
**Approval testing of welders — Fusion
welding —**

Part 5:

**Titanium and titanium alloys, zirconium and
zirconium alloys**

*Épreuve de qualification des soudeurs — Soudage par fusion —
Partie 5: Titane et ses alliages, zirconium et ses alliages*



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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

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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 3.

Draft International Standards adopted by the technical committees are circulated to member bodies for voting. Publication as an International Standard requires approval by at least 75 % of member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 9606 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 9606-5 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 44, *Welding and allied processes*, Subcommittee SC 11, *Approval requirements for welding and allied processes personnel*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard...".

ISO 9606 consists of the following parts, under the general title *Approval testing of welders — Fusion welding*:

- *Part 1: Steels*
- *Part 2: Aluminium and aluminium alloys*
- *Part 3: Copper and copper alloys*
- *Part 4: Nickel and nickel alloys*
- *Part 5: Titanium and titanium alloys, zirconium and zirconium alloys*
- *Part 6: Magnesium and magnesium alloys*

Annexes A and ZA of this part of ISO 9606 are for information only.

Annex ZA provides a list of corresponding International and European Standards for which equivalents are not given in the text.

For the purposes of this part of ISO 9606, the CEN annex regarding fulfilment of European Council Directives has been removed.

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Foreword

The text of EN ISO 9606-5:2000 has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DS, in collaboration with Technical Committee ISO/TC 44 "Welding and allied processes".

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 August 2000, and conflicting national standards shall be withdrawn at the latest by August 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of 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.

Introduction

This standard covers the principles to be observed in the approval testing of welder performance for the fusion welding of titanium, zirconium and their weldable alloys.

The ability of the welder to follow verbal or written instructions and testing of his skill are 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.

The test weld can 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 288-2).

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 titanium and zirconium.

This standard applies to the approval testing of welders for the fusion welding of titanium and zirconium.

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 will be carried out in accordance with this standard unless more severe tests are specified by the relevant application standard when these are applied.

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 A.

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

The welding processes referred to in this standard include those fusion welding processes which are designated as manual or partly mechanized welding. It does not cover fully mechanized and automatic 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 287-1 : 1992

Approval testing of welders – Fusion welding – Part 1: Steels

EN 288-2 : 1992

Specification and approval of welding procedures for metallic materials – Part 2: Welding procedure specification for arc welding

EN 571-1

Non destructive testing – Penetrant testing – Part 1: General principles

EN 910

Destructive tests on welds in metallic materials – Bend tests

EN 970

Non-destructive examination of fusion welds – Visual examination

EN 1289

Non-destructive examination of welds – Penetrant testing of welds – Acceptance levels

EN 1320

Destructive tests on welds in metallic materials – Fracture test

EN 1321

Destructive tests on welds in metallic materials – Macroscopic and microscopic examination of welds

EN 1435

Non-destructive examination of welds – Radiographic examination of welded joints

ISO 9606-5:2000(E)

EN ISO 4063

Welding and allied processes – Nomenclature of processes and reference numbers (ISO 4063 : 1998)

EN ISO 6520-1

Welding and applied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding (ISO 6520-1:1998)

EN 25817

Arc-welded joints in steel – Guidance on quality levels for imperfections (ISO 5817 : 1992)

EN ISO 6947

Welds – Working positions – Definitions of angles of slope and rotation (ISO 6947 : 1993)

CR 12187

Welding – Guidelines for a grouping system of materials for welding purposes

ISO 857

Welding, brazing and soldering processes – Vocabulary

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in EN 287-1 apply.

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 B of EN 287-1 : 1992).

4.2 Test piece

a	nominal throat thickness;
BW	butt weld;
D	outside diameter of pipe;
FW	fillet weld;
P	plate;
t	plate or pipe wall thickness;
T	pipe;
z	leg length of fillet weld.

4.3 Consumables

nm	no filler metal;
wm	with filler metal.

4.4 Miscellaneous

bs	welding from both sides;
gg	back grinding or back milling of welds;
mb	welding with backing;
nb	welding without backing;
ng	no back grinding or back milling of welds;
ss	single-side 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 accordance with ISO 857 and reference numbers of welding processes for symbolic representation are listed in accordance with EN 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 plates (P) or pipes¹⁾ (T) for approval tests in accordance with 7.2.

5.4 Material groups

An approval test carried out on any material in groups 51, 52, 53 or 54 according to CR 12187 or 61 or 62 according to CR 12187 covers all materials within these groups. In cases where the production work is predominantly zirconium welding, the welder shall carry out the approval test on zirconium.

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 pWPS or 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 ranges of plate thickness and pipe wall thickness or pipe diameter as specified in tables 1 and 2.

