

Qualification test of welders — Fusion welding —

Part 1: Steels

The European Standard EN 287-1:2011 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN 287-1:2011. It supersedes BS EN 287-1:2004 which is withdrawn. This standard was originally developed as prEN ISO 9606-1, but the ISO work item was withdrawn after the enquiry stage and the document proceeded to formal vote as a purely European work item.

The UK participation in its preparation was entrusted to Technical Committee WEE/36, Qualification of welding procedures and welders, which has the responsibility to:

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Foreword

This document (EN 287-1:2011) has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by January 2012, and conflicting national standards shall be withdrawn at the latest by January 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 287-1:2004.

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 ZA, which is an integral part of this document.

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Introduction

The ability of a welder to follow verbal or written instructions and verification of a person's skills is an 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 easier to weld on the presumption that the welder has received a specific 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 and testing requirements are satisfied (see EN ISO 15614-1).

At the end of its period of validity, the existing and valid qualification testing of welders in accordance with the requirement of the previous edition of this standard may be revalidated according to the previous edition. Alternatively, the range of qualification may be updated in accordance with this edition. All new qualifications and re-qualifications shall be in accordance with this edition.

1 Scope

This European Standard defines the qualification testing 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 welder's 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 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

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1320:1996, *Destructive tests on welds in metallic materials — Fracture test*

EN 1435:1997, *Non-destructive examination of welds — Radiographic examination of welded joints*

EN ISO 4063:2009, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063:2009)*

EN ISO 5173:2010, *Destructive tests on welds in metallic materials — Bend tests (ISO 5173:2009)*

EN ISO 5817:2007, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2003, corrected version:2005, including Technical Corrigendum 1:2006)*

EN ISO 6947, *Welding and allied processes — Welding positions (ISO 6947:2011)*

CEN ISO/TR 15608, *Welding — Guidelines for a metallic materials grouping system (ISO/TR 15608:2005)*

EN ISO 15609-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1:2004)*

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)*

EN ISO 17637, *Non-destructive testing of welds - Visual testing of fusion-welded joints (ISO 17637:2003)*

ISO 857-1:1998, *Welding and allied processes — Vocabulary — Part 1: Metal welding processes*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

welder

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

[ISO/TR 25901:2007]

3.2

manufacturer

person or organization that is responsible for the welding production

[EN ISO 15607:2003]

3.3

examiner

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

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

3.4

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.

[ISO/TR 25901:2007]

3.5

material backing

backing using material for the purpose of supporting molten weld metal

3.6

layer

stratum of weld metal consisting of one or more runs

[ISO/TR 25901:2007]

3.7

root run

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

[ISO/TR 25901:2007]

3.8

filling run

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

[ISO/TR 25901:2007]

3.9

capping run

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

[ISO/TR 25901:2007]

3.10

deposited thickness

thickness of the weld metal excluding any reinforcement

[ISO/TR 25901:2007]

3.11

leftward welding

gas welding technique in which the filler rod is moved ahead of the blow pipe in relation to the welding direction

[ISO/TR 25901:2007]

3.12

rightward welding

gas welding technique in which the filler rod is moved behind the blow pipe in relation to the welding direction

[ISO/TR 25901:2007]

3.13

branch connection

joint of one or two tubular parts at an angle of less than 180°

3.14

fillet weld

triangular weld in a square preparation for making a T-joint, corner joint or lap joint

[ISO/TR 25901:2007]

3.15

verification

confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

[ISO 9000:2005]

3.16

filler material

welding consumable added during welding to form the weld

[ISO/TR 25901:2007]

3.17

butt weld

weld other than a fillet weld (3.14) made in a groove or in a square preparation

[ISO/TR 25901:2007]

4 Reference numbers, symbols and abbreviated terms

4.1 General

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 4063:2009):

- 111 manual metal arc welding;
- 114 self-shielded tubular-cored arc welding;
- 121 submerged arc welding with solid wire electrode (partly mechanized);
- 125 submerged arc welding with tubular cored electrode (partly mechanized);
- 131 MIG welding with solid wire electrode;

135	MAG welding with solid wire electrode;
136	MAG welding with flux cored electrode;
138	MAG welding with metal cored electrode;
141	TIG welding with solid filler material;
142	Autogenous TIG welding;
143	TIG welding with tubular cored filler material;
145	TIG welding using reducing gas and solid filler material;
15	plasma arc welding;
311	oxy-acetylene welding.

