

BRITISH STANDARD

**BS EN
287-2 : 1992**

*Incorporating
Amendment A1, not
issued separately and
incorporating
Corrigendum No. 1*

Approval testing of welders for fusion welding

Part 2. Aluminium and its alloys

The European Standard EN 287-2 : 1992, with the incorporation of its amendment A1, has the status of a British Standard

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Committees responsible for this British Standard

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 British Nuclear Fuels plc
 British Railways Board
 British Stainless Steel Association
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Summary of pages

The following table identifies the current issue of each page. Issue 1 indicates that a page has been introduced for the first time by amendment. Subsequent issue numbers indicate an updated page. Vertical sidelining on replacement pages indicates the most recent changes (amendment, addition, deletion).

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b	blank	Inside back cover	original
i	3	Back cover	3
ii	blank		

National foreword

This Part of BS EN 287 has been prepared by Technical Committee WEE/36, and is the English language version of EN 287-2 : 1992 *Approval testing of welders — fusion welding — Part 2: Aluminium and aluminium alloys* including Amendment A1, published by the European Committee for Standardization (CEN). It supersedes BS 4871 : Part 2 : 1982 on 28 August 1992.

EN 287-2 and Amendment A1 were produced as a result of international discussion in which the UK took an active part.

Cross-references

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English version

Approval testing of welders — Fusion welding — Part 2: Aluminium and aluminium alloys (includes amendment A1 : 1997)

**Qualification des soudeurs — Soudage par fusion —
 Partie 2: Aluminium et ses alliages
 (inclut l'amendement A1 : 1997)**

**Prüfung von Schweißern — Schmelzschweißen —
 Teil 2: Aluminium und Aluminiumlegierungen
 (enthält Änderung A1 : 1996)**

This European Standard was approved by CEN on 1992-02-21. Amendment A1 was approved on 1996-12-11. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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
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Foreword

This standard has been prepared by Working Group 2 Approval requirements for welding and allied processes personnel of CEN/TC 121 Welding.

For this standard, ISO/DIS 9606-2, *Approval testing of welders — Fusion welding — Part 2: Aluminium and aluminium alloys*, was considered and used as a basis. However, alterations were necessary due to the consideration of experience and updated knowledge.

In accordance with the Common CEN/CENELEC Rules being part of the Internal Regulations of CEN, 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 United Kingdom.

Foreword of amendment A1

This Amendment EN 287-2 : 1992/A1 : 1997 to EN 287-2 : 1992 has been prepared by Technical Committee CEN/TC 121, Welding, the secretariat of which is held by DS.

This Amendment to the European Standard EN 287-2 : 1992 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 1997, and conflicting national standards shall be withdrawn at the latest by November 1997.

This Amendment to the European Standard EN 287-2 : 1992 has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements by EU Directive(s).

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

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0 Introduction

This standard covers the principles to be observed in the approval testing of welder performance for the fusion welding of aluminium and its alloys. The term 'aluminium' stands for aluminium and weldable aluminium alloys.

The quality of work involved in welding depends on the skill of the welder to a high degree.

The ability of the welder to follow verbal or written instructions and testing of his skill are therefore important factors in ensuring the quality of the welded product.

Testing of skill to this standard depends on welding methods in which uniform rules and test conditions are complied with, and standard test pieces are used.

This standard applies to processes where the skill of the welder has a significant influence on weld quality.

This standard is intended to provide the basis for the mutual recognition by examining bodies for approval relating to welders' competence in the various fields of application. Tests shall be carried out in accordance with this standard unless more severe tests are specified by the relevant application standard when these shall be applied.

The same test weld may be used to approve a welding procedure and a welder provided that all the relevant requirements, e.g. test piece dimensions, are satisfied (see EN 288-4).

The welder's skill and job knowledge continue to be approved only if the welder is working with reasonable continuity on welding work within the extent of approval.

All new approvals are to be in accordance with this standard from the date of this issue.

However, this standard does not invalidate previous welders approvals made to former national standards or specifications, providing the intent of the technical requirements is satisfied and the previous approvals are relevant to the application and production work on which they are to be employed.

Also, where additional tests have to be carried out to make the approval technically equivalent it is only necessary to do the additional tests on a test piece which should be made in accordance with this standard. Consideration of previous approvals to former national standards or specifications should be at the time of the enquiry/contract stage and agreed between the contracting parties.

1 Scope

This standard specifies essential requirements, ranges of approval, test conditions, acceptance requirements and certification for the approval testing of welder performance for the welding of aluminium. The recommended format for the certificate of approval testing is given in annex A.

During the approval test the welder should be required to show adequate practical experience and job knowledge (test non mandatory) of the welding processes, materials and safety requirements for which he is to be approved; information on these aspects is given in annex C.

This standard is applicable when the welder's approval testing is required by the purchaser, by inspection authorities or by other organizations.

This standard applies to the approval testing of welders for the fusion welding of aluminium using a gas shield.

The welding processes referred to in this standard include those fusion welding processes which are designated as manual or partly mechanized welding. This standard does not cover fully mechanized and automatic welding processes (see 5.2).

This standard covers approval testing of welders for work on semi-finished and finished products made from wrought, forged or cast material types listed in 5.4.

The certificate of approval testing is issued under the sole responsibility of the examiner or examining body.

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.

EN 288-2	<i>Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure specification for arc welding</i>
EN 288-4	<i>Specification and approval of welding procedures for metallic materials — Part 4: Welding procedure tests for the arc welding of aluminium and its alloys</i>
EN 571-1	<i>Non-destructive testing — Penetrant inspection — Part 1: General principles for the examination</i>
EN 910	<i>Welded butt joints in metallic materials — Bend tests</i>
EN 1320	<i>Welded joints in metallic materials — Fracture tests</i>
EN 1321	<i>Destructive examination of welds — Macroscopic and microscopic examination of welds</i>
prEN 1435	<i>Non-destructive examination of welds — Radiographic examination of welded joints</i>

EN 26520	<i>Classification of imperfections in metallic fusion welds, with explanations</i>
EN 30042	<i>Arc-welded joints in aluminium and its weldable alloys — Guidance on quality levels for imperfections (ISO 10042 : 1992)</i>
EN	<i>Welded butt joints in metallic materials — Transverse tensile test</i>
ISO 857 : 1990	<i>Welding, brazing and soldering processes — Vocabulary</i>
ISO 4063 : 1990	<i>Welding, brazing, soldering and braze welding of metals — Nomenclature of processes and reference numbers for symbolic representation on drawings</i>
ISO 6947 : 1990	<i>Welds — Working positions — Definitions of angles of slope and rotation</i>

3 Definitions

3.1 welder

A welder who holds and manipulates the welding gun or torch by hand.

3.2 welding operator

A welder who operates welding equipment with partly mechanized relative movement between the welding gun or torch and the workpiece.

3.3 examiner or examining body

A person or organization who verifies compliance with the applicable standard. The examiner/examining body shall be acceptable to any of the contracting parties.