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

Test piece thickness t mm	Range approval
$t \leq 3$	t to $2,5 t$
$t > 3$	> 3

¹⁾ The word "pipe" alone or in combination, is used to mean "pipe", "tube" or "hollow section".

Table 2 - Test piece diameter and range of approval

Test piece diameter <i>D</i> mm	Range approval
$D \leq 25$	D to $2D$
$D > 25$	$\geq 0,5 D$ (25 mm min.)

5.7 Number of test pieces

Plate: One test piece per position.

Pipe: A minimum weld length of 150 mm is required, but not more than three test pieces.

5.8 Welding positions

The welding positions shall be taken from EN ISO 6947.

The test pieces shall be welded in accordance with the nominal angles of the positions according to EN ISO 6947.

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.

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 can be approved by either of the following routes:

- a) 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 back grinding or milling.

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, diameter > 25 mm, 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 for butt joints in plates welded in the flat (PA) or horizontal (PC) position shall include approval for butt joints in pipes of outside diameter ≥ 150 mm welded in similar positions according to table 6;
- d) butt welds approve fillet welds. In cases where the majority of production work is fillet welding, the welder shall be approved also by an appropriate fillet welding test;
- e) 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;
- f) in cases where the majority of production work is predominantly branch welding or involves a complex branch connection, the welder should receive special training. In some cases a welder approval test on a branch connection can 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 baking mb	no baking nb	with grinding gg	no grinding ng	with baking mb	no baking nb
Butt weld in plate	welded from one side ss	with baking	mb	★	—	×	—	¹⁾	—
		no baking	nb	×	★	×	×	¹⁾	¹⁾
	welded from both sides bs	with grinding	gg	×	—	★	—	¹⁾	—
		no grinding	ng	×	—	×	★	¹⁾	—
Butt weld in pipe	welded from one side ss	with baking	mb	×	—	×	—	★	—
		no baking	nb	×	×	×	×	×	★

¹⁾ See 6.3b), and 6.3c)

★ 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 CR 12187)

In tables 4 and 5 the grouping systems for titanium/titanium alloys and zirconium/zirconium alloys are given.

Table 4 - Grouping system for titanium and titanium alloys

Group	Type of titanium and titanium alloys
51	Pure titanium
52	Alpha alloys ¹⁾
53	Alpha-beta alloys ²⁾
54	Near beta and beta alloys ³⁾
¹⁾ Alloys covered by group 52 are: Ti-0,2Pd; Ti-2,5Cu; Ti-5Al-2,5Sn; Ti-8Al-1Mo-1V; Ti-6Al-2Sn-4Zr-2Mo; Ti-6Al-2Nb-1Ta-0,8Mo. ²⁾ Alloys covered by group 53 are: Ti-3Al-2,5V; Ti-6Al-4V; Ti-6Al-6V-2Sn; Ti-7Al-4Mo. ³⁾ Alloys covered by group 54 are: Ti-10V-2Fe-3Al; Ti-13V-11Cr-3Al; Ti-11,5Mo-6Zr-4,5Sn; Ti-3Al-8V-6Cr-4Zr-4Mo.	

Table 5 - Grouping system for zirconium and zirconium alloys

Group	Type of zirconium and zirconium alloys
61	Pure zirconium
62	Zirconium with 2,5 % Nb

6.5 Consumables

An approval test made with a specific filler metal and shielding gas shall give approval to weld with any other filler metal compatible with the parent metal group when using the same welding process.

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 EN ISO 6947.

The welding position H-L045 for pipes approves for all pipe angles in production work. In pipes diameter $D \geq 150$ mm it is allowed to weld in two welding positions (PF 2/3 of circumference, PC 1/3 of circumference) using only one test piece.

