INTERNATIONAL STANDARD

ISO 9606-3

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Approval testing of welders — Fusion welding —

Part 3:
Copper and copper alloys

Épreuve de qualification des soudeurs — Soudage par fusion —

Partie 3: Cuivre et ses alliages

Reference number
ISO 9606-3:1999(E)

Foreword

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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.

International Standard ISO 9606-3 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*

— *Part 6: Magnesium and magnesium allloys*

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

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

Contents

Foreword

The text of EN ISO 9606-3:1999 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of an identical text or by endorsement, at the latest by August 1999, and conflicting national standards shall be withdrawn at the latest by August 1999.

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).

For relationship with EU Directive(s), see informative Annex ZB, which is an integral part of this standard.

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 copper and copper alloys.

The term "copper" stands for copper and weldable copper 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 relevant part of 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 copper.

This standard applies to the approval testing of welders for the fusion welding of copper.

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 287-2 : 1992	Approval testing of welders – Fusion welding – Part 2: Aluminium and aluminium alloys
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 895	Destructive tests on welds in metallic materials – Transverse tensile test

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
EN 24063 : 1992	Welding, brazing, soldering and braze welding of metals – Nomenclature of processes and reference numbers for symbolic representation on drawings (ISO 4063 : 1990)
EN 26520 : 1991	Classification of imperfections in metallic fusion welds, with explanations (ISO 6520 : 1982)
EN 30042 : 1994	Arc-welded joints in aluminium and its weldable alloys – Guidance on quality levels for imperfections (ISO 10042 : 1992)
EN ISO 6947 : 1997	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 : 1990	Welding, brazing and soldering processes – Vocabulary

3 Definitions

For the purposes of this standard, the 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 in accordance with Annex A of EN 287-2 : 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 material;

nb welding without backing ;
ng no back grinding or back milling ;
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 ISO 857 and reference numbers of welding processes for symbolic representation are listed in EN 24063.

This standard covers the following welding processes:

111 metal-arc welding with covered electrodes;
131 metal-arc inert gas welding (MIG welding);
141 tungsten inert gas arc welding (TIG welding);
15 plasma arc welding;
311 oxy-acetylene 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 pipes[1]) (T) for approval tests in accordance with 7.2.

5.4 Material groups

5.4.1 General

In order to minimize unnecessary multiplication of technically identical tests, copper 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 any copper in the parent metal group(s).

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 table 4 (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 table 4.

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

5.4.2 Copper groups of parent metal

5.4.2.1 General

Copper 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.

Material groups according to CR 12187

5.4.2.2 Group W 31: Pure copper

5.4.2.3 Group W 32: Copper-zinc alloys

5.4.2.4 Group W 33: Copper-tin alloys

5.4.2.5 Group W 34: Copper-nickel alloys

5.4.2.6 Group W 35: Copper-aluminium alloys

5.4.2.7 Group W 36: Copper-nickel-zinc alloys

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 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.

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 approval
t	$0{,}5\ t \le t \le 1{,}5\ t$ [1)]
1) For oxy-acetylene welding (311) the test shall be carried out on the minimum and on the maximum production thickness: $t \approx t$	

Table 2: Test piece diameter and range of approval

Test piece diameter D mm	Range approval
$D \le 25$	D to $2D$
$D > 25$	$\ge 0{,}5\ D$ (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 when item c) also applies;

c) approval on test 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 4;

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

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 31	W 32	W 33	W 34	W 35	W 36
W 31	★	—	×	×	×	—
W 32	—	★	—	—	—	x
W 33	—	—	★	—	—	—
W 34	—	—	—	★	×	—
W 35	—	—	—	×	★	—
W 36	—	x	—	—	—	★

★ 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

NOTE: This table applies only when parent metal indicated by ★ and filler metal are in the same group.

