INTERNATIONAL STANDARD

ISO 9015-1

First edition
2001-04-01

Destructive tests on welds in metallic materials — Hardness testing —

Part 1: Hardness test on arc welded joints

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

Partie 1: Essai de dureté des assemblages soudés à l'arc

Reference number
ISO 9015-1:2001(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

Foreword iv
1 Scope 1
2 Normative references 1
3 Principle 1
4 Symbols and terms 2
5 Preparation of test specimens 2
6 Test procedure 2
7 Test results 4
8 Test report 4
Annex A (informative) **Example of a test report for hardness testing (R) on welded joints** 13
Annex B (informative) **Example of a test report for hardness testing (E) on welded joints** 14

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 3.

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 part of ISO 9015 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 9015-1 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*

Annexes A and B of this part of ISO 9015 are for information only.

Destructive tests on welds in metallic materials — Hardness testing —

Part 1:
Hardness test on arc welded joints

1 Scope

This part of ISO 9015 specifies hardness tests on transverse sections of arc welded joints of metallic materials. It covers Vickers hardness tests in accordance with ISO 6507-1, normally with test loads of 49,03 N or 98,07 N (HV 5 or HV 10).

However, the principles may be applied to Brinell hardness testing (with appropriate testing loads of HB 2,5/15,625 or HB 1/2,5) in accordance with ISO 6506-1 and micro hardness testing in accordance with ISO 6507-1 and ISO 9015-2.

NOTE Testing should be carried out to ensure that the highest and the lowest level of hardness of both parent metal and weld metal is determined.

This part of ISO 9015 does not apply to test welds in austenitic stainless steels.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 9015. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 9015 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method.*

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

ISO 9015-2, *Destructive tests on welds in metallic materials — Hardness testing — Part 2: Microhardness testing on welded joints.*

3 Principle

The type and extent of testing shall be as specified by the relevant application standard or by agreement between the contracting parties.

Hardness testing shall be carried out in accordance with ISO 6507-1 or ISO 6506-1.

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

When types of weld are not shown in the examples in Figures 1 and 2, 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 terms

The symbols and terms to be used are specified in Table 1 and represented on Figures 1 to 8.

Table 1 — Symbols and terms

Symbol	Term	Unit
E	Individual indentation	–
R	Row of indentations	–
HV	Vickers hardness	a
HBW	Brinell hardness	b
L	Distance between the centrepoint of the indentations in heat affected zone	mm
H	Distance of rows of indentations from the surface reference line or fusion zone	mm
t	Thickness of test specimen	mm

a The unit of symbolisation for Vickers hardness is given in ISO 6507-1.

b The unit of symbolisation for Brinell hardness is given in ISO 6506-1.

5 Preparation of test specimens

The preparation of the test specimen shall be in accordance with ISO 6507-1 or ISO 6506-1.

A cross-section of 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.

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

6 Test procedure

6.1 Rows of indentations (R)

Figures 1 to 7 give examples of hardness indentations made in rows including the distance from the surface in such a way that these rows or parts of them permit an assessment of the welded joint. If required by the contracting parties, additional rows of indentations and/or different locations may be made. The location shall be stated in the test report.

In metals such as aluminium, copper and their alloys, the rows on the root-side of butt welds [see Figure 2 a)] may be unnecessary. Typical rows for T-joints in these materials are given in Figure 2.

The number and spacing of indentations shall be sufficient to define hardened or softened regions due to welding. The recommended distance between the centrepoint of the indentations in the heat-affected zone (HAZ) is given in Table 2.

NOTE 1 Table 2 also applies with Brinell testing using the same distances provided appropriate loads are used.

Sufficient indentations shall be made to ensure that unaffected parent metal is tested. In the weld metal, the distance between indentations shall be selected and checked so that the results obtained will enable assessment of the welded joint to be made.

For metals which harden in the HAZ as a result of welding, two additional indentations in the HAZ shall be made at a distance $\leqslant$ 0,5 mm between the centrepoint of the indentation and the fusion line (see Figures 3 to 7).

For other joint configurations or metals (e.g. austenitic steels) special requirements can be given by the relevant application standard or by agreement between the contracting parties.

NOTE 2 For electroslag welds, the loads given in Table 2 may be used. Rows of indentations for electroslag welds can be made similar to Figure 1 a).

Table 2 — Recommended distance, L, between the centrepoint of the indentations in the heat affected zone (HAZ)

Hardness symbol	Recommended distance between indentations L mm [a]	
	Ferrous metals [b]	Aluminium, copper and their alloys
HV 5	0,7	2,5 to 5
HV 10	1	3 to 5
HBW 1/2,5	not applicable	2,5 to 5
HBW 2,5/15,625	not applicable	3 to 5

[a] The distance of any indentation from the previous indentation shall be not less than the value allowed by ISO 6507-1 for the previous indentation.