Table 6 - Range of approval according to welding position

Welding position of approval test piece		Range of approval																									
		Plates									Pipes																
		Butt welds			Fillet welds						Butt welds			Pipe-axis and -angle			Fillet welds										
		PA	PC	PF	PE	PA	PB	PF	PD	PA	PC	PF	90°	45°	45°	rotating	rotating	fixed	1)	0°	90°						
Plates	Butt welds	PA	*	-	-	X	X	-	-	PA	X	-	-	PC	-	-	-	PA	PF	PC	H-L045	PA	PB	PF	PD ²⁾		
		PC	X	*	-	X	X	-	-	PC	X	-	-	PC	X	-	-	PC	-	-	X	-	X	X	-	-	
		PF	X	-	*	-	X	X	-	-	PF	X	X	-	-	-	-	-	PF	-	-	-	X	X	X	-	-
		PE	X	X	*	X	X	X	X	PE	X	X	X	-	-	-	-	-	PE	-	-	-	X	X	X	X	-
Plates	Fillet welds	PA	-	-	-	*	-	-	PA	-	-	-	-	PA	-	-	-	PA	-	-	-	X	-	-	X		
		PB	-	-	-	X	*	-	PB	-	-	-	-	PB	-	-	-	PB	-	-	-	X	X	-	-		
		PF	-	-	-	X	X	*	-	PF	-	-	-	-	PF	-	-	-	PF	-	-	-	X	X	-	-	
		PD	-	-	-	X	X	*	-	PD	-	-	-	-	PD	-	-	-	PD	-	-	-	X	X	-	X	
Pipes	Butt welds	rotating	PA	X	-	-	X	X	PA	X	-	-	-	PA	*	-	-	PA	-	-	-	X	X	-	-		
		fixed	PF	X	-	X	X	X	PF	X	X	X	X	PF	*	-	-	PF	X	-	-	X	X	X	X	-	
	Fillet welds	rotating	PC	X	X	-	X	X	PC	X	X	X	X	PC	X	-	*	-	PC	X	-	-	X	X	X	-	
		1)	H-L045	X	X	X	X	X	H-L045	X	X	X	X	H-L045	X	X	X	*	H-L045	X	X	X	X	X	X	X	
Pipes	Fillet welds	rotating	PA	-	-	X	-	PA	-	-	-	-	PA	-	-	-	-	PA	-	-	-	*	-	-	-		
		fixed	PB	-	-	X	X	PB	-	-	-	-	PB	-	-	-	-	PB	-	-	-	X	*	-	-		
Pipes	Fillet welds	rotating	PF	-	-	X	X	PF	-	-	-	-	PF	-	-	-	-	PF	-	-	-	X	X	*	-		
		fixed	PF	-	-	X	X	PF	-	-	-	-	PF	-	-	-	-	PF	-	-	-	X	X	*	X		

1) PB for pipes can be welded in two versions
 (1) pipe: rotating; axis: horizontal; weld: horizontal vertical
 (2) pipe: fixed; axis: vertical; weld: horizontal vertical
 2) This is an approved position and is covered by the other related tests.
 * indicates the welding position for which the welder is approved in the approval test
 x indicates those welding positions for which the welder is also approved
 - indicates those welding positions for which the welder is not approved

7 Examination and testing

7.1 Supervision

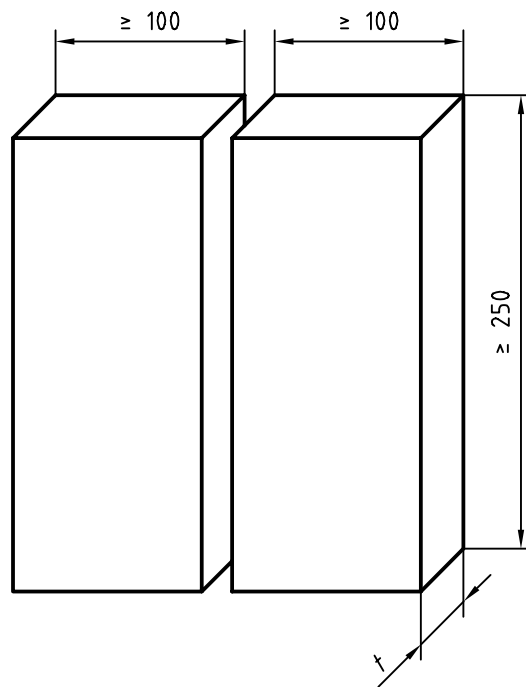
The welding and testing of test pieces shall be witnessed by an examiner or examining body acceptable to the contracting parties.

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

The examiner or examining body can stop the test if the welding conditions are not correct or if it appears that the welder does not have the technical competence to comply to the requirements of this standard, e.g. where there are excessive and/or systematic repairs.

