

**Non-destructive testing of welds - Ultrasonic testing -
Use of automated total focusing technique (TFM) and
related technologies (ISO 23864:2021)**

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 23864:2021 sisaldab Euroopa standardi EN ISO 23864:2021 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 23864:2021 consists of the English text of the European standard EN ISO 23864:2021.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
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Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.	The standard is available from the Estonian Centre for Standardisation and Accreditation.

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English Version

**Non-destructive testing of welds - Ultrasonic testing - Use
of automated total focusing technique (TFM) and related
technologies (ISO 23864:2021)**

Essais non destructifs des assemblages soudés -
Contrôle par ultrasons - Utilisation de la technique
d'acquisition automatisée de focalisation en tout point
(FTP) et de techniques associées (ISO 23864:2021)

Zerstörungsfreie Prüfung von Schweißverbindungen -
Ultraschallprüfung - Verwendung der automatisierten
Totalfokussierungsmethode (TFM) und verwandte
Technologien (ISO 23864:2021)

This European Standard was approved by CEN on 5 December 2021.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of ISO 23864:2021 has been prepared by Technical Committee IIW "International Institute of Welding" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 23864:2021 by Technical Committee CEN/TC 121 "Welding and allied processes" the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by June 2022, and conflicting national standards shall be withdrawn at the latest by June 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 23864:2021 has been approved by CEN as EN ISO 23864:2021 without any modification.

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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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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 the IIW, *International Institute of Welding*, Commission V, *NDT and Quality Assurance of Welded Products*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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 of welds — Ultrasonic testing — Use of automated total focusing technique (TFM) and related technologies

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This document specifies the application of the TFM technique and related technologies for semi- or fully automated ultrasonic testing of fusion- welded joints in metallic materials of minimum thickness 3,2 mm.

NOTE Unless stated otherwise, in this document “TFM” and “TFM technique” refer to the TFM technique as defined in ISO 23243, and to all related technologies, see for example ISO 23865 and ISO 23243.

This document is applicable to components with welds fabricated using metals which have isotropic (constant properties in all directions) and homogeneous conditions. This includes welds in low carbon alloy steels and common aerospace grade aluminium and titanium alloys, provided they are homogeneous and isotropic.

This document applies to full penetration welded joints of simple geometry in plates, pipes and vessels.

This document specifies four testing levels (A, B, C, D), each corresponding to a different probability of detection of imperfections. Guidance on the selection of testing levels is provided. Coarse-grained metals and austenitic welds can be tested when the provisions of this document have been taken into account.

This document gives provisions on the specific capabilities and limitations of the TFM technique for the detection, locating, sizing and characterization of discontinuities in fusion-welded joints. The TFM technique can be used as a stand-alone approach or in combination with other non-destructive testing (NDT) methods for manufacturing, in-service and post-repair tests.

This document includes assessment of indications for acceptance purposes based on either amplitude (equivalent reflector size) and length or height and length.

This document does not include acceptance levels for discontinuities.

The following two typical testing techniques for welded joints are referred to in this document:

- a) side scanning, where the probe(s) is (are) positioned adjacent to the weld cap, typically using wedges. Side scanning can be performed from one side or both sides of the weld;
- b) top scanning where the probe is positioned on top of weld cap with a flexible, conformable delay line or using immersion technique, or using contact technique after removing the weld cap.

Semi-automated testing encompasses a controlled movement of one or more probes along a fixture (guidance strip, ruler, etc.), whereby the probe position is measured with a position sensor. The scan is performed manually.

In addition, fully automated testing includes mechanized propulsion.

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 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

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

ISO 17635, *Non-destructive testing of welds — General rules for metallic materials*

ISO 18563-1, *Non-destructive testing — Characterization and verification of ultrasonic phased array equipment — Part 1: Instruments*

ISO 18563-2, *Non-destructive testing — Characterization and verification of ultrasonic phased array equipment — Part 2: Probes*

ISO 23865:2021, *Non-destructive testing — Ultrasonic testing — General use of full matrix capture/ total focusing method technique*

ISO 23243, *Non-destructive testing — Ultrasonic testing with arrays - Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5577, ISO 17635, ISO 23865 and ISO 23243 apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Testing levels

Quality requirements for welded joints are mainly associated with the material, the welding process and the service conditions. To accommodate all these requirements, this document specifies four testing levels (A, B, C, and D).

From testing level A to testing level C, an increasing probability of detection is achieved by an increasing testing coverage, i.e. covering the test volume in multiple ways, e.g. number of imaging paths, number of array positions.

Testing level D may be agreed for special applications using a written procedure which shall take into account the general requirements of this document. This includes tests of metals other than ferritic steel, tests on partial penetration welds, tests at object temperatures outside the range of 7.7. For level D, a verification on test blocks is mandatory.

Testing levels related to quality levels shall be in accordance with ISO 5817 or technically equivalent standards. The appropriate testing level can be specified by standards for testing of welds (e.g. ISO 17635), by product standards or by other documents. When ISO 17635 is specified, the recommended testing levels are as given in [Table 1](#).