INTERNATIONAL STANDARD

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Destructive tests on welds in metallic materials — Hardness testing —

Part 2: Microhardness testing of welded joints

Essais destructifs des soudures sur matériaux métalliques — Essais de dureté —

Partie 2: Essai de microdureté des assemblages soudés

Reference number
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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.

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 9015-2 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*.

ISO 9015 consists of the following parts, under the general title *Destructive tests on welds in metallic materials — Hardness testing*:

— *Part 1: Hardness test on arc welded joints*

— *Part 2: Microhardness testing of welded joints*

Destructive tests on welds in metallic materials — Hardness testing —

Part 2: Microhardness testing of welded joints

1 Scope

This part of ISO 9015 specifies microhardness tests on transverse sections of welded joints of metallic materials with high hardness gradients. It covers Vickers hardness tests in accordance with ISO 6507-1, normally with test loads of 0,98 N to less than 49 N (HV 0,1 to less than HV 5).

NOTE Testing should be carried out to ensure that the highest and/or the lowest level of hardness of both parent materials (in the case of dissimilar materials both parent materials) and weld metal is determined.

This part of ISO 9015 does not cover hardness testing of welds with loads of 49,03 N and above, covered by ISO 9015-1.

This part of ISO 9015 is not applicable to hardness testing of very narrow welds, e.g. those typically produced by laser and electron beam welding, covered by ISO 22826.

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 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

3 Principle

Microhardness testing is carried out in accordance with ISO 6507-1.

The microhardness tests may be carried out in the form of rows of indentations, R, or as individual indentations, E.

When a type of weld is not shown in the examples, the test procedure shall be appropriate to the welded joint.

Unless otherwise specified, the test shall be carried out at ambient temperature (23 ± 5) °C.

4 Symbols and abbreviated terms

The symbols and terms to be used are specified in Table 1 and represented on Figures 1 to 3.

Table 1 — Symbols and abbreviated terms

Symbol	Term	Unit
E	Individual indentation	—
H	Distance of rows of indentations from the reference line (surface or fusion line)	mm
HAZ	Heat affected zone	—
HV	Vickers hardness	[a]
L	Distance between the centre point of the indentations in heat affected zone	mm
R	Row of indentations	—
t	Thickness of test specimen	mm

[a] The unit of symbolization for Vickers hardness is given in ISO 6507-1.

5 Preparation of test specimens

The preparation of the test specimen shall be in accordance with ISO 6507-1.

A cross-section from the test piece shall be taken by mechanical cutting, usually transverse to the welded joint.

This operation and the subsequent preparation of the surface shall be carried out carefully so that the hardness of the surface to be tested is not affected metallurgically by heat or cold working.

The surface to be tested shall be properly prepared and preferably etched, so that accurate measurements of the diagonal lengths of the indentations can be taken in the different zones of the welded joint.

6 Test procedure

6.1 Rows of indentations (R)

Figures 1 to 3 show typical examples for the location of hardness indentations made in rows, including the distance from the surface, so that the rows or parts thereof permit an assessment of the welded joint. If specified, e.g. by reference to an application standard, additional rows of indentations and/or different locations may be made. The actual location(s) shall be included in the test report.

In metals such as aluminium or copper and their alloys, the rows on the root-side of butt welds (see Figure 1) are not always necessary and may be omitted.

The number and spacing of indentations shall be sufficient to define hardened and/or softened regions due to welding. The recommended distance, L, between the centre point of the indentations in the heat affected zone (HAZ) is given in Table 2 and in ISO 6507-1.

NOTE The larger dimension in accordance with Table 2 or ISO 6507-1 should be used.

A sufficient number of indentations shall be made to ensure that unaffected parent material is also tested. The distance between indentations in the weld metal shall be sufficient to enable a full assessment of the welded joint. For metals which, as a result of welding, harden in the HAZ, two additional indentations in the HAZ shall be made at a distance $\leqslant$ 0,5 mm between the centre point of the indentation and the fusion line (see Figure 2).

For other joint configurations or metals (e.g. austenitic steels) additional indentations may be specified, e.g. by reference to an application standard.

Table 2 — Recommended distance, L, between the centre points of indentations in the heat affected zone (HAZ) for rows of indentations (R)

Vickers hardness symbol	Recommended distance between indentations, L mm[a]	
	Ferrous metals[b]	Aluminium, copper and their alloys
HV 0,1	0,2	0,6 to 2
HV 1	0,5	1,5 to 4
HV 5	0,7	2,5 to 5

[a] The distance between centre points shall not be less than the minimum value allowed in ISO 6507-1.

[b] Excluding austenitic steels.

6.2 Individual indentations (E)

Figure 4 shows typical areas for the location of individual indentations: locations 1-4 give information about the unaffected parent material; locations 5-8 refer to the HAZ; locations 9-11 refer to the weld metal. Otherwise, the location of the indentation can be determined on the basis of metallographic examination.

To prevent the influence of deformation caused by an indentation, the minimum distance between the centre point of individual indentations in any direction shall not be less than the value given in ISO 6507-1.

For metals which harden in the HAZ as a result of welding, at least one indentation shall be made in the HAZ with its centre point $\leqslant$ 0,5 mm from the fusion line.

For hardness testing using individual indentations, the areas shall be numbered as shown in Figure 4.

7 Test results

The hardness values shall be recorded in relation to the position of the indentation.