7.2 Shapes and dimensions of test pieces

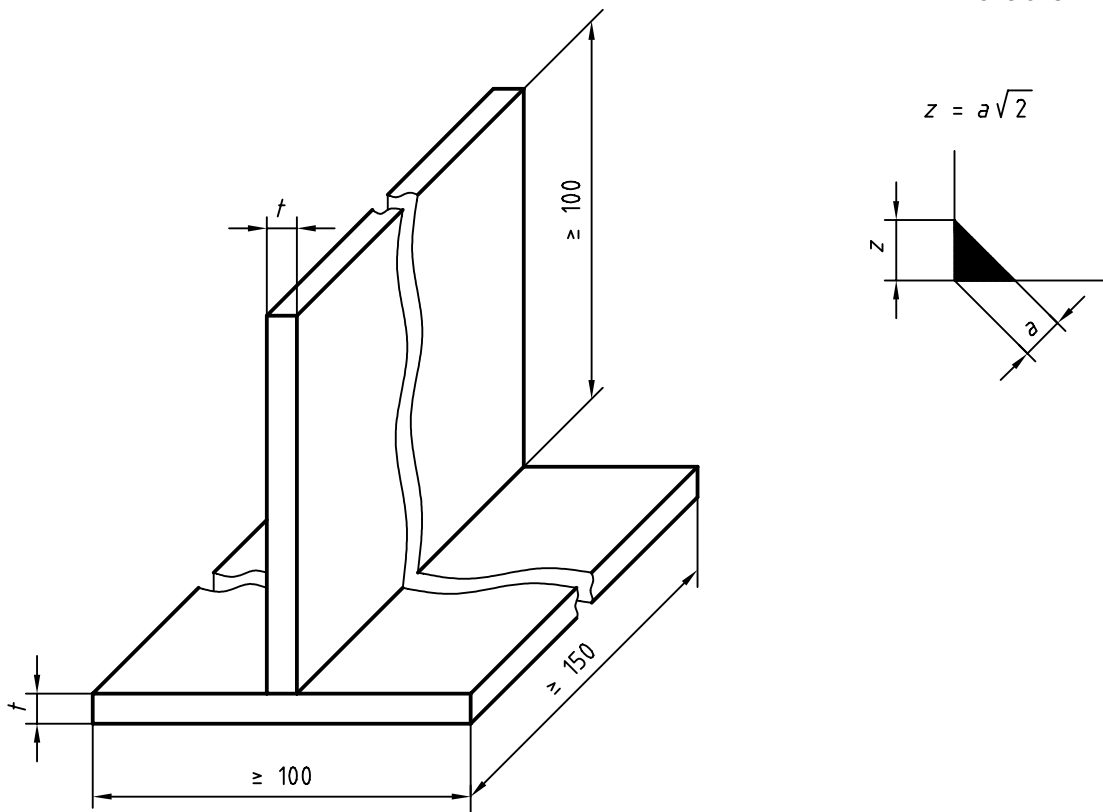
The shape and dimension of test pieces (see 5.6) required are shown in figures 1 to 4.



