
**Non-destructive testing — Ultrasonic
testing — Specification for a
calibration block for phased array
testing (PAUT)**

*Essais non destructifs — Contrôle par ultrasons — Spécifications
relatives au bloc d'étalonnage pour la technique multiéléments*

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Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviated terms	1
5 Manufacture	2
5.1 Steel.....	2
5.2 Pre-machining and heat treatment.....	2
5.2.1 Raw blocks.....	2
5.2.2 Heat treatment.....	2
5.2.3 Checking prior to final machining.....	2
5.3 Final machining.....	3
5.3.1 Dimensions and surface finish.....	3
5.3.2 Reference marks.....	3
5.3.3 Velocity checks.....	3
6 Marking	3
7 Declaration of conformity	6
8 Possible modifications to phased array calibration block	6
Annex A (normative) Determination of material anisotropy	8
Annex B (informative) Description of possible uses of the PAUT calibration block	13
Bibliography	19

[ISO 19675:2017](https://standards.iteh.ai/catalog/standards/sist/3dd3294b-ec6a-4751-9d33-a2acaef99945/iso-19675-2017)

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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).

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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/IIW, *International Institute of Welding*, Commission V.

ISO 19675:2017

Requests for official interpretations of any aspect of this document should be directed to the ISO Central Secretariat, who will forward them to the IIW Secretariat for an official response.

Non-destructive testing — Ultrasonic testing — Specification for a calibration block for phased array testing (PAUT)

1 Scope

This document specifies requirements for the dimensions, material and manufacture of a steel block for calibrating ultrasonic test equipment used in ultrasonic testing with the phased array technique.

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*

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

EN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

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3 Terms and definitions

ISO 19675:2017

For the purposes of this document, the terms and definitions given in ISO 5577 and EN 16018 apply.

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

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

4 Abbreviated terms

ACG	angle-corrected gain
FSH	full-screen height
RF	radio frequency
SDH	side-drilled hole
SNR	signal- to-noise ratio
TCG	time-corrected gain

5 Manufacture

5.1 Steel

Blocks shall be manufactured from steel grade S355J0, in accordance with EN 10025-2, or equivalent.

5.2 Pre-machining and heat treatment

5.2.1 Raw blocks

Raw blocks shall be rough-machined to a dimension of 320 mm × 120 mm × 30 mm before heat treatment.

5.2.2 Heat treatment

The heat treatment shall consist of:

- 1) austenitizing at 920 °C for 30 min;
- 2) rapid cooling (quenching) in water;
- 3) tempering by heating to 650 °C for 3 h;
- 4) cooling in still air.

5.2.3 Checking prior to final machining

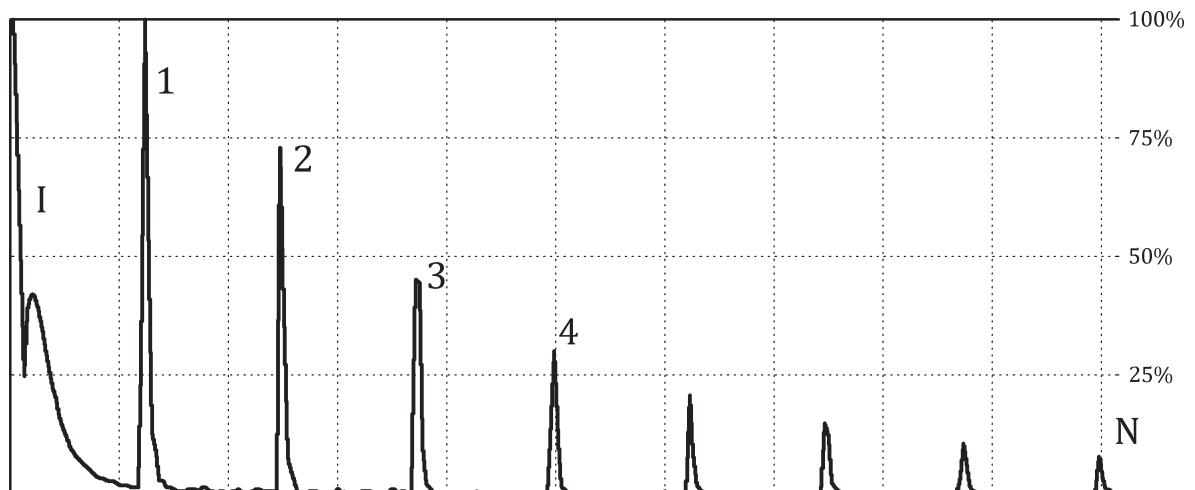
It is recommended to pre-machine the block to the following dimensions: 305 mm × 101 mm × 26,5 mm.

