INTERNATIONAL STANDARD

ISO 17405

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Non-destructive testing — Ultrasonic testing — Technique of testing claddings produced by welding, rolling and explosion

Essais non destructifs — Essais par ultrasons — Technique d'essai des placages produits par soudage, laminage et explosion

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

ISO 17405 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 138, *Non-destructive testing*, in collaboration with ISO Technical Committee TC 135, *Non-destructive testing*, Subcommittee SC 3, *Ultrasonic testing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Non-destructive testing — Ultrasonic testing — Technique of testing claddings produced by welding, rolling and explosion

1 Scope

This International Standard specifies the techniques for manual ultrasonic testing of claddings on steel applied by welding, rolling, and explosion using single-element or dual-element probes.

The test is intended to cover detection of two-dimensional or three-dimensional discontinuities in the cladding and in the region of the interface.

This International Standard does not give acceptance criteria nor define the extent of testing.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

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

EN 12668-1, *Non-destructive testing — Characterization and verification of ultrasonic examination equipment — Part 1: Instruments*

EN 12668-2, *Non-destructive testing — Characterization and verification of ultrasonic examination equipment — Part 2: Probes*

EN 12668-3, *Non-destructive testing — Characterization and verification of ultrasonic examination equipment — Part 3: Combined 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
test object
part to be tested

3.2
test surface
areas of the surface of the test object to which probes have to be coupled

4 Ultrasonic test system

4.1 General

The ultrasonic pulse-echo technique is used. For two-dimensional discontinuities parallel to the test surface and three-dimensional discontinuities, straight beam probes (dual-element or single-element) shall be used for testing with longitudinal waves.

For discontinuities with any other orientation, dual-element angle-beam probes for longitudinal waves can be used.

The nominal frequency shall be selected according to the purpose of the test and the characteristics of the materials.

Frequencies from 2 MHz to 6 MHz should be preferred.

The instrument used shall comply with the requirements given in EN 12668-1, and the probes shall comply with the requirements of EN 12668-2

The whole test system shall be checked by the operator periodically as given in EN 12668-3.

4.2 Requirements regarding probes

4.2.1 Single-element straight beam probes for longitudinal waves

A depth zone providing optimum sensitivity is defined (see Annex A) by the size of the transducer used in the probes. The position of this zone should be selected according to the expected position of the discontinuities.

4.2.2 Dual-element straight-beam probes for longitudinal waves

A depth zone providing optimum sensitivity is defined (see Annex A) by the size of the transducers used in the probes and their roof angle. The position of this zone should be selected according to the expected position of the discontinuities.

4.2.3 Dual-element angle-beam probes for longitudinal waves

The beam angle should be between 65° and 80°. The skewing angle, and the shape and size of the transducers, shall be selected so that the depth range for optimum sensitivity (see Annex A) covers the expected position of the discontinuities.

4.2.4 Matching probes to curved surfaces

The distance between the surface and the contact surface of the probe shall not exceed 0,5 mm when the centre of the probe is in contact. To achieve this, a flat probe shall be matched to the curvature of the test object by grinding, using adaptors or other aids if the radius of curvature, R, is within the range

$$R < \frac{A_P^2}{4\ \text{mm}} \tag{1}$$

where

R is the radius of the curvature of the surface, in mm;

A_P is the dimension of the contact surface of the probe in the direction of curvature, in mm, i.e. for testing cylindrical parts in the longitudinal direction, it is the width, and for testing in the circumferential direction, it is the length of the contact surface.

4.3 Additional requirements

4.3.1 Test ranges

There shall be a facility for an expanded time base (“zoom mode”).

4.3.2 Echo width

The echo width visible on the screen shall be taken into account when assessing the suitability for coverage of the selected depth zone. This applies to all types of probes: single-element straight beam probes, dual-element straight beam probes, and dual-element angle-beam probes.

4.4 Instrument settings

4.4.1 Range setting

Range setting of the ultrasonic instrument for accurate localization of discontinuities when using dual-element probes can be carried out using reference blocks (see Reference [2]) as shown in Figure 1 or Figure 2 for example, made of materials that are similar to the test object, or it can be carried out on the test object itself.

