INTERNATIONAL STANDARD

ISO 7963

Third edition
2022-10

Non-destructive testing — Ultrasonic testing — Specification for calibration block No. 2

Essais non destructifs — Contrôle par ultrasons — Spécifications relatives au bloc d'étalonnage n° 2

Reference number
ISO 7963:2022(E)

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Published in Switzerland

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Foreword

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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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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 Technical Committee ISO/TC 135, *Non-destructive testing*, Subcommittee SC 3, *Ultrasonic testing* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 138, *Non-destructive testing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 7963:2006), which has been technically revised.

The main changes are as follows:

— document structure aligned with ISO 2400;

— normative references updated;

— wording updated;

— Annex A deleted and the relevant information shifted to the main text;

— Figures 1, 3 and 6 corrected;

— tempering aligned with ISO 2400.

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.

Introduction

Calibration block No. 2 is made of steel and may be used for all ultrasonic testing, as calibration block No. 1 described in ISO 2400.

Calibration block No. 2 differs in size and shape from calibration block No.1 but is made from the same material.

Calibration block No. 2 is much smaller and lighter, and its geometry is much simpler than block No 1.

Calibration block No. 2 does not offer as much scope as the larger block No.1; in particular it is not meant to check an ultrasonic instrument completely.

However, calibration block No. 2 makes it possible, during practical testing, to check simply, from time to time, the setting of the time base and the sensitivity of the ultrasonic instrument. Moreover, it is suited to check the beam angle and the probe index point of miniature angle-beam probes.

The International Institute of Welding (IIW) and its members developed the designs of steel calibration blocks in the 1950s and 1960s which were originally indicated as “IIW calibration block 1” and “IIW calibration block 2”. These designs have been adopted widely and they form the basis of many blocks currently available.

The smaller type block is sometimes indicated as “Rompas block” or “miniature angle-beam block (MAB)”, respectively named after the original Dutch designer or the intended use.

Some commercially available blocks look similar to calibration block No. 2, however such blocks are not necessarily according to this document and can have different features, dimensions or materials.

The details of calibration block No. 2, as specified in this document, have been adapted over time.

Non-destructive testing — Ultrasonic testing — Specification for calibration block No. 2

1 Scope

This document specifies the requirements for the dimensions, material, manufacture and methods of use for calibration block No. 2 for setting and checking ultrasonic test equipment.

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 2400, *Non-destructive testing — Ultrasonic testing — Specification for calibration block No. 1*

ISO 5577, *Non-destructive testing — Ultrasonic testing — Vocabulary*

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

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Manufacture

4.1 Steel

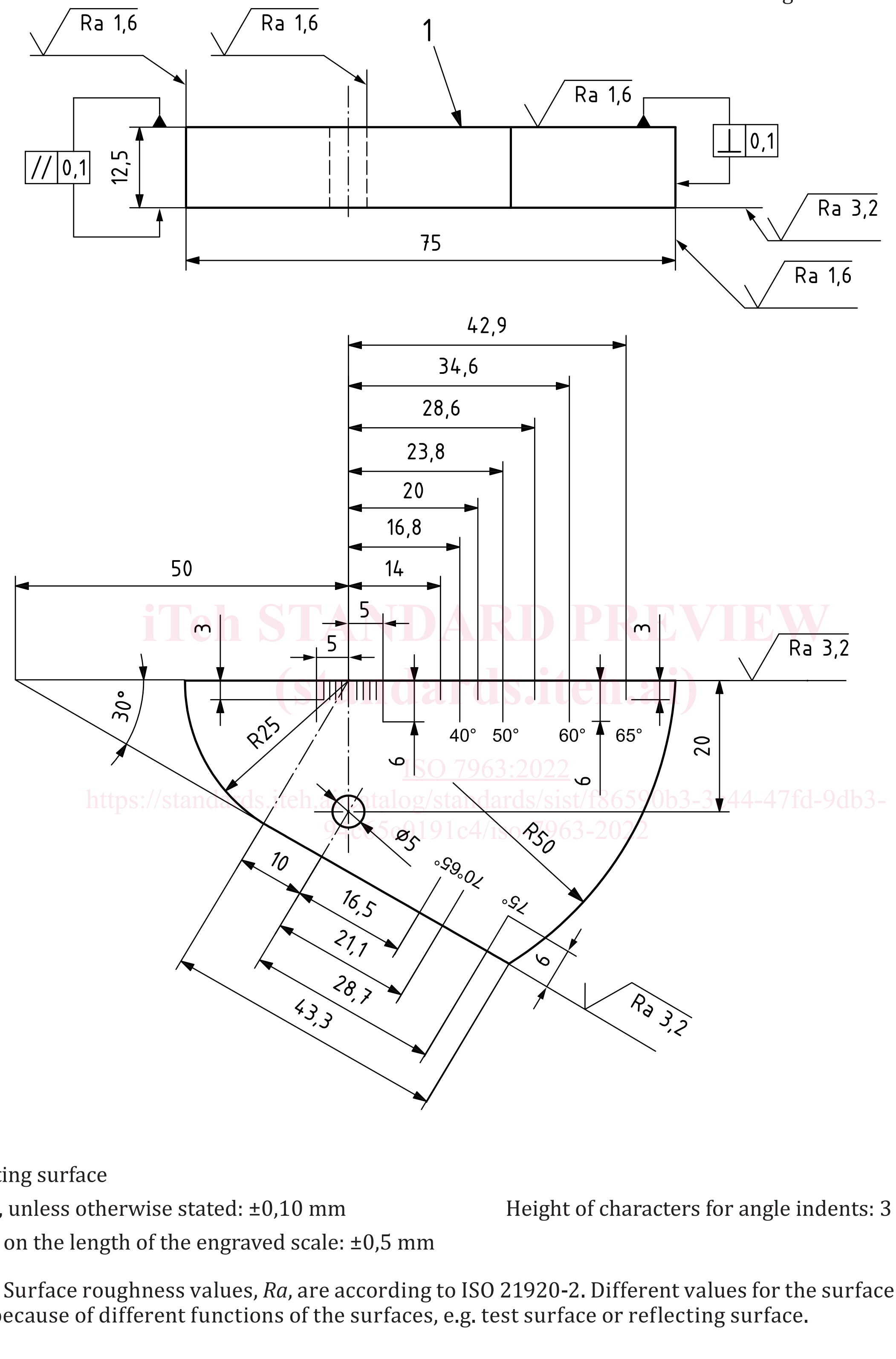
Blocks shall be manufactured from steel grade S355J0, specified in EN 10025-2, or from steel of an equivalent grade.

