SLOVENSKI STANDARD
oSIST prEN ISO 16809:2024

01-september-2024

Neporušitvene preiskave - Ultrazvočno merjenje debeline (ISO/DIS 16809:2024)

Non-destructive testing - Ultrasonic thickness determination (ISO/DIS 16809:2024)

Zerstörungsfreie Prüfung - Dickenbestimmung mit Ultraschall (ISO/DIS 16809:2024)

Essais non destructifs - Détermination de l'épaisseur par ultrasons (ISO/DIS 16809:2024)

Ta slovenski standard je istoveten z: **prEN ISO 16809**

ICS:

19.100	Neporušitveno preskušanje	Non-destructive testing

oSIST prEN ISO 16809:2024 **en,de**

DRAFT International Standard

ISO/DIS 16809

Non-destructive testing — Ultrasonic thickness determination

ICS: 19.100

ISO/TC **135**/SC **3**

Secretariat: **DIN**

Voting begins on:
2024-06-17

Voting terminates on:
2024-09-09

This document is circulated as received from the committee secretariat.

ISO/CEN PARALLEL PROCESSING

Reference number
ISO/DIS 16809:2024(en)

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Published in Switzerland

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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).

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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 3, *Ultrasonic testing*.

This third edition cancels and replaces the second edition (ISO 16809:2017), which has been technically revised.

The main changes are as follows:

— the terminology in the document has been changed from measurement to determination. Only the time of flight of the ultrasonic signal can be measured in relation to traceable references. Thickness and sound velocity can therefore only be determined;

— the terminology has been aligned with ISO 16831;

— ultrasonic instruments with A-scan presentation that comply with ISO 22232-1 can be used to determine wall thicknesses;

— all figures have been improved.

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 — Ultrasonic thickness determination

1 Scope

This document specifies the principles for the determination of the thickness of metallic and non-metallic materials by contact technique or immersion technique, based on measurement of time of flight of ultrasonic pulses only.

2 Normative references

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 5577, *Non-destructive testing — Ultrasonic testing — Vocabulary*

ISO 16831, *Non-destructive testing — Ultrasonic testing — Characterization and verification of ultrasonic equipment for the determination of thickness*

ISO 22232-1, *Non-destructive testing — Characterization and verification of ultrasonic test equipment — Part 1: Instruments*

ISO 22232-2, *Non-destructive testing — Characterization and verification of ultrasonic test equipment — Part 2: Probes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5577 apply.

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 Modes of determination

The thickness of a test object is determined by accurately measuring the time required for a short ultrasonic pulse generated by a transducer to travel through the thickness of the material once, twice or several times.

The material thickness is calculated by multiplying the known sound velocity of the material of the test object with the measured time of flight and dividing by the number of times the pulse transits the material wall.

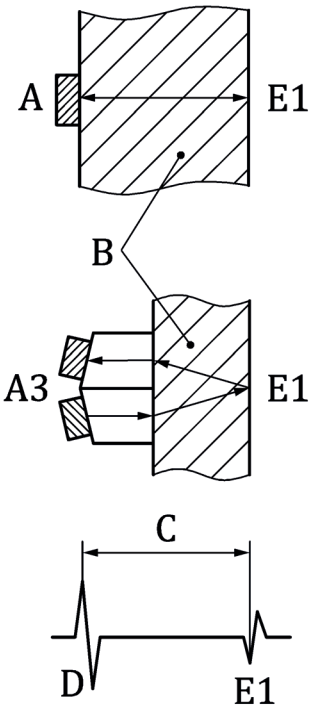
This principle can be accomplished by applying one of the following modes, see Figure 1.

Mode 1: Measure the time of flight from an initial excitation pulse to a first returning echo, minus a zero-point correction to account for the thickness of the probe's wear plate or delay path and the couplant layer (single-echo mode).

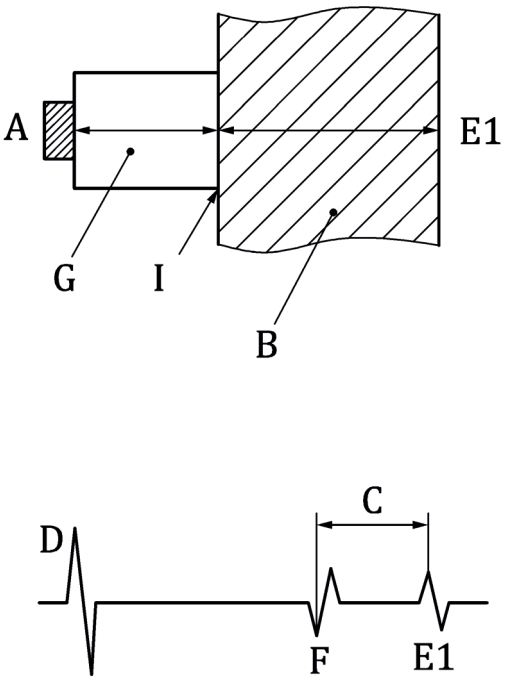
Mode 2: Measure the time of flight from the end of a delay line to the first back wall echo (single-echo delay line mode).

Mode 3: Measure the time of flight between back wall echoes (multiple-echo mode).

Mode 4: Measure the time of flight for a pulse travelling from the transmitter to a receiver in contact with the back wall (through-transmission mode).



