

ICS 25.160.10

English version

Qualification test of welders - Fusion welding - Part 1: Steels

Qualification des soudeurs - Soudage par fusion - Partie 1:
Aciers

Prüfung von Schweißern - Schmelzschweißen - Teil 1:
Stahl

This draft European Standard is submitted to CEN members for formal vote. It has been drawn up by the Technical Committee CEN/TC 121.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

Foreword.....	4
1 Scope	5
2 Normative references	5
3 Terms and definitions.....	6
4 Symbols and abbreviated terms.....	7
4.1 General.....	7
4.2 Reference numbers of welding processes.....	7
4.3 Abbreviations	7
5 Essential variables and range of qualification.....	8
5.1 General.....	8
5.2 Welding processes	8
5.3 Product type	9
5.4 Type of weld	9
5.5 Material groups	10
5.6 Welding consumables	11
5.7 Dimensions.....	12
5.8 Welding positions	13
5.9 Weld details	14
6 Examination and testing	15
6.1 Supervision.....	15
6.2 Shapes, dimensions and numbers of test pieces	15
6.3 Welding conditions	19
6.4 Test methods.....	20
6.5 Test piece and test specimen	20
6.6 Test record.....	25
7 Acceptance requirements for test pieces	25
8 Re-tests	26
9 Period of validity	26
9.1 Initial qualification	26
9.2 Confirmation of the validity	26
9.3 Prolongation of qualification	26
10 Certificate.....	26
11 Designation.....	27
Annex A (informative) Welder's qualification test certificate.....	28
Annex B (informative) Designation examples	29
Annex C (informative) Job knowledge	33
Annex D (informative) Variables to be confirmed and traceable for prolongation.....	37

Annex ZA (normative) Normative references to International publications with their corresponding European publications	38
Annex ZB (informative) Clauses of this European Standard addressing essential requirements or other provisions of EU Directives	39
Bibliography	40

Foreword

This document (prEN 287-1:2003) has been prepared by Technical Committee CEN /TC 121, "Welding", the secretariat of which is held by DS.

This document is currently submitted to the Formal Vote.

This document 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 document.

This document will supersede EN 287-1:1992.

EN 287 consists of the following parts, under the general title *Qualification test of welders — Fusion welding*:

- *Part 1: Steels*
- *Part 2: Aluminium and aluminium alloys*

Annexes A, B, C and D are informative.

Annex ZA is normative.

This document includes a Bibliography.

Introduction

The ability of a welder to follow verbal or written instructions and verification of a person's skills are important factors in ensuring the quality of the welded product.

The testing of a welder's skill in accordance with this standard depends on welding techniques and conditions used in which uniform rules are complied with, and standard test pieces are used.

The principle of this standard is that a qualification test qualifies the welder not only for the conditions used in the test, but also for all joints which are considered to weld easier on the presumption that the welder has received a particular training and/or has industrial practice within the range of qualification.

The qualification test can be used to qualify a welding procedure and a welder provided that all the relevant requirements, e.g. test piece dimensions, are satisfied.

Qualifications in accordance with EN 287-1 existing at the date of publication of this standard should, at the end of their period of validity, be interpreted in accordance with the requirements of this standard.

1 Scope

This European Standard defines the qualification test of welders for the fusion welding of steels.

It provides a set of technical rules for a systematic qualification test of the welder, and enables such qualifications to be uniformly accepted independently of the type of product, location and examiner/examining body.

When qualifying welders, the emphasis is placed on the welders ability to manually manipulate the electrode/ welding torch/ welding blowpipe and thereby producing a weld of acceptable quality.

The welding processes referred to in this European Standard include those fusion welding processes which are designated as manual or partly mechanized welding. It does not cover fully mechanized and automated welding processes (see EN 1418).

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 (including amendments).

EN 910, *Destructive tests on welds in metallic materials — Bend tests.*

EN 970, *Non-destructive examination of fusion welds — Visual examination.*

EN 1320, *Destructive tests on welds in metallic materials — Fracture test.*

EN 1435, *Non-destructive examination of welds — Radiographic examination of welded joints.*

EN ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063:1998).*

pEN ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO/DIS 5817:2002).*

EN ISO 6947, *Welds — Working positions — Definitions of angles of slope and rotation (ISO 6947:1993).*

prEN ISO 15607:2000, *Specification and approval of welding procedures for metallic materials — General rules (ISO/DIS 15607:2000)*.

CR ISO 15608, *Welding — Guidelines for a metallic material grouping system (ISO/TR 15608:2000)*.

prEN ISO 15609-1:2000, *Specification and approval of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO/DIS 15609-1:2000)*.

EN ISO 15609-2:2001, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 2: Gas welding (ISO 15609-2:2001)*.

ISO 857-1, *Welding and allied processes — Vocabulary — Part 1: Metal welding processes*.

NOTE A list of ISO Standards conforming to these EN Standards is given at the end of this standard in annex ZA.

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in prEN ISO 15607:2000 and the following apply.

3.1

welder

person who holds and manipulates the electrode holder, welding torch or blowpipe by hand

3.2

examiner

person who has been appointed to verify compliance with the applicable standard

NOTE In certain cases, an external independent examiner can be required.

3.3

examining body

organization that has been appointed to verify compliance with the applicable standard

NOTE In certain cases, an external independent examining body can be required.

3.4

backing

material placed at the reverse side of a joint preparation for the purpose of supporting molten weld metal

3.5

root run

in multi layer welding, the run(s) of the first layer deposited in the root

3.6

filling run

in multi layer welding, the run(s) deposited after the root run(s) and before the capping run(s)

3.7

capping run

in multi layer welding, the run(s) visible on the weld face(s) after completion of welding

3.8

weld metal thickness

thickness of the weld metal excluding any reinforcement

4 Symbols and abbreviated terms

4.1 General

Where the full wording is not used, the following abbreviations and reference numbers shall be used when completing the welder's qualification test certificate (see annex A).

4.2 Reference numbers of welding processes

This standard covers the following manual or partly mechanized welding processes (reference numbers of welding processes for symbolic representation are listed in EN ISO 4063):

111	manual metal arc welding;
114	self-shielded tubular-cored arc welding;
121	submerged arc welding with one wire electrode;
125	submerged arc welding with tubular cored electrode;
131	metal inert gas welding (MIG welding);
135	metal active gas welding (MAG welding);
136	tubular cored metal arc welding with active gas shield;
141	tungsten inert gas arc welding (TIG welding);
15	plasma arc welding;
311	oxy-acetylene welding.

NOTE The principles of this standard can be applied to other fusion welding processes.

4.3 Abbreviations

4.3.1 For test pieces

a	design throat thickness
BW	butt weld
D	outside pipe diameter
FW	fillet weld
l_1	length of test piece
l_2	half width of test piece
l_f	examination length
P	plate
s_1	weld metal thickness for welding process 1
s_2	weld metal thickness for welding process 2
t	material thickness of test piece (plate or wall thickness)
t_1	material thickness of test piece for welding process 1
t_2	material thickness of test piece for welding process 2
T	pipe ¹⁾
z	leg length of fillet weld.