[b] Excluding austenitic steels.

6.2 Individual indentations (E)

Figure 8 shows typical areas for the location of individual indentations. The series 1 to 4 gives information about the unaffected parent metal, the series 5-10 refers to the HAZ and the series 11 to 14 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 centrepoint of individual indentations in any direction shall be not less than 2,5 times the mean diagonal/diameter of the nearest adjacent indentation.

For metals which harden in the HAZ as a result of welding, at least one indentation shall be made in the HAZ at a distance $\leqslant$ 0,5 mm between the centrepoint of the indentation and the fusion line.

For testing with individual indentations, the areas shall be numbered as shown in Figure 8.

7 Test results

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

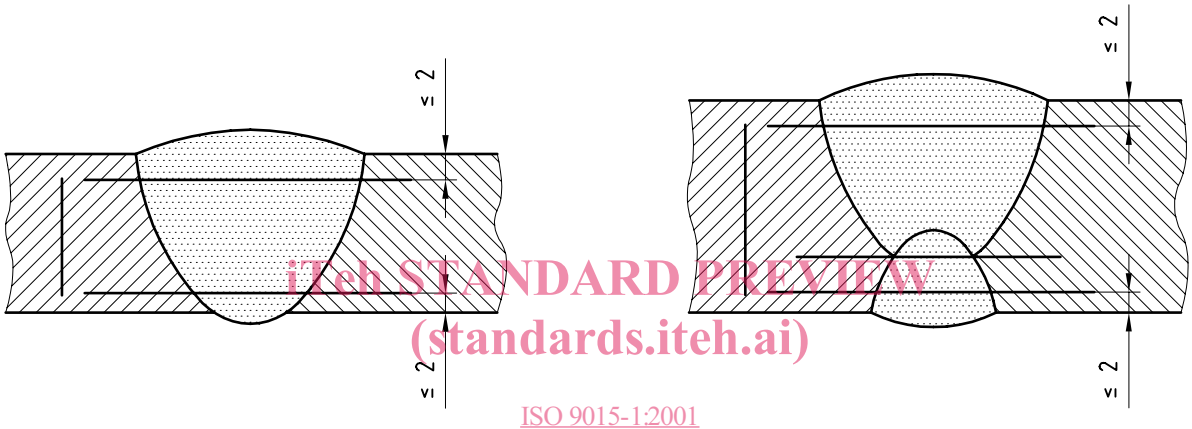
8 Test report

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.

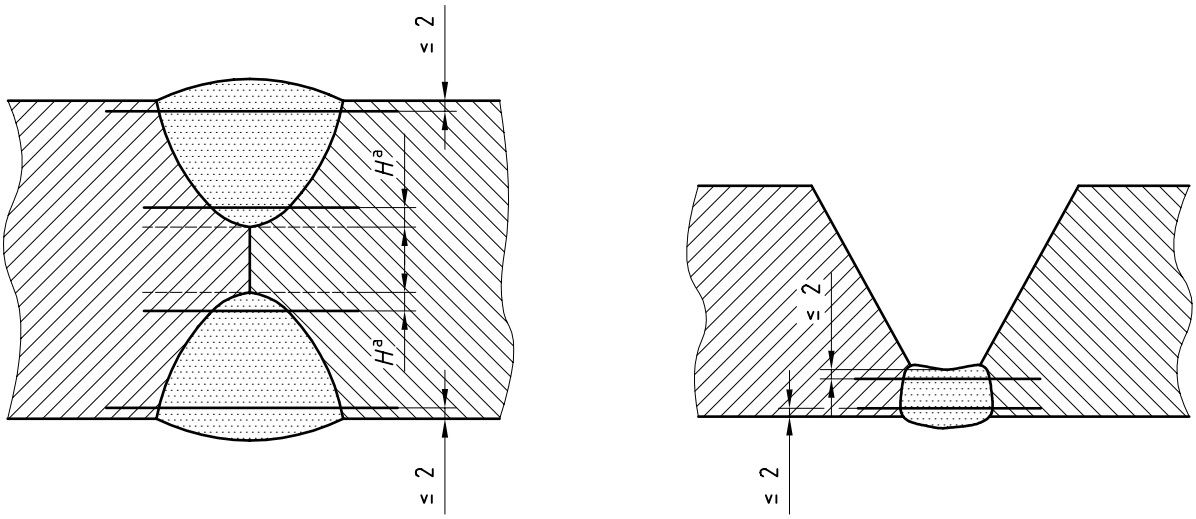
Other formats may be used provided they contain all the required information. Additional information may be required by the relevant application standard or by agreement between the contracting parties.