All external surfaces shall be pre-machined to a roughness value not greater than 1,6 µm R_a .

The pre-machined block shall be in accordance with the following.

- a) It shall be free from internal discontinuities. For this purpose, an ultrasonic test shall be carried out after heat treatment, with a longitudinal wave straight-beam probe of at least 10 MHz nominal centre frequency and having a transducer size of 10 mm to 15 mm. The block shall be checked on all four long faces to cover the complete volume. With the probe positioned on the largest face of the block, the instrument's gain shall be set to achieve a grain scatter noise of 10 % of full screen height. No echo shall have an amplitude greater than that of the grain scatter noise;
- b) It shall be isotropic for transverse and longitudinal waves proved by velocity measurements in accordance with [Annex A](#) (see [A.3](#)). Probes shall be located around the mid-position of each of the three faces;
- c) It shall present low sound attenuation.

NOTE Absolute measurements of attenuation may be difficult to obtain because echo amplitudes depend on many factors. The significance of attenuation can be estimated by simple qualitative tests. Relative attenuation measurements can be made by examining the exponential decay of multiple back wall reflections [a satisfactory attenuation generally is proven by the observation of at least four echoes above of 25 % of FSH when a probe as recommended in [5.2.3 a\)](#) is used]. See [Figure 1](#).



Key

- I initial pulse
1, 2, 3, 4... N multiple back wall echoes

Figure 1 — Acceptable sound attenuation

5.3 Final machining

5.3.1 Dimensions and surface finish

The dimensions and tolerances of the phased array calibration block shall be determined and recorded in accordance with [Annex A](#) (see [A.2](#)) and shall be in accordance with [Figure 2](#). All external surfaces shall be machined to a roughness value not greater than $0.8 \mu\text{m } R_a$.

5.3.2 Reference marks

Permanent reference marks shall be engraved on the block in accordance with [Figure 3](#) and [Table 1](#).

Reference marks shall be regular and not too deep (approx. 0,1 mm max.) and shall not be generated by a metal deformation process. Stamping shall not be used. Etching or laser engraving are the preferred marking processes.

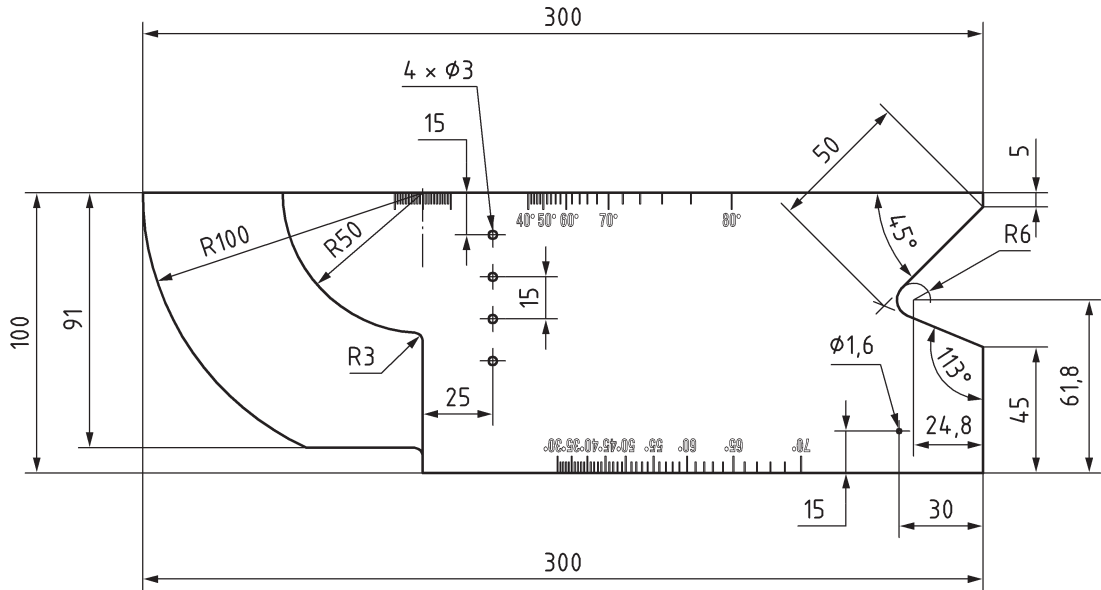
5.3.3 Velocity checks

The velocities of longitudinal and transverse waves shall be determined and recorded in accordance with [Annex A](#) (see [A.3](#)).

