
**Non-destructive testing of welds —
Phased array ultrasonic testing
(PAUT) — Acceptance levels**

*Essais non destructifs des assemblages soudés — Technique ultrasons
multi-éléments (PAUT) — Niveaux d'acceptation*

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Foreword

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

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Non-destructive testing of welds — Phased array ultrasonic testing (PAUT) — Acceptance levels

1 Scope

This document specifies acceptance levels for the phased array ultrasonic testing technique (PAUT) of full penetration welds in ferritic steels of minimum thickness of 6 mm which correspond to the quality levels of ISO 5817.

These acceptance levels are applicable to indications classified in accordance with ISO 13588.

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 11666, *Non-destructive testing of welds — Ultrasonic testing — Acceptance levels*

ISO 13588, *Non-destructive testing of welds — Ultrasonic testing — Use of automated phased array technology*

ISO 15626, *Non-destructive testing of welds — Time-of-flight diffraction technique (TOFD) — Acceptance levels*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5577 and ISO 13588 apply.

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

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

4 Symbols

h	height
h_g	sum of the heights of the individual indications plus the distance between them
l	length
l_g	sum of the lengths of the individual indications plus the distance between them
t	thickness

5 Acceptance levels

For the evaluation, three different acceptance levels are defined. The relation between these acceptance levels and the quality levels as mentioned in ISO 5817 are given in [Table 1](#).

Table 1 — Related levels for phased array ultrasonic testing

Quality level according to ISO 5817	Testing level according to ISO 13588	Acceptance level according to this document
C, D	A	3
B	B	2
By agreement	C	1
Special application	D	By agreement
NOTE Acceptance criteria for acceptance level 1 are only specified for evaluation based on length and height.		

6 Evaluation of indications

Indications detected when applying ISO 13588 shall be evaluated as specified in the test procedure either by:

- length and height, then [Clause 7](#) and [Clause 9](#) shall be applied;
- or by length and maximum amplitude, then [Clause 8](#) and [Clause 10](#) shall be applied.

7 Determination of length and height

7.1 General

The size of a discontinuity is determined by its length and height.

7.2 Determination of length

The length of an indication shall be measured as described in ISO 11666, using the focal law which provides the maximum amplitude.

If TOFD is used, the length of an indication shall be measured as described in ISO 15626.

In any other case, testing level D of [Table 1](#) is applicable.

7.3 Determination of height

7.3.1 General

For indications displaying varying height along their length, the height shall be determined at the scan position of maximum extent.

7.3.2 Using diffracted signals

If diffracted signals are observed, they shall be used to determine height. The height is determined using either:

- two diffracted signals observed from the same discontinuity (upper and lower tip);
- one diffracted signal and a surface signal observed from the same discontinuity;
- one diffracted signal and the known wall thickness for root connected discontinuities;

- one diffracted signal in relation to the surface for a surface breaking discontinuity.

If TOFD is used, the height shall be measured as described in ISO 15626.

7.3.3 Using other signals

In case a height cannot be measured using diffracted signals, then the determination can be based on:

- amplitudes using the reference levels as described in ISO 11666. Other sizing techniques may be used (TCG, DGS, 6 dB drop);
- the time-of-flight of reflections (e.g. hollow root, mismatch);
- the time-of-flight of mode converted signals.

8 Determination of length and maximum amplitude

The length of an indication shall be determined by measuring the distance along the weld over which the echo amplitude is above the evaluation level using the fixed amplitude level technique specified in [Annex B](#).

Alternative techniques for measuring indication length may be used when specified.

9 Acceptance criteria based on length and height

9.1 General

When indications are detected, length and height are determined in accordance with [7.2](#) and [7.3](#). Indications shall be evaluated according to their acceptance level and the acceptance criteria listed in this clause.

For welds joining two different thicknesses, the thinner of those two is leading for the acceptance criteria.

9.2 Single indications

9.2.1 Acceptance criteria for level 1

Acceptance criteria for level 1 are given in [Table 2](#).

Table 2 — Acceptance criteria for level 1

Thickness range	Maximum allowable length ($l_{\max}$) if $h < h_2$ or h_3			Maximum allowable height (h_1) when $l > l_{\max}$
	$l_{\max}$ mm	Surface breaking h_3 mm	Embedded h_2 mm	
$6 \text{ mm} < t \leq 15 \text{ mm}$	$0,75t$	1,5	2	1
$15 \text{ mm} < t \leq 50 \text{ mm}$	$0,75t$	2	3	1
$50 \text{ mm} < t \leq 100 \text{ mm}$	40	2,5	4	2
$t > 100 \text{ mm}$	50	3	5	2

9.2.2 Acceptance criteria for level 2

Acceptance criteria for level 2 are given in [Table 3](#).