Mode 1



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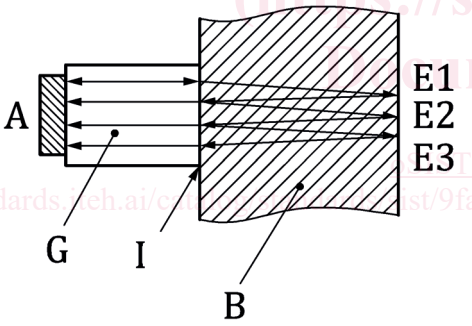
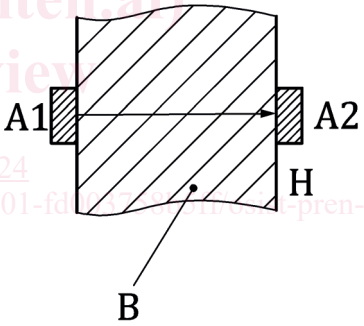
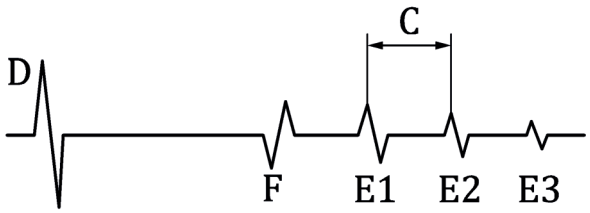
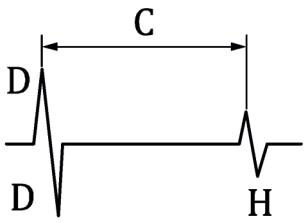






Mode 3



Mode 4

Key

A	transmit/receive probe	D	transmission pulse indication
A1	transmit probe	E1 to E3	back wall echoes
A2	receive probe	F	interface
A3	dual-transducer probe	G	delay path
B	test object	H	received pulse
C	time of flight used in a specific mode	I	interface

NOTE The interface echo is typically not visible for mode 1.

Figure 1 — Modes of determination

5 General requirements

5.1 Instruments

The ultrasonic instrument shall fulfil the requirements of ISO 16831 or ISO 22232-1, depending on the type of instrument. The following types of instruments shall be used to perform thickness determination:

a) dedicated ultrasonic instruments for the determination of thickness with only numerical display showing the determined thickness value;

b) dedicated ultrasonic instruments for the determination of thickness with numerical display showing the determined thickness value and A-scan presentation;

c) ultrasonic instruments not limited to thickness determination but designed primarily for the detection of discontinuities with A-scan presentation. The operator reads the positions of a signal on the time base of the display, or this type of instrument can also include a gate and numerical display showing the determined thickness value.

See 6.4 for the selection of instrument.

5.2 Probes

The probe(s) shall initially fulfil the requirements of ISO 22232-2. The following types of probes shall be used; these are generally longitudinal wave probes:

— dual-transducer probes;

— single-transducer probes.

See 6.3 for the selection of probe.

5.3 Couplant

a) Acoustic contact between the probe(s) and the test object shall be provided, normally by application of a fluid or gel.

b) The couplant shall not have any adverse effect on the test object, the equipment or represent a health hazard to the operator.

c) The couplant shall be chosen to suit the surface conditions and the irregularities of the surface to ensure adequate coupling.

For the use of the couplant in special test conditions, see 6.6.

5.4 Reference blocks

a) The equipment for the determination of thickness shall be set using one or more samples or reference blocks representative of the test object, i.e. having comparable dimensions, material and structure.

b) The thickness of the blocks or the steps should cover the range of thickness to be determined.

c) Either the thickness or the sound velocity of the reference blocks shall be known.

5.5 Test objects

a) The test object shall allow for ultrasonic wave propagation.

b) There shall be free access to each individual area to be tested.

c) The surface of the area to be tested shall be free of all dirt, grease, lint, scale, welding flux and spatter, oil or other extraneous matter that could interfere with the testing.

d) If the surface is coated, the coating shall have good adhesion to the material. Otherwise it shall be removed.

e) When testing through coating its thickness and sound velocity need to be known unless mode 3 is used.

For further details, see 6.1 and Clause 8.

5.6 Qualification of test personnel

a) An operator performing ultrasonic thickness determination according to this document shall have a basic knowledge of the physics of ultrasound, and a detailed understanding and training related to ultrasonic thickness determination.

b) In addition, the operator shall have knowledge of the product and material to be tested.

c) It is assumed that ultrasonic thickness determination is performed by qualified and capable personnel. In order to prove this qualification, it is recommended that personnel be qualified in accordance with ISO 9712 or equivalent.

6 Application of the techniques

6.1 Surface conditions and surface preparation

Using the pulse-echo technique means that the ultrasonic pulse needs to pass the test surface between test object and the probe at least twice: when entering the object and when leaving it.

Therefore, a clean and even contact area with at least twice the probe's diameter is preferred. Poor contact will result in loss of energy, distortion of signals and sound path.

a) To enable sound propagation all loose parts and non-adherent coatings shall be removed by brushing or grinding.

b) Attached layers, like colour coating, plating, enamels, may stay on the object, but only a few ultrasonic instruments are able to exclude these layers from the thickness determination.

c) Very often, thickness determination needs to be done on corroded surfaces, e.g. storage tanks and pipelines.

To increase the accuracy in this case the test surface should be ground within an area at least two times the probe's diameter.

This area should be cleaned from corrosion products.