4.3.2 For consumables

nm	no filler metal
A	acid covering
B	basic covering or electrode core - basic
C	cellulosic covering
M	electrode core - metal powder
P	electrode core - rutile, fast freezing slag
R	rutile covering or electrode core – rutile, slow freezing slag
RA	rutile-acid covering
RB	rutile-basic covering

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

RC	rutile-cellulosic covering
RR	rutile-thick covering
S	solid wire/rod
V	electrode core - rutile or basic / fluoride
W	electrode core - basic / fluoride, slow freezing slag
Y	electrode core - basic / fluoride, fast freezing slag
Z	electrode core - other types

4.3.3 For other weld details

bs	welding from both sides
lw	leftward welding
mb	welding with backing
ml	multi layer
nb	welding without backing
rw	rightward welding
sl	single layer
ss	single-side welding

4.3.4 For bend tests

A	minimum tensile elongation required by the material specification
d	diameter of the former or the inner roller
t_s	thickness of the bend test specimen

5 Essential variables and range of qualification

5.1 General

The qualification of welders is based on essential variables. For each essential variable a range of qualification is defined. All test pieces shall be welded using the essential variables independently, except for 5.7 and 5.8. If the welder has to weld outside the range of qualification a new qualification test is required. The essential variables are:

- welding process,
- product type (plate and pipe),
- type of weld (butt and fillet),
- material group,
- welding consumable,
- dimension (material thickness and outside pipe diameter),
- welding position,
- weld detail (backing, single side welding, both side welding, single layer, multi layer, leftward welding, rightward welding).

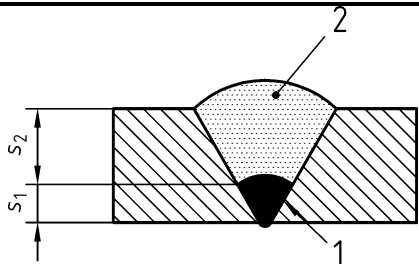
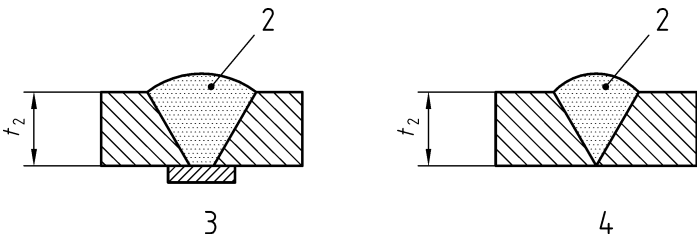
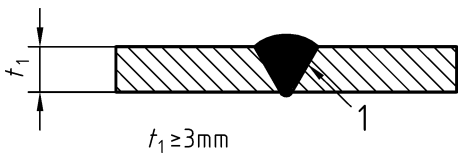
5.2 Welding processes

Welding processes are defined in ISO 857-1 and listed in 4.2.

Each test normally qualifies only one welding process. A change of welding process requires a new qualification test. Exceptions are the changes of solid wire (welding process 135) to metal flux core wire (welding process 136) or vice versa which do not require a new qualification test (see Table 3). However, it is permitted for a welder to be qualified for two or more welding processes by welding a single test piece (multi process joint) or by two or more

separate qualification tests. The ranges of qualification for each welding process used and for the multi process joint for butt welds are given in Table 1 (see also Table 4).

Table 1 — Thickness range for single and multi process joints for butt welds

Welding process used for the test piece	Thickness range	
	Single process joint	Multi process joint
 <p>Key</p> <p>1 Welding process 1 (nb) 2 Welding process 2 (mb)</p>	<p>according to Table 4 for welding process 1: $t = s_1$ for welding process 2: $t = s_2$</p>	<p>according to Table 4 with $t = s_1 + s_2$</p>
 <p>Key</p> <p>2 Welding process 2 3 Welding with backing (mb) 4 Welding without backing (nb)</p>	<p>according to Table 4 for welding process 1: $t = t_1$ for welding process 2: $t = t_2$</p>	<p>according to Table 4 $t = t_1 + t_2$ Welding process 1 only for welding of the root area</p>
 <p>Key</p> <p>1 Welding process 1</p>		

5.3 Product type

The qualification test shall be carried out on plate or pipe. The following criteria are applicable:

- a) welds in pipes, outside pipe diameter $D > 25$ mm, cover welds in plates;
- b) welds in plates cover welds in pipe:
 - of outside pipe diameter $D \geq 150$ mm, for welding positions PA, PB and PC;
 - of outside pipe diameter $D \geq 500$ mm, for all welding positions.

5.4 Type of weld

The qualification test shall be carried out as butt or fillet weld. The following criteria are applicable:

- a) butt welds cover butt welds in any type of joint except branch connections (see also 5.4 c));

- b) in cases where the majority of work is fillet welding, the welder shall also be qualified by an appropriate fillet welding test; in case where the majority of work is butt welding, butt welds qualify fillet welds;
- c) butt welds in pipes without backing qualify branch connections with an angle $\geq 60^\circ$ and the same range of qualification as in Tables 1 to 8. For a branch weld the range of qualification is based on the outside pipe diameter of the branch;
- d) for applications where the type of weld cannot be qualified by means of either a butt or fillet weld test then a specific test piece should be used to qualify the welder, e.g. branch connection, preheating.

5.5 Material groups

5.5.1 Steel groups of parent material

In order to reduce the number of qualification tests, materials with similar welding characteristics are grouped according to CR ISO 15608.

5.5.2 Range of qualification

The welding of any one metal in a group confers qualification on the welder for the welding of all other metal within the same group as well as other groups according to Table 2.

When welding parent materials outside the grouping system a separate test is required.

Qualification of dissimilar metal joints: When using filler metals from group 8 or 10 (see Table 2), all combinations with group 8 or 10 to other groups are covered.

A qualification test made on wrought material groups gives qualification for cast material and a mixture of cast and wrought material in the same material group.

Table 2 — Range of qualification for parent metal

Material group ^a of the test piece	Range of qualification												
	1.1 1.2 1.4	1.3	2	3	4	5	6	7	8	9.1	9 9.2 + 9.3	10	11
1.1, 1.2, 1.4	X	—	—	—	—	—	—	—	—	—	—	—	—
1.3	X	X	X	X	—	—	—	—	—	X	—	—	X
2	X	X	X	X	—	—	—	—	—	X	—	—	X
3	X	X	X	X	—	—	—	—	—	X	—	—	X
4	X	X	X	X	X	X	X	X	—	X	—	—	X
5	X	X	X	X	X	X	X	X	—	X	—	—	X
6	X	X	X	X	X	X	X	X	—	X	—	—	X
7	X	X	X	X	X	X	X	X	—	X	—	—	X
8	—	—	—	—	—	—	—	—	X	—	X	X	—
9	9.1	X	X	X	—	—	—	—	—	X	—	—	X
	9.2 + 9.3	X	—	—	—	—	—	—	—	—	X	—	—
10	—	—	—	—	—	—	—	—	X	—	X	X	—
11	X	X	—	—	—	—	—	—	—	—	—	—	X

^a Material group according to CR ISO 15608.

Key:

X indicates those material groups for which the welder is qualified.

— indicates those material groups for which the welder is not qualified.

5.6 Welding consumables

Qualification with filler metal, e.g. with processes 141, 15 and 311, qualifies for welding without filler metal but not vice versa.

The ranges of qualification for welding consumables are given in Table 3.

Table 3 — Range of qualification for welding consumables ^a

Welding process	Welding consumables used in the test ^b	Range of qualification			
		A, RA, RB, RC, RR, R	B	C	
111	A, RA, RB, RC, RR, R	X	—	—	
	B	X	X	—	
	C	—	—	X	
—	—	solid wire (S)	electrode core (M)	electrode core (B)	electrode core — (R, P, V, W, Y, Z)
131 135 136 141	solid wire (S)	X	X	—	—
	electrode core (M)	X	X	—	—
136	electrode core (B)	—	—	X	X
114 136	electrode core — (R, P, V, W, Y, Z)	—	—	—	X

^a Abbreviations see 4.3.2.

^b The type of welding consumables used in the qualification test of welders for root run welding without backing (ss nb) is the type of welding consumables qualified for root run welding in production.

Key:

X indicates those welding consumables for which the welder is qualified.

— indicates those welding consumables for which the welder is not qualified.

5.7 Dimensions

The welder qualification test of butt welds is based on the material thickness and outside pipe diameters. The ranges of qualification are specified in Tables 4 and 5.