6.5 Consumables

An approval test made with a specific filler metal and shielding gas (pure gas or gas mixture) 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 gas mixture) 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 5. 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 5: Range of approval according to welding position

Welding position of approval test piece						Range of approval													
						Plates								Pipes					
						Butt welds				Fillet welds				Butt welds				Fillet welds	
														Pipe-axis and -angle					
														rotating	fixed			rotating	1)
														0°	0°	90°	45°	45°	
						PA	PC	PF	PE	PA	PB	PF	PD	PA	PF	PC	H-L045	PA	PB
Plates	Butt welds				PA	*	-	-	-	x	x	-	-	x	-	-	-	x	x
					PC	x	*	-	-	x	x	-	-	x	-	x	-	x	x
					PF	x	-	*	-	x	x	x	-	x	-	-	-	x	x
					PE	x	x	x	*	x	x	x	x	x	-	-	-	x	x
	Fillet welds				PA	-	-	-	-	*	-	-	-	-	-	-	-	x	-
					PB	-	-	-	-	x	*	-	-	-	-	-	-	x	x
					PF	-	-	-	-	x	x	*	-	-	-	-	-	x	x
					PD	-	-	-	-	x	x	-	*	-	-	-	-	x	x
Pipes	Butt welds	Axis of the pipe and angle	rotating	0°	PA	x	-	-	-	x	x	-	-	*	-	-	-	x	x
			fixed	0°	PF	x		x	x	x	x	x	x	x	*	-	-	x	x
				90°	PC	x	x	-	-	x	x	-	-	x	-	*	-	x	x
				45°	H-L0	x	x	x	x	x	x	x	x	x	x	x	*	x	x
	Fillet welds		rotating	45°	PA	-	-	-	-	x	-	-	-	-	-	-	-	*	-
			1)		PB	-	-	-	-	x	x	-	-	-	-	-	-	x	*
			fixed	0°	PF	-	-	-	-	x	x	x	x	-	-	-	-	x	x

1) PB for pipes can be welded in two versions
- pipe: rotating; axis: horizontal; weld: horizontal vertical
- 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

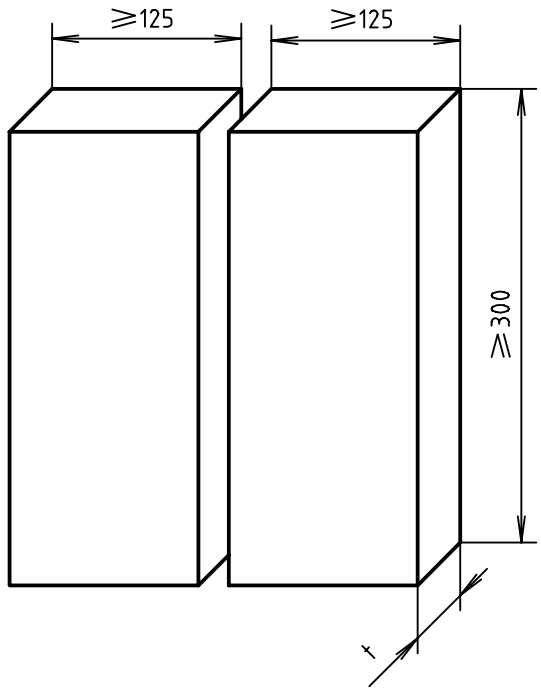
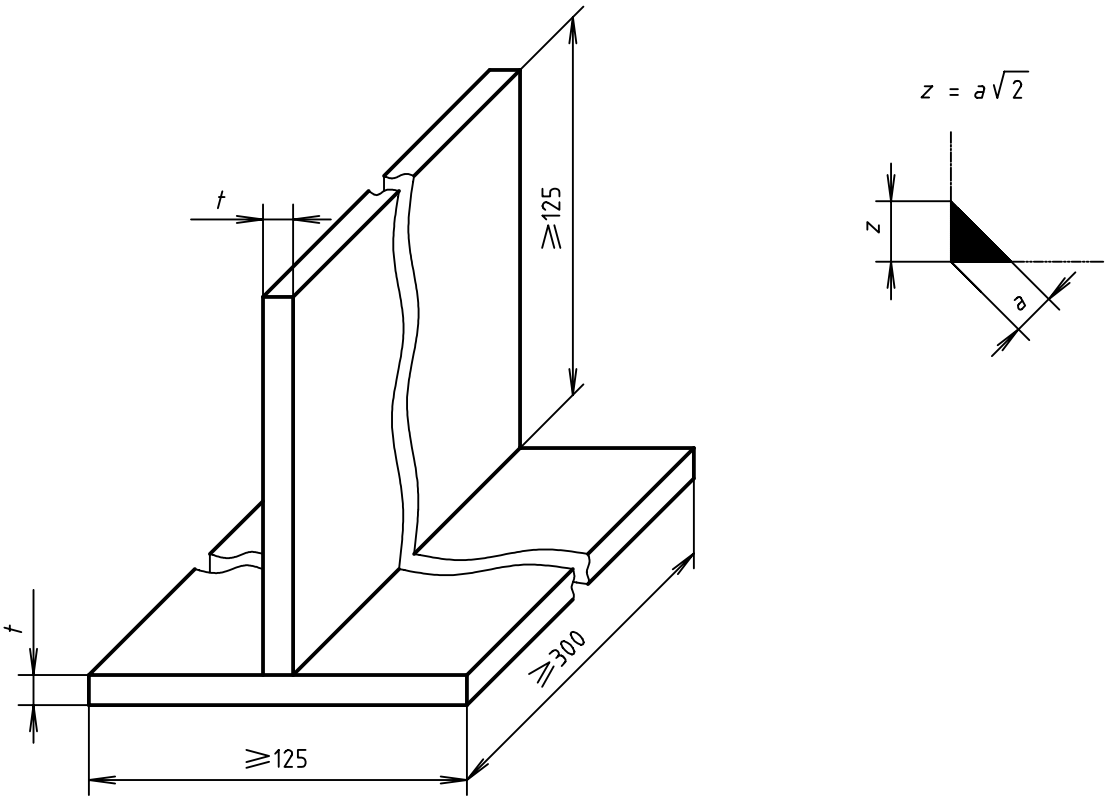


