



SLOVENSKI STANDARD
oSIST prEN ISO 17640:2016
01-junij-2016

Neporušitveno preskušanje zvarnih spojev - Ultrazvočno preskušanje - Tehnike, stopnje sprejemljivosti in kriteriji ocenjevanja (ISO/DIS 17640:2016)

Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels, and assessment (ISO/DIS 17640:2016)

Zerstörungsfreie Prüfung von Schweißverbindungen - Ultraschallprüfung - Techniken, Prüfklassen und Bewertung (ISO/DIS 17640:2016)

Contrôle non destructif des assemblages soudés □ Contrôle par ultrasons - □ Techniques, niveaux d'essai et évaluation (ISO/DIS 17640:2016)

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25.160.40 Varjeni spoji in vari Welded joints and welds

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

Contrôle non destructif des assemblages soudés — Contrôle par ultrasons — Techniques, niveaux d'essai et évaluation

ICS: 25.160.40

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ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel three month enquiry.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.



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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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ISO 17640:2016(E)**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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 17640 was prepared by the European Committee for Standardization (CEN) Technical Committee TC 121, *Welding*, Subcommittee SC 5, *Testing of welds*, in collaboration with ISO Technical Committee TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 17640:2005), which has been technically revised.

Requests for official interpretations of any aspect of this International Standard 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.

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

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1 Scope

SIST EN ISO 17640:2018

This International Standard specifies techniques for the manual ultrasonic testing of fusion-welded joints in metallic materials of thickness greater than or equal to 8 mm which exhibit low ultrasonic attenuation (especially that due to scatter) at object temperatures from 0 °C to 60 °C. It is primarily intended for use on full penetration welded joints where both the welded and parent material are ferritic.

Where material-dependent ultrasonic values are specified in this International Standard, they are based on steels having an ultrasonic sound velocity of $(5\,920 \pm 50)$ m/s for longitudinal waves and $(3\,255 \pm 30)$ m/s for transverse waves.

This International Standard specifies four testing levels, each corresponding to a different probability of detection of imperfections. Guidance on the selection of testing levels A, B, and C is given in Annex A.

This International Standard specifies that the requirements of testing level D, which is intended for special applications, be in accordance with general requirements. Testing level D can only be used when defined by specification. This includes tests of metals other than ferritic steel, tests on partial penetration welds, tests with automated equipment, and tests at object temperatures outside the range 0 °C to 60 °C.

This International Standard can be used for the assessment of indications, for acceptance purposes, by either of the following techniques:

- a) evaluation based primarily on length and echo amplitude of the indication;
- b) evaluation based on characterization and sizing of the indication by probe movement techniques.

The techniques used shall be specified.

2 Normative references

The following referenced documents are indispensable for the application 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 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

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

ISO 11666:2010, *Non-destructive testing of welds — Ultrasonic testing of welded joints — Acceptance levels*

ISO 16810, *Non-destructive testing - Ultrasonic testing - General principles*

ISO 16811, *Non-destructive testing - Ultrasonic testing - Sensitivity and range setting*

ISO 16826, *Non-destructive testing - Ultrasonic testing - Examination for discontinuities perpendicular to the surface*

ISO 17635, *Non-destructive testing of welds — General rules for metallic materials*

ISO 23279, *Non-destructive testing of welds — Ultrasonic testing — Characterization of discontinuities in welds*

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

EN 12668 (all parts), *Non-destructive testing — Characterization and verification of ultrasonic examination equipment*

3 Symbols and definitions

3.1 For the purposes of this International Standard, the definitions given in EN 1330-4 and ISO 17635 apply.

3.2 For symbols, their definitions, and units, see Table 1.

Indications shall be considered to be either longitudinal or transverse, depending on the direction of their major dimension with respect to the weld axis, x , in accordance with Figure 2.

Table 1 — Symbols, their definitions, and units

Symbol	Definition	Unit
D_{DSR}	diameter of the disk-shaped reflector	mm
h	extension of the indication in depth direction	mm
l	length of the indication	mm
l_x	projected length of the indication in the x -direction	mm
l_y	projected length of the indication in the y -direction	mm
p	full skip distance	mm

t	thickness of parent material *	mm
x	position of the discontinuity in the longitudinal direction	mm
y	position of the discontinuity in the transverse direction	mm
z	position of the discontinuity in depth	mm

* If the joined parts have no equal thickness, the smallest thickness shall be considered

4 Principle

The purpose of this International Standard is to describe general techniques of ultrasonic weld testing, using standard criteria, for the most commonly used welded joints at object temperatures in the range 0 °C to 60 °C. The specific requirements of this International Standard cover the equipment, preparation, performance of the testing, and reporting. The parameters specified, in particular those for the probes, are compatible with the requirements of ISO 11666 and ISO 23279.

