



# SLOVENSKI STANDARD SIST EN ISO 10863:2011

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Nadomešča:

SIST-TS CEN/TS 14751:2005

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**Neporušitveno preskušanje zvarov - Ultrazvočna preiskava - Uporaba tehnike TOFD (ISO 10863:2011)**

Non-destructive testing of welds - Ultrasonic testing - Use of time-of-flight diffraction technique (TOFD) (ISO 10863:2011)

Zerstörungsfreie Prüfung von Schweißverbindungen - Ultraschallprüfung - Anwendung der Beugungslaufzeittechnik (TOFD) (ISO 10863:2011)

Contrôle non destructif des assemblages soudés - Contrôle par ultrasons - Utilisation de la technique de diffraction des temps de vol (méthode TOFD) (ISO 10863:2011)

**Ta slovenski standard je istoveten z: EN ISO 10863:2011**

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**ICS:**

25.160.40 Varjeni spoji in vari Welded joints

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN ISO 10863**

September 2011

ICS 25.160.40

Supersedes CEN/TS 14751:2004

English Version

## Non-destructive testing of welds - Ultrasonic testing - Use of time-of-flight diffraction technique (TOFD) (ISO 10863:2011)

Contrôle non destructif des assemblages soudés - Contrôle par ultrasons - Utilisation de la technique de diffraction des temps de vol (méthode TOFD) (ISO 10863:2011)

Zerstörungsfreie Prüfung von Schweißverbindungen - Ultraschallprüfung - Anwendung der Beugungslaufzeittechnik (TOFD) (ISO 10863:2011)

This European Standard was approved by CEN on 27 August 2011.

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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 CEN-CENELEC Management Centre has the same status as the official versions.

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## Foreword

This document (ISO 10863:2011) has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 44 "Welding and allied processes".

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of an identical text or by endorsement, at the latest by March 2012, and conflicting national standards shall be withdrawn at the latest by March 2012.

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

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# INTERNATIONAL STANDARD

**ISO**  
**10863**

First edition  
2011-09-01

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## **Non-destructive testing of welds — Ultrasonic testing — Use of time-of-flight diffraction technique (TOFD)**

*Contrôle non destructif des assemblages soudés — Contrôle par  
ultrasons — Utilisation de la technique de diffraction des temps de vol  
(méthode TOFD)*

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## ISO 10863:2011(E)

## 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 10863 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding*, in collaboration with Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 5 via your national standards body. A complete listing of these bodies can be found at [www.iso.org](http://www.iso.org).

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# Non-destructive testing of welds — Ultrasonic testing — Use of time-of-flight diffraction technique (TOFD)

## 1 Scope

This International Standard specifies the application of the time-of-flight diffraction (TOFD) technique to the semi- or fully automated ultrasonic testing of fusion-welded joints in metallic materials of minimum thickness 6 mm. It applies to full penetration welded joints of simple geometry in plates, pipes, and vessels, where both the weld and parent material are low-alloyed carbon steel. Where specified and appropriate, TOFD can also be used on other types of materials that exhibit low ultrasonic attenuation (especially that due to scatter).

Where material-dependent ultrasonic parameters are specified in this International Standard, they are based on steels having a sound velocity of  $(5\,920 \pm 50)$  m/s for longitudinal waves, and  $(3\,255 \pm 30)$  m/s for transverse waves. It is necessary to take this fact into account when examining materials with a different velocity.

This International Standard makes reference to the basic standard EN 583-6 and provides guidance on the specific capabilities and limitations of TOFD for the detection, location, sizing and characterization of discontinuities in fusion-welded joints. TOFD can be used as a stand-alone method or in combination with other non-destructive testing (NDT) methods or techniques, for manufacturing inspection, and for in-service inspection.

This International Standard specifies four testing levels (A, B, C, D) in accordance with ISO 17635 and corresponding to an increasing level of inspection reliability. Guidance on the selection of testing levels is provided.

This International Standard permits assessment of TOFD indications for acceptance purposes. This assessment is based on the evaluation of transmitted, reflected and diffracted ultrasonic signals within a generated TOFD image.

This International Standard does not include acceptance levels for discontinuities.