3.4 welding procedure specification (WPS)

A document providing in detail the required variables for a specific application to assure repeatability.

3.5 heat treatment

The term heat treatment in this standard covers the following procedures:

Preheat, controlled heat input, post-weld heat treatment and ageing.

3.6 range of approval

The extent of approval for an essential variable.

3.7 test piece

The welded assembly which is used in the approval test.

3.8 test specimen

The part or portion cut from the test piece in order to perform a specified destructive test.

3.9 test

A series of operations which will include the making of a welded test piece and subsequent non-destructive and/or destructive testing and reporting of results.

4 Symbols and abbreviations

4.1 General

Where the full wording is not used, the following symbols and abbreviations shall be used when completing the test certificate (see annex A).

4.2 Test piece

<i>a</i>	nominal throat thickness
BW	butt weld
<i>D</i>	outside diameter of pipe
FW	fillet weld
P	plate
<i>t</i>	plate or pipe wall thickness
T	pipe
<i>z</i>	leg length of fillet weld

4.3 Filler metal

nm	no filler metal
wm	with filler metal

4.4 Miscellaneous

ag	ageing
bs	welding from both sides
gg	back gouging or back grinding of welds
mb	welding with backing material
nb	welding without backing
ng	no back gouging or no back grinding
ss	single-sided welding

5 Essential variables for approval testing

5.1 General

The criteria specified in this clause shall be examined in order to identify the ability of the welder in these areas. Each criterion is considered to be a significant factor in the approval testing.

The welder's approval test shall be carried out on test pieces and is independent of the type of construction.

5.2 Welding processes

Welding processes are defined in ISO 857 and reference numbers of welding processes for symbolic representation are listed in ISO 4063.

This standard covers the following welding processes:

- 131 — metal-arc inert gas welding (MIG welding);
- 141 — tungsten inert gas arc welding (TIG welding);
- 15 — plasma arc welding;
- other fusion welding processes by agreement.

5.3 Joint types (butt and fillet welds)

Test pieces shall be produced for butt weld (BW) and fillet weld (FW) in plates¹⁾ (P) or pipes²⁾ (T) for approval tests in accordance with 7.2.

¹⁾ The word 'plate' alone or in combination is used to mean 'wrought plate' and 'flat extruded bars'.

²⁾ The word 'pipe' alone or in combination is used to mean 'pipe', 'tube' or 'hollow section'.

5.4 Material groups

5.4.1 General

In order to minimize unnecessary multiplication of technically identical tests, aluminium with similar metallurgical and welding characteristics are grouped for the purpose of a welder's approval (see 5.4.2).

In general, a welder's approval test shall involve depositing weld metal having a chemical composition compatible with the parent metal.

The welding of any one material in a group confers approval on the welder for the welding of all other materials within the same group.

When welding parent metals from two different groups which do not give approval to each other according to tables 4 and 5 (see 6.4), an approval for the combination as a separate group is required.

When the filler metal is dissimilar to the parent metal group, an approval for that combination of parent metal group and filler metal is needed, except when permitted by tables 4 and 5.

5.4.2 Aluminium groups of parent metal

Aluminium casting alloys are included in the following groups but the filler metal shall be compatible with the filler metal used for the wrought materials in the same group.

5.4.2.1 Group W 21: pure aluminium

Pure aluminium and aluminium-manganese-alloys with $\leq 1,5\%$ impurities or alloy content, e.g.

EN AW-Al 99,8 (A)
EN AW-Al 99,5
EN AW-Al Mn 1

5.4.2.2 Group W 22: non-heat treatable alloys

Non-heat treatable alloys (aluminium-magnesium-alloys), e.g.

EN AW-Al Mg 1,5 (C)
EN AW-Al Mg 5
EN AW-Al Mg 3 Mn
EN AW-Al Mg 4,5 Mn 0,7
EN AW-Al Si alloys

5.4.2.3 Group W 23: heat treatable alloys

Heat treatable alloys, e.g.

EN AW-Al Mg 1 SiCu
EN AW-Al Si 1 MgMn
EN AC-Al SiMg (castings)
EN AC-Al SiCu (castings)
EN AW-Al Zn 4,5 Mg 1

5.5 Consumables

In the approval test, the filler metal and the shielding gas, including plasma gas, shall be compatible with the parent metal and the process used in accordance with the relevant WPS (see EN 288-2).

5.6 Dimensions

The welder approval test should be based on the thickness of the material (i.e. plate thickness or wall thickness of pipe) and pipe diameters which the welder will use in production. A test is listed for each of the two ranges of plate thickness and pipe wall thickness or pipe diameter as specified in tables 1 and 2.

It is not intended that thicknesses or diameters should be measured precisely but rather the general philosophy behind the values given in tables 1 and 2 should be applied.

Table 1. Test piece (plate or pipe) and range of approval

Test piece thickness t mm	Range of approval
$t \leq 6$	$0,7 t$ to $2,5 t$
$6 < t \leq 15$	$6 \text{ mm} < t \leq 40 \text{ mm}^{1)}$
¹⁾ A special test is required for material thickness $> 40 \text{ mm}$. Such a special test shall be indicated on the welder's certificate.	

Table 2. Test piece diameter and range of approval

Test piece diameter $D^{1)}$ mm	Range of approval
$D \leq 125$	$0,5 D$ to $2 D$
$D > 125$	$\geq 0,5 D$
¹⁾ For structural hollow sections D is the dimension of the smallest side.	

5.7 Welding positions

For the purpose of this standard the welding positions identified in figures 1 and 2 shall apply (according to ISO 6947). Angles of slope and rotation for straight welds in the welding positions shall be in accordance with ISO 6947.

The positions and angles used in the approval test shall be based on the same tolerances as used in production.

6 Range of approval for the welder

6.1 General

As a general rule, the test piece approves the welder not only for the conditions used in the test, but also for all joints which are considered easier to weld. The range of approval for each type of test is given in the relevant sub-clauses and tables. In these tables the range of approval is indicated in the same horizontal line.

