British Standard

BRITISH STANDARD

BS EN
1320 : 1997

Destructive tests on welds in metallic materials — Fracture tests

The European Standard EN 1320 : 1996 has the status of a British Standard

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee WEE/2, upon which the following bodies were represented:

Association of Consulting Scientists
British Constructional Steelwork Association Ltd.
British Iron and Steel Producers' Association
Electricity Association
Health and Safety Executive
Institution of Structural Engineers
Lloyd's Register of Shipping
Ministry of Defence
Power Generation Contractors' Association (PGCA) (BEAMA Ltd.)
Welding Institute
Welding Manufacturers' Association (BEAMA Ltd.)

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Amendments issued since publication

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The following BSI references relate to the work on this standard:
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Contents

National foreword

This British Standard has been prepared by Technical Committee WEE/2 and is the English language version of EN 1320 : 1996 *Destructive tests on welds in metallic materials — Fracture test*, published by the European Committee for Standardization (CEN).

EN 1320 : 1996 was produced as a result of international discussions in which the United Kingdom took an active part.

BS EN 1320 : 1996 supersedes tests detailed in BS 709 : 1983, BS 4206 : 1987 and BS 3451 : 1973 which have been withdrawn by amendment.

Cross-references

Publication referred to	Corresponding British Standard
EN 970	BS EN 970 *Welding — Visual examination of fusion welded joints*
EN 25817	BS EN 25817 : 1992 *Arc-welded joints in steel — Guidance on quality levels for imperfections*
EN 30042	BS EN 30042 : 1994 *Arc-welded joints in aluminium and its weldable alloys — Guidance on quality levels for imperfections*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 12 an inside back cover and a back cover.

EUROPEAN STANDARD
NORME EUROPÉENNE
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EN 1320

October 1996

ICS 25.160.40

Descriptors: Welded joints, metals, fusion welding, butt welds, fillet welds, tests, texture, defects, visual examination, test specimen, designation

English version

Destructive tests on welds in metallic materials — Fracture test

Essais destructifs des soudures sur matériaux métalliques — Essai de texture

Zerstörende Prüfung von Schweißverbindungen an metallischen Werkstoffen — Bruchprüfung

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 121, Welding, the Secretariat of which is held by DS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 1997, and conflicting national standards shall be withdrawn at the latest by April 1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

1 Scope

This European Standard specifies the sizes of test specimen and the procedures for carrying out fracture tests in order to obtain information about types, sizes and distribution of internal imperfections such as porosity, cracks, lack of fusion, lack of penetration and solid inclusions on the fracture surface.

This European Standard applies to metallic materials in all forms of product, with joints made by any fusion welding process with a thickness greater than or equal to 2 mm.

This European Standard is used if required by the application standard, or by the agreement between the contracting parties.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 970	*Non-destructive examination of fusion welds — Visual examination*
EN 25817	*Arc-welded joints in steel — Guidance on quality levels for imperfections (ISO 5817 : 1992)*
EN 30042	*Arc-welded joints in aluminium and its weldable alloys — Guidance on quality levels for imperfections (ISO 10042 : 1992)*

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1 examination length (L_f)

Length of the test specimen measured along the weld axis between any side notches (see figure 6).

3.2 total examination length (ΣL_f)

Sum of the lengths of all the test specimens composing the test piece, measured along the weld axis, of the fracture faces between the side notches of the test specimens (see figure 6).

3.3 examination thickness (a_f)

Thickness of the fracture area for each test specimen (see figures 7 and 8).

3.4 examination area (A_f)

Product of the examination length and the examination thickness for each test specimen.

3.5 total examination area (ΣA_f)

Sum of all examination areas.

4 Principle

Fracture the joint through the weld metal in order to examine the fracture surface. The fracture can be induced by bending or tension, static or dynamic loading. Furthermore, notch dimensions and temperature can be varied to induce the fracture.

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

5 Denominations and symbols

The denominations and symbols to be used for fracture tests are specified in table 1 and represented in figures 5 to 8.

Normally, it is sufficient to give the basic denomination, but for special application, additional denominations about the notching and test method can be requested.

