

ICS

English version

**Approval testing of welders - Fusion welding - Part 1: Steels  
(ISO/DIS 9606-1:2000)**

Epreuve de qualification des soudeurs - Soudage par  
fusion - Partie 1: Aciers (ISO/DIS 9606-1:2000)

Prüfung von Schweißern - Schmelzschiessen - Teil 1:  
Stähle (ISO/DIS 9606-1:2000)

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## **Foreword**

The text of prEN ISO 9606-1 : 2000 has been prepared by the Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DS, in collaboration with Technical Committee ISO/TC 44 "Welding and allied processes".

This document is currently submitted to the parallel enquiry.

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.

This European Standard supersedes EN 287-1:1992.

## Introduction

This standard covers the principles to be observed in the approval of welder performance for the fusion welding of steels.

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

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

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

Approvals existing at the date of publication of this standard are, at the end of their period of validity, to be interpreted in accordance with the requirements of this standard.

## 1 Scope

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

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

When approving 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 standard include those fusion welding processes which are designated as manual or partly mechanized welding. It does not cover fully mechanized and automated processes.

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 499 : 1994

Welding consumables – Covered electrodes for manual metal arc welding of non-alloy and fine grain steels – Classification

EN 571-1

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

EN 729-1

Quality requirements for welding – Fusion welding of metallic material – Part 1: Guidelines for selection and use

EN 729-2

Quality requirements for welding – Fusion welding of metallic material – Part 2: Comprehensive quality requirements

EN 729-3

Quality requirements for welding – Fusion welding of metallic material – Part 3: Standard quality requirements

EN 729-4

Quality requirements for welding – Fusion welding of metallic material – Part 4: Elementary quality requirements

- EN 758 : 1997  
Welding consumables – Tubular cored electrodes for metal arc welding with and without a gas shield of non alloy and fine grain steels – Classification
- EN 910  
Destructive tests on welds in metallic materials – Bend tests
- EN 970  
Non-destructive examination of fusion welds – Visual examination
- EN 1290  
Non-destructive examination of welds – Magnetic particle examination of welds
- EN 1320  
Destructive tests on welds in metallic materials – Fracture test
- EN 1321  
Destructive tests on welds in metallic materials – Macroscopic and microscopic examination of welds
- EN 1435  
Non-destructive examination of welds – Radiographic examination of welded joints
- EN 1714  
Non destructive examination of welds – Ultrasonic examination of welded joints
- EN ISO 4063  
Welding and allied processes – Nomenclature of processes and reference numbers (ISO 4063 : 1998)
- EN 22553  
Welded, brazed and soldered joints – Symbolic representation on drawings (ISO 2553 : 1992)
- EN 25817  
Arc-welded joints in steel – Guidance on quality levels for imperfections (ISO 5817:1992)
- EN ISO 6947  
Welds – Working positions – Definitions of angles of slope and rotation (ISO 6947:1993)
- prEN ISO 15607  
Specification and approval of welding procedures for metallic materials – General rules (ISO/DIS 15607 : 2000)
- prEN ISO 15609-1  
Specification and approval of welding procedures for metallic materials – Welding procedure specification – Part 1: Arc welding (ISO/DIS 15609-1 : 2000)
- prEN ISO 15609-2  
Specification and approval of welding procedures for metallic materials – Welding procedure specification – Part 2: Gas welding (ISO/DIS 15609 : 1998)
- CR ISO/TR 15608  
Welding – Guidelines for a metallic material grouping system
- ISO 857-1  
Welding and allied processes – Vocabulary – Part 1: Welding processes

NOTE: A list of ISO Standards conforming to these EN Standards is given at the end of this standard in the clause bibliography.

### 3 Terms and definitions

For the purposes of this standard the following terms and definitions and the definitions in prEN ISO 15607 apply.

### **3.1**

#### **Welder**

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

### **3.2**

#### **Examiner**

A person who verifies compliance with the applicable standard.

### **3.3**

#### **Examining body**

A organization which verifies compliance with the applicable standard.

### **3.4**

#### **Backing**

A 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**

#### **Thickness of weld deposit**

The thickness of the metal (or material) deposited with one or more weld process(es) excluding excess weld metal and/or deep penetration (see also EN 22553).

## **4 Abbreviations and reference numbers**

### **4.1 General**

Where the full wording is not used, the following abbreviations and reference numbers shall be used when completing the 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;
- 13 gas-shielded metal arc welding;
- 141 tungsten inert gas arc welding (TIG welding);
- 15 plasma arc welding;
- 311 oxy-acetylene welding.