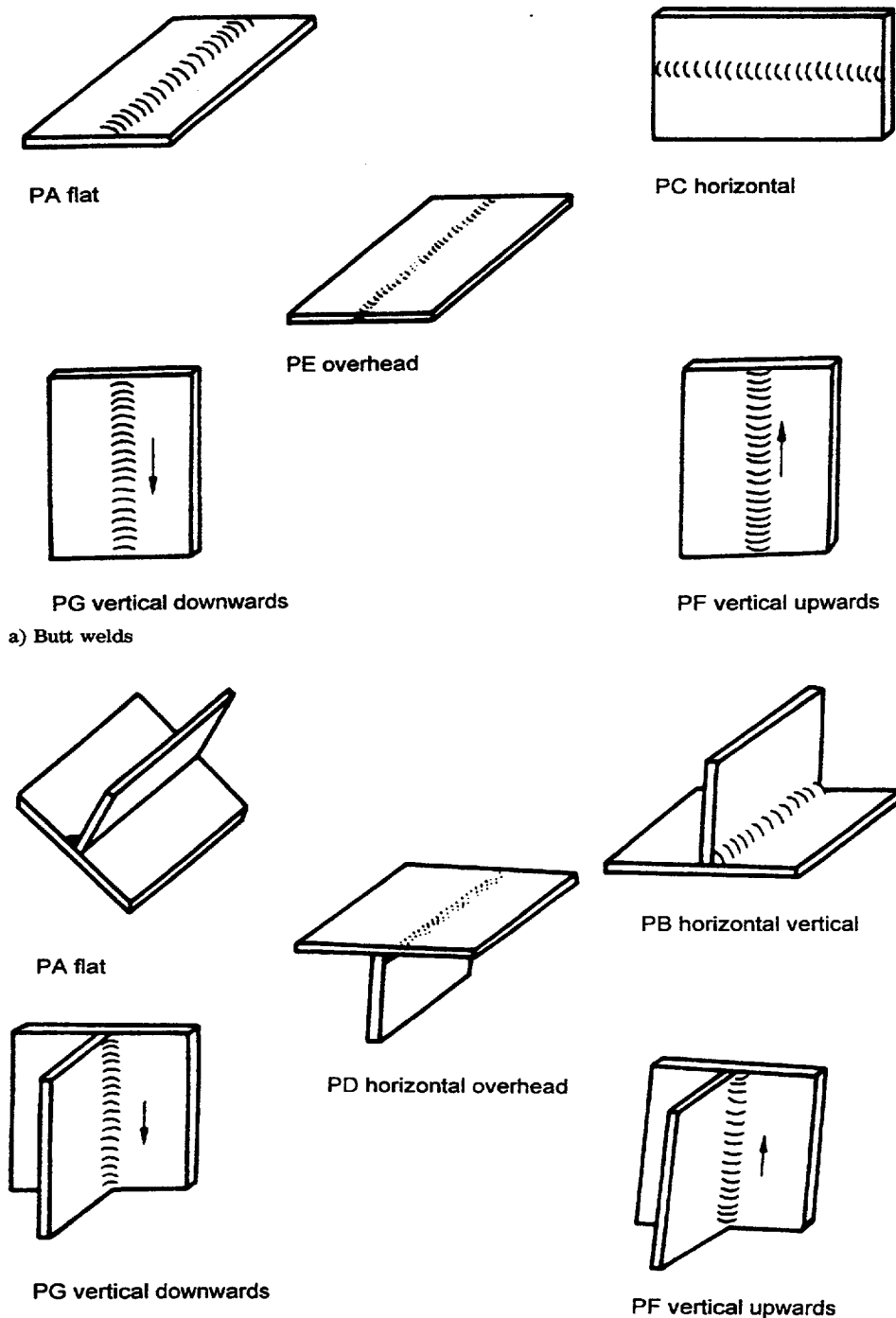


Figure 1. Welding positions for plates

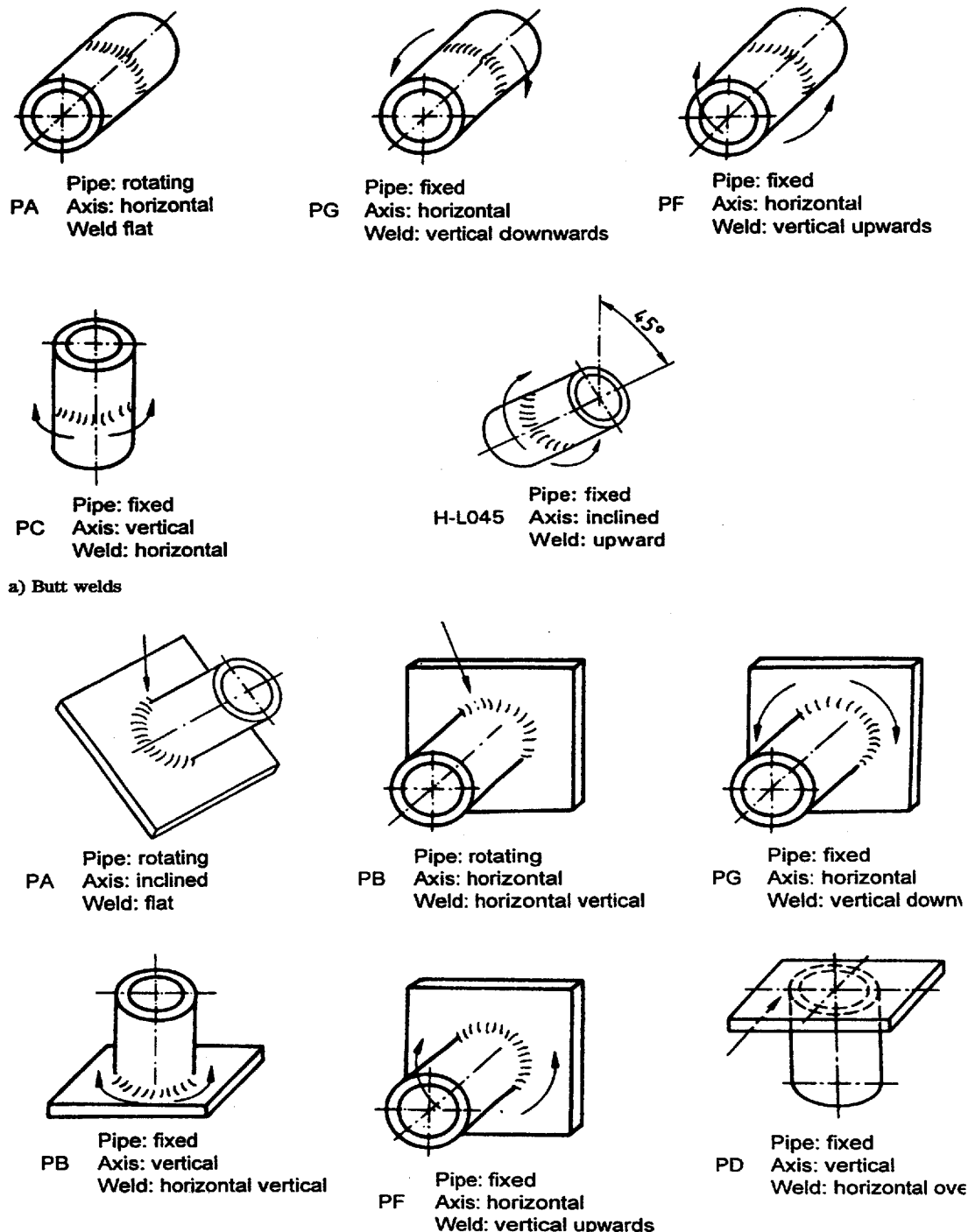


Figure 2. Welding positions for pipes

6.2 Welding process

Each test normally approves one process. A change of process requires a new approval test. However, it is possible for a welder to be approved for more than one welding process by a single test or by two separate approval tests to be used to cover a multi-process joint. For example in a case where approval is required for a single-side butt joint with the root to be welded by TIG (141) without backing and to be filled by MIG (131), the welder may be approved by either of the following routes:

- a) successful completion of an approval test simulating the multi-process joint, i.e. the root run welded by TIG (141) without backing, subsequent runs or layers welded by MIG (131) within the limits of the range of approval for each welding process;
- b) successful completion of separate relevant approval tests one for TIG (141) without backing for the root run and a separate test for the fill by MIG (131) with backing or welded from both sides with or without gouging.

