
Non-destructive testing of welds — General rules for metallic materials

*Contrôle non destructif des assemblages soudés — Règles générales
pour les matériaux métalliques*

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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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*.

This third edition cancels and replaces the second edition (ISO 17635:2010), which has been technically revised. Notably, it has been changed as follows:

- International Standards have replaced European standards as normative references;
- “examined” has been replaced by “tested” in the whole document;
- important modifications have been made to Annex A, *Rules and standards to be applied*;
- Annex C, *Non-acceptable indications*, has been deleted.

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 — General rules for metallic materials

1 Scope

This document gives guidelines for the choice of non-destructive testing (NDT) methods for welds and evaluation of the results for quality control purposes, based on quality requirements, material, weld thickness, welding process and extent of testing.

This document also specifies general rules and standards to be applied to the different types of testing, for either the methodology or the acceptance levels for metallic materials.

Acceptance levels cannot be a direct interpretation of the quality levels defined in ISO 5817 or ISO 10042. They are linked to the overall quality of the produced batch of welds.

Requirements for acceptance levels for NDT comply with quality levels stated in ISO 5817 or ISO 10042 (moderate, intermediate, stringent) only on a general basis and not in detail for each indication.

[Annex A](#) gives correlations between quality, NDT and acceptance level standards.

[Annex B](#) gives an overview of the standards linked to quality levels, acceptance levels and NDT methods.

2 Normative references (standards.iteh.ai)

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 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

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

ISO 10042, *Welding — Arc-welded joints in aluminium and its alloys — Quality levels for imperfections.*

ISO 10675-1, *Non-destructive testing of welds — Acceptance levels for radiographic testing — Part 1: Steel, nickel, titanium and their alloys*

ISO 10675-2, *Non-destructive testing of welds — Acceptance levels for radiographic testing — Part 2: Aluminium and its alloys*

ISO 10863, *Non-destructive testing of welds — Ultrasonic testing — Use of time-of-flight diffraction technique (TOFD)*

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 17636-1:2013, *Non-destructive testing of welds — Radiographic testing — Part 1: X- and gamma-ray techniques with film*

ISO 17636-2:2013, *Non-destructive testing of welds — Radiographic testing — Part 2: X- and gamma-ray techniques with digital detectors*

ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints*

ISO 17638, *Non-destructive testing of welds — Magnetic particle testing*

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

ISO 17643, *Non-destructive testing of welds — Eddy current testing of welds by complex-plane analysis*

ISO 19285, *Non-destructive testing of welds — Phased Array technique (PA) — Acceptance criteria*

ISO 23277, *Non-destructive testing of welds — Penetrant testing — Acceptance levels*

ISO 23278, *Non-destructive testing of welds — Magnetic particle testing — Acceptance levels*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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>

3.1 testing level

degree of thoroughness and selection of parameter settings with which a testing method is applied

[SOURCE: ISO/TR 25901-1:2016, 2.2.4.5, modified — “non-destructive” was deleted from the definition.]

Note 1 to entry: Different levels correspond to different sensitivities and/or probabilities of detection. The selection of testing levels is normally related to the quality requirements.

3.2 testing organization

internal or external organization carrying out non-destructive testing

[SOURCE: ISO/TR 25901-1:2016, 2.2.1.7, modified — “destructive testing” was deleted from the definition.]

3.3 indication

<non-destructive testing> representation or signal from a discontinuity in the format allowed by the non-destructive testing method used

[SOURCE: ISO/TR 25901-1:2016, 2.2.4.2, modified — “in the format allowed by the non-destructive testing method used” was added to the definition.]

3.4 internal discontinuity

<non-destructive testing of welds> discontinuity that is not open to a surface or not directly accessible

3.5 quality level

description of the quality of a weld on the basis of type, size and amount of selected imperfections

[SOURCE: ISO/TR 25901-1:2016, 2.5.17]

3.6

inspection lot

<non-destructive testing of welds> group of welds which is expected to show a uniform quality

Note 1 to entry: Group members can be a part of a weld, a full weld or several welds.