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

4.3 Symbols and abbreviations

4.3.1 For test pieces

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
R_{eH}	yield strength
s_1	deposited thickness of weld metal for welding process 1
s_2	deposited thickness of weld metal for welding process 2
t	material thickness of test piece (plate or wall thickness)
T	pipe ¹⁾

4.3.2 For consumables

nm	no filler metal
A	acid covering

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

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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
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

<i>A</i>	minimum tensile elongation required by the material specification
<i>d</i>	diameter of the former or the inner roller
<i>t_S</i>	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(es);
- product type (plate and pipe);
- type of weld (butt and fillet);
- material group;
- filler material;
- 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

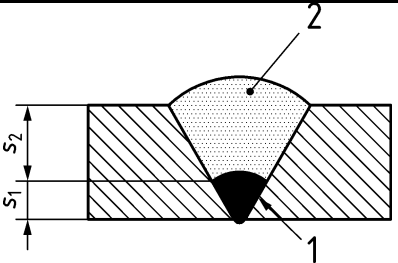
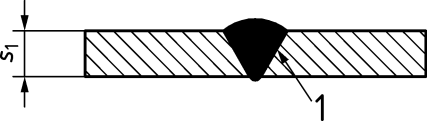
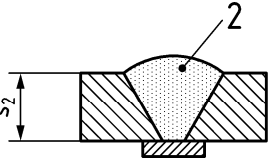
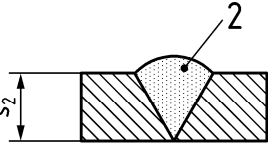
Welding processes are defined in ISO 857-1 and listed in 4.2.

Each qualification test normally qualifies only one welding process. A change of welding process requires a new qualification test. Exceptions are as follows:

- a change from solid wire electrode 135 to a metal cored electrode 138 or vice versa does not require requalification. (see Table 4);
- welding with 141, 143 or 145 qualifies for 141, 142, 143 and 145 but 142 only qualifies for 142.

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 concerning the deposited thickness of weld metal for each welding process used and for the multi process joint for butt welds are given in Table 1 (see also Table 5).

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

Welding process used for the test piece	Thickness range qualified	
	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 5 for welding process 1: $t = s_1$ for welding process 2: $t = s_2$</p>	<p>according to Table 5 with $t = s_1 + s_2$</p>
 <p>Key</p> <p>1 Welding process 1</p>	<p>according to Table 5</p>	<p>according to Table 5</p>
  <p>Key</p> <p>2 Welding process 2 3 Welding with backing (mb) 4 Welding without backing (nb)</p>	<p>according to Table 5 for welding process 1: $t = s_1$ for welding process 2: $t = s_2$</p>	<p>according to Table 5 $t = s_1 + s_2$ welding process 1 only for welding of the root area</p>

5.3 Product type

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

- a) Test piece welds with outside pipe diameter $D > 25$ mm cover welds in plates;
- b) Test piece welds in plates cover welds in pipes of outside pipe diameter $D \geq 150$ mm, for welding positions PA, PB and PC, according to range of qualification of Table 8;
- c) Test piece welds in plates cover welds in pipe of outside pipe diameter $D \geq 500$ mm for all other 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 d));
- b) butt welds do not qualify fillet welds or vice versa;

- c) when a welder is qualified by butt weld test, a supplementary fillet weld test piece can be welded which shall be in a plate thickness of at least 10 mm and completed using a single layer in the PB position. For this supplementary test the welder shall become qualified for all fillet welds as given for the butt weld qualifications;
- d) butt welds in pipes 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;
- e) 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.

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 CEN ISO/TR 15608.

NOTE Examples of parent material in accordance with the grouping system in CEN ISO/TR 15608 are given in CEN ISO/TR 20172, CEN ISO/TR 20173 and CEN ISO/TR 20174.