NOTE It is not intended that material thickness or outside pipe diameters should be measured precisely but rather the general philosophy behind the values given in Tables 4 and 5 should be applied.

For fillet welds the range of qualification for material thickness is specified in Table 6.

In the case of branch welding the material thickness criteria to which Table 4 applies and the outside pipe diameter criteria to which Table 5 applies is as follows:

- Set on: The material thickness and outside pipe diameter of the branch;
- Set in or set through: The material thickness of the main pipe or shell and the outside pipe diameter of the branch.

For test pieces of different outside pipe diameters and material thicknesses, the welder is qualified for:

- 1) the thinnest and thickest material thickness qualified in accordance with Table 4.
- 2) the smallest and largest outside pipe diameter qualified in accordance with Table 5;

Table 4 — Range of qualification of material thickness and weld metal thickness (multi process) of test piece for butt welds

Dimension in millimetres	
Thickness ^a t	Range of qualification
$t < 3$	t to $2 \times t$ ^b
$3 \leq t \leq 12$	3 to $2 \times t$ ^c
$t > 12$	≥ 5
^a For multi processes, s_1 and s_2 of Table 1 apply. ^b For oxy-acetylene welding (311): t to $1,5 \times t$ ^c For oxy-acetylene welding (311): 3 mm to $1,5 \times t$	

Table 5 — Range of qualification for outside pipe diameter ^a

Dimension in millimetres	
Outside pipe diameter of test piece D	Range of qualification
$D \leq 25$	D to $2 \times D$
$D > 25$	$\geq 0,5 \times D$ (25 mm min.)
^a For structural hollow sections, D is the dimension of the smaller side.	

Table 6 — Range of qualification of material thickness of test piece for fillet welds^a

Dimension in millimetres	
Material thickness of test piece t	Range of qualification
$t < 3$	t to 3
$t \geq 3$	≥ 3
^a See also Table 9.	

5.8 Welding positions

The range of qualification for each welding position is given in Table 7. The welding positions and symbols refer to EN ISO 6947.

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

The welding positions J-L045 and H-L045 for pipes qualify for all pipe angles.

Welding two pipes with the same outside pipe diameter, one in welding position PF and one in welding position PC, also covers the range of qualification of a pipe welded in welding position H-L045.

Welding two pipes with the same outside pipe diameter, one in welding position PG and one in welding position PC, also covers the range of qualification of a pipe welded in welding position J-L045.

Outside pipe diameters $D \geq 150$ mm can be welded in two welding positions (PF or PG 2/3 of circumference, PC 1/3 of circumference) using only one test piece.

Table 7 — Range of qualification for welding positions

Welding position of test piece	Range of qualification ^a										
	PA	PB ^b	PC	PD ^b	PE	PF (Plate)	PF (Pipe)	PG (Plate)	PG (Pipe)	H-L045	J-L045
PA	X	X	—	—	—	—	—	—	—	—	—
PB ^b	X	X	—	—	—	—	—	—	—	—	—
PC	X	X	X	—	—	—	—	—	—	—	—
PD ^b	X	X	X	X	X	X	—	—	—	—	—
PE	X	X	X	X	X	X	—	—	—	—	—
PF (Plate)	X	X	—	—	—	X	—	—	—	—	—
PF (Pipe)	X	X	—	X	X	X	X	—	—	—	—
PG (Plate)	—	—	—	—	—	—	—	X	—	—	—
PG (Pipe)	X	X	—	X	X	—	—	X	X	—	—
H-L045	X	X	X	X	X	X	X	—	—	X	—
J-L045	X	X	X	X	X	—	—	X	X	—	X
^a Additionally the requirements of 5.3 and 5.4 shall be observed. ^b Welding position PB and PD are only used for fillet welds (see 5.4 b)) and can only qualify fillet welds in other welding positions. Key: X indicates those welding positions for which the welder is qualified — indicates those welding positions for which the welder is not qualified											

5.9 Weld details

Depending on the weld details, the ranges of qualification are shown in Tables 8 and 9.

When welding with process 311 a change from rightward welding to leftward welding and vice versa requires a new qualification test.

Table 8 — Range of qualification for weld details on butt welds

Weld details of test piece	Range of qualification		
	single-side welding / welding without backing (ss nb)	single-side welding / welding with backing (ss mb)	welding from both sides (bs)
single-side welding /welding without backing (ss nb)	X	X	X
single-side welding /welding with backing (ss mb)	—	X	X
welding from both sides (bs)	—	X	X
Key: X indicates those welds for which the welder is qualified — indicates those welds for which the welder is not qualified			

Table 9 — Range of qualification of layer technique for fillet welds

Test piece ^a	Range of qualification	
	single layer (sl)	multi layer (ml)
single layer (sl)	X	—
multi layer (ml)	X	X
^a Throat thickness shall be in the range of $0,5 \times t \leq a \leq 0,7 \times t$. Key: X indicates the layer technique for which the welder is qualified — indicates the layer technique for which the welder is not qualified		

6 Examination and testing

6.1 Supervision

The welding of test pieces shall be witnessed by the examiner or examining body. The testing shall be verified by the examiner or examining body.

The test pieces shall be marked with the identification of the examiner and the welder before welding starts. Additionally welding positions for all test pieces are to be marked on the test piece and for fixed pipe welds, the 12 o'clock welding position shall also be marked.

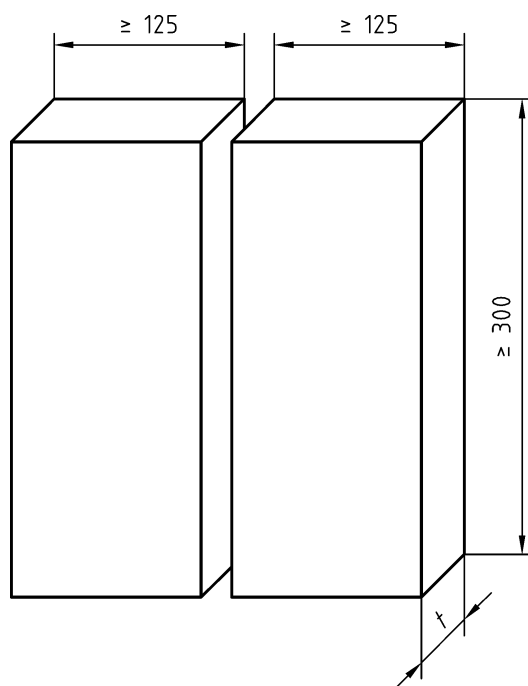
The examiner or examining body may stop the test if the welding conditions are not correct or if it appears that the welder does not have the skill to fulfil the requirements, e.g. where there are excessive and/or systematic repairs.

6.2 Shapes, dimensions and numbers of test pieces

The shape and dimension of test pieces (see 5.7) required are shown in Figures 1 to 4.

For pipes a minimum examination length of 150 mm is required. However, if the circumference of pipes is less than 150 mm additional test pieces will be required with a maximum of three test pieces.