Table 1 Denominations and symbols		
Denomination	**Symbol**	**Unit**
Butt weld	BW	—
Fillet weld	FW	—
Test specimen and test piece		
- Examination length	L_f	mm
- Examination thickness	a_f	mm
- Examination area	A_f	mm^2
- Area of imperfections	A_i	mm^2
Side notch	S	
- square (q)	Sq	—
- round (r)	Sr	—
- sharp (s)	Ss	—
Longitudinal notch		
- Face notch	F	—
- square (q)	Fq	—
- round (r)	Fr	—
- sharp (s)	Fs	—
- Root notch	R	—
- square (q)	Rq	—
- round (r)	Rr	—
- sharp (s)	Rs	—

EXAMPLE 1: Test specimen taken from a fillet weld with an examination length of 40 mm and examination thickness of 10 mm.

– without any requirement about notching and test method:

Basic denomination: FW / $L_f \times a_f$;

EXAMPLE: FW / 40 × 10.

– with additional requirement (square face notching and test method):

Comprehensive denomination:
FW / $L_f \times a_f$ / Fq / Figure 8;

EXAMPLE: FW / 40 × 10 / Fq / Figure 8.

EXAMPLE 2: Test specimen taken from a butt weld with an examination length of 40 mm and examination thickness of 10 mm.

– without any requirement about notching and test method:

Basic denomination: BW / $L_f \times a_f$;

EXAMPLE: BW / 40 × 10.

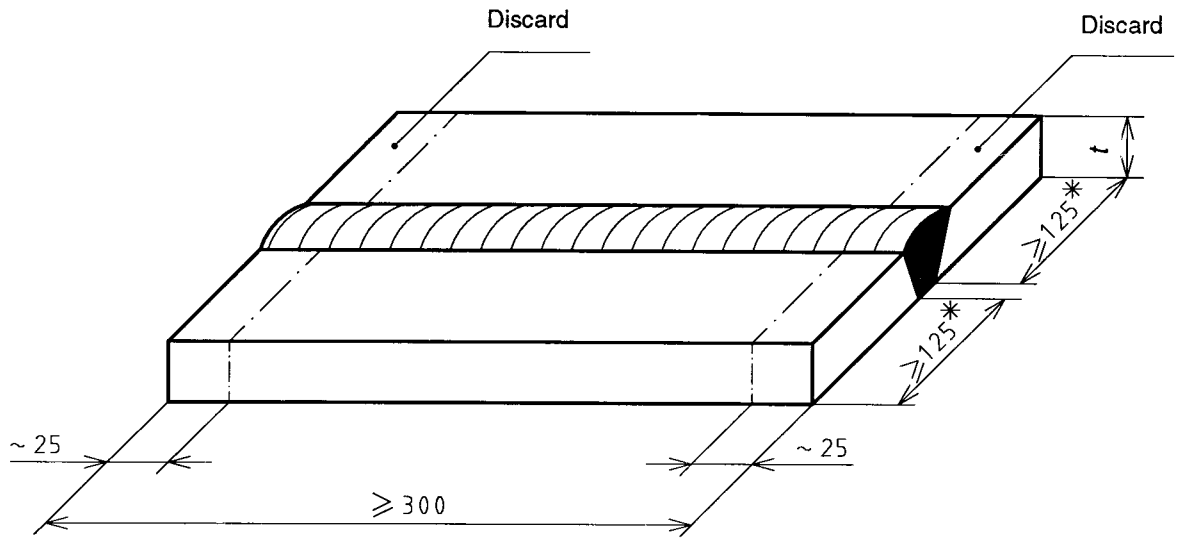
– with additional requirement (round side notching and test method):

Comprehensive denomination:
BW / $L_f \times a_f$ / Sr / Figure 6;

EXAMPLE: BW / 40 × 10 / Sr / Figure 6.

6 Dimensions of test pieces

Unless otherwise specified by the application standard or by agreement between the contracting parties, test piece dimensions shall be in accordance with figures 1 to 4. The test piece shall provide sufficient test specimens for the required total examination length (ΣL_f) and area (ΣA_f).

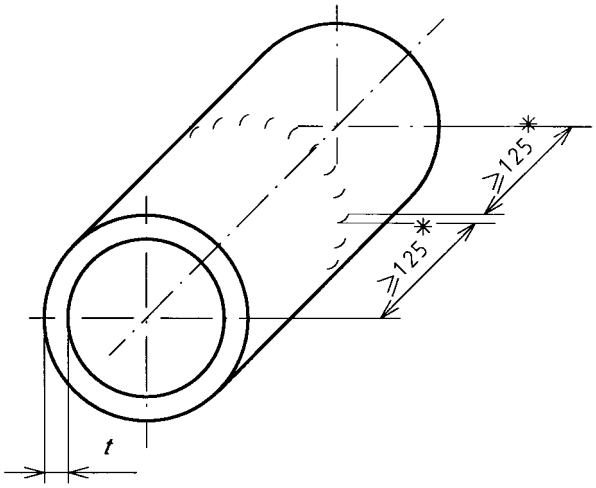


NOTE. *≥ 150 mm for materials of high thermal conductivity (e.g. aluminium and copper).

t is the thickness of the test piece.