Figure 1: Dimensions of test piece for a butt weld in plate

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

Dimensions in millimetres

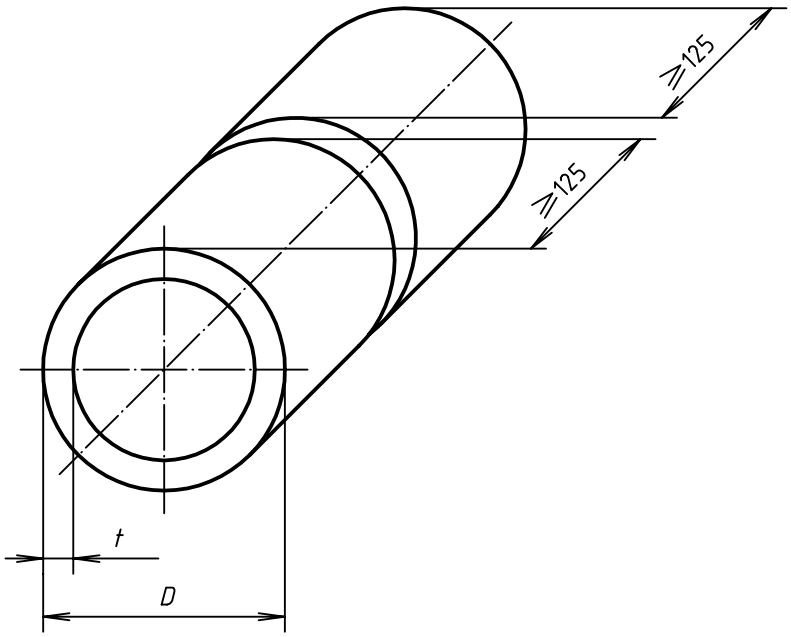


Figure 3: Dimensions of test piece for a butt weld in pipe

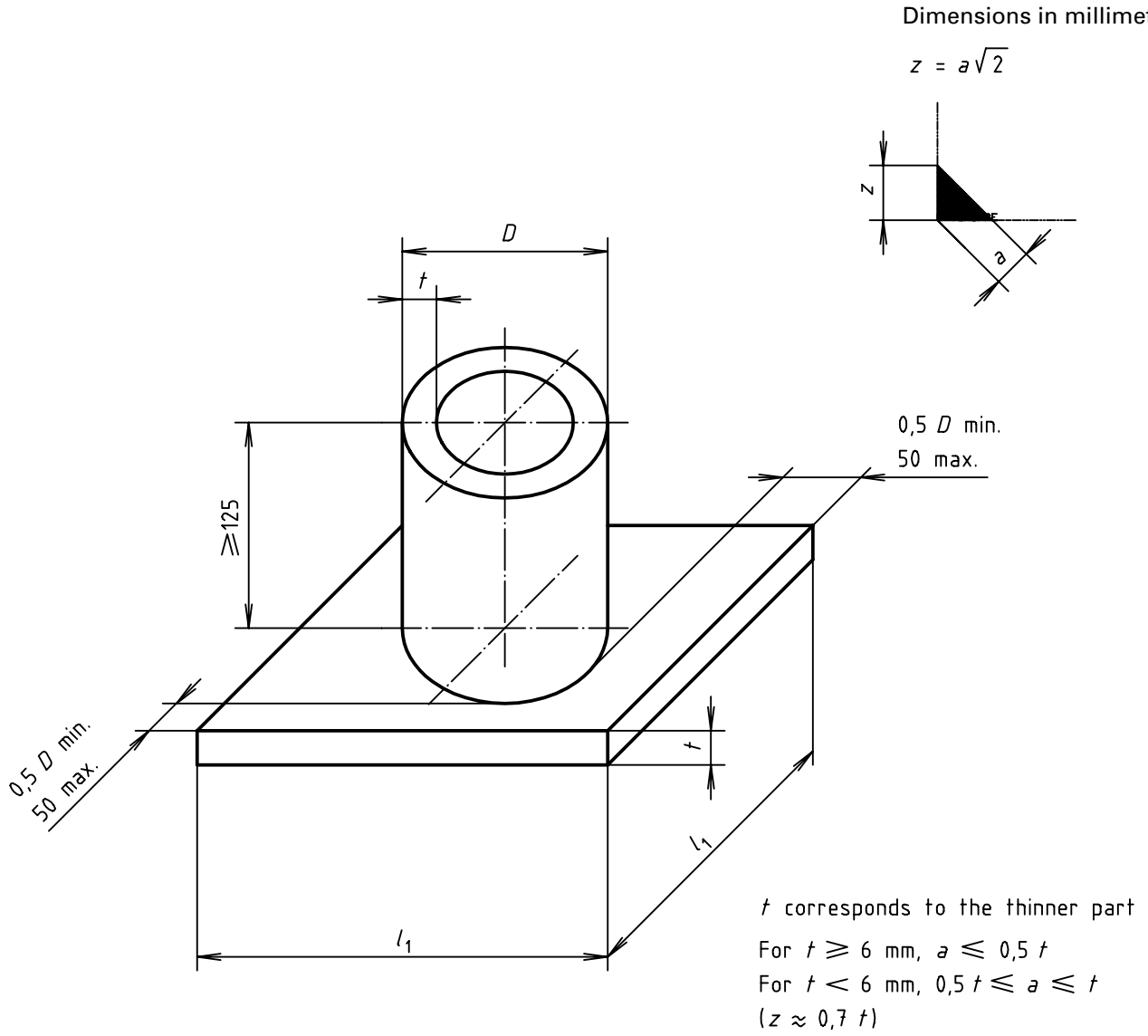


Figure 4: Dimensions of test piece for a fillet weld on pipe

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

d) any post-weld heat treatment required in the pWPS or WPS can be omitted unless bend tests are required;

e) identification of the test piece;

f) 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 according to EN 970 in the as-welded condition. When required, visual examination can be supplemented by penetrant (see EN 571-1) or other test methods (see table 6).

If accepted by visual examination, additional radiographic tests (see EN 1435), fracture tests (see EN 1320), bend tests (see EN 910) and/or macroscopic tests (see EN 1321) are required (see table 6).

The macroscopic specimen shall be prepared and etched on one side to clearly reveal the weld (see EN 1321), polishing is not required.

In addition to radiography, two bend tests, one face, one root (see EN 910) or two fracture tests, one face, one root (see EN 1320) shall always be applied to butt welds.

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 6: Test methods

Test method	Butt weld plate	Butt weld pipe	Fillet weld
Visual	mandatory	mandatory	mandatory
Radiography	mandatory	mandatory	not mandatory
Bend	mandatory [1)]	mandatory [1)]	not mandatory
Fracture	mandatory [1)]	mandatory [1)]	mandatory [2)]
Macroscopic	not mandatory	not mandatory	not mandatory [2)]
Penetrant	not mandatory	not mandatory	not mandatory

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

2) The fracture test can be replaced by a macroscopic examination of at least four sections, one of which shall be taken from stop/start location.