Dimensions in millimetres

Figure 1 - Dimensions of test piece for a butt weld in plate

Dimensions in millimetres



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

Figure 2 - Dimensions of test piece for fillet weld(s) on plate

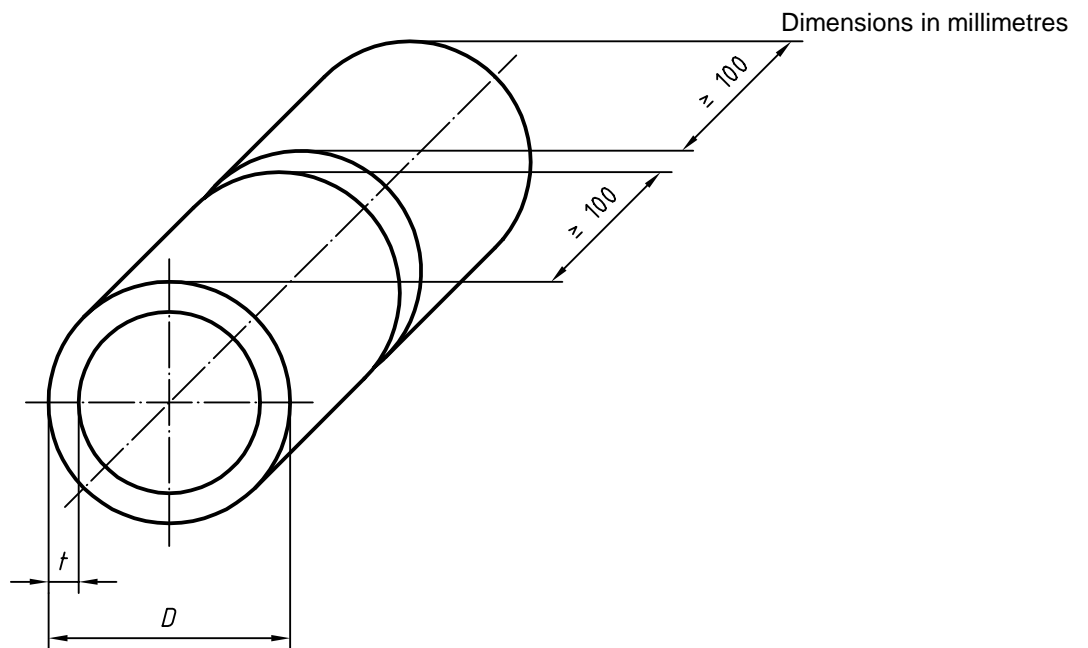
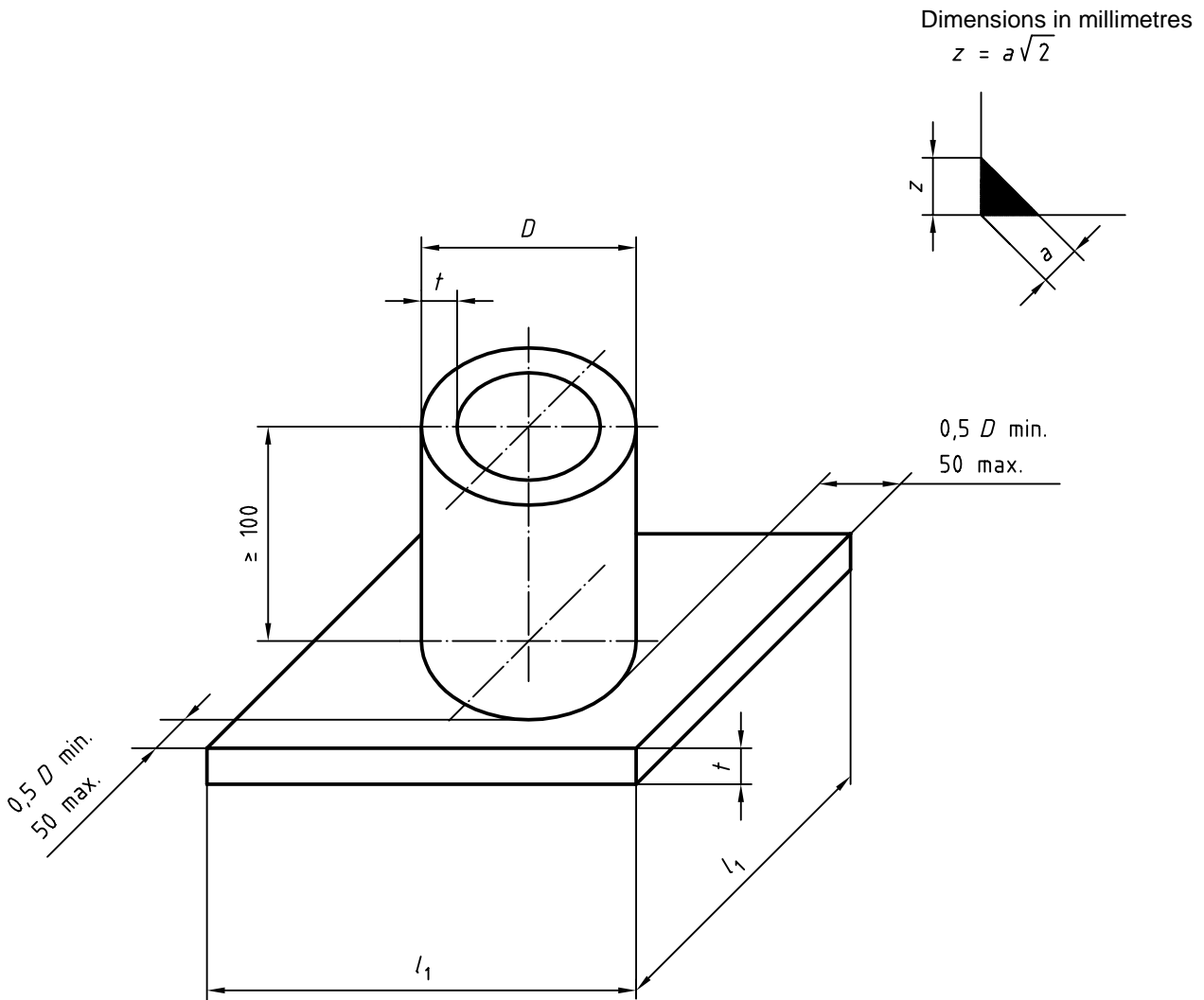


Figure 3 - Dimensions of test piece for a butt weld in pipe



t corresponds to the thinner part

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

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

($z \approx 0,7 t$)

Figure 4 - 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 prepared in accordance with EN 288-2.

The following conditions shall apply:

- a) the welding time for the test piece shall correspond to the working time under usual production conditions;
- b) 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;
- c) identification of the test piece;
- d) the welder shall be allowed to remove minor imperfections, except on the surface layer, by grinding 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 accordance with EN 970 including temper colour on the root and face side in the as-welded condition. The visual examination shall be supplemented by penetrant testing in accordance with EN 571-1 or other test methods (see table 7).

For the root examination on pipes, the test piece shall be cut into two half pipes.

If accepted by visual examination with assessment of temper colours, the mandatory tests according to table 7 have to be carried out.

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 5 and 6).