All dimensions are in millimetres

Figure 1. Test piece for butt welds in plate

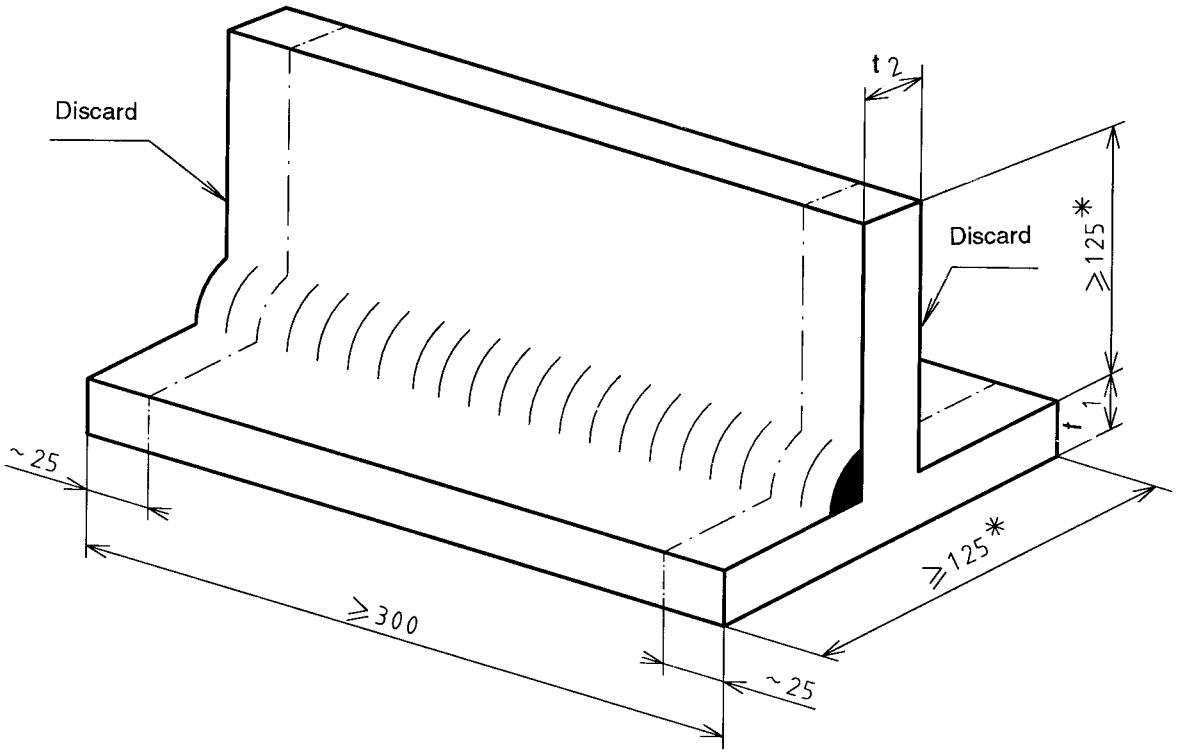


NOTE. * ≥ 150 mm for materials of high thermal conductivity (e.g. aluminium and copper).

t is the thickness of the test piece.

All dimensions are in millimetres

Figure 2. Test piece for butt welds in pipe



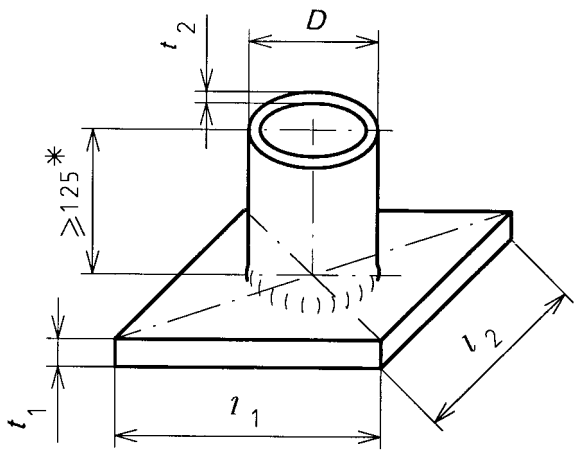
$l_1 \approx l_2$
$l_1 \geq (D + 100)$
$l_2 \geq (D + 100)$

NOTE. * ≥ 150 mm for materials of high thermal conductivity (e.g. aluminium and copper).

t_1, t_2 are the thicknesses of the test piece.