Dimensions in millimetres



a) Butt weld from one side only both single and multirun

b) Butt weld from both sides both single and multirun

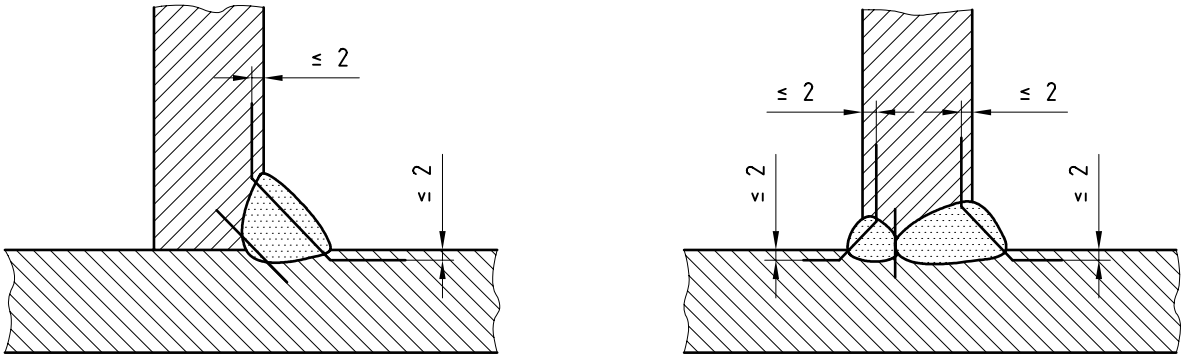


[a] For multirun welds only.

c) Partial penetration butt weld from both sides both single and multirun

d) For assessment of hardenability on single run root runs (e.g. for TIG weld on pipe and/or plate)