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

### 4.3 Abbreviations

#### 4.3.1 For test pieces

a	nominal throat thickness
BW	butt weld
D	outside diameter of pipe
FW	fillet weld
P	plate
s	thickness of weld deposit for butt welds only (plate thickness or pipe wall thickness for single process)
t	plate or pipe wall thickness
T	pipe <sup>1)</sup>
z	leg length of fillet weld

#### 4.3.2 For consumables

nm	no filler metal
A	acid covering
B	basic covering or core
C	cellulosic covering
M	electrode core - metal powder
P	electrode core - rutile, fast freezing slag
R	rutile covering or core
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
mb	welding with backing
ml	multi layer
nb	welding without backing
sl	single layer
ss	single-side welding

## 5 Essential variables for approval testing and range of approval

### 5.1 General

In order to avoid repeating technically identical tests, essential variables and their range of approval are introduced in the applicable clauses.

In situations requiring a special welders test approval not covered by the general provisions of this standard, the range of approval is limited to the actual test conditions.

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

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

## 5.2 Welding processes

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

Each test normally approves only one process. A change of process requires a new approval test.

However, it is permitted for a welder to be approved for more than one welding process by a single test or by two separate approval tests to be used to cover a multi-process joint (see table 1).

When welding with process 311 a change in the position of filler metal with respect to flame i.e. from leading (in front of flame) to trailing (behind the flame) and vice versa requires a new approval.

**Table 1 – Range of approval for types of runs for butt welds<sup>b</sup>**

Test piece		Range of approval	
Type of run with a given process		Type of run	
		root run (nb)	other runs <sup>a</sup> (mb)
multi-process	root run (nb)	X	X
	other runs <sup>a</sup> (mb)	–	X
single process	root run (nb) + other runs <sup>a</sup> (mb)	X	X
	other runs <sup>a</sup> (mb)	–	X

<sup>a</sup> Other runs includes filling run, capping run and root run with backing.  
<sup>b</sup> See also table 4.

Key:  
X type of run approved  
– type of run not approved

## 5.3 Material groups

### 5.3.1 Steel groups of parent material

In order to minimize unnecessary duplication of technically identical tests, steels with similar metallurgical and welding characteristics are grouped according to CR ISO/TR 15608 : 1999 (see annex D).

### 5.3.2 Range of approval

The welding of any one metal in a group confers approval 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.

Approval of dissimilar metal joints: When using filler metals from group 8 or 10 (see table 2), all combinations are covered.

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



**Table 2 – Range of approval for parent metal**

Material group <sup>a</sup> of the test piece	Range of approval											
	1	2	3	4	5	6	7	8	9		10	11
									9.1	9.2 + 9.3		
1	X	X	X	–	–	–	–	–	X	–	–	X
2	X	X	X	–	–	–	–	–	X	–	–	X
3	X	X	X	–	–	–	–	–	X	–	–	X
4	X	X	X	X	X	X	X	–	X	–	–	–
5	X	X	X	X	X	X	X	–	X	–	–	–
6	X	X	X	X	X	X	X	–	X	–	–	–
7	X	X	X	X	X	X	X	–	X	–	–	–
8	X	–	–	–	–	–	–	X	–	–	X	–
9	9.1	X	X	X	X	X	X	X	–	X	–	–
	9.2 + 9.3	X	–	–	–	–	–	–	–	X	–	–
10	X	–	–	–	–	–	–	X	–	–	X	–
11	X	X	X	–	–	–	–	–	X	–	–	X

<sup>a</sup> Material group according to CR ISO/TR 15608.

Key:  
X indicates those groups for which the welder is approved  
– indicates those groups for which the welder is not approved

#### 5.4 Consumables

In the approval test, the filler metal and the shielding gas, including plasma gas, shall be compatible with the parent metal and the process used in accordance with the relevant pWPS or WPS (see prEN ISO 15609-1 or prEN ISO 15609-2).

If the approval test piece is welded without using filler metal, e.g. with processes 141, 15 and 311, the approval is not valid when using a filler metal.

The symbols for covered electrodes are given in EN 499 : 1994 and for tubular cored electrodes are given in EN 758 : 1997. The ranges of approval for consumables are given in table 3.