All dimensions are in millimetres

Figure 3. Test piece for fillet welds on plate



NOTE. * ≥ 150 mm for materials of high thermal conductivity (e.g. aluminium and copper).

t_1, t_2 are the thicknesses of the test piece.

l_1, l_2 are the lengths of the test piece.

All dimensions are in millimetres

Figure 4. Test piece for fillet welds on pipe

7 Removal of test specimens

7.1 General

The examination length (L_f) and area (A_f), and the number of test specimens shall be specified by the application standard or by agreement between the contracting parties. Welded joints in plates shall be cut transversely to the welded joint into test specimens including approximately equal weld length. The weld axis shall remain in the middle of the test specimen for butt welds.

Unless otherwise specified in the application standard for welded joints in pipe or by agreement between the contracting parties, the test piece shall provide at least two test specimens.

When testing in bending, equal numbers of specimens shall be tested with the root in tension and the face in tension. If the pipe diameter is too small for removing the required number of test specimens, additional test pieces shall be welded.

7.2 Marking

Each test piece shall be marked to identify its exact location in the manufactured product or in the joints from which it has been removed.

When removed from the test piece, each test specimen shall be marked.

7.3 Extraction

7.3.1 *General*

The extraction method shall avoid the introduction of detrimental thermal or mechanical effects.

In general, 25 mm from both ends of the test welds shall be discarded, unless information about the ends of the welds is required (e.g. start/stop imperfections).

7.3.2 *Steels*

The test specimens shall be cut by thermal cutting or by mechanical means.

7.3.3 *Other metallic materials*

Other metallic materials shall only be cut mechanically.

7.4 Preparation

Fracture of welds in plates or pipes may be assisted by one or more of the following:

– removing the weld reinforcement;
– notching both edges of the weld (side notching);
– notching into the reinforcement (longitudinal notching).

Depending on the ductility of the weld metal square, round or sharp notches may be used (see figures 5, 6, 7 and 8). For materials of high ductility (e.g. aluminium and copper), sharp notches may be recommended.

The depth of the notches shall be sufficient to induce fracture in the weld.

Unless otherwise specified by the application standard or by agreement between the contracting parties, the notch depth should be such that:

– for the side notch, the examination length L_f shall be greater than or equal to 70 % of the original width of the test specimen, w (see figure 6), or the total examination length, ΣL_f, shall be greater than or equal to 60 % of the length of the test specimen;
– for the longitudinal notch, the examination thickness, a_f, shall be greater than or equal to 80 % of the original thickness of the test specimen, t (see figure 7).

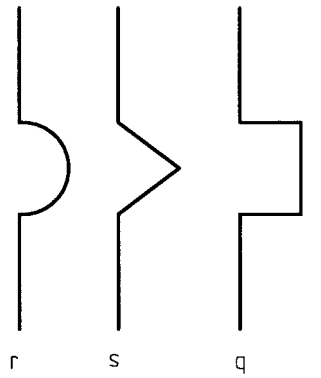
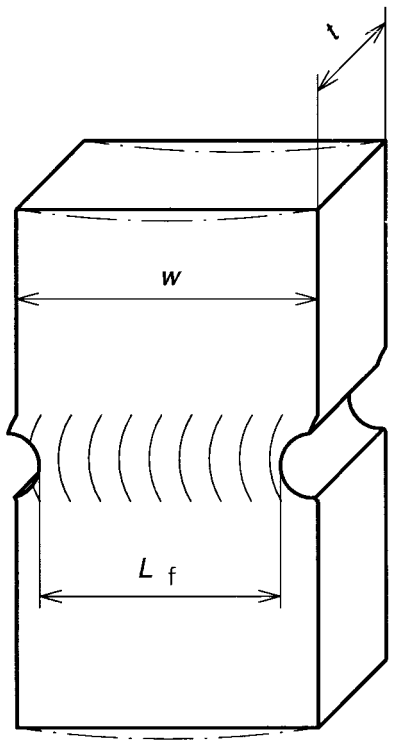


Figure 5. Notch profiles



NOTE. Full line for plates - chain dotted line for pipes.