6.3 Joint types

Depending on the test piece, the range of welds for which the welder is approved is shown in table 3; the following criteria are applicable:

- a) approval for butt welds in pipes includes butt welds in plates;
- b) approval for butt welds in plates in all relevant positions covers butt welds on pipes having an outside diameter ≥ 500 mm, except item c) also applies;

c) approval on test butt joints in plates welded in the flat (PA) or horizontal vertical/PC position shall include approval for butt joints in pipes of outside diameter ≥ 150 mm welded in similar positions according to table 6;

d) welding from one side without backing approves welds from one side with backing and welds from both sides with and without gouging;

e) welding in plates or pipes with backing approves welds made from both sides, but not for welds without backing;

f) butt welds approve fillet welds for similar welding conditions;

g) in cases where the production work is predominantly fillet welding, it is recommended that the welder should be approved also by an appropriate fillet welding test, i.e. on plate, pipe or branch connection (see EN 288-4);

h) welding from both sides without gouging approves welds from one side with backing and welds from both sides with gouging;

i) approval for butt welds in pipes without backing includes approval for branch connections within the same range of approval as in tables 3 to 6. For a branch weld the range of approval is based on the diameter of the branch;

j) in cases where the production work is either predominantly branch welding or involves a complex branch connection, it is recommended that the welder should receive special training. In some cases a welder approval test on a branch connection may be necessary.

Table 3. Range of approval for tests on butt joints (Details of the weld type)

Details of the weld type				Range of approval					
				Butt welds in plate				Butt welds in pipe	
				Welded from one side ss		Welded from both sides bs		Welded from one side ss	
				with backing mb	no backing nb	with gouging gg	no gouging ng	with backing mb	no backing nb
Butt weld in plate	Welded from one side ss	with backing	mb	*	—	×	—	1)	—
		no backing	nb	×	*	×	×	1)	1)
	Welded from both sides bs	with gouging	gg	×	—	*	—	1)	—
		no gouging	ng	×	—	×	*	1)	—
Butt weld in pipe	Welded from one side ss	with backing	mb	×	—	×	—	*	—
		no backing	nb	×	×	×	×	×	*

1) See 6.3 b) and 6.3 c).

Key

* indicates the weld for which the welder is approved in the approval test.

× indicates those welds for which the welder is also approved.

— indicates those welds for which the welder is not approved.

6.4 Material groups

According to the material group of the test piece, the range of materials for which a welder is approved is shown in tables 4 and 5 (see 5.4). For any aluminium alloy not covered by any of the aluminium groups the welder shall carry out an approval test, which only approves for that aluminium alloy.

An approval test made on wrought material groups gives approval for cast material and a mixture of cast and wrought material in the same material group (see 5.4).

Table 4. Range of approval for parent metal

Material group of approval test piece	Range of approval		
	W 21	W 22	W 23
W 21	*	×	—
W 22	×	*	—
W 23	×	×	*
Key * indicates the material group for which the welder is approved in the approval test. × indicates those material groups for which the welder is also approved — indicates those material groups for which the welder is not approved.			

Table 5. Range of approval for dissimilar metal joints

Material group of approval test piece	Range of approval
W 21	W 21 welded to W 22 ¹⁾
W 22	W 22 welded to W 21 ¹⁾
W 23	W 22 welded to W 21 ¹⁾ W 23 welded to W 21 ¹⁾ W 23 welded to W 22 ¹⁾
¹⁾ For a dissimilar metal joint the filler metal shall correspond to the group of one of the parent metals.	

6.5 Welding consumables

An approval test made with a specific filler metal and shielding gas (pure gas or combination) shall give approval to weld with any other filler metal compatible with the parent metal group when using the same welding process and a shielding gas (pure gas or combination) which does not require a change in the welder's technique.

6.6 Dimensions

The range of approval according to plate thickness or wall thickness of pipe and/or pipe diameter is shown in tables 1 and 2.

6.7 Welding positions

The range of approval for each welding position is given in table 6. The welding positions and codes refer to figures 1 and 2 (according to ISO 6947).

7 Examination and testing

7.1 Supervision

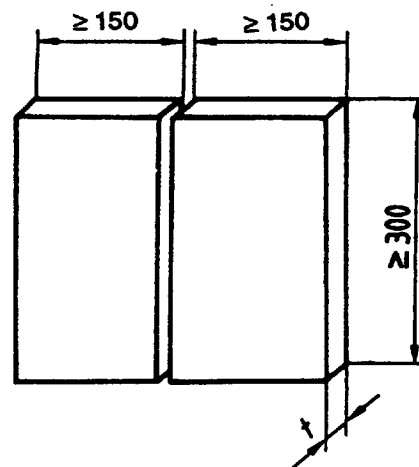
The welding and testing of test piece shall be witnessed by an examiner or examining body.

The test pieces shall be marked with the identification of the examiner and the welder before welding starts.

The examiner or test body may stop the test if the welding conditions are not correct or if it appears that the welder does not have the technical competence to achieve the required standard, e.g. where there are excessive and/or systematic repairs.

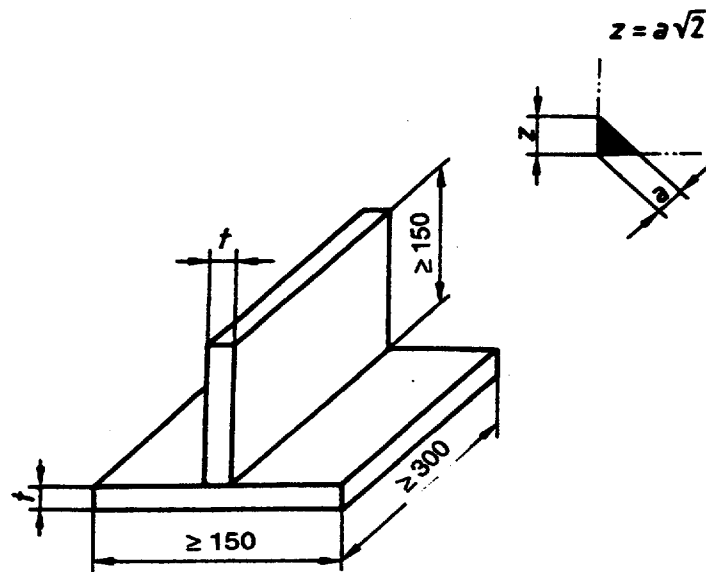
7.2 Shapes and dimensions of test pieces

The shape and dimension of test pieces (see 5.6) required are shown in figures 3 to 6.