5.5.2 Range of qualification

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

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

Qualification of dissimilar metal joints: When using filler metals from the material group 8 or 10 (see Table 2), all combinations with the material group 8 or 10 to other material 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	×	–	–	–	–	–	–	–	–	–	–	–	–
1.3	×	×	×	×	–	–	–	–	–	×	–	–	×
2	×	×	×	×	–	–	–	–	–	×	–	–	×
3	×	×	×	×	–	–	–	–	–	×	–	–	×
4	×	×	×	×	×	×	×	×	–	×	–	–	×
5	×	×	×	×	×	×	×	×	–	×	–	–	×
6	×	×	×	×	×	×	×	×	–	×	–	–	×
7	×	×	×	×	×	×	×	×	–	×	–	–	×
8	–	–	–	–	–	–	–	–	×	–	×	×	–
9	9.1	×	×	×	×	–	–	–	–	×	–	–	×
	9.2 + 9.3	×	–	–	–	–	–	–	–	–	×	–	–
10	–	–	–	–	–	–	–	–	×	–	×	×	–
11	×	×	–	–	–	–	–	–	–	–	–	–	×

^a Material group according to CEN ISO/TR 15608.

Key

- ×
 -
- × indicates those material groups for which the welder is qualified.
 – indicates those material groups for which the welder is not qualified.

5.6 Filler materials

Welding with filler material qualifies for welding without filler material, but not vice versa.

The ranges of qualification for filler materials are given in Tables 3 and 4.

Table 3 — Range of qualification for covered electrodes ^{a, b}

Electrode used in the test	Range of qualification		
	A, RA, RB, RC, RR, R	B	C
A, RA, RB, RC, RR, R	×	–	–
B	×	×	–
C	–	–	×

^a Abbreviations, see 4.3.2.

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

Key

- ×
 -
- × indicates those covered electrodes for which the welder is qualified.
 – indicates those covered electrodes for which the welder is not qualified.

Table 4 — Range of qualification for wire electrodes ^{a, b}

Wire electrodes used in the test piece	Range of qualification			
	Solid (S)	Metal cored (M)	Flux cored (B)	Flux cored (R, P, V, W, Y, Z)
Solid (S)	×	×	—	—
Metal cored (M)	×	×	—	—
Flux cored (B)	—	—	×	×
Flux cored (R, P, V, W, Y, Z)	—	—	—	×

^a Abbreviations, see 4.3.2.

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

Key

× indicates those filler materials for which the welder is qualified.

— indicates those filler materials 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 5 and 6.

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 5 and 6 should be applied.

For fillet welds the range of qualification for material thickness is specified in Table 7.

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

- thinnest through to the thickest weld metal and/or parent metal thickness qualified (refer to Table 5); and
- the smallest through to the largest diameter qualified (refer to Table 6).

Table 5 — Range of qualification of material thickness and deposited thickness of weld metal (multi process) of test piece for butt welds

Dimension in millimetres	
Thickness ^a <i>t</i>	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 6 — Range of qualification for outside pipe diameter ^a

Dimension in millimetres

Outside pipe diameter of test piece <i>D</i>	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, <i>D</i> is the dimension of the smaller side.	

Table 7 — Range of qualification of material thickness of test piece for fillet welds ^a

Dimension in millimetres

Material thickness of test piece <i>t</i>	Range of qualification
$t < 3$	t to 3
$t \geq 3$	≥ 3
^a See also Table 10.	

In the case of branch welding, the material thickness criteria to which Table 5 applies and the outside pipe diameter criteria to which Table 6 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.

5.8 Welding positions

The range of qualification for each welding position is given in Table 8. The welding positions and symbols refer to EN ISO 6947.

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

Welding two pipes with the same outside pipe diameter, one in welding position PH 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 PJ 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 (PH or PJ 2/3 of circumference, PC 1/3 of circumference) using only one test piece.

Table 8 — Range of qualification for welding positions

Testing position	Range of qualification ^a										
	PA	PB ^b	PC	PD ^b	PE	PF (Plate)	PH (Pipe)	PG (Plate)	PJ (Pipe)	H-L045	J-L045
PA	×	×	–	–	–	–	–	–	–	–	–
PB ^b	×	×	–	–	–	–	–	–	–	–	–
PC	×	×	×	–	–	–	–	–	–	–	–
PD ^b	×	×	×	×	×	×	–	–	–	–	–
PE	×	×	×	×	×	×	×	–	–	–	–
PF (Plate)	×	×	–	–	–	×	–	–	–	–	–
PH ^c (Pipe)	×	×	–	×	×	×	×	–	–	–	–
PG (Plate)	–	–	–	–	–	–	–	×	–	–	–
PJ ^c (Pipe)	×	×	–	×	×	–	–	×	×	–	–
H-L045	×	×	×	×	×	×	×	–	–	×	–
J-L045	×	×	×	×	×	–	–	×	×	–	×

^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.

