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**Non-destructive testing of welds —  
Ultrasonic testing — Use of automated  
phased array technology for thin-  
walled steel components**

*Essais non destructifs des assemblages soudés — Contrôle par  
ultrasons — Utilisation de la technique multi-éléments automatisés  
pour les composants en acier à paroi mince*



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ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

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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](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*.

Any feedback, question or request for official interpretation related to any aspect of this document 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/members.html](http://www.iso.org/members.html). Official interpretations, where they exist, are available from this page: <https://committee.iso.org/sites/tc44/home/interpretation.html>.



# Non-destructive testing of welds — Ultrasonic testing — Use of automated phased array technology for thin-walled steel components

## 1 Scope

This document specifies the application of phased array technology for the semi- or fully automated ultrasonic testing of fusion-welded joints in steel parts with thickness values between 3,2 mm and 8,0 mm. This meets the typical range of tube wall thickness values in boilers, which is an important application of this testing technology. The minimum and maximum value of the wall thickness range can be exceeded, when testing level “D” of this document is applied. This document applies to full penetration welded joints of simple geometry in plates, tubes, pipes, and vessels, where both the weld and parent material are low-alloy and/or fine grained steel.

NOTE “Semi-automated testing” encompasses a controlled movement of one or more probes on the surface of a component along a fixture (guidance strip, ruler, etc.), whereby the probe position is unambiguously measured with a position sensor. The probe is moved manually. “Fully automated testing” includes mechanized propulsion in addition.

Where material-dependent ultrasonic parameters are specified in this document, 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 testing materials with a different velocity.

This document provides guidance on the specific capabilities and limitations of phased array technology for the detection, location, sizing and characterization of discontinuities in fusion-welded joints. Ultrasonic phased array technology can be used as a stand-alone technique or in combination with other non-destructive testing (NDT) methods or techniques, during manufacturing and testing of new welds/repair welds (pre-service testing).

This document specifies two testing levels:

- level “C” for standard situations;
- level “D” for different situations/special applications.

This document describes assessment of discontinuities for acceptance purposes based on:

- height and length;
- amplitude (equivalent reflector size) and length;
- go/no-go decision.

This document does not include acceptance levels for discontinuities.

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

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

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 18563-3, *Non-destructive testing — Characterization and verification of ultrasonic phased array equipment — Part 3: Combined systems*

EN 16018, *Non-destructive testing — Terminology — Terms used in ultrasonic testing with phased arrays*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5577 and EN 16018 and the following 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/>

**3.1  
phased array image**  
one- or two-dimensional display, constructed from the collected information of phased array operation

**3.2  
indication**  
**phased array indication**  
pattern or disturbance in the *phased array image* (3.1) which may need further evaluation

**3.3  
phased array set-up**  
probe arrangement defined by probe characteristics (e.g. frequency, probe element size, beam angle, wave mode), probe position, and the number of probes, adaptation to the curvature of the test object

**3.4  
scan increment**  
distance between successive data collection points in the direction of scanning (mechanically or electronically)

**3.5  
skewed scan**  
scan performed with a skewed beam angle

Note 1 to entry: The skewed beam angle can be achieved electronically or by changing the probe orientation.

### 4 Testing levels

Quality requirements for welded joints are mainly associated with the material, welding process and service conditions. To accommodate all of these requirements, this document specifies two testing levels “C” and “D”. A written procedure is mandatory for both testing levels C and D.

Testing level C applies to the standardized approach for thin-walled components (see [Tables 1](#) and [2](#)), e.g. testing from two sides or testing from one side of the weld with the cap removed.