Dimensions in millimetres

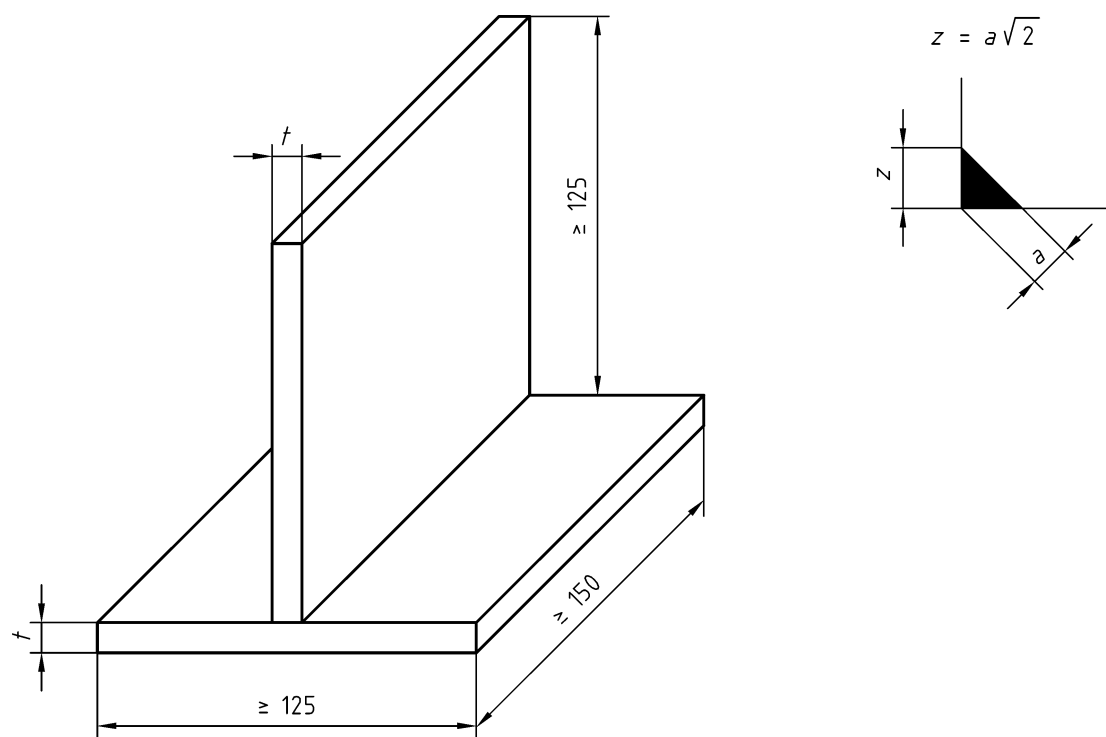


Key

t Material thickness of test piece

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

Dimensions in millimetres

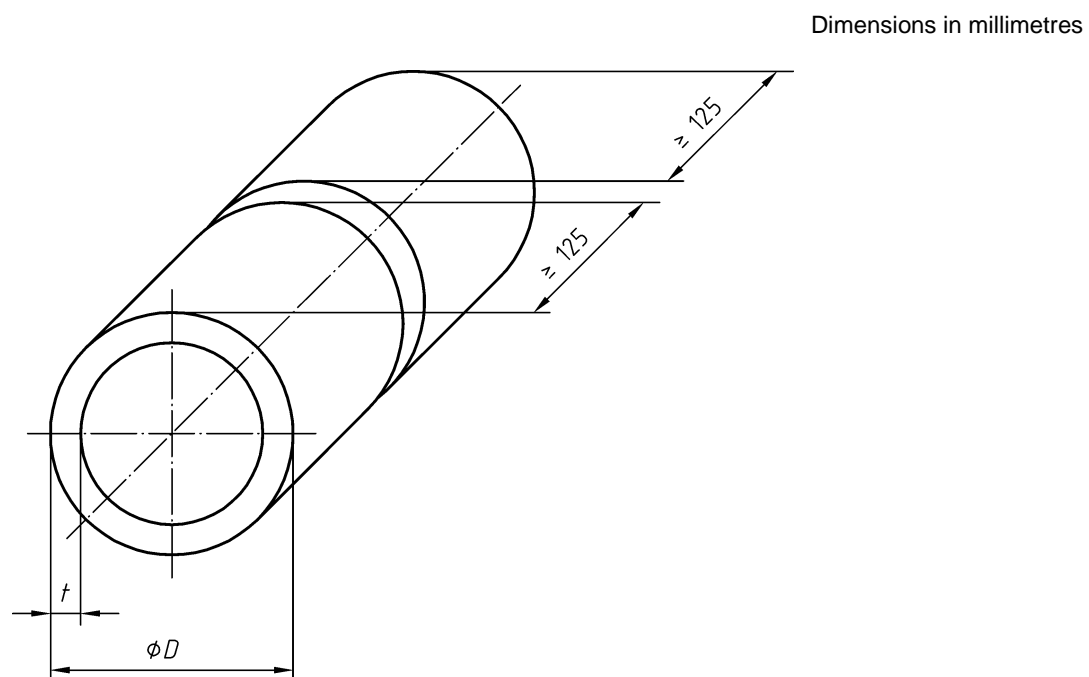


$$0,5 \times t \leq a \leq 0,7 \times t$$

Key

- a Design throat thickness
- t Material thickness of test piece
- z Leg length of fillet weld

Figure 2 — Dimensions of test piece for a fillet weld on plate



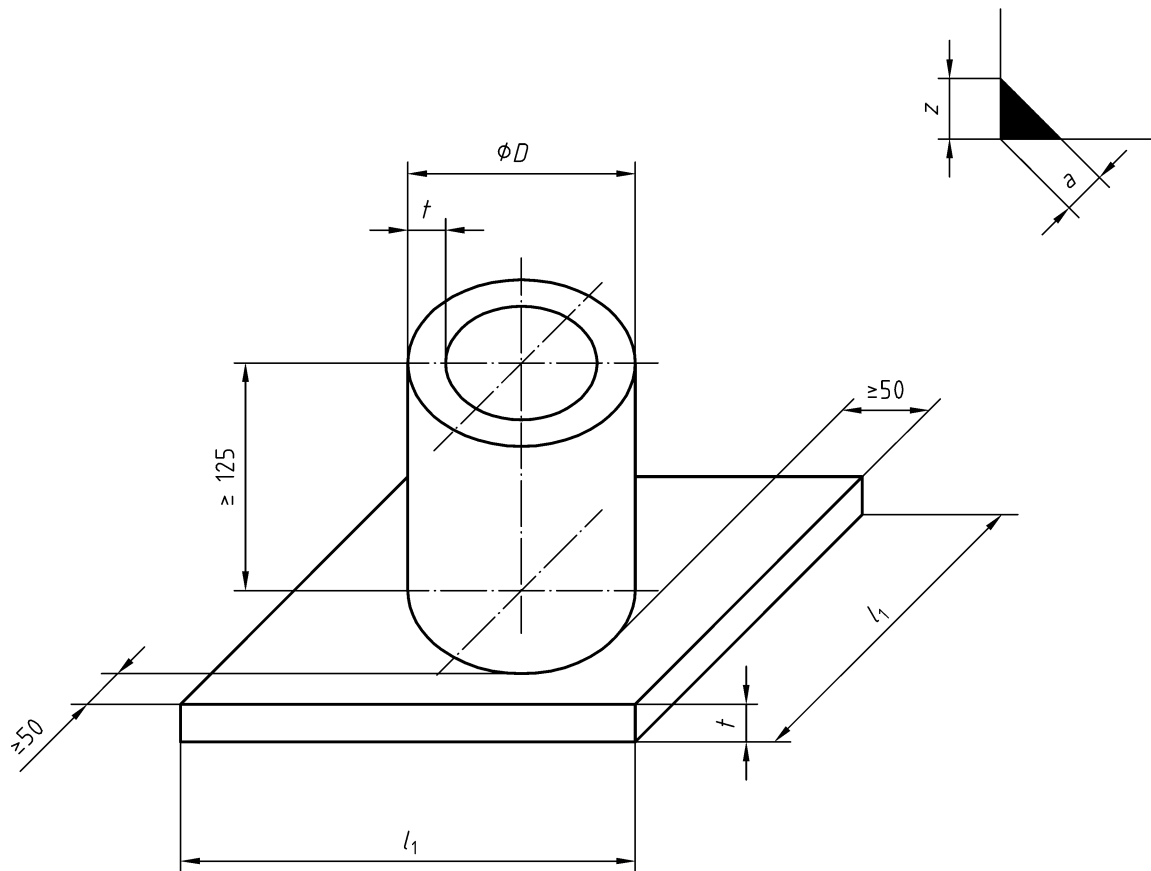
Key

- D Outside pipe diameter
- t Material thickness of test piece (wall thickness)

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

Dimensions in millimetres

$$z = a\sqrt{2}$$



t corresponds to the thinner part

$$0,5 \times t \leq a \leq 0,7 \times t$$

Key

- a Design throat thickness
- D Outside pipe diameter
- l_1 Length of test piece
- t Material thickness of test piece (plate or wall thickness)
- z Leg length of fillet weld

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

6.3 Welding conditions

The qualification test of welders shall follow a pWPS or WPS prepared in accordance with prEN ISO 15609-1 or EN ISO 15609-2.