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, 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 in plate

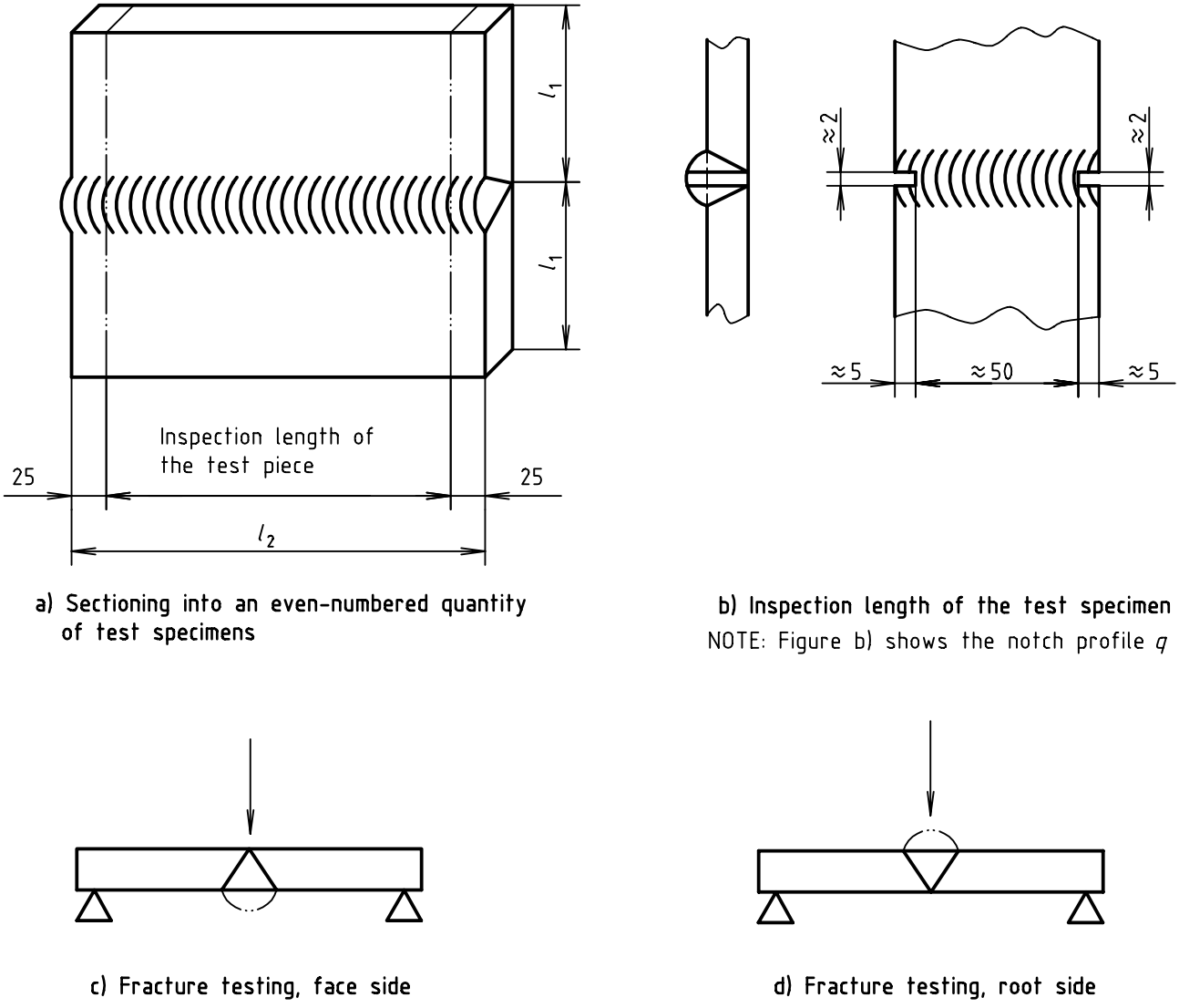
When radiographic testing is used, the inspection length of the weld (see figure 5 a) in the test piece shall be radiographed in the as-welded condition in accordance with EN 1435 using class B technique.

When fracture testing is used, it shall be carried out in accordance with EN 1320. One root fracture test specimen and one face fracture test specimen shall be tested. The inspection length of the test specimen shall be ≈ 50 mm. The specimen preparation, types of notch profiles and methods of fracture shall be in accordance with EN 1320.