4.2 Dimensions

The dimensions of calibration block No. 2 shall be as shown in Figure 1.

The thickness of the block may be greater than 12,5 mm, for example 20 mm or 25 mm, when using non-miniature probes.

Dimensions in millimetres
Surface roughness in micrometres



Key

1 reflecting surface

Tolerances, unless otherwise stated: ±0,10 mm

Height of characters for angle indents: 3 mm

Tolerances on the length of the engraved scale: ±0,5 mm

NOTE Surface roughness values, *Ra*, are according to ISO 21920-2. Different values for the surface roughness are given because of different functions of the surfaces, e.g. test surface or reflecting surface.

Figure 1 — Calibration block No. 2 — Dimensions of block and scales

4.3 Machining, heat treatment and surface finish

A proof for homogeneity of the material and the determination of the sound velocities in perpendicular directions is only possible on a rectangular block.

Additionally, to determine the sound velocities with the required precision, a thickness larger than 12,5 mm of calibration block No. 2 is needed.

Therefore, it is recommended to manufacture a large rectangular block as for calibration block No. 1 according to ISO 2400 as a semi-finished block.

a) The block shall be rough-machined to a dimension of 320 mm × 120 mm × 30 mm before heat treatment which 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.

b) At least 2 mm shall be removed from all surfaces after heat treatment.

c) Prior to final machining, the semi-finished block shall be proven to be free from internal discontinuities.

   1) For this purpose, an ultrasonic test shall be carried out after the heat treatment, with a longitudinal wave 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 the basis of all four long faces to cover the complete volume.

   2) With the probe positioned on the largest face of the block, the instrument gain shall be set to achieve a grain scatter noise of 10 % of the full screen height.

   3) No echo from internal imperfections shall have an amplitude greater than that of the grain scatter noise.

d) Prior to final machining, the velocities of longitudinal and transverse waves shall be determined as specified in ISO 2400.

   1) The velocities shall be determined within a maximum permissible error of ±0,2 %, i.e. with an uncertainty of ±6 m/s for transverse waves and ±12 m/s for longitudinal waves.

   2) The determined longitudinal wave velocity, v_l, shall be (5 920 ± 30) m/s and the transverse wave velocity, v_t, shall be (3 255 ± 15) m/s.

e) Then cut this large block into smaller parts to continue with the manufacturing of calibration blocks No. 2.

f) All external surfaces shall be machined to a *Ra* value according to Figure 1.

g) In order to prevent parasitic effects, the depth of the marks of the engraved scale, text and numbers shall be (0,1 ± 0,05) mm.

h) The length of the marks shall be 6 mm or 3 mm, and the tolerance on the positioning of the marks shall be ±0,2 mm.

4.4 Reference marks

a) Reference marks as shown in Figure 1 shall be permanent.

b) Additionally, the block shall be permanently marked with:

   1) the manufacturer's name or logo;

   2) the reference to this document (i.e. ISO 7963); and

3) a unique serial number.

5 Methods of use

5.1 Setting of the time base

5.1.1 General

To set the time base, the leading edge (left side) of successive echoes shall be adjusted to coincide with the appropriate scale markings on the screen of the ultrasonic instrument.

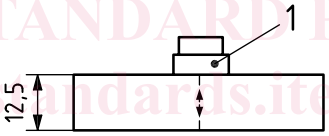
The time of flight of the pulses depends on the velocity of ultrasonic waves in the tested material.

5.1.2 Setting of the time base up to 125 mm steel with a straight-beam probe

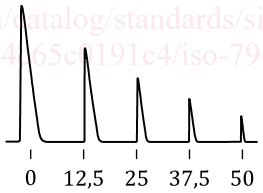
The position of the probe on the test surface of the calibration block shall be as indicated in Figure 2 a). Figure 2 b) is a schematic representation of the screen (A-scan) of the instrument for setting a range of 50 mm steel.

NOTE Depending on the probe and the frequency used, difficulties can arise when setting distances greater than 10 times the thickness of the block.

Dimensions in millimetres



a) Position of a straight-beam probe on calibration block No. 2



b) Schematic representation of the A-scan for setting of a range of 50 mm

Key

1 straight-beam probe

Figure 2 — Setting of the time base for straight-beam probes

5.1.3 Setting of the time base for 100 mm or 125 mm steel with a miniature angle-beam probe

The position of the miniature angle-beam probe on the calibration block shall be as shown in Figure 3 a) for a distance of 125 mm and in Figure 3 b) for a distance of 100 mm. The screen of the instrument for the setting of these two ranges is shown schematically in Figures 3 a) and 3 b).