(Dimensions in millimetres)

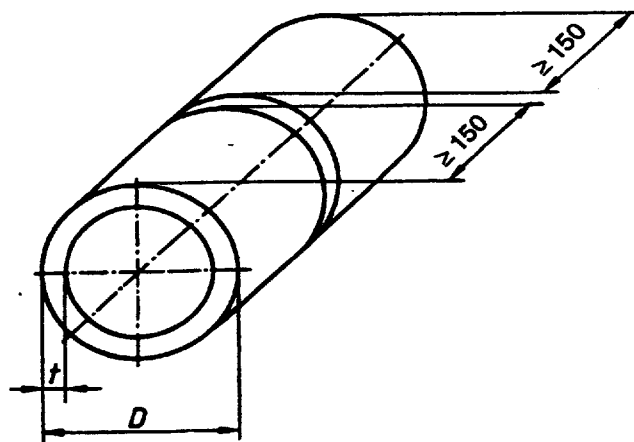
Figure 3. Dimensions of test piece for a butt weld in plate



For $t \geq 6 \text{ mm}$, $a \leq 0,5t$
For $t < 6 \text{ mm}$, $0,5t \leq a \leq t$
($z \approx 0,7t$)

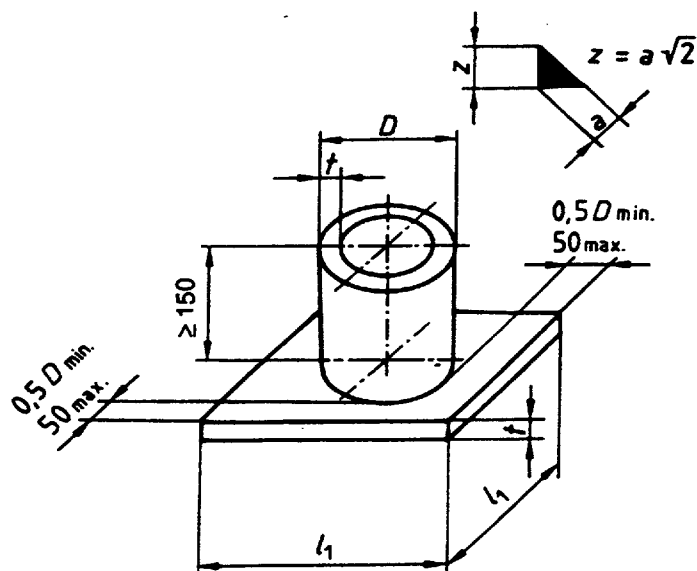
(Dimensions in millimetres)

Figure 4. Dimensions of test piece for fillet weld(s) on plate



(Dimensions in millimetres)

Figure 5. Dimensions of test piece for a butt weld in pipe



t corresponds to the thinner part

For $t \geq 6 \text{ mm}$, $a \leq 0,5t$

For $t < 6 \text{ mm}$, $0,5t \leq a \leq t$

($z \approx 0,7t$)

(Dimensions in millimetres)

Figure 6. Dimensions of test piece for a fillet weld on pipe

7.3 Welding conditions

The approval test for the welder shall correspond to the conditions used in production and follow a WPS or pWPS (see 3.4) prepared in accordance with EN 288-2. A format for the WPS or pWPS is given in annex B.

When preparing the WPS the following conditions shall apply:

- a) the test shall be carried out with the welding process(es) to be used in production;
- b) filler metal(s) shall be compatible for the particular welding process(es) and position(s);
- c) the edge preparation of plates and/or pipes for the test piece shall be representative of that to be used in production; cleaning and degreasing is necessary;
- d) the dimensions of the test piece shall be specified in the tables and figures in this standard (see tables 1 and 2 and figures 3 to 6);

- e) the welding shall be carried out in the position(s) and angle(s) of branch connections normally used in production (see figures 1 and 2);

- f) the weld shall be assessed in accordance with clause 8;

- g) the welding time for the test piece shall correspond to the working time under usual production conditions;

- h) the test piece shall have at least one stop and one re-start in the root run and in the top capping run and be identified in the inspection length to be examined;

- i) any pre-heat or controlled heat input required in the WPS or pWPS is mandatory for the welder's test piece;

- j) any post-weld heat treatment and/or ageing required in the WPS or pWPS may be omitted unless bend or tensile tests are required;

- k) identification of the test piece;

- l) the welder shall be allowed to remove minor imperfections, except on the surface layer, by grinding, gouging or any other method used in production. The approval of the examiner or test body shall be obtained.

7.4 Test methods

Each completed weld shall be examined visually in the as-welded condition. When required (see table 7), visual examination can be supplemented by penetrant (see EN 571-1) or other test methods, and macro tests (see EN 1321) on butt welds.

If accepted by visual inspection, additional radiographic, fracture tests and/or macro tests are required (see table 7).

The macro specimen shall be prepared and etched on one side to clearly reveal the weld.

When radiography is used, bend or tensile tests shall always be applied to butt welds made by the MIG (131) process.

Prior to mechanical testing, backing strips, where used, shall be removed. The test piece can be sectioned by mechanical means discarding the first and the last 25 mm of the test piece at the end of the plates (figures 7 and 8).

Table 7. Test methods

Test method	Butt weld plate	Butt weld pipe	Fillet weld
Visual	*	*	*
Radiography	*1)	*1)	+
Bend or tensile	*2)	*2)	+
Fracture	*1)	*1)	*3) 4)
Macro (without polishing)	+	+	+4)
Penetrant	+	+	+

1) Radiography or fracture test shall be used, but not both.

2) Tensile test may be used instead of bend test, e.g. for heat treated alloys which receive no post-weld heat treatment. Bend or tensile shall be used additionally to radiography for MIG-welding (131) only.

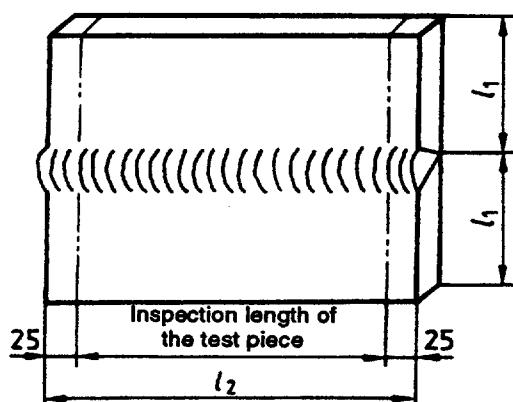
3) The fracture test should be supported by macro examination and penetrant testing when required by the examiner or examining body.

4) The fracture test may be replaced by a macro examination of at least 4 sections, one of which will be taken from the stop/start location.