Figure 6. Side notches

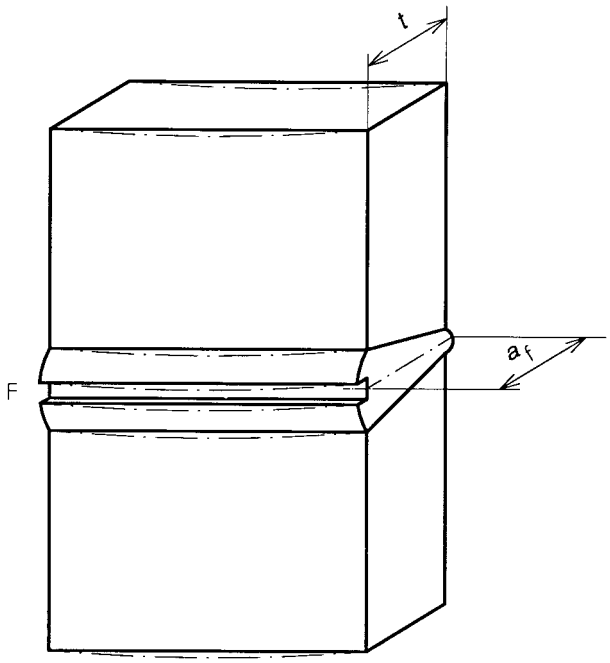


Figure 7a. Face notch

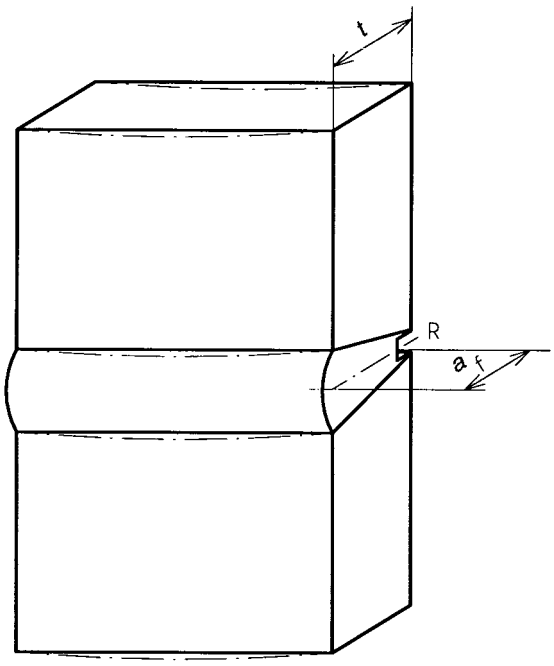


Figure 7b. Root notch

NOTE. Full line for plates - chain dotted line for pipes.

Figure 7. Longitudinal notches in butt welds

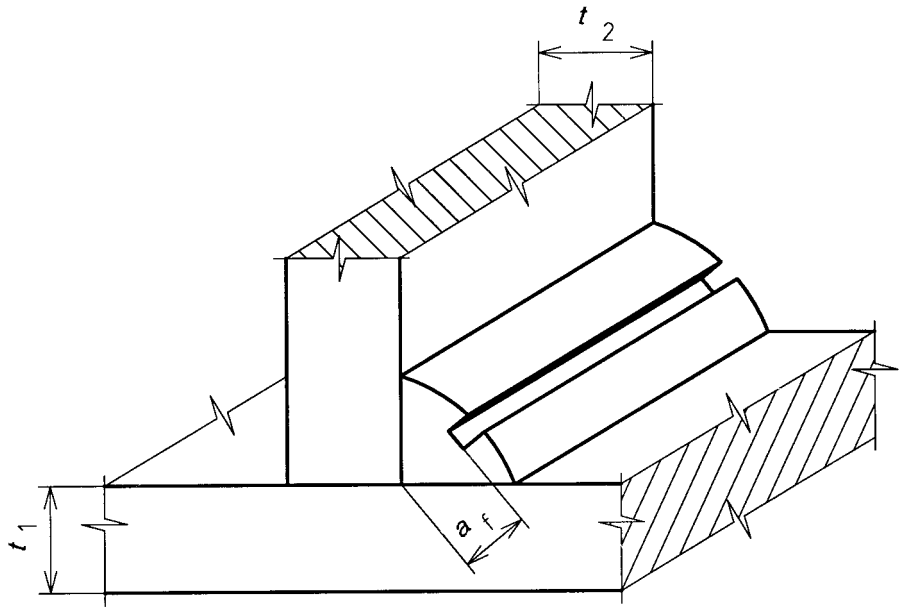


Figure 8. Longitudinal notch in fillet welds

8 Test procedure

8.1 Butt welds

8.1.1 *General*

Fracture tests may be carried out by:

– dynamic strokes, e.g. with a hammer (see figures 9a, 9b and 9c);

– applying a load by pressing in a vice, bending machine or workshop press (see figures 9d, 9e and 9f);

– applying a load by tension (see figure 9g).

For ductile materials, it should be useful to have a minimum distance between the notch and the jaws of the clamping device (see figure 9c).

For some materials, it may be useful to test at a low temperature to initiate fracture.

8.1.2 *Thin material*

For fracturing thin welded joints alternating bending may be necessary. The limit depends on the ductility of the material. It shall be carried out by pressing the test specimen in the jaws close to the notch. If no fracture occurs, straightening and repeated bending shall follow.

Tension testing (see figure 9g) may also be used instead of bending. Striking with a hammer is not recommended for fracture tests on thin materials.

8.1.3 *Thick material*

Thicker materials may be fractured by hammer strokes.

When a bending machine is used, the diameter of the former shall be chosen in such a way that the fracture occurs without the need for alternating bending.

Bending may be carried out either with the weld perpendicular or transverse to the direction of the applied force according to figures 9c to 9f. The lowest limit for the test for aluminium is approximately 8 mm thickness.

8.2 Fillet welds

Test methods are similar to those for butt welds (see **8.1**), except that tension testing is not possible. Examples are given in figure 10.

8.3 Special recommendations for ductile weld metals

For ductile weld metals such as austenitic steels, aluminium, copper, nickel and their alloys, it may be necessary to restrict the thickness of the test specimen and the throat thickness, increase the width of the notch, decrease the radius of the notch and increase the severity (stroke loading, hammer loading) of the test, if fracture is required in the weld metal.

For ductile weld metals such as ferritic steel, it may be necessary to cool the test specimen.

9 Test result

The fracture surface shall be examined visually in accordance with prEN 970. For clear detection and identification of imperfections, a low magnifying glass (up to five times) may be used.

A full description of the appearance of the fracture surface and the type and location of any imperfection present shall be reported. It shall be stated that the quality has been evaluated in accordance with EN 25817 or EN 30042. The quality level is specified by the application standard or by agreement between the contracting parties.

10 Test report

The test report shall contain:

– reference to this European Standard;

– identification of test specimen;

– specimen denomination in accordance with table 1;

– records of types, locations and sizes of all unacceptable imperfections in accordance with the relevant quality level.

An example of a typical test report is given in annex A.