**Table 3 – Range of approval for consumables**

Process	Requirements				
111	The type of covering used in the welder approval test for root run welding without backing (ss nb) is the type of covering approved.				
	Range of approval for filling / capping runs and also backed / double sided welds and fillet welds is as follows: Covering used in test <b>B</b> → all types of covering, except <b>C</b> <b>C</b> → only <b>C</b> <b>R, RA, RB, RC, RR, A</b> → all types of <b>R</b> and <b>A</b>				
141	A change from a solid or metal cored wire/rod to a tubular cored rod/wire or vice versa requires a new welder approval test.				
13	Test piece	Range of approval			
		solid wire/rod (S) <sup>a</sup>	metal cored wire/rod (M) <sup>a</sup>	flux cored wire/rod - basic (B) <sup>a</sup>	flux cored wire/rod - other flux types (R, P, V, W, Y, Z) <sup>a</sup>
	solid wire/rod (S) <sup>a</sup>	X	X	–	–
	metal cored wire/rod (M) <sup>a</sup>	X	X	–	–
	flux cored wire/rod - basic (B) <sup>a</sup>	–	–	X	X
	flux cored wire/rod - other flux types (R, P, V, W, Y, Z) <sup>a</sup>	–	–	–	X
<sup>a</sup> Abbreviations see 4.3.2.  Key: X indicates those types of wires/rods for which the welder is approved – indicates those types of wires/rods for which the welder is not approved					

## 5.5 Dimensions

The welder approval test of butt welds should be based on the thickness of the weld deposit (plate thickness or pipe wall thickness for single process) and pipe diameters which the welder will use in production. A test is listed for each of the ranges of weld deposit or pipe diameter as specified in tables 4 and 5.

It is not intended that thickness or 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 approval is specified in table 6. The range of approval is independent of throat thickness and test piece thickness.

In the case of branch welding the thickness criteria to which table 4 applies and the diameter criteria to which table 5 applies is as follows:

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

**Table 4 – Thickness of weld deposit (s) and range of approval for butt welds**

Dimension in millimetres

Thickness of weld deposit, s	Range of approval
$s \leq 3$	s to $2 s^a$
$3 < s \leq 12$	3 to $2 s^b$
$s > 12$	$\geq 5$

<sup>a</sup> For oxy-acetylene welding (311): s to 1,5 s  
<sup>b</sup> For oxy-acetylene welding (311): 3 to 1,5 s

**Table 5 – Test piece outside diameter and range of approval**

Dimension in millimetres

Outside diameter $D$	Range of approval
$D \leq 25$	$D$ to $2D$
$D > 25$	$\geq 0,5 D$ (25 mm min.)

**Table 6 – Range of approval for fillet welds**

Test piece <sup>a</sup>	Range of approval	
	single layer (sl)	multi layer (ml)
single layer (sl)	X	–
multi layer (ml)	X	X

<sup>a</sup> Throat thickness has to be in the range of  $0,5 t \leq a \leq 0,7 t$ .

Key:  
X indicates the type of layers which are approved  
– indicates the type of layers which are not approved

## 5.6 Number of test pieces

Pipe: A minimum inspection length of 150 mm is required except that no more than three test pieces should be produced at any one time.

In order to minimize the number of approval tests of pipe welders it is allowed to combine the test pieces according to table 4 and the test piece diameter according to table 5 of this standard, provided that the same type of parent metal and process is used (see also annex B.4).

## 5.7 Joint types

Depending on the test piece, the range of welds for which the welder is approved is shown in table 7; the following criteria are applicable:

- a) welds in pipes, diameter > 25 mm, cover welds in plates;
- b) welds in plates cover welds in pipe:
  - of outside diameter  $\geq 150$  mm, for positions PA, PB and PC;
  - of outside diameter  $\geq 500$  mm, for all other positions;
- c) butt welds cover butt welds in any type of joint;

d) in cases where the majority of production work is fillet welding, the welder shall also be approved by an appropriate fillet welding test; in case where the majority of production work is butt welding, butt welds include fillet welds;

e) butt welds in pipes without backing cover branch connections with the same range of approval as in tables 7 and 8. For a branch weld the range of approval is based on the diameter of the branch;

f) in cases where the majority of production work is predominantly branch welding or involves a complex branch connection, the welder should receive special training. In some cases a welder approval test on a branch connection can be necessary.

**Table 7 – Range of approval for tests on butt welds (weld details)**

Test conditions	Range of approval		
	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 approved  
– indicates those welds for which the welder is not approved

## 5.8 Welding positions

The range of approval for each welding position is given in table 8. The welding positions and codes refer to EN ISO 6947.