^c Testing position PH in pipe includes welding position PE, PF and PA. Testing position PJ in pipe includes welding position PA, PG and PE.

Key

× 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 9 and 10.

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

Table 9 — 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)	×	×	×
single-side welding /welding with backing (ss mb)	–	×	×
welding from both sides (bs)	–	×	×

Key
 × indicates those welds for which the welder is qualified.
 – indicates those welds for which the welder is not qualified.

Table 10 — Range of qualification of layer technique for fillet welds

Test piece	Range of qualification	
	single layer (sl)	multi layer (ml)
single layer (sl)	×	–
multi layer (ml)	×	×

Key
 × 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 Examination

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. 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.

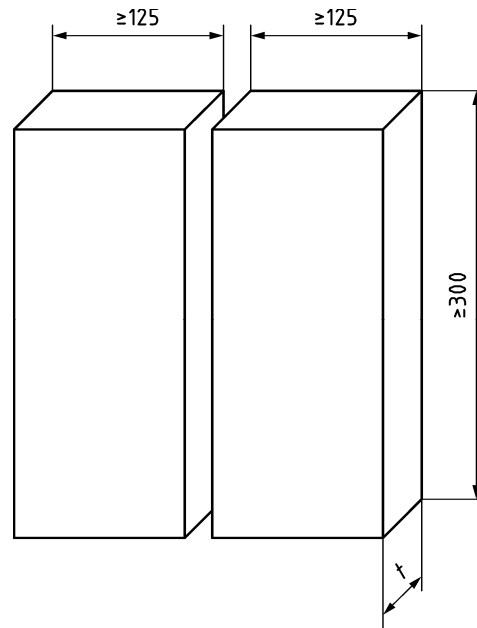
The examiner or examining body may stop the test if the welding conditions are not correct or if it appears that the welder does not have the skill to fulfil the requirements, e.g. where there are excessive and/or systematic repairs.

6.2 Test pieces

The shape and dimension of test pieces 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

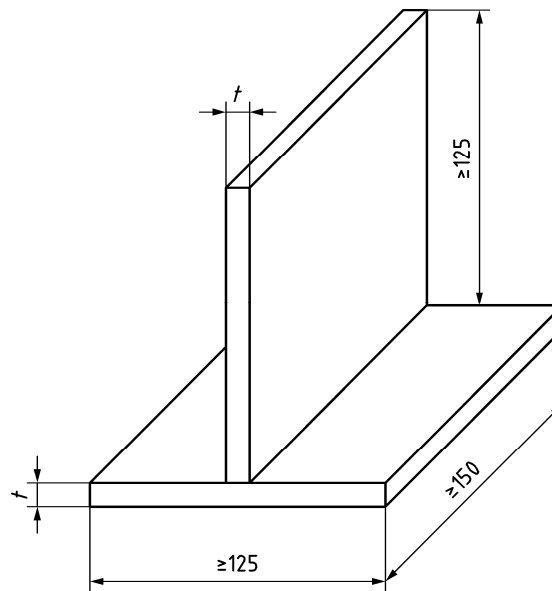


Key

t material thickness of test piece

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

Dimensions in millimetres



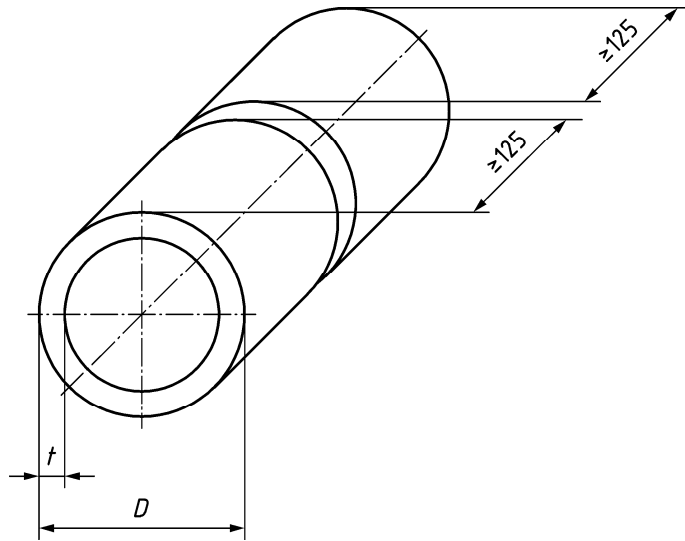
Key

t material thickness of test piece

NOTE The parent materials may be of dissimilar thickness.