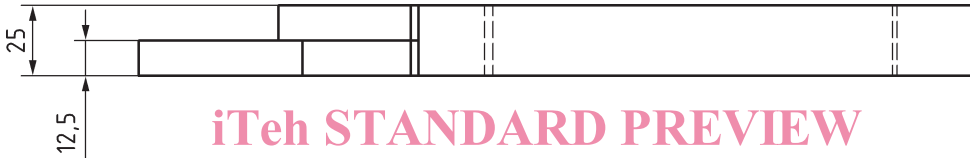
6 Marking

The block shall be permanently marked, in the area shown in [Figure 2 c\)](#), with the following:

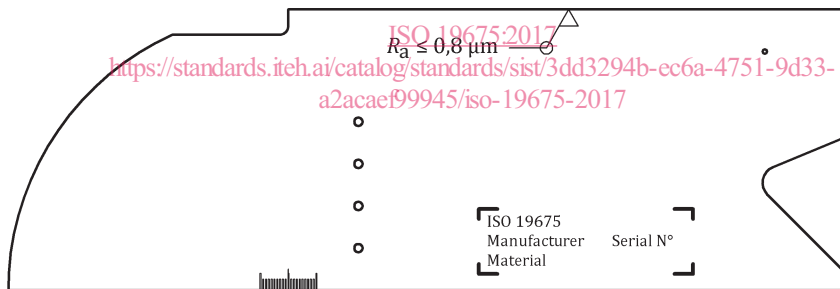
- a reference to this document (i.e. ISO 19675:2016);
- the manufacturer's serial number and trade mark;
- the steel grade used to make the block.



a) Front view



b) Bottom view



c) Back view

Tolerances:

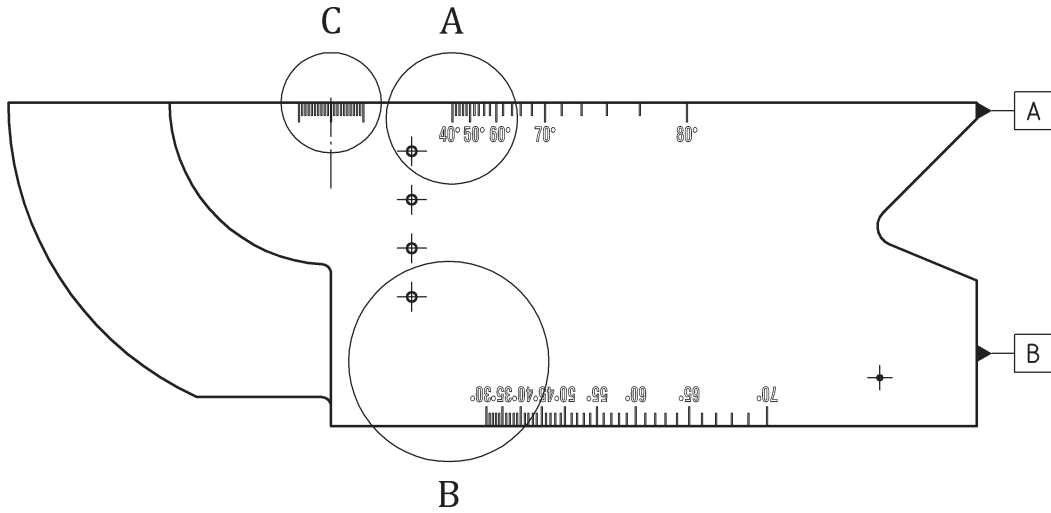
Reflector tolerance per chart, Overall block size tolerance $\pm 0,1$ mm.

Remove all burrs, break all edges, no sharp corners. Mill all surfaces, surface finish, all over $R_a \leq 0,8$ μm .