## 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 9712, *Non-destructive testing — Qualification and certification of NDT personnel — General principles*

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

ISO 17640:2010, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment*

EN 473, *Non-destructive testing — Qualification and certification of NDT personnel — General principles*

EN 583-6, *Non-destructive testing — Ultrasonic examination — Part 6: Time-of-flight diffraction technique as a method for detection and sizing of discontinuities*

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EN 1330-4, *Non-destructive testing — Terminology — Part 4: Terms used in ultrasonic testing*

EN 12668 (all parts), *Non-destructive testing — Characterization and verification of ultrasonic examination equipment*

**3 Terms and definitions**

For the purposes of this document, the terms and definitions given in EN 1330-4 and the following apply.

**3.1**  
**time-of-flight diffraction setup**  
**TOFD setup**  
probe arrangement defined by probe characteristics (e.g. frequency, probe element size, beam angle, wave mode) and probe centre separation

**3.2**  
**probe centre separation**  
**PCS**  
distance between the index points of the two probes

NOTE The PCS for two probes located on a curved surface is the straight-line, geometric separation between the two probe index points and not the distance measured along the surface.

**3.3**  
**beam intersection point**  
point of intersection of the two main beam axes

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**3.4**  
**time-of-flight diffraction indication**  
**TOFD indication**  
pattern or disturbance in the time-of-flight diffraction image which may need further evaluation

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**3.5**  
**time-of-flight diffraction image**  
**TOFD image**  
two-dimensional image, constructed by collecting adjacent A-scans while moving the time-of-flight diffraction setup

NOTE The signal amplitude of the A-scans is typically represented by grey-scale values.

**3.6**  
**offset scan**  
scan parallel to the weld axis, where the beam intersection point is not on the centreline of the weld

**4 General remarks on the capabilities of the technique**

General principles of the TOFD technique are described in EN 583-6. For the testing of fusion-welded joints, some specific capabilities and limitations of the technique have to be considered.

The TOFD technique is an ultrasonic image-generating technique, which offers the capability of detection, location, and sizing. To a certain extent, characterization of discontinuities in the weld material as well as in the adjacent parent material is also possible.

Compared with purely reflection-based techniques, the TOFD technique, which is based upon diffraction as well as reflection, is less sensitive to the orientation of the discontinuity. Discontinuities oriented perpendicular to the surface, and at intermediate angles of tilt, are detectable as well as discontinuities in the weld fusion faces.

In certain circumstances (thickness, weld preparation, scope of testing, etc.) more than one single TOFD setup is required.

A typical TOFD image is linear in time (vertical axis) and probe movement (horizontal axis). Because of the V-configuration of the ultrasound paths, the location of a possible discontinuity is then non-linear. TOFD testing has to be carried out in a correct and consistent way, such that valid images are generated which can be evaluated correctly, e.g. coupling losses and data acquisition errors have to be avoided, see 12.2.

The interpretation of TOFD images requires skilled and experienced operators. Some typical TOFD images of discontinuities in fusion-welded joints are provided in Annex B.

There is a reduced capability for the detection of discontinuities close to or connected with the scanning surface or with the opposite surface. This has to be considered especially for crack-sensitive steels or at in-service inspections. In cases where full coverage of these zones is required, additional measures shall be taken, e.g. TOFD can be accompanied by other NDT methods or techniques.

Diffraction signals from weld discontinuities can have small amplitude responses. The grain scatter effect from coarse-grained material can hinder the detection and evaluation of such responses. This shall be taken into account whenever inspecting such material.

## 5 Testing levels

This International Standard specifies four testing levels (A, B, C and D, see Table 1). From testing level A to testing level C an increasing reliability is achieved.

Table 1 — Testing levels

Testing level	TOFD setup	Reference block for setup verification (see 8.2)	Reference block for sensitivity settings (see 10.1.4)	Offset scan	Written test procedure
A	As in Table 2	No	No	No	This International Standard
B	As in Table 2	No	Yes	No	This International Standard
C	As in Table 2	Yes	Yes	a	Yes
D	As defined by specification	Yes	Yes	a	Yes

<sup>a</sup> The necessity, number and position of offset scans have to be determined.

If the specified acceptance level requires detection of a certain size of discontinuity at both or one surface of the weld (see Clause 4), this can necessitate the use of techniques or methods outside the scope of this International Standard.

For manufacturing inspections (see also ISO 17635), all testing levels are applicable. Level A is only applicable for wall thicknesses up to 50 mm. For in-service inspections, only testing level D shall be applied.

## 6 Information required prior to testing

### 6.1 Items to be defined by specification

Information on the following items is required:

- a) purpose and extent of TOFD testing (see Clauses 5 and 8);