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

Dimensions in millimetres

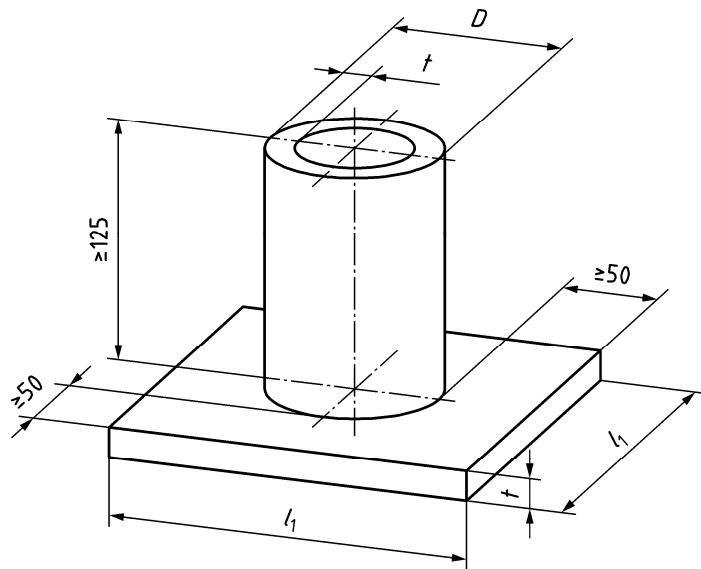


Key

- 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



Key

- D Outside pipe diameter
- l_1 Length of test piece
- t Material thickness of test piece (plate or wall thickness)

NOTE The parent materials may be of dissimilar thickness.

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 EN ISO 15609-1 or EN ISO 15609-2. The required throat thickness of the fillet weld test piece shall be defined in the pWPS or WPS used for the test.

The following welding conditions shall apply:

- the welding time for the test piece shall correspond to the working time under usual production conditions;
- the examination length of the test pieces shall have at least one stop and re-start in the root run and in the capping run(s). The stop and re-starts in both root and cap runs shall be identified;
- the welder shall be allowed to remove minor imperfections by grinding, except for capping run(s) for which only the stop and start may be ground; the permission of the examiner or examining body shall be obtained;
- any post-welded heat treatment required in the pWPS or WPS can be omitted at the discretion of the manufacturer.

6.4 Test methods

After welding the test piece shall be tested in accordance with Table 11.

If the weld is accepted by visual testing, the additional test(s) according to Table 11 shall be carried out.

When permanent backing was used in the qualification test it shall be removed prior to destructive testing, but need not be removed before non-destructive testing (NDT).

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

Table 11 — Test methods

Test method	Butt weld (in plate or pipe)	Fillet weld and branch connection
Visual testing according to EN ISO 17637	mandatory	mandatory
Radiographic testing according to EN 1435	mandatory ^{a b d}	not mandatory
Bend test according to EN ISO 5173	mandatory ^{a b f}	not applicable
Fracture test according to EN 1320	mandatory ^{a b f}	mandatory ^{c e}
<p>^a Either radiographic testing or bend or fracture tests shall be used.</p> <p>^b When radiographic testing is used, then additional bend or fracture tests are mandatory for welding processes 131, 135, 138 and 311.</p> <p>^c The fracture tests may be replaced by a macroscopic examination according to EN 1321 of at least two sections.</p> <p>^d The radiographic testing may be replaced by an ultrasonic testing according to EN ISO17640 for thickness ≥ 8 mm on ferritic steels only.</p> <p>^e The fracture tests on pipes may be replaced by radiographic testing.</p> <p>^f The bend or fracture tests may be replaced by a of notched tensile test piece with outside pipe diameter $D \leq 25$ mm (example is given in Figure 8).</p>		

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 test specimens of equal width and all of them shall be tested in such a manner that fracture occur. 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 $4t$ 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:

$$d = \frac{100 \times t_s}{A} - t_s \quad (1)$$

where

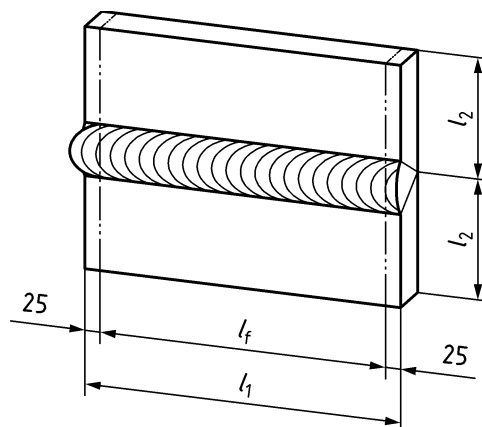
- d is the diameter of the former or the inner roller, in mm;
- t_s is the thickness of the bend test specimen, in mm;
- A is the minimum tensile elongation required by the material specification, in %.