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

The welding positions J-L045 and H-L045 for pipes conveys approval for all pipe angles in production work.

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

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

Pipes diameter  $D \geq 150$  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 8 – Range of approval according to welding position**

Test position	Range of approval <sup>a</sup>										
	PA	PB <sup>b</sup>	PC	PD <sup>b</sup>	PE	PF (Plate)	PF (Pipe)	PG (Plate)	PG (Pipe)	H-L045	J-L045
PA	X	X	–	–	–	–	–	–	–	–	–
PB <sup>b</sup>	X	X	–	–	–	–	–	–	–	–	–
PC	X	X	X	–	–	–	–	–	–	–	–
PD <sup>b</sup>	X	X	X	X	X	–	–	–	–	–	–
PE	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

<sup>a</sup> Additionally the requirements of 5.7 have to be observed.  
<sup>b</sup> Test position PB and PD are only used for fillet welds (see 5.7 d)) and can only qualify fillet welds in other positions.

Key:  
X indicates those welding positions for which the welder is approved  
– indicates those welding positions for which the welder is not approved

## 6 Examination and testing

### 6.1 Supervision

The welding and testing of test pieces shall be witnessed 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 the welding positions shall also be marked on pipe test pieces.

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

### 6.2 Shapes and dimensions of test pieces

The shape and dimension of test pieces (see 5.5) required are shown in figures 1 to 4.

Dimensions in millimetres

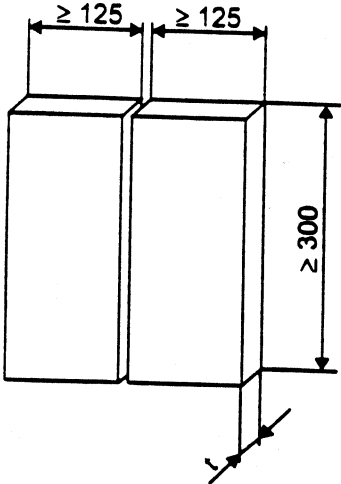
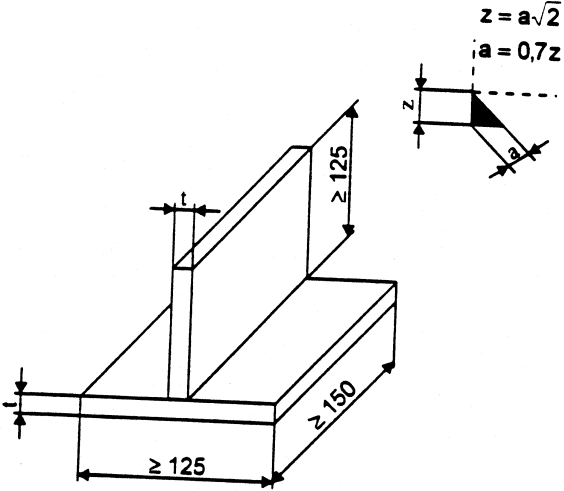


Figure 1 – Dimensions of test piece for a butt weld (fully penetrated) in plate

Dimensions in millimetres



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

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

Dimensions in millimetres

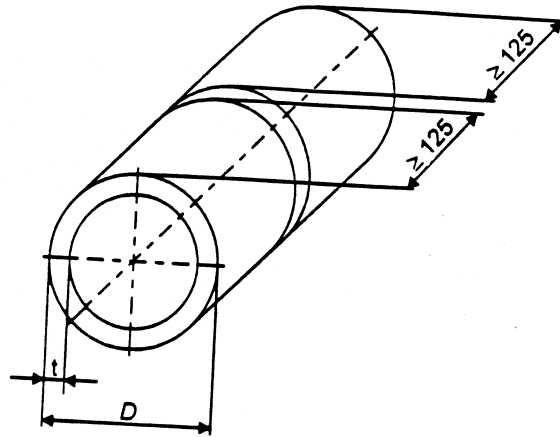
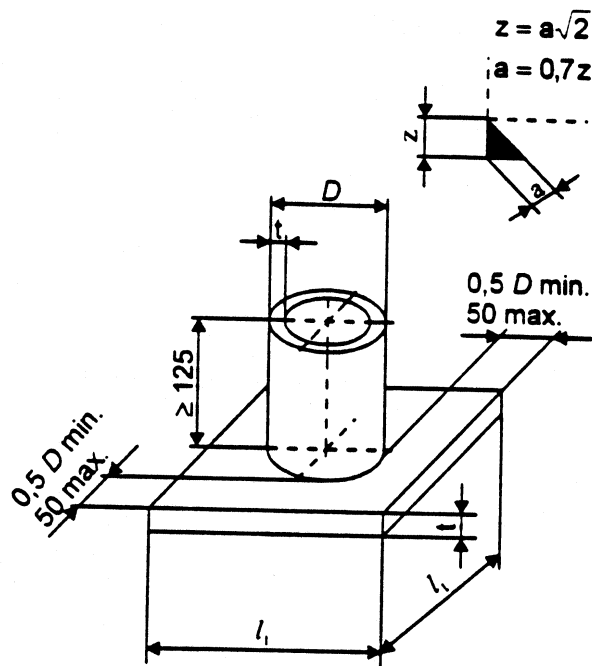