Dimensions in millimetres

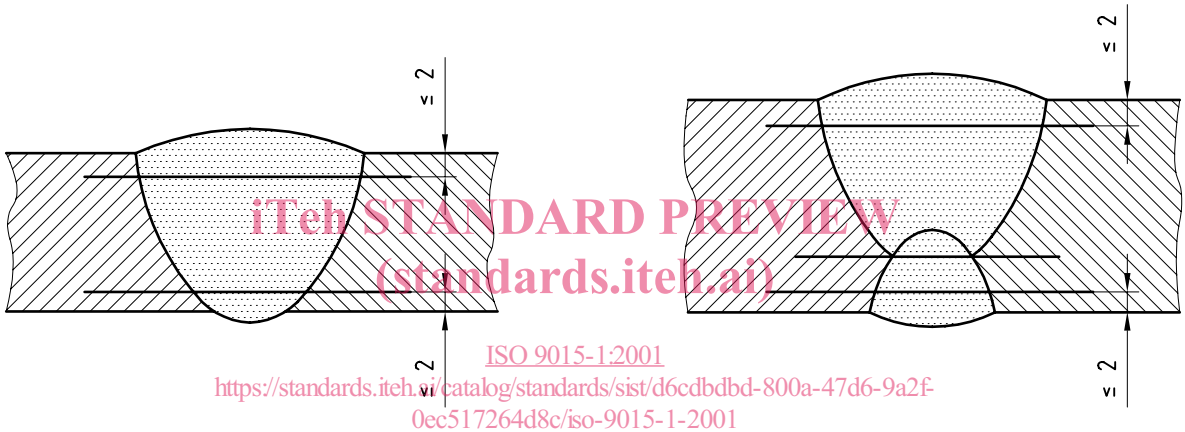


e) Fillet weld

f) T-butt weld

Figure 1 — Examples of rows of indentations (R) in steel welds

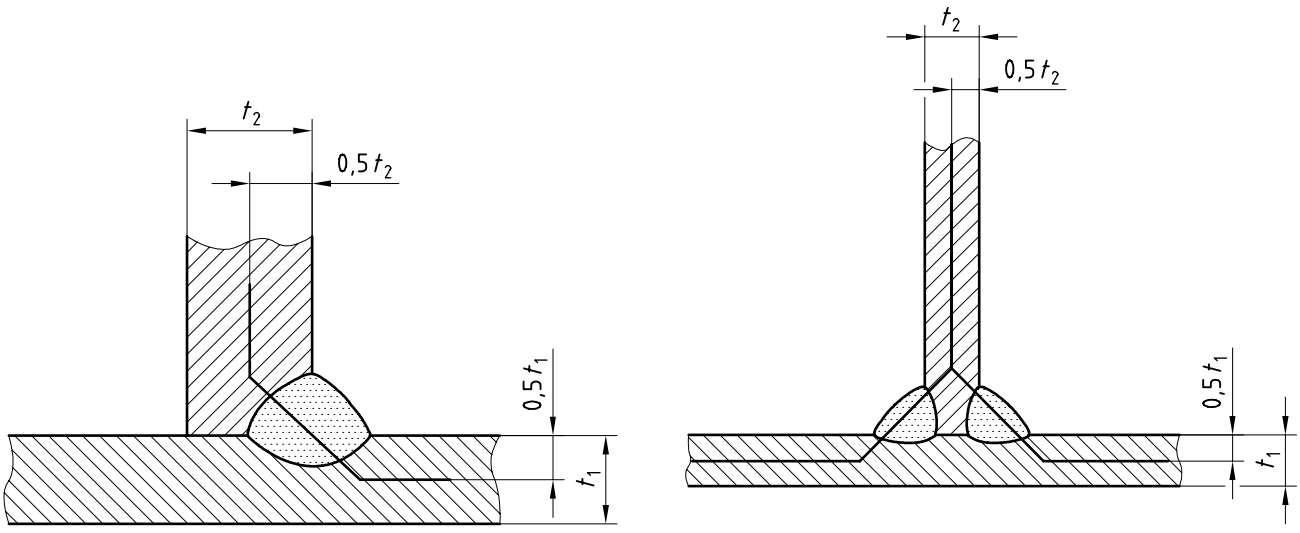
Dimensions in millimetres



a) Butt weld from one side only both single and multirun

NOTE For thickness $t \leqslant 4$ mm, rows of indentations shall be in mid-thickness

b) Butt weld from both sides both single and multirun

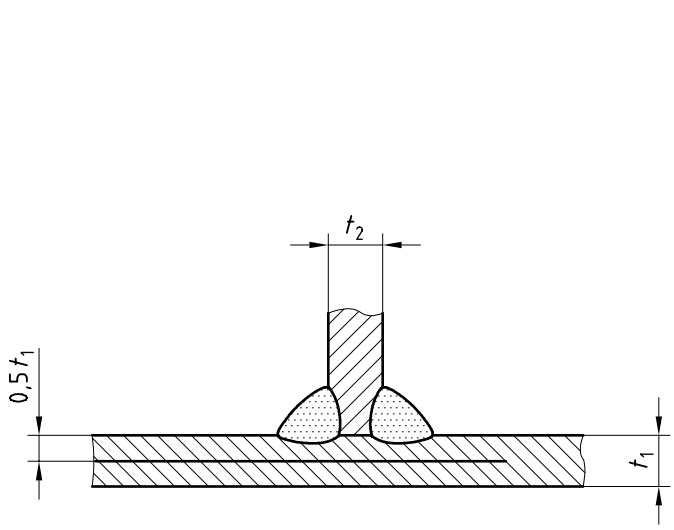


c) Fillet weld from one side only a single run

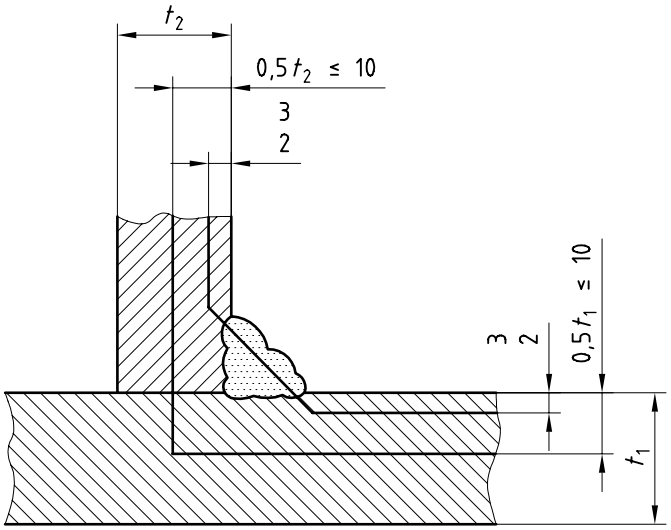
d) Fillet weld from both sides single run

Figure 2 — Examples of rows of indentations (R) in aluminium, copper and their alloys