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 specimens 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 ISO 5173.

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

When using radiography, the number of additional fracture or transverse bend test specimens for welding processes 131, 135, 138 or 311, 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).

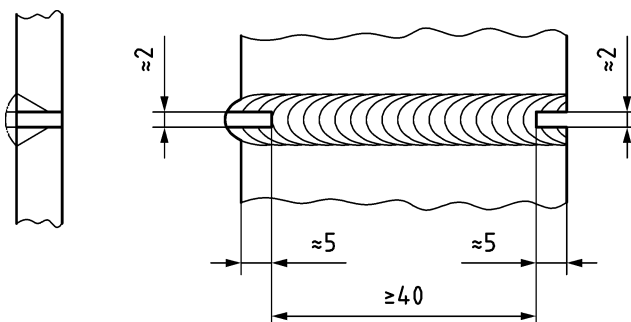
Dimensions in millimetres

**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

Dimensions in millimetres

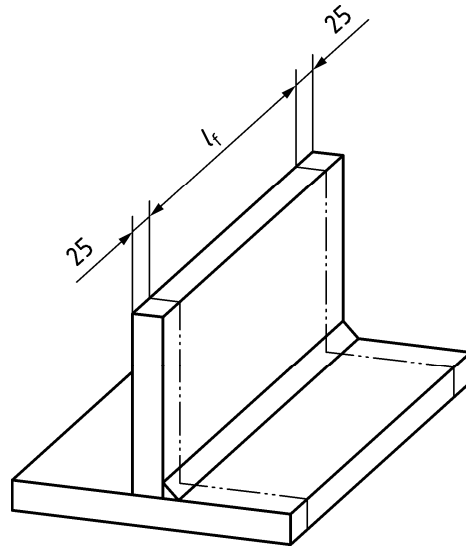
**b) Examination length of the test specimen**

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.

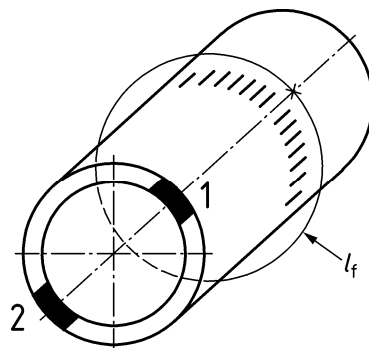
When macroscopic examination is used, at least two test specimens shall be taken. One macroscopic specimen shall be taken at the stop/start location.



Key

l_f Examination length

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

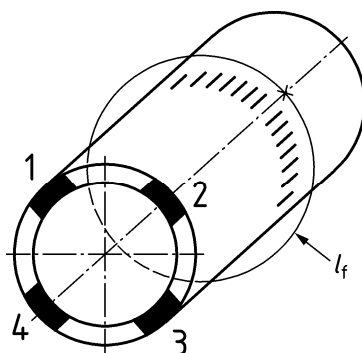


Key

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

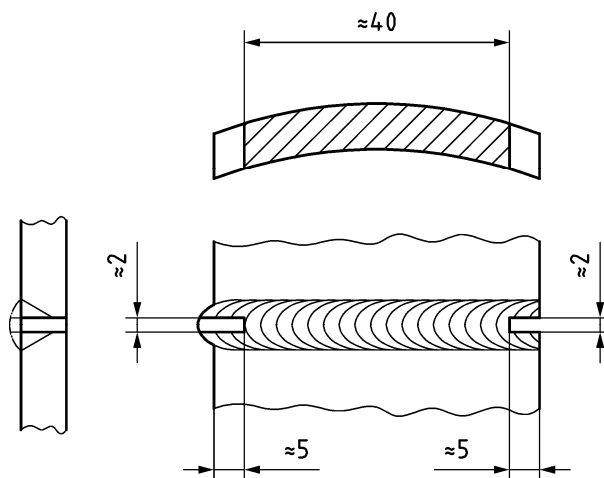
a) Sectioning of additional fracture or bend test specimens for testing positions PA and PC