Note 2 to entry: The uniform quality can be due to welding procedure applied, material, type of joint, welder, environmental conditions during execution, time period or other items affecting the quality.

4 Abbreviated terms

For the purposes of this document, the abbreviated terms given in [Table 1](#) apply.

Table 1 — Abbreviated terms

Testing method	Abbreviation
Eddy current testing	ET
Magnetic particle testing	MT
Penetrant testing	PT
Radiographic testing	RT
Ultrasonic testing	UT
Visual testing	VT

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5 Limitations

5.1 Stage of manufacture

This document has been prepared for the testing of completed welds (see [10.3](#)). Testing of parent materials prior to welding or between welding sequences is not covered by this document. It is, however, recommended that such testing be performed in accordance with the reference standards for methods and acceptance levels.

5.2 Extent of testing

The extent of testing shall be given in an application standard or defined in a specification.

5.3 Materials

This document includes requirements for testing of fusion welds in the following materials, their alloys and their combinations:

- a) steel;
- b) aluminium;
- c) copper;
- d) nickel;
- e) titanium.

The use of this document for other metallic materials shall be specified.

6 Personnel qualification

Personnel performing NDT and the evaluation of the results for final acceptance of welds shall be qualified in accordance with ISO 9712 or equivalent at an appropriate level in the relevant industrial sector.

7 Testing organization

The testing organization should be organized independently of the production and its activities should be controlled by a quality management system.

8 Documentation

8.1 Documentation prior to testing

Prior to testing, all necessary preliminary information required by the testing method standards shall be provided.

8.1.1 Written procedures

All testing shall be performed in accordance with written procedures as required by the standard for the individual testing method or as specified.

8.1.2 Testing plan

It can be necessary to carry out additional testing including more than one NDT method or multiple applications of one method. In such cases, all methods used shall be defined in a testing plan, which shall determine the sequence and extent of testing and other relevant aspects for control of testing and other related activities.

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8.2 Documentation after testing

8.2.1 Records of individual testing

All testing shall be recorded as required by the referred standard for the relevant testing method.

8.2.2 Final report

For each test object or group of test objects, a final report shall contain the information required by the testing plan and shall, as a minimum, include:

- a) reports required by the standards for the individual testing method;
- b) identification of the test object;
- c) reference to the individual testing records, including status (not tested, accepted, rejected);
- d) identification of tested welds and/or reference to documents identifying these welds;
- e) system for marking of the individual welds and/or reference to documents indicating the description of system used for the coordination of the testing;
- f) identification of personnel and organizations that have performed the testing;
- g) record of deviations from the applied standard regarding testing technique and acceptance levels.

9 Selection of testing method

9.1 General

This document determines requirements for selection of testing methods for various types of materials and types of fusion welds. These methods may be used alone or in combination in order to give the required result.

Before selecting testing methods and levels, the following items should be considered:

- a) welding processes;
- b) parent metal, welding consumable and treatment;
- c) joint type and geometry;
- d) component configuration (accessibility, surface condition, etc.);
- e) quality levels;
- f) discontinuity type and orientation expected.

If necessary, testing methods and levels other than those listed in [Annex A](#) may be selected. If an application standard only requires another selection of methods, testing levels listed in [Annex A](#) can be used as appropriate. Such alterations shall be specified.

9.2 Butt- and T-joints with full penetration

The generally accepted methods for testing of welds are given in [Table 2](#) for surface discontinuities and in [Table 3](#) for internal discontinuities.

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Table 2 — Generally accepted methods for detection of accessible surface discontinuities for all types of welds, including fillet welds

Materials	Testing methods
Ferritic steel	VT VT and MT VT and PT VT and (ET)
Austenitic steel	VT
Aluminium and nickel	VT and PT
Copper and titanium	VT and (ET)
NOTE Methods in parentheses are only applicable with limitations.	