Table 7 - Test methods

Test method	Butt weld plate	Butt weld pipe	Fillet weld
Visual	mandatory	mandatory	mandatory
Bend	mandatory	mandatory	–
Fracture	–	–	mandatory
Penetrant	not mandatory	not mandatory	not mandatory
Macroscopic incl. hardness	not mandatory	not mandatory	not mandatory
Radiography	not mandatory	not mandatory	–

7.5 Test piece and test specimens

7.5.1 General

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

7.5.2 Butt weld

The transverse bend testing shall be carried out in accordance with EN 910, and the bending angle shall be 180°.

Two root and two face bend tests shall be performed as a minimum (for pipes, see figure 5). In general, the diameter of the former or the inner roller should be:

- 4 *t* for group 51;
- 6 *t* for groups 52, 53, 54 and 61, 62.

Depending on the ductility of the parent metal, larger diameter for the former or inner roller can be used by agreement.

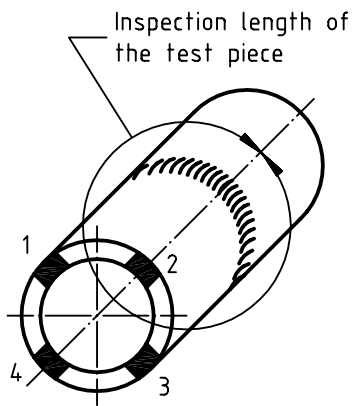
For plate or wall thickness ≥ 10 mm, the transverse bend tests can be substituted by four side bend tests in accordance with EN 910.

When radiographic testing is used, the test piece shall be radiographed in the as-welded condition in accordance with EN 1435 using class B technique.

7.5.3 Fillet weld on plate

For fracture tests according to EN 1320 the test piece can be cut, if necessary, into several test specimens (see figure 6a). Each test specimen shall be positioned for breaking as shown in figure 6b, and examined after fracture.

When macroscopic examination is used, at least four test specimens shall be taken equally spaced in the inspection length. Macroscopic tests shall be carried out in accordance with EN 1321.



Position 1 + 3:
Each position one root transverse bend
or one side bend test specimen

Position 2 + 4:
Each position one face transverse bend
or one side bend test specimen