Key

- l_f Examination length
 1 One root fracture
 2 One face fracture
 3 One root fracture
 4 One face fracture

b) Sectioning of additional fracture or bend test specimens for testing positions PH, PJ, H-L045, J-L045

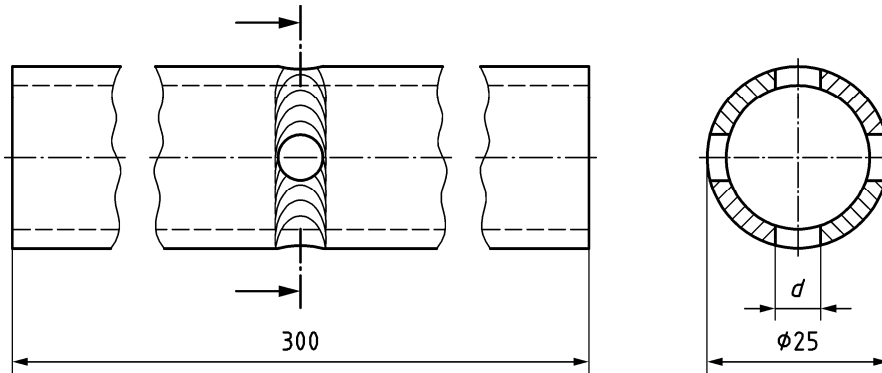


c) Examination length of the fracture test specimen

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).

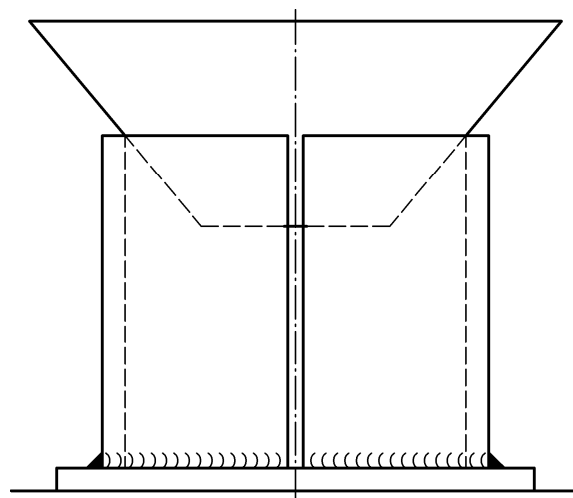


Figure 9 — Preparation and fracture testing of test specimens for a fillet weld on pipe

When macroscopic examination is used, at least two 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 EN ISO 5817. A welder is qualified if the imperfections are within quality level B in EN ISO 5817, except for imperfections types as follows; excess weld metal, excessive convexity, excessive throat thickness, excessive penetration, incorrect weld toe and undercut for which level C shall apply.

Bend test specimens shall not reveal any one single discontinuity ≥ 3 mm in any direction. Discontinuities 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 discontinuity.

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 EN ISO 5817 and the acceptance levels of the different non-destructive testing techniques are given in EN ISO 17635.

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.

9 Period of validity

9.1 Initial qualification

The welder's 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 welding within the initial range of qualification. This shall be confirmed every six months and an electronic signature may be used.

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 shall be traceable to the welder and shall identify the WPS(s) used in production;
- b) Evidence used to support prolongation shall be of a volumetric (radiographic testing or ultrasonic testing) or destructive nature (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 shall 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.

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. All essential variables for both tests shall be recorded on the combined certificate. 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 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 examination of job knowledge (see Annex C) shall be designated by "Accepted" or "Not tested".

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;
- c) welding processes: refer to 4.2, 5.2 and EN ISO 4063;
- d) product type: plate (P), pipe (T), refer to 4.3.1 and 5.3;
- e) type of weld: butt weld (BW), fillet weld (FW), refer to 5.4;
- f) material group: refer to 5.5;
- g) filler materials: refer to 5.6;
- h) dimensions of test piece: material thickness t and outside pipe diameter D , refer to 5.7;
- i) welding positions: refer to 5.8 and EN ISO 6947;
- j) 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 Annex A).

Designation examples are shown in Annex B.

Annex A
(informative)

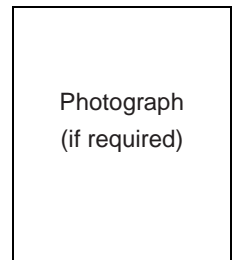
Welder's qualification test certificate

The user of this form is allowed to copy this present form.