5 Information required prior to testing

5.1 Items to be specified

These include:

- a) method for setting the reference level;
- b) method to be used for evaluation of indications;
- c) acceptance levels;
- d) testing level;
- e) manufacturing and operation stage(s) at which the testing is to be carried out;
- f) qualification of personnel;
- g) extent of the testing for transverse indications;

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- h) requirements for additional tandem testing (see ISO 16826);
- i) parent metal testing prior to and/or after welding;
- j) whether or not a written testing procedure is required;
- k) requirements for written testing procedures.

5.2 Specific information required before testing

Before any testing of a welded joint can begin, the operator shall have access to the following essential information:

- a) written testing procedure, if required (see 5.3);
- b) type(s) of parent material and product form (i.e. cast, forged, rolled);
- c) manufacturing or operation stage at which testing is to be made, including heat treatment, if any;
- d) time and extent of any post-weld heat treatment;
- e) joint preparation and dimensions;
- f) requirements for surface conditions;
- g) welding procedure or relevant information on the welding process;
- h) reporting requirements;
- i) acceptance levels;
- j) extent of testing, including requirements for transverse indications, if relevant;
- k) testing level;
- l) personnel qualification level;
- m) procedures for corrective actions when unacceptable indications are revealed.

5.3 Written test procedure

The definitions and requirements in this International Standard normally satisfy the need for a written test procedure.

Where this is not the case, or where the techniques described in this International Standard are not applicable to the weld joint to be examined, additional written test procedures shall be used, if required by specification.

6 Requirements for personnel and equipment

6.1 Personnel qualifications

Personnel performing testing in accordance with this International Standard shall be qualified to an appropriate level in ultrasonic testing in accordance with ISO 9712 or equivalent in the relevant industrial sector.

In addition to a general knowledge of ultrasonic weld testing, personnel shall also be familiar with testing problems specifically associated with the type of welded joints to be examined.

6.2 Equipment

Any equipment used for testing in conjunction with this International Standard shall comply with the requirements of EN 12668 (all parts).

6.3 Probe parameters

6.3.1 Test frequency

The frequency shall be within the range 1,5 MHz to 5 MHz, and shall be selected to comply with the specified acceptance levels.

For the initial testing, the frequency shall be as low as possible, within the above range, when the evaluation is carried out according to acceptance levels based on length and amplitude, e.g. ISO 11666. Higher frequencies may be used to improve range resolution if this is necessary when using standards for acceptance levels based on characterization of discontinuities, e.g. ISO 23279.

Frequencies of approximately 1 MHz may be used for testing at long sound paths where the material shows above average attenuation.

6.3.2 Angles of incidence

When testing is carried out with transverse waves and techniques that require the ultrasonic beam to be reflected from an opposite surface, care shall be taken to ensure that the angle between the beam and the normal to the opposite reflecting surface is between 35° and 70°. Where more than one probe angle is used, at least one of the angle probes used shall conform with this requirement. One of the probe angles used shall ensure that the weld fusion faces

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are examined at, or as near as possible to, normal incidence. When the use of two or more probe angles is specified, the difference between the nominal beam angles shall be 10° or greater.

Angles of incidence at the probe and opposite reflecting surface, when curved, may be determined by drawing a sectional view of the weld or in accordance with the techniques given in ISO 16811. Where angles of incidence cannot be determined as specified by this International Standard, the testing report shall contain a comprehensive description of the scans used and the extent of any incomplete coverage caused, together with an explanation of the difficulties encountered.

6.3.3 Element size

The element size shall be chosen according to the ultrasonic path to be used and the frequency.

The smaller the element, the smaller the length and width of the near field, and the larger the beam spread in the far field at a given frequency.

Small probes having 6 mm to 12 mm diameter elements (or rectangular elements of equivalent area) are therefore most useful when working at short beam path ranges. For longer ranges, i.e. greater than 100 mm for single normal beam probes and greater than 200 mm for angle beam probes, an element size of 12 mm to 24 mm is more suitable.

6.3.4 Adaptation of probes to curved scanning surfaces

The gap, g , between test surface and bottom of the probe shoe shall not be greater than 0,5 mm.

For cylindrical or spherical surfaces, this requirement can be checked with Equation (1):

$$g = a^2/4D \quad (1)$$

where

a is the dimension, in millimetres, of the probe shoe in the direction of testing;

D is the diameter, in millimetres, of the component.

If a value for g larger than 0,5 mm results from the equation, the probe shoe shall be adapted to the surface and the sensitivity and range shall be set accordingly.

6.3.5 Coupling media

The coupling media shall be in accordance with ISO 16810. The coupling medium used for range and sensitivity setting and for the test shall be the same.