic microphone while structure-borne ultrasound is generated within and propagated through the structure, and is usually detected with a stethoscope (contact) module, although other sensors may be used. These stethoscope modules do not require any coupling agent, as the detection frequencies are low enough that, unlike traditional pulse-echo ultrasound, small air gaps between the contact probe and the structure under test do not significantly attenuate the received signal. If permanently mounted sensors are used, careful mounting techniques should be utilized to avoid signal attenuation or resonances, or both. The structure may be a machine or any component of a machine or a system.

5 Applications of the ultrasound method

Airborne and structure-borne ultrasound can be applied to a wide range of applications of equipment or machinery. Any equipment or machinery that produces turbulent flow, ionization or friction produces ultrasound. Table 1 shows typical examples of ultrasound applications to machine condition monitoring.

6 Training requirements

When performing ultrasound inspections under less-than-ideal conditions with considerable background noise, the confidence in the information obtained is dependent upon the training and experience of the practitioner and the detection method applied. The skills and expertise of the practitioner performing the measurements and analysing the data are critical to the effective application of ultrasound¹⁾. A skilled practitioner shall utilize the proper shielding techniques for minimizing the background ultrasound noise and incorporate methods and procedures that lead to reliable inspection results.

1) ISO 18436-8^[5] will specify the requirements for qualification and assessment of personnel who perform machinery condition monitoring and diagnostics using ultrasound.