When transverse bend testing is used, one root bend test specimen and one face bend test specimen shall be tested in accordance with EN 910. The diameter of the former or the inner roller shall be 4 *t* and the bending angle 180° unless the low ductility of the parent metal or filler metal imposes other limitations.

For plate thickness ≥ 12 mm, the transverse bend tests can be substituted by two side bend tests in accordance with EN 910.

Dimensions in millimetres



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

b) Inspection length of the test specimen

NOTE: Figure b) shows the notch profile *q*

c) Fracture testing, face side

d) Fracture testing, root side

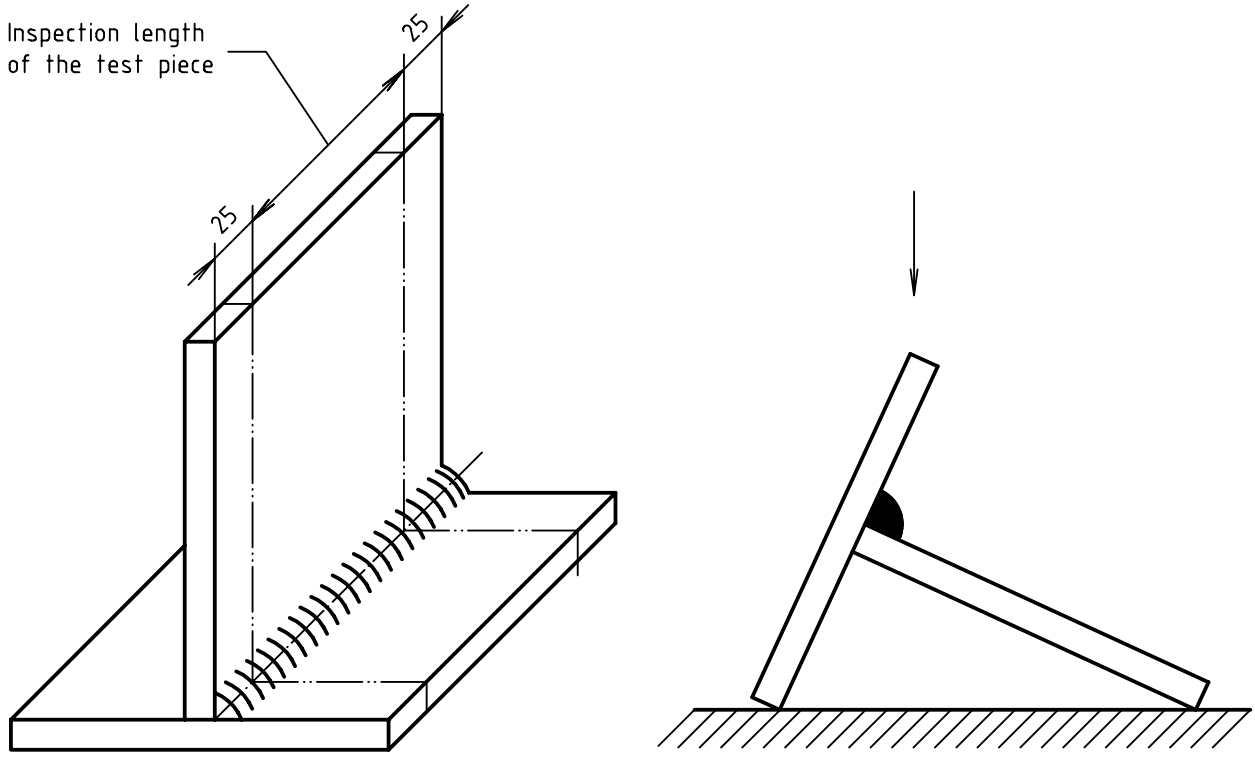
Figure 5: Preparation and fracture testing of test specimens for a butt weld in plate

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.

Dimensions millimetres



a) Inspection length of the fillet welds

b) Fracture testing
(The fillet weld can be notched,
if necessary)

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

7.5.4 Butt weld in pipe

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 will be required.

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

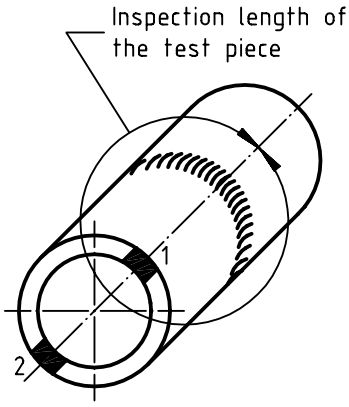
When fracture testing is used, it shall be carried out in accordance with EN 1320. The inspection length of the fracture test specimen shall be ≈ 40 mm. Test specimen preparation, types of notch profiles and methods of fracture shall be in accordance with EN 1320.