The following welding conditions shall apply:

- the welding time for the test piece shall correspond to the working time under usual production conditions;
- the test pieces shall have at least one stop and one re-start in the root run and in the capping run and be identified in the examination length to be examined;
- any post-welded heat treatment required in the pWPS or WPS can be omitted unless bend tests are required;

- identification of the test piece;
- the welder shall be allowed to remove minor imperfections by grinding, except on the surfaces after finishing the weld. The permission of the examiner or examining body shall be obtained.

6.4 Test methods

Each completed weld shall be tested according to Table 10 in the as-welded condition.

If the weld is accepted by visual testing, the additional test(s) according to Table 10 shall be carried out.

When permanent backing was used in the qualification test it shall be removed prior to destructive testing.

The test specimen for macroscopic examination shall be prepared and etched on one side to clearly reveal the weld. Polishing is not required.

When radiographic testing of butt welds made by welding processes 131, 135, 136 (only metal cored wires) and 311 (see also Table 10, footnote b) is undertaken it shall be supplemented by either two additional bend tests (one face and one root or two side bends) or two fracture tests (one face and one root).

Table 10 — Test methods

Test method	Butt weld (in plate or pipe)	Fillet weld and branch connection
Visual testing according to EN 970	mandatory	mandatory
Radiographic testing according to EN 1435	mandatory ^{a b d}	not mandatory
Bend test according to EN 910	mandatory ^{a b f}	not applicable
Fracture test according to EN 1320	mandatory ^{a b f}	mandatory ^{c e}
^a Either radiographic testing or bend or fracture tests shall be used. ^b When radiographic testing is used, then additional bend or fracture tests are mandatory for welding processes 131, 135, 136 (only metal cored wire) and 311 (see 6.4). ^c The fracture tests may be replaced by a macroscopic examination according to EN 1321 of at least two sections. ^d The radiographic testing may be replaced by an ultrasonic testing according to EN 1714 for thickness ≥ 8 mm on ferritic steels only. ^e The fracture tests on pipes may be replaced by radiographic testing. ^f For outside pipe diameter $D \leq 25$ mm, the bend or fracture tests may be replaced by a notched tensile test of the complete test piece (example is given in Figure 8).		

6.5 Test piece and test specimen

6.5.1 General

In 6.5.2 to 6.5.4 details of the type, dimensions and preparation of the test pieces and test specimens are given. In addition, the requirements for destructive tests are indicated.

6.5.2 Butt weld in plate and pipe

When radiographic testing is used, the examination length of the weld (see Figures 5a, 7a and 7b) in the test piece shall be radiographed in the as-welded condition (no removal of excess weld metal).

When fracture testing is used, the test piece examination length shall be cut into the test specimens of equal width and all of them tested in such a manner that the fracture will be reached. The examination length of each test specimen shall be ≥ 40 mm. All notch profiles according to EN 1320 are permitted.

When transverse bend testing or side bend testing is used the diameter of the former or the inner roller shall be $4 t$ and the bending angle 180° for parent metal with elongation $A \geq 20 \%$. For parent metal with elongation $A < 20 \%$, the following equation shall apply:

$$d = \frac{100 \times t_s}{A} - t_s$$

where

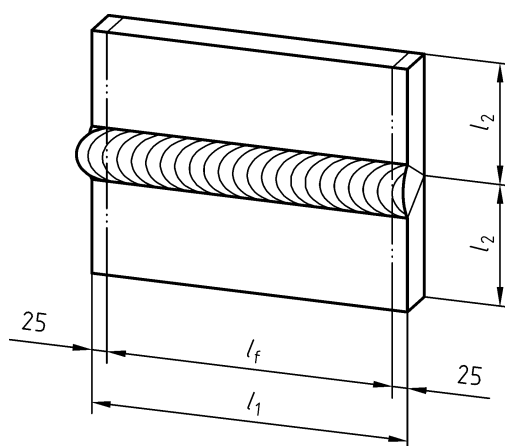
- d is the diameter of the former or the inner roller,
- t_s is the thickness of the bend test specimen,
- A is the minimum tensile elongation required by the material specification.

When only transverse bend testing is carried out, the examination length shall be cut into test specimens of equal width and all of them shall be tested. When only side bend tests are used, a minimum of four test specimen shall be taken equally spaced along the examination length. One of these side bend tests shall be taken from the start and stop area in the examination length. Bend tests shall be performed in accordance with EN 910.

For thickness $t > 12$ mm, the transverse bend tests can be substituted by side bend tests.

For pipes, the number of the additional fracture or transverse bend test specimens to welding processes 131, 135, 136 (only metal cored wire) or 311, using the radiographic testing, depends on the welding position. For welding position PA or PC one root and one face bend test specimen shall be tested (see Figure 7a). For all other welding positions, two root and two face bend test specimens shall be tested (see Figure 7b).

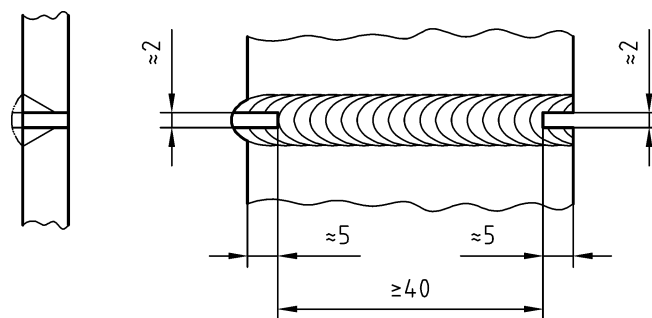
Dimensions in millimetres



Key

- l_1 Length of test piece
- l_2 Half width of test piece
- l_f Examination length

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



b) Examination length of the test specimen

NOTE In addition, the test specimen can be longitudinally notched in the centre of the weld of the tension side in order to achieve a fracture in the weld of the test specimen.

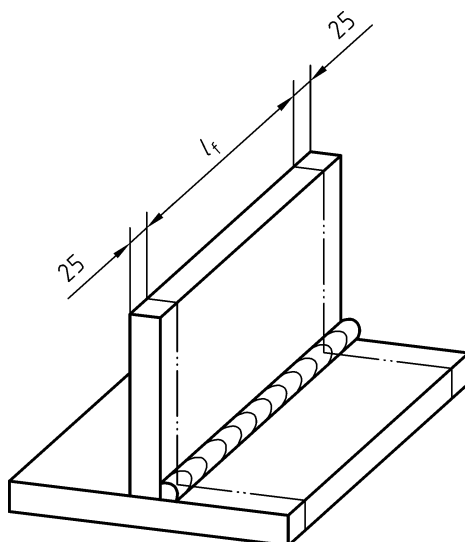
Figure 5 — Preparation and fracture testing of test specimens for a butt weld in plate

6.5.3 Fillet weld on plate

For fracture tests (see Figure 6) the test piece can be cut, if necessary, into several test specimens. Each test specimen shall be positioned for breaking in accordance with EN 1320 and examined after fracture.