Machining Tolerances for reflectors and marks

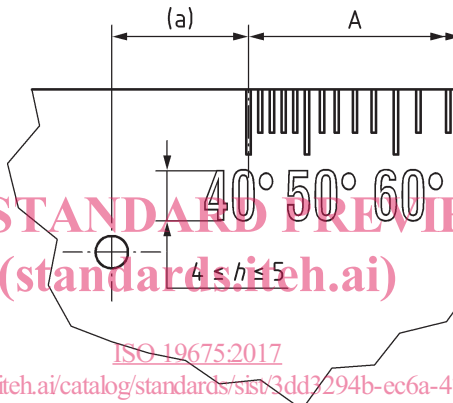
- a) hole diameters, $\pm 0,2$ mm
- c) central position of reference reflectors, $\pm 0,1$ mm
- b) all pertinent angles, $\pm 1^\circ$
- d) angle identification and index mark lengths, $\pm 0,4$ mm

Figure 2 — Block dimensions with tolerances



B

a) Side view

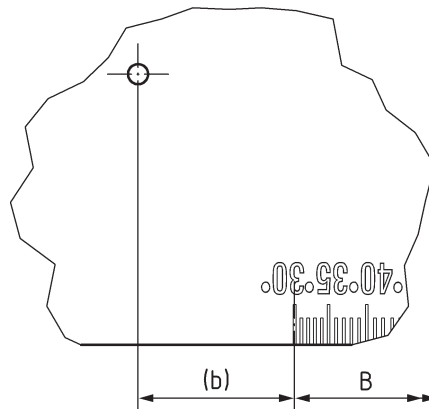


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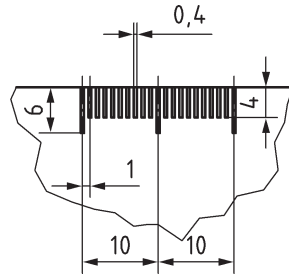
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b) Detail A



c) Detail B



d) Detail C

NOTE See [Table 1](#) for dimensions.

Figure 3 — Reference marks — Dimensions and positions

7 Declaration of conformity

A declaration of conformity shall be issued by the manufacturer for each block, containing:

- a statement that the block complies with this document;
- main physical dimensions of the block and hole diameters as measured;
- attenuation results measured in accordance with [5.2.3](#);
- results of all velocity measurements in accordance with [Annex A](#) (see [A.3](#)).

8 Possible modifications to phased array calibration block

Blocks of thickness greater than 25 mm are permitted to accommodate probes with larger active apertures.

Table 1 — Distances of indents

Distance (a) mm	Distance from datum "A" mm	Indent with label degrees	Indent without label degrees	Distance (b) mm	Distance from datum "B" mm	Indent with label degrees	Indent without label degrees
12,6	162,4	40		23,1	151,9	30	
13,5	161,5		42	24,0	151,0		31
14,5	160,5		44	25,0	150,0		32
15,5	159,5		46	26,0	149,0		33
16,7	158,3		48	27,0	148,0		34
17,9	157,1	50		28,0	147,0	35	
19,2	155,8		52	29,1	145,9		36
20,6	154,4		54	30,1	144,9		37
22,2	152,8		56	31,3	143,7		38
24,0	151,0		58	32,4	142,6		39
26,0	149,0	60		33,6	141,4	40	
28,2	146,8		62	34,8	140,2		41
30,8	144,2		64	36,0	139,0		42
33,7	141,3		66	37,3	137,7		43
37,1	137,9		68	38,6	136,4		44
41,2	133,8	70		40,0	135,0	45	
46,2	128,8		72	41,4	133,6		46
52,3	122,7		74	42,9	132,1		47
60,2	114,8		76	44,4	130,6		48
70,6	104,4		78	46,0	129,0		49
85,1	89,9	80		47,7	127,3	50	
				49,4	125,6		51
				51,2	123,8		52
				53,1	121,9		53
				55,1	119,9		54
				57,1	117,9	55	
				59,3	115,7		56
				61,6	113,4		57
				64,0	111,0		58
				66,6	108,4		59
				69,3	105,7	60	
				72,2	102,8		61
				75,2	99,8		62
				78,5	96,5		63
				82,0	93,0		64
				85,8	89,2	65	
				89,8	85,2		66
				94,2	80,8		67
				99,0	76,0		68
				104,2	70,8		69
				109,9	65,1	70	