When transverse bend testing is used, it shall be carried out in accordance with EN 910. The diameter of the former or the inner roller shall be 4 *t*, and the bending angle shall be 180° unless the low ductily of the parent metal or filler metal imposes other limitations.

The number of fracture or transverse bend test specimens depends on the welding position. For welding position PA or PC, one root and one face bend test specimen shall be tested (see figure 7 a). For all other welding positions, two root and two face bend test specimens shall be tested (see figure 7 b).

For wall thickness ≥ 12 mm, the transverse bend tests can be substituted by side bend tests in accordance with EN 910.

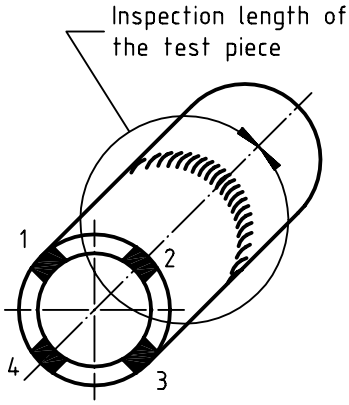
Dimensions in millimetres



Position 1:
For one root fracture or one root transverse bend or one side bend test specimen

Position 2:
For one face fracture or one root face transverse bend or one side bend test specimen

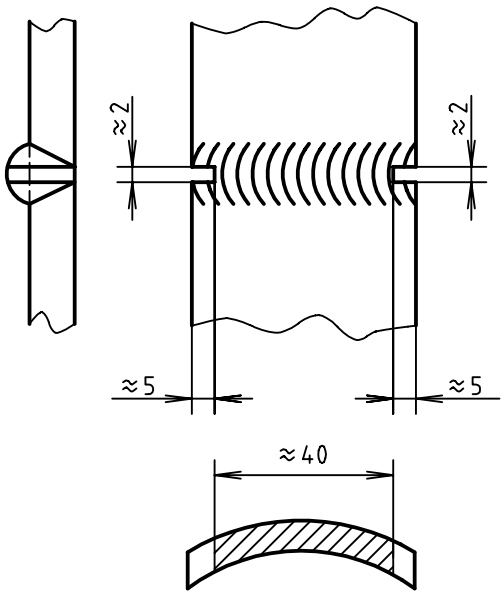
a) Sectioning into at least two test specimens



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

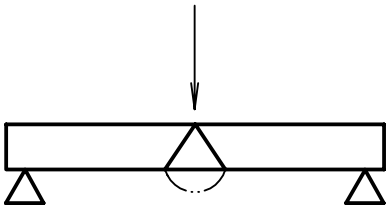
Position 2 + 4:
Each position one face fracture or one face transverse bend or one side bend test specimen

b) Sectioning into at least four test specimens

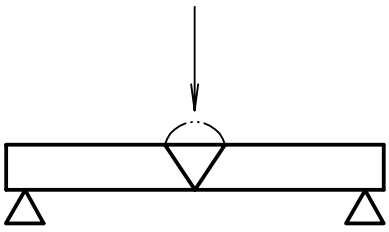


c) Inspection length of the test specimen

NOTE Figure c) shows the notch profile q



d) Fracture testing, face side



e) Fracture testing, root side

Figure 7: Preparation and fracture testing of test specimens for a butt weld in pipe

7.5.5 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 8.

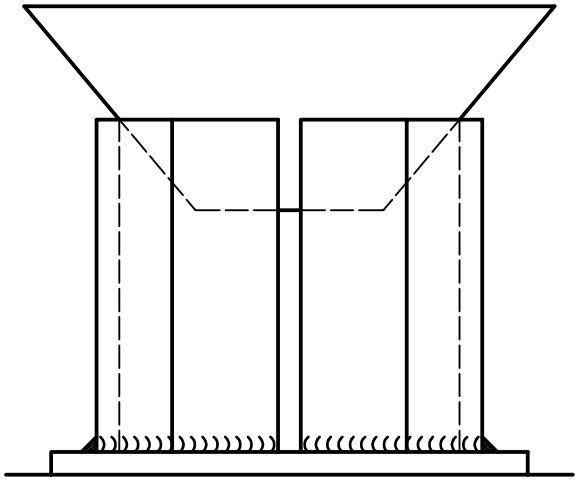


Figure 8: Preparation and fracture testing of test specimens for a fillet weld on pipe

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 EN 26520. The acceptance requirements for imperfections found by test methods according to this standard shall, unless otherwise specified, be assessed following 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, excessive throat thickness and excessive penetration, for which level C in EN 30042 applies.