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:
 Supplementary fillet weld test: yes / no (Delete as necessary)
 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)		
Filler material (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: Place, date and signature of examiner or examining body: Date of welding: Validity of qualification until:
Visual testing			
Radiographic testing			
Fracture test			
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 with solid wire electrode	135, 138
P	Product type	Plate	P T: $D \geq 150$ mm
FW	Type of weld	Fillet weld	FW
1.2	Material group according to CEN ISO/TR 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	Filler material	Solid wire electrode	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	MAG welding with flux cored electrode	136
P	Product type	Plate	P T: $D \geq 150$ mm PA, PB, PC $D \geq 500$ mm PD, PE, PF
BW	Type of weld	Butt weld	BW
1.3	Material group according to CEN ISO/TR 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	Filler material	Basic electrode core	Root: B Fill: 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, PC, PE, PF
ss nb	Weld details	Single-side welding, no backing Multi layer	ss nb, ss mb, bs

B.3 Example 3

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

Explanation			Range of qualification
141	Welding process	TIG welding with solid filler material	141, 142, 143 and 145
T	Product type	Pipe	T, P
BW	Type of weld	Butt weld	BW
8	Material group according to CEN ISO/TR 15608	Material group 8: Austenitic stainless steels	8, 9.2, 9.3, 10
S	Filler material	Solid rod	Root: S Fill: M, nm
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
PH	Welding position	Butt weld on pipe, pipe fixed, axis horizontal fix	PA, PB, PD, PE, PF, PH
ss nb	Weld details	Single-side welding, no backing multi layer	ss nb, ss mb, bs

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	Product type	Plate	P T: $D \geq 150$ mm
BW	Type of weld	Butt weld	BW, FW
FW	Type of weld	Fillet weld	
2	Material group according to CEN ISO/TR 15608	Material group 2: Thermomechanically treated fine grain steels with yield strength $R_{eH} > 360$ N/mm ²	1, 2, 3, 9.1, 11
B	Type of covering	Basic covering	Root: B Fill: all, C excluded
t13	Thickness	Material thickness: 13 mm	≥ 5 mm
PA	Welding position	Butt weld, flat	PA, PB
PB		fillet weld, horizontal-vertical	
ss nb	Weld details	Single-side welding, no backing	ss nb, ss mb, bs for FW: sl, ml
ml		multi layer	

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	Welding process	TIG welding with solid filler material, root run (2 layers)	141, 142, 143 and 145
135		MAG welding with solid wire electrode, filling runs	135, 138
T	Product type	Pipe	T, P
BW	Type of weld	Butt weld	BW
1.2	Material group according to CEN ISO/TR 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	Filler material	Solid wire and solid wire electrode	Root: S Fill: M, nm
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 138: ss mb, bs 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 with solid filler material	141, 142, 143 and 145
T	Product type	Pipe	T P
BW	Type of weld	Butt weld	BW
10	Material group according to CEN ISO/TR 15608	Material group 10: Austenitic ferritic stainless steels	8, 9.2, 9.3, 10
S	Filler material	Solid rod	Root: S Fill: M, nm
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	$\geq 16 \text{ mm}$
H-L045	Welding position	Butt weld on pipe, pipe fixed, axis inclined (45°)	all, except downward welding

Explanation			Range of qualification
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 PH 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 with solid filler material	141, 142, 143 and 145
T	Product type	Pipe	T P
BW	Type of weld	Butt weld	BW
5	Material group according to CEN ISO/TR 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	Filler material	Solid rod	Root: S Fill: M, nm
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
PH PC	Welding position	Butt weld on pipe, axis horizontal fix axis vertical	all, except downward welding
ss nb	Weld details	Single-side welding, no backing multi layer	ss nb, ss mb, bs

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) Construction and maintenance of welding equipment and typical parameters;
- 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 Manual metal arc welding (111)

- a) Classification of electrodes.

C.2.2.3 Gas and self-shielded metal arc welding (114, 13, 14, 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;
- e) Control of wire spooling;

²⁾ The numbers refer to EN ISO 4063.

- 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 Gas-shielded metal 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 ZA (informative)

Relationship between this European Standard and the Essential Requirements of EC Directive 97/23/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 97/23/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive 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
Clauses 5, 6, 7, 8, 9, 10, 11	Annex I, 3.1.2	Permanent joining

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

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