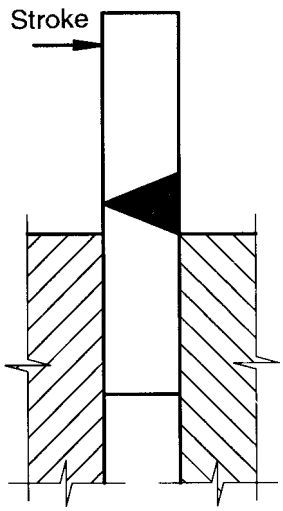


Figure 9a

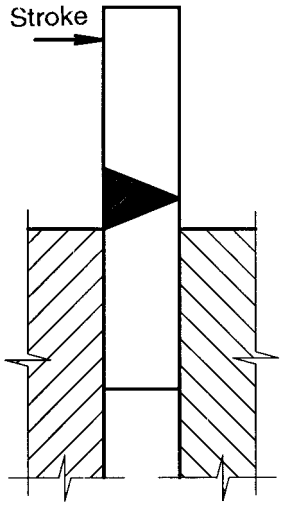


Figure 9b

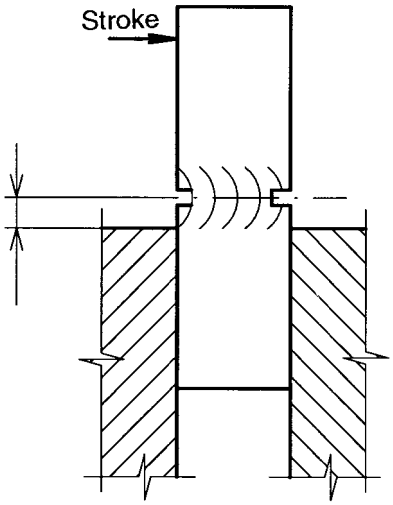


Figure 9c

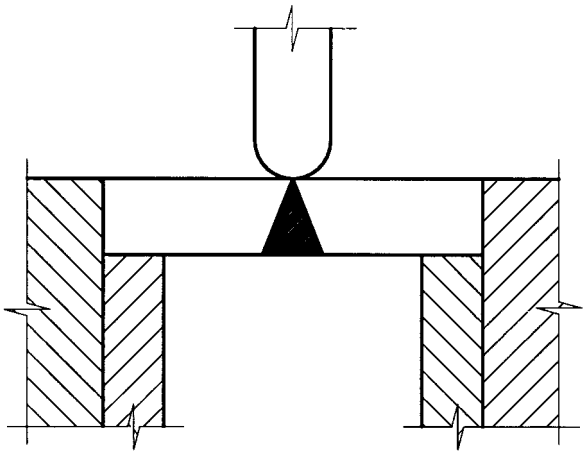


Figure 9d

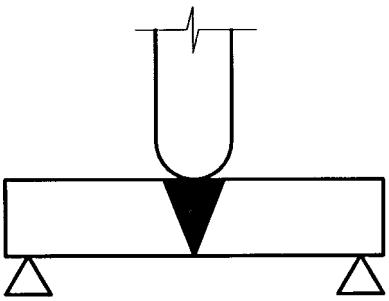


Figure 9e

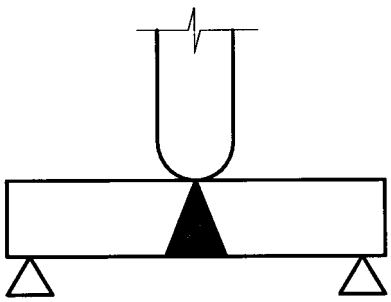


Figure 9f

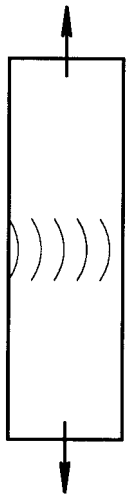
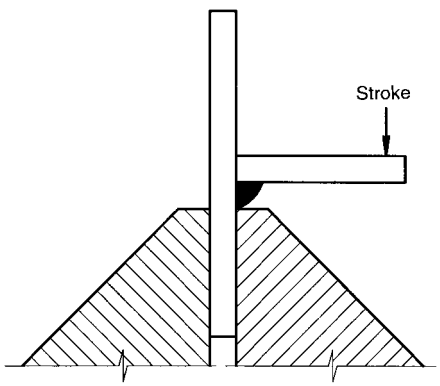
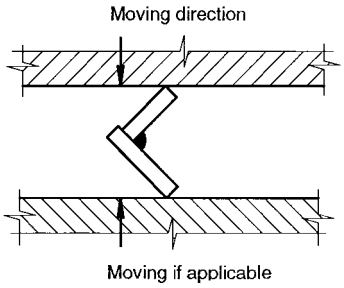


Figure 9g

Figure 9 Examples of test methods for butt welds (BW) (notches according to figures 5 to 7)





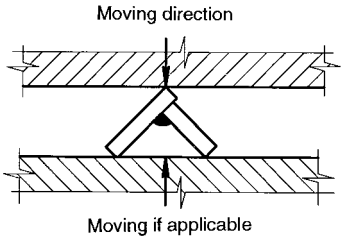


Figure 10a **Figure 10b** **Figure 10c**

Figure 10. Examples of test methods for fillet welds (FW) (notches according to figures 5 and 8)

Annex A (informative)
Test report

No .....

According to WPS.....
According to test result 'fracture test'
test result '.....'

Manufacturer: .....
Purpose of the examination: .....
Form of product: .....
Parent metal: .....
Consumable: .....

Denomination of test piece:

Table A.1 Fracture test in accordance with EN 1320

Test specimen	Denomination	Results	
		Type and size of imperfections	Quality level

Examiner or examining body:

.....
(name, date and signature)

Certified by:

.....
(name, date and signature)

blank

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