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

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

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Foreword

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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.

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ISO 23277 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding* (as EN 1289:1998 and its Amd.1:2002 and Amd.2:2003), and was adopted, under a special “fast-track procedure”, by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*, in parallel with its approval by the ISO member bodies.

This document constitutes a consolidated version.

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 http://www.iso.org.

Non-destructive testing of welds — Penetrant testing of welds — 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 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.

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 3452, *Non-destructive testing — Penetrant inspection — 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 — Terminology — Terms used in penetrant testing*

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

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

EN 1330-2, *Non-destructive testing — Terminology — Part 2: Terms common to the non-destructive testing methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 18173, EN 1330-2 and 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.

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 standard, it is the size of the indication which should be assessed against the values shown in Table 1.

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 may 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.

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 [a]		
	1	2	3
Linear indication l = length of indication	$l \leqslant 2$	$l \leqslant 4$	$l \leqslant 8$
Non-linear indication d = major axis dimension	$d \leqslant 4$	$d \leqslant 6$	$d \leqslant 8$

[a] Acceptance levels 2 and 3 may 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 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 Grouped indications

Any adjacent indications separated by less than the major dimension of the smaller shall be assessed as a single, continuous indication.

Grouped indications shall be evaluated in accordance with an application standard.

5.4 Removal of imperfections

Where the product specification permits, local grinding may 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 [a]	Fluorescent penetrant system, normal sensitivity or higher to ISO 3452-2. Colour contrast penetrant, high sensitivity to ISO 3452-2
2	Smooth surface [b]	Any
3	General surface [c]	Any

[a] 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.

[b] 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.

[c] 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.