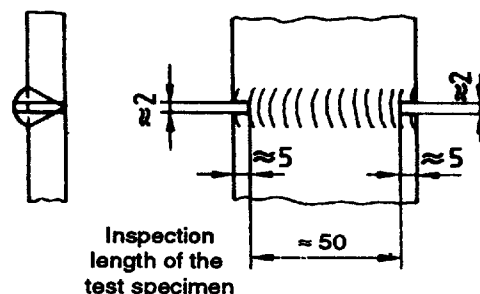
Key

* indicates that the test method is mandatory.

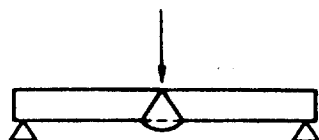
+ indicates that the test method is not mandatory.



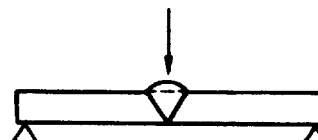
a) Sectioning into an even-numbered quantity of test specimens



b) Preparation



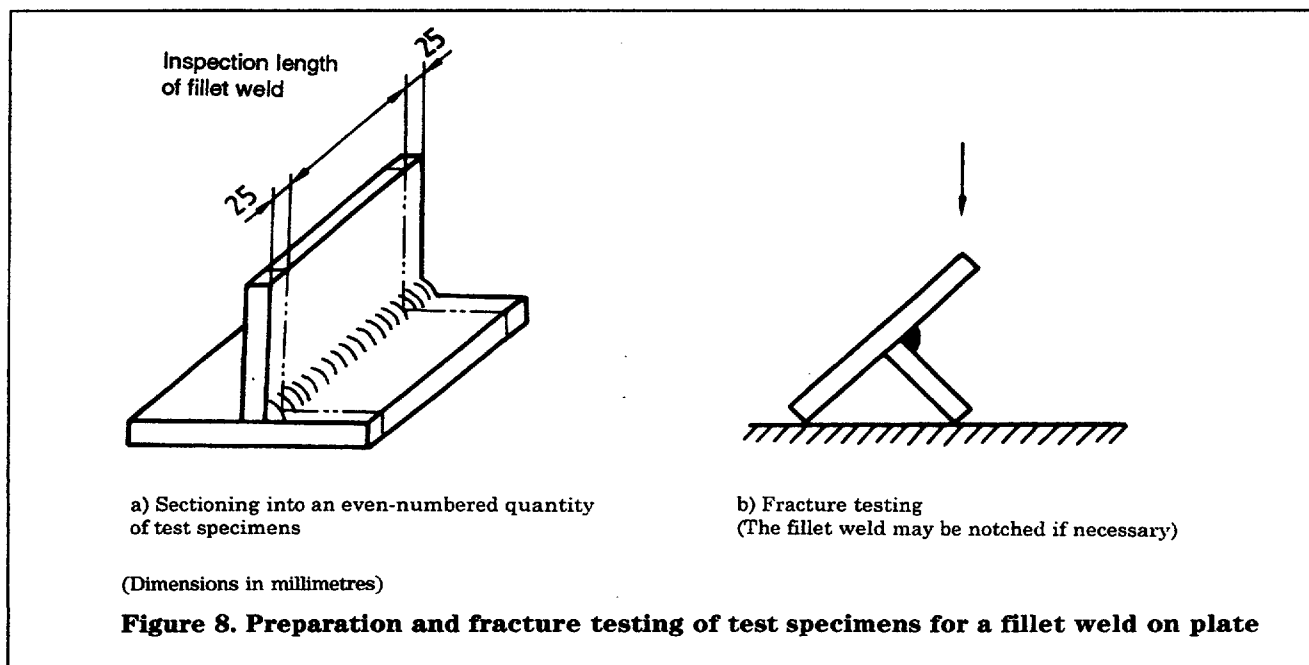
c) Fracture testing face bend test



d) Fracture testing root bend test

(Dimensions in millimetres)

Figure 7. Preparation and fracture testing of test specimens for a butt weld in plate



Bend or tensile tests are used for detecting imperfections without determining the values for tensile strength or bending values.

If any special tests are to be carried out because of the characteristics of particular welding processes, materials or dissimilar alloys, these shall be defined prior to carrying out the welder's test. Special tests do not have any range of approval, outside the range of tolerances for the test carried out.

7.5 Test piece and test specimens

7.5.1 General

In 7.5.2 to 7.5.5 details of the type, size and preparation of test pieces and test specimens are given. In addition, the requirements for mechanical tests are indicated.

7.5.2 Butt welds in plate

When radiography is used, the inspection length (see figure 7a) of the weld in the test piece shall be radiographed in the as-welded condition in accordance with EN 1435 using class B technique.

When fracture testing according to EN 1320 is used, the full test piece inspection length shall be tested and to do this, the test piece shall be cut into several test specimens (see figure 7a). The length of any fracture test specimen shall be ≈ 50 mm. If necessary, the excess weld metal of the test specimen may be removed and additionally the weld edges may be notched to a depth of ≈ 5 mm to facilitate fracture in the weld metal (see figure 7b). In the case of single-sided welding (ss) without backing (nb), half of the inspection length shall be tested against the face side and the other half against the root side (see figures 7c and 7d).

When transverse bend testing according to EN 910 is used, 2 root bend test specimens and 2 face bend test specimens shall be tested in accordance with EN 288-4.

During testing, the test specimens shall not reveal any one single flaw > 3 mm in any direction. Flaws appearing at the corners of a test specimen during testing shall be ignored in the evaluation.

For plate thickness ≥ 12 mm the transverse bend tests may be substituted by 4 side bend tests.

7.5.3 Fillet weld on plate

For fracture tests according to EN 1320, the test piece may be cut, if necessary, into several test specimens (see figure 8a). Each test specimen shall be positioned for breaking as shown in figure 8b, and examined after fracture.

When macro examination is used, it shall be in accordance with EN 1321.

7.5.4 Butt weld in pipe

When radiography is used, the inspection length of the weld in the test piece shall be radiographed in the as-welded condition in accordance with EN 1435, using class B technique, except where double wall technique is necessary.

When fracture testing according to EN 1320 is used, the full test piece inspection length shall be tested and to do this, the test piece shall be cut into a least 4 test specimens (see figure 9a).

A minimum weld length of 150 mm is required for testing of pipes. If the circumference is less than 150 mm, additional weld test pieces, but max. 3 test pieces will be required.

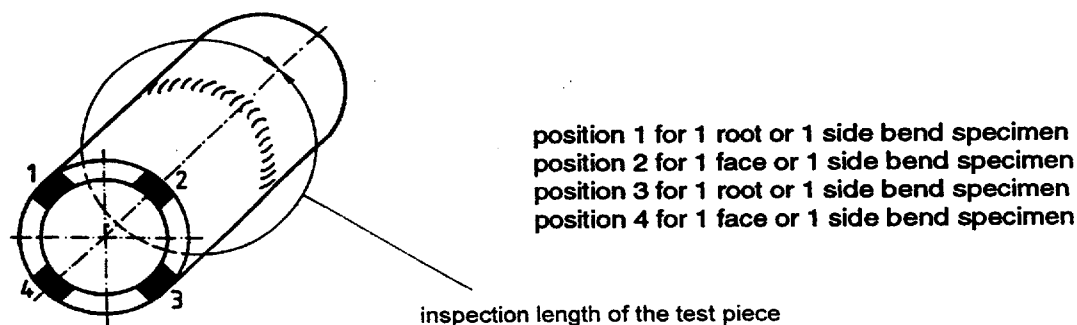
The inspection length of any test specimen shall be ≥ 40 mm. If necessary, the excess weld metal of the test specimen may be removed and additionally the weld edges may be notched to a depth of ≥ 5 mm to facilitate fracture in the weld metal (see figure 9b). In the case of single-side welding (ss) without backing (nb), half of the inspection length (see figure 9a) shall be tested against the face side and the other half against the root side (see figures 9c and 9d).