When macroscopic examination is used, at least two test specimens shall be taken. One macroscopic specimen shall be taken at the stop/start location.

Dimensions in millimetres

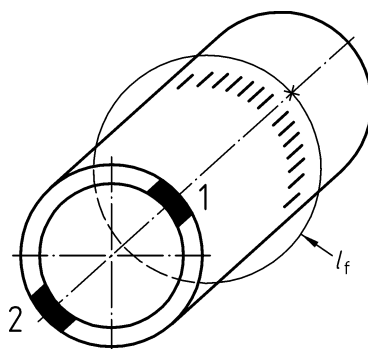


Key

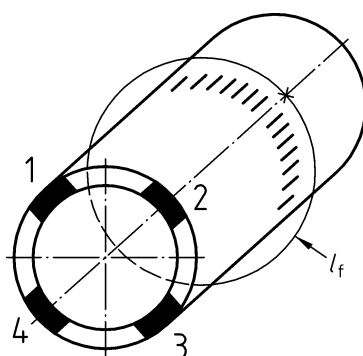
l_f Examination length

Figure 6 — Examination length for fracture testing for a fillet weld on plate

Dimensions in millimetres

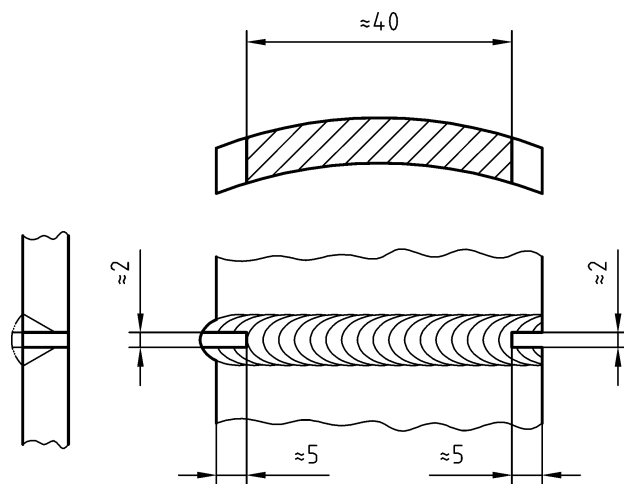
**Key**

- l_f Examination length
 1 Location for one root fracture or one root transverse bend or one side bend test specimen
 2 Location for one face fracture or one face transverse bend or one side bend test specimen

a) Sectioning of additional fracture or bend test specimens for welding positions PA and PC**Key**

- l_f Examination length
 1 One root fracture or one root transverse bend or one side bend test specimen
 2 One face fracture or one face transverse bend or one side bend test specimen
 3 One root fracture or one root transverse bend or one side bend test specimen
 4 One face fracture or one face transverse bend or one side bend test specimen

b) Sectioning of additional fracture or bend test specimens for welding positions PF, PG, H-L045, J-L045



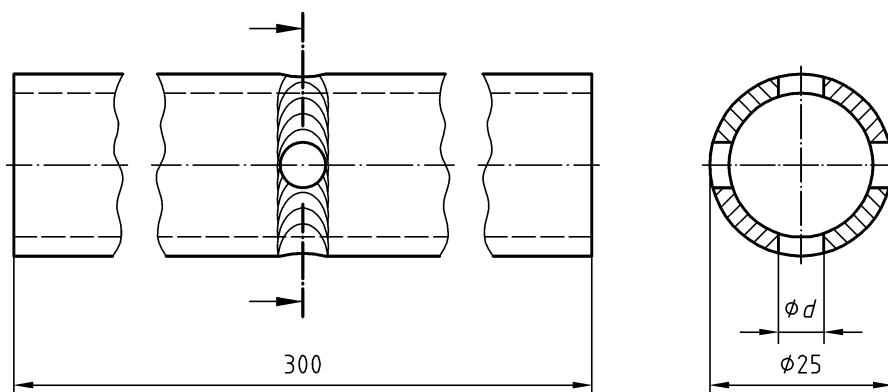
c) Examination length of the fracture test specimen

NOTE In addition, the test specimen can be longitudinally notched in the centre of the weld of the tension side in order to achieve a fracture in the weld of the test specimen.

Figure 7 — Preparation and locations of test specimens for a butt weld in pipe

For $t \geq 1,8$ mm: $d = 4,5$ mm

For $t < 1,8$ mm: $d = 3,5$ mm



Holes are not allowed in start and stop areas.

NOTE Notch profiles s and q are also permitted in circumferential direction according to EN 1320.

Figure 8 — Example for notch tensile test for pipe test piece outside diameter ≤ 25 mm

6.5.4 Fillet weld on pipe

For fracture tests, the test piece shall be cut into four or more test specimens and fractured (one possibility is shown in Figure 9).

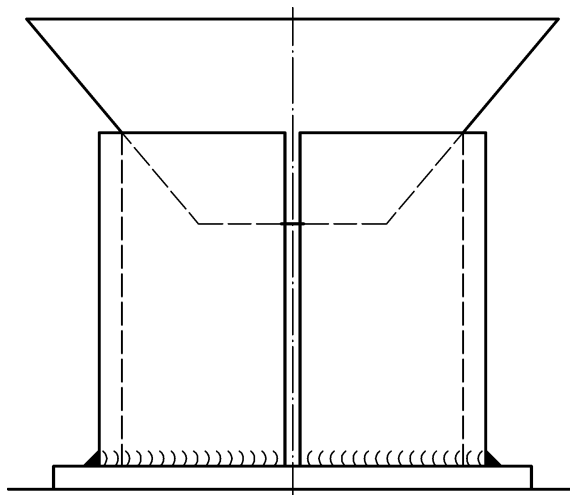


Figure 9 — Preparation and fracture testing of test specimens for a fillet weld on pipe

When macroscopic examination is used, at least two test specimens shall be taken. One macroscopic specimen shall be taken at the stop/start location.

6.6 Test record

The results of all testing shall be documented.

7 Acceptance requirements for test pieces

Test pieces shall be evaluated according to the acceptance requirements specified for relevant types of imperfections.

Prior to any testing the following shall be checked:

- all slag and spatters are removed;
- no grinding on the root and the face side of the weld (according to 6.3);
- stop and restart in the root run and in the capping run are identified (according to 6.3);
- profile and dimensions.

The acceptance requirements for imperfections found by test methods according to this standard shall, unless otherwise specified, be assessed in accordance with prEN ISO 5817. A welder is qualified if the imperfections are within quality level B in prEN ISO 5817, except for imperfections types as follows; excess weld metal, excessive convexity, excessive throat thickness and excessive penetration, for which level C shall apply.

Bend test specimens shall not reveal any one single flaw ≥ 3 mm in any direction. Flaws appearing at the edges of a test specimen during testing shall be ignored in the evaluation unless there is evidence that cracking is due to incomplete penetration, slag or other flaw.

If the imperfections in the welder's test piece exceed the permitted maximum specified, then the welder fails the test.

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

NOTE The correlation between the quality levels of prEN ISO 5817 and the acceptance levels of the different non-destructive testing techniques are given in EN 12062.

8 Re-tests

If any test fails to comply with the requirements of this standard, the welder shall be given the opportunity to repeat the qualification test.

If it is established that failure is due to metallurgical or other extraneous causes that 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.

9 Period of validity

9.1 Initial qualification

The validity of the welders qualification begins from the date of welding of the test piece(s).

This is providing that the required testing has been carried out and the test results obtained were acceptable.

9.2 Confirmation of the validity

The welder's qualification test certificate issued is valid for a period of two years. This is providing that the welding coordinator or the responsible personnel of the employer can confirm that the welder has been working within the initial range of qualification. This shall be confirmed every six months.