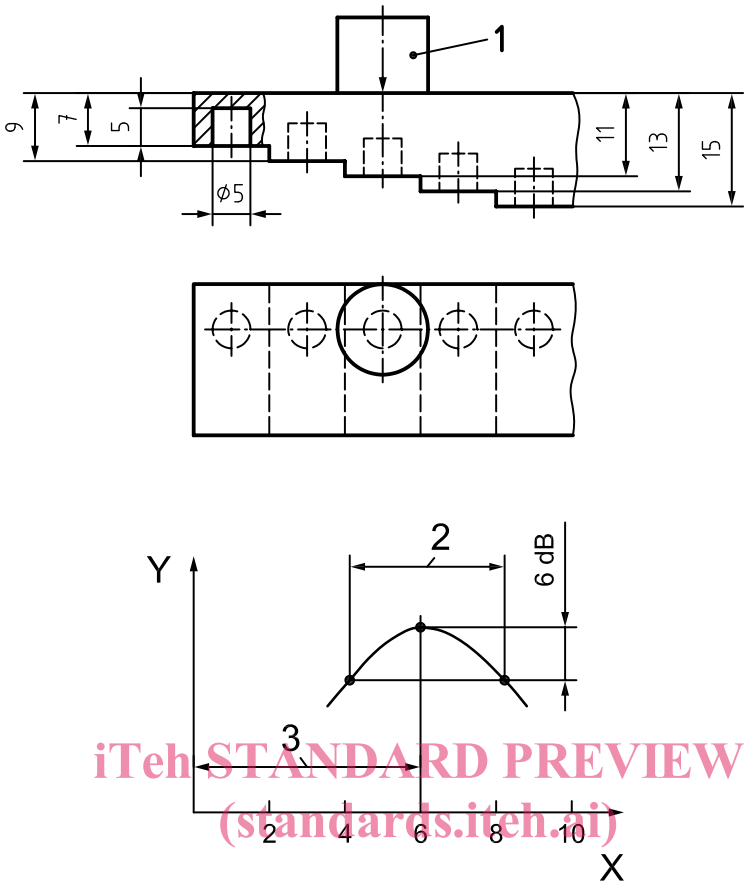
In the case of a dual-element straight-beam probe, the probe can, for example, be placed on the various steps of a stepped wedge calibration block. The front edge of the associated echo shall be set on the appropriate marks on the screen by adjusting the zero shift and the sweep (velocity). When dual-element angle-beam probes are used on a reference block as shown in Figure 2, for example, the shortened projected distances (distance between the front edge of the probe and the projection of the reflection point on the test surface) shall be lined up with the appropriate marks on the screen. In this manner, it is possible to read the position of a reflection point directly on the screen, i.e. for the setting with shortened projected distances as well as with depth positions.

NOTE 1 It is recommended to mark the range of any discontinuities to be detected on the screen according to their depth position (normally corresponding to the thickness of the cladding).

When straight beam probes are used, the range of the ultrasonic instrument can be calibrated using multiple echo series from a plane-parallel steel plate of known thickness and sound velocity (e.g. calibration block No. 1 according to ISO 2400).

NOTE 2 Since when dual-element angle-beam probes are used for longitudinal waves, transverse waves are also generated, care has to be taken to ensure that no erroneous indications of transverse waves are used during the setting procedure. In any case, these indications have a considerable larger time-of-flight than those of longitudinal waves.

Dimensions in millimetres



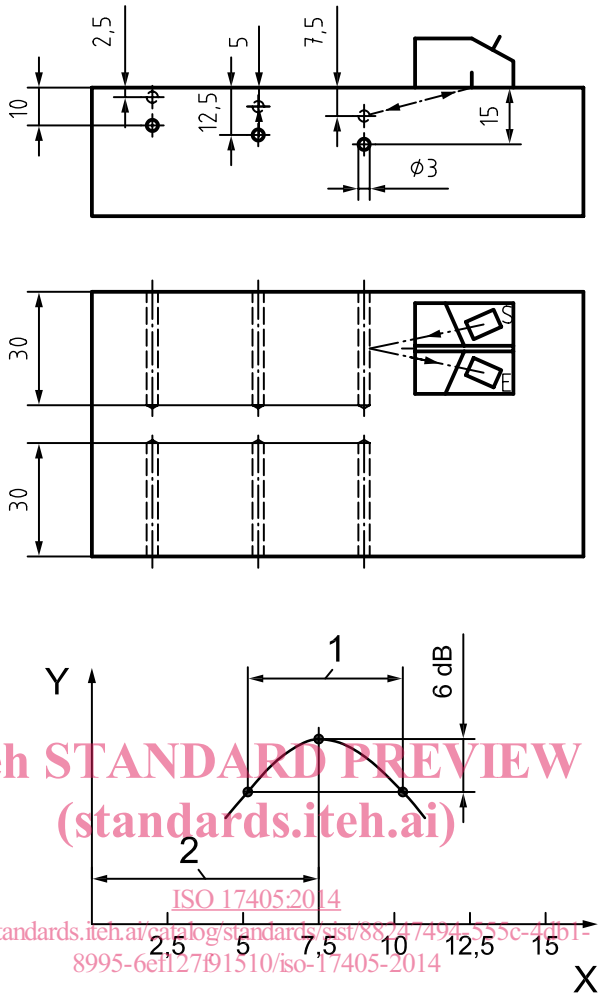
Key

1 probe
2 focal range
3 focal depth
X reflector depth
Y echo height

NOTE When reference blocks are used, all dimensions not specified should be selected so that the measurement or setting is not impaired by echoes from the geometry of the test block.

Figure 1 — Reference block for dual-element straight beam probes with representation of the focal zone

Dimensions in millimetres



Key

1 focal range
2 focal depth
X reflector depth
Y echo height

NOTE When reference blocks are used, all unspecified dimensions should be selected so that the placing of the probe on the test surface and the measurement or adjustment is not affected by shape echoes.

Figure 2 — Reference block for dual-element angle-beam probes showing the focal zone

4.4.2 Sensitivity setting

For sensitivity setting, it is recommended to choose reference reflectors (type and size) according to the expected discontinuities.

A reference block with a cladding of the same type as that to be tested shall be used for setting the sensitivity. The thickness of the cladding, the surface preparation, and the shape of the test surface shall be the same as those of the object to be tested (see Clause 5). If the probes have to be matched to curved test surfaces, the reference blocks used shall also have test surfaces on which the probe fits, as specified in 4.2.3.

For the detection of volumetric discontinuities, side-drilled holes of e.g. 3 mm diameter and 30 mm length in the parent metal at the interface with the cladding can be used for sensitivity setting (see Figure 3).