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 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 welders 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 is 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 are of the required quality;

b) records of tests, e.g. either half yearly documentation about radiographic testing 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 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 EN 287-2 : 1992. The format of this Annex A of EN 287-2 : 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 287-2 : 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: see 5.2 and EN 24063;
2) semi-finished product: plate (P), pipe (T), see 5.3;
3) joint type: butt weld (BW), fillet weld (FW), see 5.3;
4) material group: see 5.4;
5) consumables: see 5.5;
6) dimension of test piece: thickness (*t*) and pipe diameter (*D*), see 5.6;
7) welding positions: see 5.8 and EN ISO 6947;
8) details of the joint type: see 6.3 and table 3, for abbreviations see 4.4.

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 of EN 287-2).

DESIGNATION EXAMPLE 1:
Welder approval EN ISO 9606-3 141 T BW W34 wm t03 D50 PA ss nb

Explanation
Welding process: TIG-welding 141
Pipe: ..... T
Butt weld: ..... BW
Material group: copper nickel alloy W34
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 9606-3 131 P FW W31 wm t10 PB

EXPLANATION

Welding process: MIG welding 131
Plate: ..... P
Fillet weld: ..... FW
Material group: pure copper W31
Consumables: with filler metal ..... wm
Dimension of test piece: thickness 10 mm t10
Welding position: fillet weld in 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 clause 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 Welding equipment

A.2.1.1 Oxy-acetylene welding

a) Identification of gas cylinders;
b) Identification and assembly of essential components;
c) Selection of correct nozzles and welding torches.

A.2.1.2 Arc welding

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[2)]

A.2.2.1 Oxy-acetylene welding (311)

a) Gas pressure;
b) Selection of nozzle size;
c) Type of gas flame;
d) Effect of overheating.

[2)] The numbers refer to EN 24063.

A.2.2.2 Metal-arc welding with covered electrode (111)

a) Handling and drying of electrodes;
b) Differences of types of electrodes.

A.2.2.3 Shielded metal-arc welding (131, 141, 15)

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) Methods and control of pre-heating;
c) Control of interpass temperature.

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 Oxy-acetylene welding

a) Safe storage, handling and use of compressed gases;
b) Leak detection on gas hoses and fittings;
c) Procedure to be taken in the event of a flashback.

A.2.5.3 All arc processes

a) Environment of increase hazard of electric shock;
b) Radiation from the arc;
c) Effects of stray arcing.

A.2.5.4 Shielded gas arc welding

a) Safe storage, handling and use of compressed gases;
b) 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 Edge preparation and weld representation

a) Conformance of weld 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 corresponding to the European standards quoted in clause 2

European standards quoted in clause 2	Corresponding ISO standards	Title of the ISO standard
EN 287-1:1992	ISO 9606-1 : 1994	Approval testing of welders – Fusion welding – Part 1: Steels
EN 287-2:1992	ISO 9606-2 : 1994	Approval testing of welders – Fusion welding – Part 2: Aluminium and aluminium alloys
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 895	ISO/DIS 4136.2 : 1996	Destructive tests on welds in metallic materials – Transverse tensile test (Revision of ISO 4136:1989)
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 24063:1992	ISO 4063 : 1990	Welding, brazing, soldering and braze welding of metals – Nomenclature of processes and reference numbers for symbolic representation on drawings
EN 26520:1991	ISO 6520 : 1982	Classification of imperfections in metallic fusion welds, with explanations – Bilingual edition
EN 30042:1994	ISO 10042 : 1992	Arc-welded joints in aluminium and its weldable alloys – guidance on quality levels for imperfections
EN ISO 6947:1997	ISO 6947 : 1990	Welds – Working positions – Definitions of angles of slope and rotation (Revision of ISO 6947:1980)
CR 12187	–	

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