9.3 Prolongation of qualification

Welder's qualification test certificates according to this standard can be prolonged every two years by an examiner/examining body.

Before prolongation of the certification takes place, 9.2 needs to be satisfied and also the following conditions need to be confirmed:

- a) All records and evidence used to support prolongation are traceable to the welder and identifies the WPS(s) that have been used in production;
- b) Evidence used to support prolongation shall be of a volumetric nature (radiographic testing or ultrasonic testing) or for destructive testing (fracture or bends) made on two welds during the previous six months. Evidence relating to prolongation needs to be retained for a minimum of two years;
- c) The welds satisfy the acceptance levels for imperfections as specified in clause 7;
- d) The test results mentioned in 9.3 b) shall demonstrate that the welder has reproduced the original test conditions, except for thickness and outside pipe diameter.

NOTE Examples for variables to be confirmed and traceable see annex D.

10 Certificate

It shall be verified that the welder has successfully passed the qualification test. All essential variables shall be recorded on the certificate. If the test piece(s) fail(s) any of the required 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 information detailed in annex A. The format of this annex A is recommended to be used as the welder's qualification test certificate. If any other form of welder's qualification test certificate is used, it shall contain the information required in annex A.

In general for each test piece a separate welder's qualification test certificate shall be issued.

If more than one test piece is welded a single welder's qualification test certificate can be issued that combines the ranges of qualification of the individual test pieces. In this case, only one of the following essential variables is permitted to differ, except the samples given in 5.7.

- type of weld,
- welding position,
- material thickness.

Other essential variables are not allowed to be changed.

It shall be ensured that the welder's qualification test certificate cannot lead to ambiguity. Therefore, it is recommended to issue the welder's qualification test certificate in at least one of the languages English, French or German in combination with any other language, if necessary.

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 qualification test beyond the permitted ranges requires a new test and a new welder's qualification test certificate.

11 Designation

The designation of a welder qualification 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 4.2, 5.2 and EN ISO 4063;
 - 2) product type: plate (P), pipe (T), refer to 4.3.1 and 5.3;
 - 3) type of weld: butt weld (BW), fillet weld (FW), refer to 5.4;
 - 4) material group: refer to 5.5;
 - 5) welding consumables: refer to 5.6;
 - 6) dimensions of test piece: material thickness t and outside pipe diameter D , refer to 5.7;
 - 7) welding positions: refer to 5.8 and EN ISO 6947;
 - 8) weld details: refer to 5.9.

The type of shielding and backing gas shall not be incorporated in the designation but shall be included in the welder's qualification test certificate (see prEN ISO 15609-1:2000, annex A, or EN ISO 15609-2:2001, annex A).

Designation examples are shown in annex B.

Annex A (informative)

Welder's qualification test certificate

Designation(s):

.....

WPS – Reference:

Examiner or examining body – Reference No.:

Welder's Name:

Identification:

Method of identification:

Date and place of birth:

Employer:

Code/Testing Standard:

Photograph
(if required)

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

	Test piece	Range of qualification
Welding process(es) Product type (plate or pipe) Type of weld Material group(s) Welding consumable (Designation) Shielding gas Auxiliaries (e.g. backing gas) Material thickness (mm) Outside pipe diameter (mm) Welding position Weld details		

Type of tests	Performed and accepted	Not tested	Name of examiner or examining body:
Visual testing			Place, date and signature of examiner or examining body:
Radiographic testing			Date of welding:
Fracture test			Validity of qualification until:
Bend test			
Notch tensile test			
Macroscopic examination			

Confirmation of the validity by employer/welding coordinator for the following 6 month (refer to 9.2)

Date	Signature	Position or title

Prolongation for qualification by examiner or examining body for the following 2 years (refer to 9.3)

Date	Signature	Position or title

Annex B (informative)

Designation examples

B.1 Example 1

Welder qualification **EN 287-1 135 P FW 1.2 S t10 PB ml**

Explanation			Range of qualification
135	Welding process	MAG-Welding	135, 136 (M only)
P	Plate	—	P T: $D \geq 150$ mm
FW	Fillet weld	—	FW
1.2	Material group according to CR ISO 15608	Material group 1.2: Yield strength $275 \text{ N/mm}^2 < R_{eH} \leq 360 \text{ N/mm}^2$	1.1, 1.2, 1.4
S	Welding consumable	solid wire	S, M
t10	Thickness	Material thickness: 10 mm	≥ 3 mm
PB	Welding position	horizontal - vertical position (fillet weld)	PA, PB
ml	Weld details	multi layer	sl, ml

B.2 Example 2

Welder qualification **EN 287-1 136 P BW 1.3 B t15 PE ss nb**

Explanation			Range of qualification
136	Welding process	Tubular cored metal arc welding with active gas shield	136
P	Plate	—	P T: $D \geq 150$ mm PA, PB, PC $D \geq 500$ mm PF
BW	Butt weld	—	BW, FW (see 5.4 b))
1.3	Material group according to CR ISO 15608	Material group 1.3: Normalised fine grain steels with a yield strength $R_{eH} > 360 \text{ N/mm}^2$	1, 2, 3, 9.1, 11
B	Welding consumable	electrode core basic	B, R, P, V, W, Y, Z
t15	Material thickness of test piece	Material thickness: 15 mm	≥ 5 mm
PE	Welding position	overhead position (butt weld)	PA, PB, PC, PD, PE, PF
ss nb	Weld details	single-side welding, no backing multi layer	ss nb, ss mb, bs for FW: sl, ml

B.3 Example 3

Welder qualification EN 287-1 141 T BW 8 S t3.6 D60 PF ss nb

Explanation			Range of qualification
141	Welding process	TIG-Welding	141
T	Tube	–	T P
BW	Butt weld	–	BW, FW (see 5.4 b))
8	Material group according to CR ISO 15608	Material group 8: Austenitic stainless steels	8, 9.2, 9.3, 10
S	Welding consumable	solid rod	S
t3.6	Thickness	Material thickness: 3,6 mm	3 mm to 7,2 mm
D60	Outside pipe diameter of test piece	Outside pipe diameter: 60 mm	≥ 30 mm
PF	Welding position	butt weld on pipe, pipe fixed, axis horizontal fix	PA, PB, PD, PE, PF
ss nb	Weld details	single-side welding, no backing multi layer	ss nb, ss mb, bs for FW: sl, ml

B.4 Example 4

Welder qualification EN 287-1 111 P BW 2 B t13 PA ss nb

Welder qualification EN 287-1 111 P FW 2 B t13 PB ml

Explanation			Range of qualification
111	Welding process	Manual metal arc welding	111
P	Plate	–	P T: $D \geq 150$ mm
BW FW	Butt weld Fillet weld	–	BW, FW (see 5.4 b))
2	Material group according to CR ISO 15608	Material group 2: Thermomechanically treated fine grain steels with $R_{eH} > 360$ N/mm ²	1, 2, 3, 9.1, 11
B	Welding consumable	basic covering	all, C excluded
t13	Thickness	Material thickness: 13 mm	≥ 5 mm
PA PB	Welding position	butt weld, flat fillet weld, horizontal-vertical	PA, PB
ss nb ml	Weld details	single-side welding, no backing multi layer	ss nb, ss mb, bs for FW: sl, ml