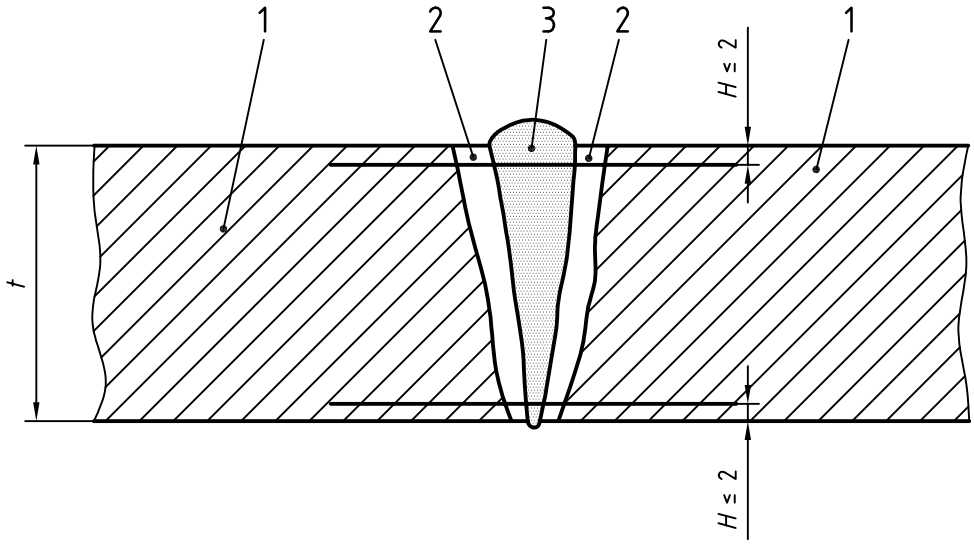
8 Test report

A test report is required. The information to be recorded is listed in Annexes A and B.

The use of the format given in Annexes A and B is recommended.

Other formats may be used provided they contain all the required information. Additional information may be required, e.g., by an application standard.

Dimensions in millimetres



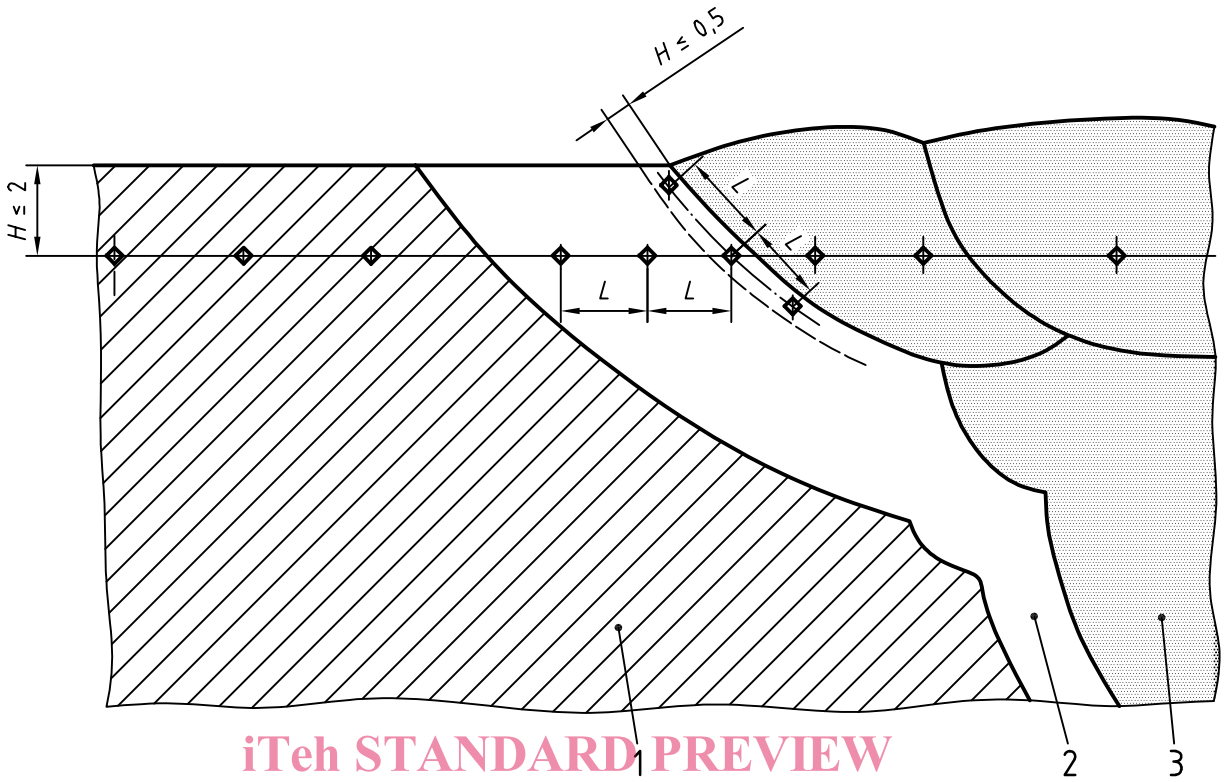
Key

1 parent material
2 heat affected zone
3 weld metal

NOTE For thickness ⩽ 4 mm, the rows of indentations shall be at the mid-thickness position.

Figure 1 — Example of rows of indentation (R) in butt welds in ferrous metals

Dimensions in millimetres



Key

1 parent material
2 heat affected zone
3 weld metal

Figure 2 — Location of indentations in butt welds in ferrous metals (excluding austenitic steels)