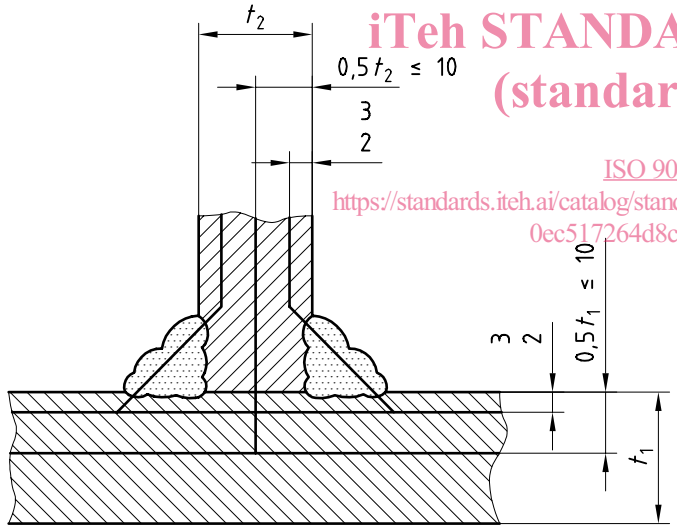
Dimensions in millimetres



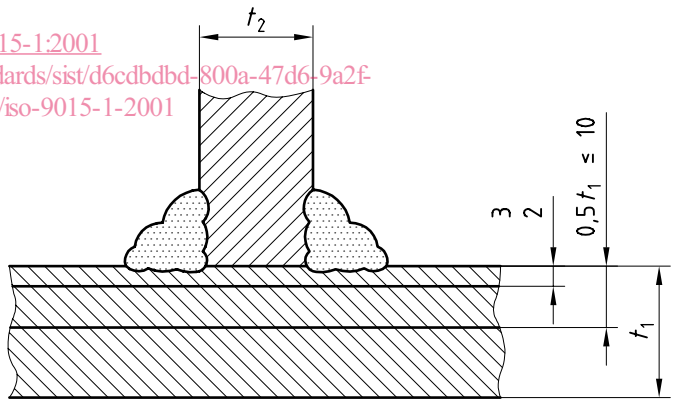
e) Fillet weld from both sides single run non load bearing stiffener ($t \leqslant 4$ mm)



f) Fillet weld from one side multirun



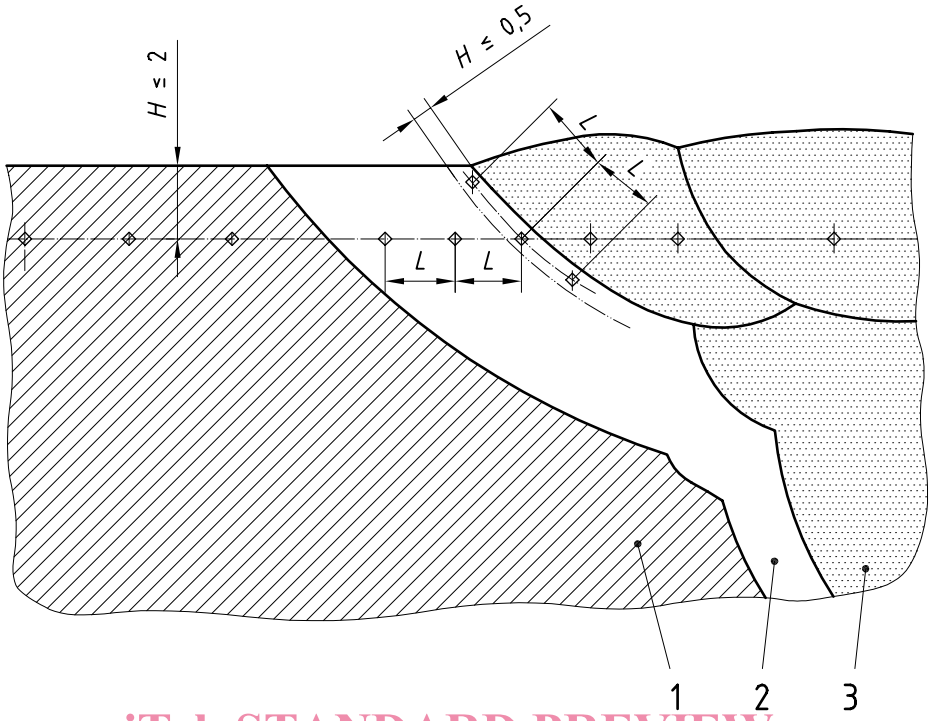
g) Fillet weld from both side multirun



h) Fillet weld from both side multirun non load bearing stiffener

Figure 2 — Examples of rows of indentations (R) in aluminium, copper and their alloys *(continued)*

Dimensions in millimetres



Key

1 Parent metal
2 Heat affected zone
3 Weld metal

Figure 3 — Location of the indentations in butt welds in ferrous metals (excluding austenitic steels)