B.5 Example 5

Welder qualification EN 287-1 141/135 T BW 1.2 S t20(5/15) D200 PA ss nb

Explanation			Range of qualification
141 135	Welding process	TIG-Welding, root run (2 layers) MAG-Welding, filling runs	141 135, 136 (M only)
T	Tube	–	T P
BW	Butt weld	–	BW, FW (see 5.4 b))
1.2	Material group according to CR ISO 15608	Material group 1.2: Yield strength $275 \text{ N/mm}^2 < R_{eH} \leq 360 \text{ N/mm}^2$	1.1, 1.2, 1.4
S	Welding consumable	solid wire	141: S 135: S, 136: M only
t20	Thickness	141: $s_1 = 5 \text{ mm}$ 135: $s_2 = 15 \text{ mm}$	141: $t = 3 \text{ mm}$ to 10 mm 135: $t \geq 5 \text{ mm}$ 141/135: $t \geq 5 \text{ mm}$
D200	Outside pipe diameter of test piece	Outside pipe diameter: 200 mm	$\geq 100 \text{ mm}$
PA	Welding position	butt weld on rotating pipe, axis horizontal	PA, PB
ss nb	Weld details	single-side welding, no backing multi layer	141: ss nb, ss mb, bs 135: ss mb, bs (136: M) for FW: sl, ml

B.6 Example 6

Welder qualification **EN 287-1 141 T BW 10 S t8.0 D100 H-L045 ss nb**

Welder qualification **EN 287-1 141 T BW 10 S t1.2 D 16 H-L045 ss nb**

Explanation			Range of qualification
141	Welding process	TIG-Welding	141
T	Tube	–	T P
BW	Butt weld	–	BW, FW (see 5.4 b))
10	Material group according to CR ISO 15608	Material group 10: Austenitic ferritic stainless steels	8, 9.2, 9.3, 10
S	Welding consumable	solid rod	S
t8.0 t1.2	Thickness	Material thickness: 1,2 mm/ 8 mm	1,2 mm to 16 mm
D100 D16	Outside pipe diameter of test piece	Outside pipe diameter: 100 mm/ 16 mm	≥ 16 mm
H-L045	Welding position	butt weld on pipe, pipe fixed, axis inclined (45°)	all, PG and J-L045 excluded
ss nb	Weld details	single-side welding, no backing single/multi layer	ss nb, ss mb, bs For FW: sl, ml

B.7 Example 7

Welder qualification **EN 287-1 141 T BW 5 S t5.0 D60 PF ss nb**

Welder qualification **EN 287-1 141 T BW 5 S t5.0 D60 PC ss nb**

Explanation			Range of qualification
141	Welding process	TIG-Welding	141
T	Tube	–	T P
BW	Butt weld	–	BW, FW (see 5.4 b))
5	Material group according to CR ISO 15608	Material group 5: Cr-Mo steels free of vanadium with C ≤ 0,35 %	1, 2, 3, 4, 5, 6, 7, 9.1, 11
S	Welding consumable	solid rod	S
t5.0	Thickness	Material thickness: 5,0 mm	3 mm to 10 mm
D60	Outside pipe diameter of test piece	Outside pipe diameter: 60 mm	≥ 30 mm
PF PC	Welding position	butt weld on pipe, axis horizontal fix axis vertical	all, PG and J-L045 excluded
ss nb	Weld details	single-side welding, no backing multi layer	ss nb, ss mb, bs For FW: sl, ml

Annex C **(informative)**

Job knowledge

C.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 qualification test 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 question used should be drawn up by the individual country, but should include questions on areas covered in C.2, relevant to the qualification test of welders.

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.

C.2 Requirements

C.2.1 Welding equipment

C.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.

C.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.

C.2.2 Welding process ²⁾

C.2.2.1 Oxy-acetylene welding (311)

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

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

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

C.2.2.3 Shielded metal-arc welding (114, 131, 135, 136, 141, 15)

- a) Types and size of electrodes;
- b) Identification of shielding gas and flow rate (without 114);
- 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.

C.2.2.4 Submerged arc welding (121, 125)

- a) Drying, feeding and correct recovery of flux;
- b) Correct alignment and travel of welding head.

C.2.3 Parent metals

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

C.2.4 Welding consumables

- a) Identification of welding consumables;
- b) Storage, handling and conditions of welding consumables;
- c) Selection of correct size;
- d) Cleanliness of electrodes and filler wires;

2) The numbers refer to EN ISO 4063.

- e) Control of wire spooling;
- f) Control and monitoring of gas flow rates and quality.

C.2.5 Safety precautions

C.2.5.1 General

- a) Safe assembly, setting up and turn off 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

C.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.

C.2.5.3 All arc welding processes

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

C.2.5.4 Shielded gas arc welding

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

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

C.2.8 Weld imperfections

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

C.2.9 Welder qualification

The welder should be aware of the range of the qualification.

Annex D (informative)

Variables to be confirmed and traceable for prolongation

In order to prolong a welder's qualification test certificate, it should be confirmed that the welder has done welding representative of the original qualification test with regards to the variables given in Table D.1.

Table D.1 —Variables to be confirmed and traceable for prolongation

Variables	to be confirmed
Welding process(es)	X
Product type (pipe, plate, branch)	X
Type of weld	X
Material group	X
Welding consumable (designation)	X
Material thickness ^a	X
Outside pipe diameter ^b	X
Welding position	X
Weld details	X
^a Thickness can vary providing that it is within the original range of qualification. ^b Outside pipe diameter can vary ± 50 % from the initial test piece.	

Annex ZA (normative)

Normative references to International publications with their corresponding European publications

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 (including amendments).

Publication	Year	Title	EN	Year
ISO 5173	2000	Destructive tests on welds in metallic materials — Bend test (Revision of ISO 5173:1981 and ISO 5177:1981).	EN 910	1996
ISO 4063	1998	Welding and allied processes – Nomenclature of processes and reference numbers.	EN ISO 4063	2000
ISO/DIS 5817	2002	Arc-welded joints in steel — Guidance on quality levels for imperfections.	prEN ISO 5817	2002
ISO 6947	1990	Welds – Working positions – Definitions of angles of slope and rotation.	EN ISO 6947	1997
ISO 9017	2001	Destructive tests on welds in metallic materials — Fracture test.	EN 1320	1996
ISO/DIS 15607	2000	Specification and approval of welding procedures for metallic materials — General rules.	prEN ISO 15607	2000
ISO/TR 15608	2000	Welding — Guidelines for a metallic materials grouping system.	CR ISO 15608	2000
ISO/DIS 15609-1	2000	Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding.	prEN ISO 15609-1	2000
ISO 15609-2	2001	Specification and approval of welding procedures for metallic materials — Welding procedure specification — Part 2: Gas welding.	EN ISO 15609-2	2001
ISO/DIS 17636	2000	Non-destructive examination of welds — Radiographic examination of welded joints.	EN 1435	1997
ISO/DIS 17637	2000	Non-destructive examination of fusion welds — Visual examination.	EN 970	1997

Annex ZB

(informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

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 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment.

WARNING : Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

The following clauses of this standard as detailed in Table ZA.1, are likely to support requirements of the Directive 97/23/EC.

Compliance with these clauses of this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 97/23/EC

Clauses/sub-clauses of this European Standard	Essential requirements (Ers) of Directive 97/23/EC	Qualifying remarks/Notes
All clauses	Annex I, 3.1.2	Permanent joining

Bibliography

Publication	Year	Title	EN	Year
ISO 2553	1992	Welded, brazed and soldered joints – Symbolic representation on drawings.	EN 22553	1994
ISO 2560	1973	Covered electrodes for manual arc welding of mild steel and low alloy steel — Code of symbols for identification.	EN 499	1994
–	–	Welding consumables — Tubular cored electrodes for metal arc welding with and without a gas shield of non alloy and fine grain steels — Classification.	EN 758	1997
–	–	Welding personnel — Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials.	EN 1418	1997
–	–	Non-destructive examination of welds — General rules for metallic materials.	EN 12062	1997
ISO/DIS 17639	2000	Non-destructive examination of fusion welds - Macroscopic and microscopic examination of welds.	EN 1321	1996
ISO/DIS 17640	2000	Non destructive examination of welds — Ultrasonic examination of welded joints.	EN 1714	1997