Sectioning into at least four test specimens

Figure 5 - Preparation of bend test specimens for a butt weld in pipe

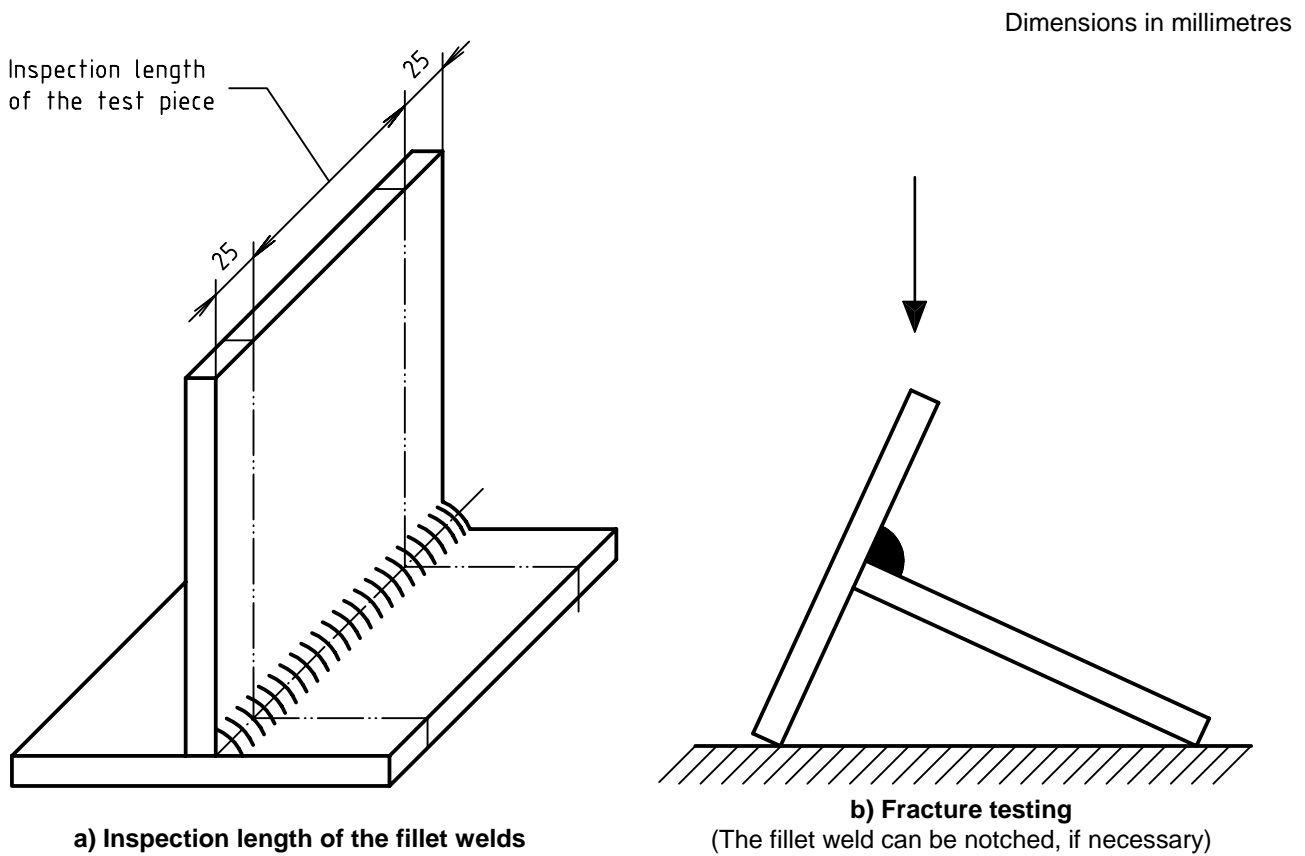


Figure 6 - Preparation and fracture testing of test specimens for a fillet weld on plate

7.5.4 Fillet weld on pipe

For fracture tests in accordance with EN 1320, the test piece shall be cut into four or more test specimens and fractured as shown on figure 7.

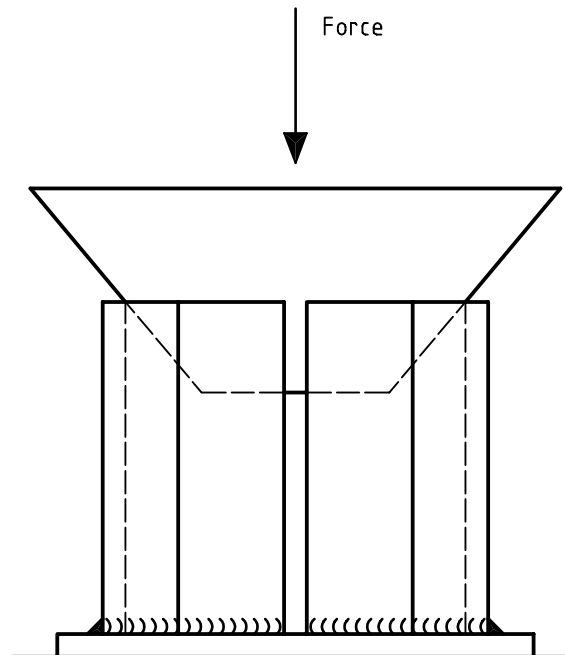


Figure 7 - Preparation and fracture testing of test specimens for fillet welds on pipe

When macroscopic examination in accordance with EN 1321 is used, at least four test specimens shall be taken equally spaced around the 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 accordance with EN ISO 6520-1. The acceptance requirements for imperfections found by test methods according to this standard shall, unless otherwise specified, be assessed in accordance with EN 25817. A welder is approved if the imperfections in the test piece are within the specified limits of level B in accordance with EN 25817, except for imperfection types as follows: excess weld metal, excessive convexity, excessive 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.

Colouration: Accepted colours on the weld metal surface: silver and straw. A narrow band of intensive colours close to the limits of the gas shielding is acceptable. Darker brown, purple and blue colours and grey or flaky white are not acceptable.

Bend test: The test specimens shall bend uniformly and the weld, HAZ and parent metal areas will each conform closely to the radius of the forming tool. This will indicate that any gas pick-up during welding has not reduced the ductility of the weld and that the welding has not adversely affected the formability of the parent metal.

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 is 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 the required tests are satisfactorily completed. This date can be different to the date of issue marked on the certificate.

A welder's approval is valid for a period of two years provided that the relevant certificate is confirmed at six months intervals by the welding coordinator or the employer, 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) 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 revoked.

10.2 Prolongation

The validity of the approval on the certificate can 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:

- a) the production welds made by the welder have been of the required quality;
- b) records of tests, e.g. either half yearly documentation about radiographic testing or test reports about destructive testing, 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 Certificate

It shall be verified 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 examining body and shall contain all the information detailed in Annex A of 287-1:1992. The format of this Annex A of EN 287-1:1992 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 of EN 287-1:1992.

