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## Non-destructive testing of welds — Penetrant testing — Acceptance levels

*Contrôle non destructif des assemblages soudés — Contrôle par  
ressuage — Niveaux d'acceptation*



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Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

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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](http://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](http://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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

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

This second edition cancels and replaces the first edition (ISO 23277:2006), which has been technically revised.

# Non-destructive testing of welds — Penetrant testing — Acceptance levels

## 1 Scope

This International Standard specifies acceptance levels for indications from surface breaking imperfections in metallic welds detected by penetrant testing.

The acceptance levels are primarily intended for use during manufacture examination, but where appropriate, they can be used for in-service inspection.

The acceptance levels in this International Standard are based on detection capabilities that can be expected when using techniques specified in ISO 3452 series and parameters recommended in [Annex A](#). The acceptance levels can be related to welding standards, application standards, specifications, or codes. Such a relationship is shown in ISO 17635 for ISO 5817 and ISO 10042.

Acceptance levels for grouped indications are not covered by this International Standard.

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

ISO 3452-2, *Non-destructive testing — Penetrant testing — Part 2: Testing of penetrant materials*

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

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

ISO 12706, *Non-destructive testing — Penetrant testing — Vocabulary*

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

ISO/TS 18173, *Non-destructive testing — General terms and definitions*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 18173, ISO 12706, and the following apply.

### 3.1

#### **linear indication**

indication having a length greater than three times its width

### 3.2

#### **non-linear indication**

indication having a length less than or equal to three times its width

## 4 Testing parameters

### 4.1 General

Many parameters, either individually or in combination, will affect the shape and size of a penetrant indication produced by a weld imperfection.

The following items are significant factors that will affect the shape and size of indications.

### 4.2 Sensitivity

Penetrant materials are classified in accordance with ISO 3452-2, including a sensitivity level which relates to the ability to detect small imperfections. Generally, higher sensitivity materials should be used for the detection of small imperfections.

### 4.3 Surface condition

Surface condition is directly related to the minimum detectable imperfection size. Best results are normally achieved when inspecting smooth surfaces. Surface roughness or irregularities (e.g. undercut, spatter) can cause high background and non-relevant indications resulting in a low probability of detection for small imperfections.

### 4.4 Process and technique

Penetrant systems and techniques should be selected according to the test surface condition. In some cases, the choice will have a direct effect on the limits of reliable detection, for example, the removal of excess penetrant by swab cleaning on rough surfaces is not recommended when seeking small imperfections.

Guidance on these matters is given in [Annex A](#) and in ISO 3452-1.

## 5 Acceptance levels

### 5.1 General

The width of the test surface shall include the weld metal and the adjacent parent metal up to a distance of 10 mm on each side.

Indications produced by penetrant testing do not usually display the same size and shape characteristics as the imperfection causing that indication. For the purposes of this International Standard, it is the size of the indication which should be assessed against the values shown in [Table 1](#).

Indications that are approximately in line, which are separated by less than the length of the smaller indication, shall be considered as a single, continuous indication.

Acceptance levels prescribed for linear indications are those corresponding to the evaluation level. Indications lower than this shall not be taken into account. Normally, acceptable indications shall not be recorded.

Local grinding can be used to improve the classification of all or part of a test surface when it is required to work to a higher detection limit than that recommended by the existing weld surface condition in [Table A.1](#).

NOTE Local grinding is a very often used practice.

Acceptance levels for welds in metallic materials are given in [Table 1](#).

**Table 1 — Acceptance levels for indications**

Dimensions in millimetres

Type of indication	Acceptance level <sup>a</sup>		
	1	2	3
Linear indication <i>l</i> = length of indication	$l \leq 2$	$l \leq 4$	$l \leq 8$
Nonlinear indication <i>d</i> = major axis dimension	$d \leq 4$	$d \leq 6$	$d \leq 8$
<sup>a</sup> Acceptance levels 2 and 3 can be specified with a suffix, "X", which denotes that all linear indications detected shall be evaluated to level 1. However, the probability of detection of indications smaller than those denoted by the original acceptance level can be low.			

## 5.2 Evaluation of indications

Initial evaluation shall be carried out as described in ISO 3452-1 and final evaluation of indication size shall be carried out after a designated minimum development time has elapsed, and before the indication has degenerated, such that it no longer represents the causing imperfection.

## 5.3 Removal of imperfections

Where the product specification permits, local grinding can be used to reduce or remove imperfections which are the cause of unacceptable indications. All such areas shall be re-tested and evaluated with the same penetrant system and technique.

## Annex A (informative)

### Recommended testing parameters

The recommended parameters for reliable detection of small imperfections are given in [Table A.1](#).

**Table A.1 — Recommended testing parameters**

Acceptance level	Surface condition	Type of penetrant system
1	Fine surface <sup>a</sup>	Fluorescent penetrant system, normal sensitivity or higher to ISO 3452-2. Colour contrast penetrant, high sensitivity to ISO 3452-2
2	Smooth surface <sup>b</sup>	Any
3	General surface <sup>c</sup>	Any
<sup>a</sup> The weld cap and parent material offer smooth clean surfaces with negligible undercut, rippling, and spatter. The surface finish is typical of welds made by automatic TIG-welding, submerged arc welding (fully mechanized), and manual metal arc welding process using iron powder electrodes. <sup>b</sup> The weld cap and parent material offer reasonably smooth surfaces with minimal undercut, rippling, and spatter. The surface finish is typical of welds made by manual metal arc welding vertical downwards and MAG welding using argon rich gas for the capping runs. <sup>c</sup> The weld cap and parent material are in the as-welded condition. The surface finish is typical of welds produced by the manual metal arc and MAG welding processes in any position.		