When transverse bend testing according to EN 910 is used, 2 root and 2 face bend test specimens shall be tested under the conditions in accordance with EN 288-4.

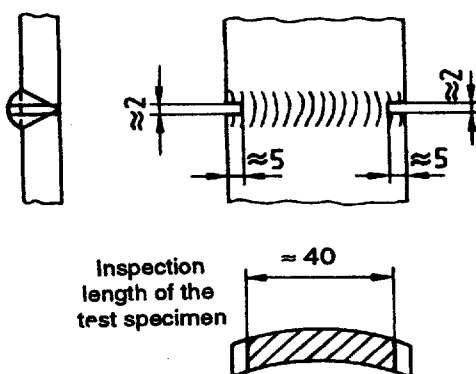
For the sectioning of test pieces welded in position PF, PG and H-L045 (see figures 2 and 9), the test specimens shall be taken from different welding positions.

During testing, the test specimens shall not reveal any one single failure > 3 mm in any direction. Failures appearing at the corners of a test specimen during testing shall be ignored in the evaluation.

For wall thickness ≥ 12 mm the transverse bend tests may be substituted by 4 side bend tests.

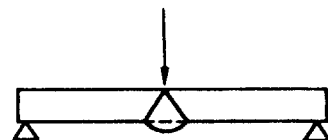


a) Sectioning into at least four test specimens

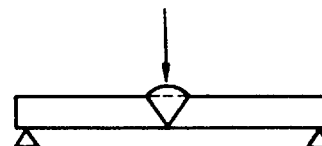


b) Preparation

(Dimensions in millimetres)



c) Fracture testing face bend test



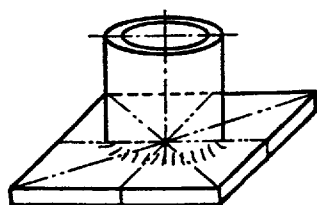
d) Fracture testing root bend test

Figure 9. Preparation and fracture testing of test specimens for a butt weld in pipe

7.5.5 Fillet weld on pipe

For fracture tests according to EN 1320, the test piece shall be cut into 4 or more test specimens and fractured (see figure 10).

When macro examination according to EN 1321 is used, at least 4 test specimens shall be taken equally spaced around the pipe.



Sectioning into test specimens
(Dimensions in millimetres)

Figure 10. Preparation and fracture testing of test specimens for a fillet weld on pipe

8 Acceptance requirements for test pieces

Test pieces shall be evaluated according to the acceptance requirements specified for relevant types of imperfections. A full explanation of these imperfections is given in EN 26520. The acceptance requirements for imperfections found by test methods according to this standard shall, unless otherwise specified, be assessed in accordance with EN 30042. A welder is approved if the imperfections in the test piece are within the specified limits of level B in EN 30042, except for imperfection types as follows: excess weld metal, excessive convexity, excess throat thickness and excessive penetration, for which level C shall apply. If the imperfections in the welder's test piece exceed the permitted maximum specified, then the welder shall not be approved.

Reference should also be made to the corresponding acceptance criteria for non-destructive examination. Specified procedures shall be used for all destructive and non-destructive examinations.

9 Re-tests

If any test piece fails to comply with the requirements of this standard, the welder shall produce a new test piece.

If it is established that failure is attributed to the welder's lack of skill, the welder shall be regarded as incapable of complying with the requirements of this standard without further training before re-testing.

If it is established that failure is due to metallurgical or other extraneous causes and cannot be directly attributed to the welder's lack of skill, an additional test or additional specimens are required in order to assess the quality and integrity of the new test material and/or new test conditions.

10 Period of validity**10.1 Initial approval**

The validity of the welder's approval begins from the date when all the required tests are satisfactorily completed. This date may be different to the date of issue marked on the certificate.

A welder's approval shall remain valid for a period of two years providing that the relevant certificate is signed at six month intervals by the employer/coordinator and that all the following conditions are fulfilled:

- a) the welder shall be engaged with reasonable continuity on welding work within the current range of approval. An interruption for a period no longer than six months is permitted;
- b) the welder's work shall be in general accordance with the technical conditions under which the approval test is carried out;
- c) there shall be no specific reason to question the welder's skill and knowledge.

If any of these conditions are not fulfilled, the approval shall be cancelled.

10.2 Prolongation

The validity of the approval on the certificate may be prolonged for further periods of two years, within the original range of approval, provided each of the following conditions according to 10.1 are fulfilled:

- the production welds made by the welder are of the required quality;
- records of tests, e.g. half-yearly documentation about X-ray or ultrasonic inspections or test reports about fracture test shall be maintained on file with the welder's approval certificate.

The examiner or examining body shall verify compliance with the above conditions and sign the prolongation of the welder's approval test certificate.

11 Certification

It shall be certified that the welder has successfully passed the performance approval test. All relevant test conditions shall be recorded on the certificate. If the welder fails any of the prescribed tests, no certificate shall be issued.

The certificate shall be issued under the sole responsibility of the examiner or test body and shall contain all the information detailed in annex A. The format of annex A is recommended to be used as the welder's approval test certificate.

If any other form of welder's approval test certificate is used, it shall contain the information required in annex A. The manufacturer's WPS as shown in annex B shall give information about materials, welding positions, processes and range of approval etc., in accordance with this standard.

The welder's approval test certificate shall be issued at least in one of the official CEN languages (English, French, German).

The practical test and the examination of job knowledge (see annex C) shall be designated by 'Accepted' or 'Not tested'.

Each change of the essential variables for the approval testing beyond the permitted ranges requires a new test and a new approval certificate.

12 Designation

The designation of a welder approval shall comprise the following items in the order given (the system is arranged so that it can be used for computerization):

NOTE. The type of shielding gas shall not be incorporated in the designation but shall be included in the welder's approval test certificate (see annex A).

- the number of this standard;
- the essential variables:
 - welding processes: refer to 5.2 and ISO 4063;
 - semi-finished product: plate (P), pipe (T), refer to 5.3;
 - joint type: butt weld (BW), fillet weld (FW), refer to 5.3;
 - material group: refer to 5.4;
 - filler metal: refer to 5.5;
 - size of test piece: thickness (*t*) and pipe diameter (*D*), refer to 5.6;
 - welding positions: refer to 5.7, figures 1 and 2 and ISO 6947;
 - details of the weld type: refer to 6.3 and table 3, for abbreviations to 4.4.