The manufacturer's pWPS or WPS as shown in Annex A of EN 288-2:1992 shall give information about materials, welding positions, welding processes, 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 A) 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):

- a) the number of this standard;
- b) the essential variables:
 - 1) welding processes: refer to 5.2 and EN ISO 4063;
 - 2) semi-finished product: plate (P), pipe (T), refer to 5.3;
 - 3) joint type: butt weld (BW), fillet weld (FW), refer to 5.3;
 - 4) material group: refer to 5.4 and 6.4;
 - 5) consumables: refer to 5.5;
 - 6) dimension of test piece: thickness (t) and pipe diameter (D), refer to 5.6;
 - 7) welding positions: refer to 5.8 and EN ISO 6947;
 - 8) details of the joint type: refer to 6.3 and table 3, for abbreviations to 4.4.

DESIGNATION EXAMPLE 1:

Welder approval EN ISO 9606-5 141 T BW W61 wm t03 D50 PA ss nb

EXPLANATION

Welding process: TIG-welding	141
Pipe:	T
Butt weld:	BW
Material group: pure zirconium	W61
Consumables: with filler metal	wm
Dimension of test piece:	
– thickness 3 mm	t03
– pipe diameter 50 mm	D50
Welding position: butt weld in pipe, rotating pipe, horizontal axis, flat	PA
Details of the weld type:	
– single side	ss
– without backing	nb

DESIGNATION EXAMPLE 2:

Welder approval EN ISO 9606-5 131 P FW W51 wm t10 PB

EXPLANATION

Welding process: MIG welding	131
Plate:	P
Fillet weld:	FW
Material group: pure titanium	W51
Consumables: with filler metal	wm
Dimension of test piece: thickness 10 mm	t10
Welding position: fillet weld on plate, horizontal vertical	PB

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

Annex A (informative)

Job knowledge

A.1 General

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

However, some countries can 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 in A.2, relevant to the welders approval test.

The actual tests of a welder's job knowledge can 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.

A.2 Requirements

A.2.1 Arc welding

A.2.1.1 Welding equipment

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

A.2.2 Welding process

A.2.1.2 Gas shielded arc welding (131, 141, 15) ²⁾

- a) Types and size of electrodes;
- b) Identification of shielding gas and flow rate;
- c) Type, size and maintenance of nozzles/contact tip;
- d) Selection and limitations of mode of metal transfer;
- e) Protection of the welding arc from draughts.

A.2.3 Parent metals

- a) Identification of material;
- b) Behaviour under higher temperature

²⁾ The numbers refer to EN ISO 4063.

A.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.

A.2.5 Safety and accident prevention

A.2.5.1 General

- 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.

A.2.5.2 Gas-shielded arc welding

- a) Environment of increase hazard of electric shock;
- b) Radiation from the arc;
- c) Effects of stray arcing;
- d) Safe storage, handling and use of compressed gases;
- e) Leak detection on gas hoses and fittings.

A.2.6 Welding sequences/procedures

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

A.2.7 Joint preparation and weld representation

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

A.2.8 Weld imperfections

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

A.2.9 Welder approval

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

Annex ZA (informative)

Bibliography

Table ZA.1 - ISO standards conforming to the European Standards quoted in clause 2

European Standard quoted in clause 2	Corresponding ISO standard	Title of the ISO standard
EN 287-1 : 1992	ISO 9606-1 : 1994	Approval testing of welders – Fusion welding – Part 1: Steels
EN 288-2 : 1992	ISO 9956-2 : 1995	Specification and approval of welding procedures for metallic materials – Part 2: Welding procedure specification for arc welding
EN 571-1	–	
EN 910	ISO/DIS 5173.2 : 1996	Destructive tests on welds in metallic materials – Bend test (Revision of ISO 5173:1981 and ISO 5177:1981)
EN 970	–	
EN 1289	–	
EN 1320	ISO/DIS 9017.3 : 1996	Destructive tests on welds in metallic materials – Fracture test
EN 1321	–	
EN 1435	ISO 1106-1 : 1984	Recommended practice for radiographic examination of fusion welded joints – Part 1 : Fusion welded butt joints in steel plates up to 50 mm thick
	ISO 1106-2 : 1985	Recommended practice for radiographic examination of fusion welded joints – Part 2: Fusion welded butt joints in steel plates thicker than 50 mm and up to and including 200 mm in thickness
EN ISO 4063	ISO 4063 : 1998	Welding and allied processes – Nomenclature of processes
EN 25817	ISO 5817 : 1992	Arc-welded joints in steel – Guidance on quality levels for imperfections
EN ISO 6520-1	ISO 6520-1 : 1998	Welding and allied processes - Classification of geometric imperfections in metallic fusion welds, with explanations - Part 1: Fusion welding
EN ISO 6947	ISO 6947 : 1990	Welds – Working positions – Definitions of angles of slope and rotation (Revision of ISO 6947:1980)
CR 12187	–	