The designation, where used for computerization, shall be in to the following format:

'XX XXXXX', 'XXX', 'X', 'XX', 'XXX', 'XX', 'XXX', 'XXXX', 'XXXXXX', 'XX', 'XX'

Example:

'EN 287-2', '141', 'P', 'BW', 'W21', 'nm', 't02', 'D030', 'H-L045', 'ss', 'nb'

followed by further elements of the details of weld type in the order as given in clause 4, separated by ', '. These elements are not part of the computer record.

Designation example 1

Welder approval EN 287-2 141 P BW W21 nm t02 PC ss nb

Explanation

Welding process: TIG welding.....	141
Plate:	P
Butt weld:	BW
Material group: pure aluminium	W21
Filler metal: no filler metal.....	nm
Dimension of test piece: thickness 2 mm.....	t02
Welding position: butt weld on plate, horizontal vertical.....	PC
Details of the weld type: single side.....	ss
without backing	nb

Designation example 2

Welder approval EN 287-2 131 T BW W23 wm t10 D150 PA bs gg

Explanation

Welding process: MIG-welding.....	131
Pipe:	T
Butt weld:	BW
Material group: heat treatable alloy.....	W23
Filler metal: AlMg 5	wm
Dimension of test piece: thickness 10 mm	t10
pipe diameter 150 mm	D150
Welding position: butt weld on pipe, rotating pipe, horizontal axis, flat	PA
Details of the weld type: both sides.....	bs
gouging.....	gg

NOTE. For explanation of abbreviations used in the designation examples, see clause 4.

Annex A (informative)
Welder Approval Test Certificate

Designation:

Manufacturer's Welding Procedure Specification

Reference No. (if applicable):

Welder's name:

Identification:

Method of identification:

Date and place of birth:

Employer:

Code/Testing Standard:

Examiner or examining body

Reference No.

Photograph
(if required)

Job knowledge: Acceptable/Not tested (Delete as necessary)

	Weld test details	Range of approval
Welding process Plate or pipe Joint type Parent metal group(s) Filler metal type/designation Shielding gases Auxiliaries Test piece thickness (mm) Pipe outside diameter (mm) Welding position Gouging/backing		

Additional information is available on attached sheet and or welding procedure specification No.:

Type of test	Performed and acceptable	Not required	Name, date and signature
Visual Radiography Magnetic particle/ Penetrant Macro Fracture Bend Additional Tests*			Examiner or examining body Date of issue Location Validity of approval until

*Append separate sheet if required

Prolongation for approval by examiner or examining body for the following 2 years (refer to 10.2)

Prolongation for approval by employer/coordinator for the following 6 months (refer to 10.2)

Date	Signature	Position or title

Date	Signature	Position or title

Annex B (informative)**Manufacturer's Welding Procedure Specification (WPS)**

(See EN 288-2)

Location:

Examiner or examining body:

Manufacturer's welding procedure:

Reference No.:

WPAR No.:

Method of preparation and cleaning:

Parent material specification:

Manufacturer:

Welding process:

Material thickness (mm):

Joint type:

Outside diameter (mm):

Weld preparation details (sketch)*:

Welding position:

Joint design	Welding sequences

Welding details

Run	Process	Size of filler metal	Current A	Voltage V	Type of current/polarity	Wire feed speed	Run-out length/travel speed	Heat input*

Designation of welding consumables

Any special baking or drying:

Gas/flux: shielding:

backing:

Gas flow rate: shielding:

backing:

Tungsten electrode type/size:

Details of back gouging/backing:

Preheat temperature:

Interpass temperature:

Post-weld heat treatment and/or ageing:

Time, temperature, method:

Heating and cooling rates*:

Other information*:

e.g. weaving (maximum width of run):

Oscillation: amplitude, frequency, dwell time:

Pulse welding details:

Stand off distance:

Plasma welding details:

Torch angle:

Manufacturer

Name, date and signature

* If required

Examiner or examining body

Name, date and signature

Annex C (informative)

Job knowledge

C.1 General

The test of job knowledge is recommended, but it is not mandatory.

However, some countries may require that the welder undergoes a test of job knowledge. If the job knowledge test is carried out, it should be recorded on the welder's certificate.

This annex outlines the job knowledge that a welder should have to ensure that procedures are followed and common practices are complied with. The job knowledge indicated in this annex is only pitched at the most basic level.

Owing to different training programmes in various countries, it is only proposed to standardize general objectives or categories of job knowledge. The actual questions used should be drawn up by the individual country, but should include questions on areas covered by clause C.2, relevant to the welders approval test.

The actual tests of a welder's job knowledge may be given by any of the following methods or combinations of these methods:

- a) written objective tests (multiple choice);
- b) oral questioning following a set of written questions;
- c) computer testing;
- d) demonstration/observation testing following a written set of criteria.

The test of job knowledge is limited to the matters related to the welding process used in the test.

C.2 Requirements

C.2.1 *Welding equipment for gas-shielded metal-arc welding (131, 141, 15)¹⁾*

- a) Identification and assembly of essential components and equipment;
- b) Type of welding current;
- c) Correct connection of the welding return cable.

C.2.2 *Welding processes*

- a) Types and size of electrodes - tungsten electrodes, wire electrodes;
- b) Identification of shielding gas and flow rate;
- c) Type, size and maintenance of nozzles contact tip;
- d) Protection of the welding arc from draughts.

C.2.3 *Parent metals*

- a) Identification of material;
- b) Methods and control of preheat;
- c) Control of interpass temperature.

C.2.4 *Consumables*

- a) Identification of consumables;
- b) Storage, handling and conditions of consumables;
- c) Selection of correct size;
- d) Cleanliness of electrodes and filler wires;
- e) Control of wire spooling;
- f) Control and monitoring of gas flow rates and quality.

C.2.5 *Safety and accident prevention*

- a) Safe assembly, setting up and closing down procedures;
- b) Safe control of welding fumes and gases;
- c) Personal protection;
- d) Fire hazards;
- e) Welding in confined spaces;
- f) Awareness of welding environment;
- g) Environment of increase hazard of electric shock;
- h) Radiation from the arc;
- i) Effects of stray arcing;
- j) Safe storage, handling and use of compressed gases;
- k) Leak detection on gas hoses and fittings.

C.2.6 *Welding sequences/procedures*

Appreciation of welding procedure requirements and the influence of welding parameters.

C.2.7 *Edge preparation and weld representation*

- a) Conformance of weld preparation to procedure specification (WPS);
- b) Cleanliness and drying of fusion faces.

C.2.8 *Weld imperfections*

- a) Identification of imperfections;
- b) Causes;
- c) Prevention and remedial action.

C.2.9 *Welder approval*

The welder shall be aware of the range of the approval.

¹⁾ The numbers refer to ISO 4063.

List of references

See national foreword.



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