Figure 3 – Dimensions of test piece for a butt weld (fully penetrated) in pipe

Dimensions in millimetres



t corresponds to the thinner part

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

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

### 6.3 Welding conditions

The approval test for the welder shall follow a pWPS or WPS prepared in accordance with prEN ISO 15609-1 or prEN ISO 15609-2. The test should correspond to the conditions used in production.

The following 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 inspection length to be examined;
- any pre-heat or controlled heat input required in the pWPS or WPS is mandatory for the welder's test piece;
- 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 or any method used in production, except on the surfaces after finishing the weld. The approval of the examiner or examining body shall be obtained.

### 6.4 Test methods

Each completed weld shall be examined visually according to EN 970 in the as-welded condition. When required, visual examination can be supplemented by magnetic particle (according to EN 1290), or by penetrant testing (according to EN 571-1) according to table 9.

If the weld is accepted by visual examination, the additional test(s) according to table 9 shall be carried out.

Prior to destructive or non-destructive testing, backing strips, where used, shall be removed.

The macro specimen shall be prepared and etched on one side to clearly reveal the weld (according to EN 1321). Polishing is not required.

When performing radiographic examination (according to EN 1435) two transverse bend tests, one face and one root (according to EN 910) or two side bend tests (according to EN 910) or two fracture tests, one face and one root (according to EN 1320) shall always be applied to butt welds, made by processes 13 (except using flux cored wires) and 311 (see also table 9).

When ultrasonic examination is used instead of radiographic examination it shall be carried out according to EN 1714.



**Table 9 – Test methods**

Test method	Butt weld (in plate or pipe)	Fillet weld and branch connection
Visual examination	mandatory	mandatory
Radiographic examination	mandatory <sup>a e</sup>	not mandatory
Bend test	mandatory <sup>a b</sup>	not applicable
Fracture test	mandatory <sup>a b</sup>	mandatory <sup>c d f</sup>
Macro examination (without polishing)	not mandatory	not mandatory
Magnetic particle/penetrant examination	not mandatory	not mandatory

<sup>a</sup> Either radiographic examination or bend or fracture tests shall be used.

<sup>b</sup> When radiographic examination is used, then additional bend or fracture tests are mandatory for the processes 13 (except flux cored wires) and 311 (see 6.4).

<sup>c</sup> The fracture tests should be supported by magnetic particle/penetrant testing when required.

<sup>d</sup> The fracture tests may be replaced by a macro examination of at least 4 sections.

<sup>e</sup> The radiographic examination may be replaced by an ultrasonic examination for thickness  $\geq 8$  mm on ferritic steels only.

<sup>f</sup> The fracture tests on pipes may be replaced by radiographic examination.

## 6.5 Test piece and test specimen

### 6.5.1 General

In 6.5.2 to 6.5.5 details of the type, dimensions and preparation of the test pieces and test specimens are given. In addition, the requirements for mechanical tests are indicated.

### 6.5.2 Butt weld in plate and pipe

When radiographic examination is used, the inspection 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) in accordance with EN 1435.

When fracture testing is used the full test piece inspection length shall be cut into the specimens of equal width and all of them tested in such a manner that the fracture will be reached. The inspection length of each test specimen shall be  $\geq 40$  mm.

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  $180^\circ$  unless the low ductility of the parent metal or filler metal imposes other limitations.

When transverse bend tests are used, the full inspection length has to be cut into the specimens of equal width and all of them tested. When only side bend tests are used, a minimum of six test specimen shall be taken equally spaced along the inspection length. One of these side bend tests has to be taken from the start and stop area in the inspection length.

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

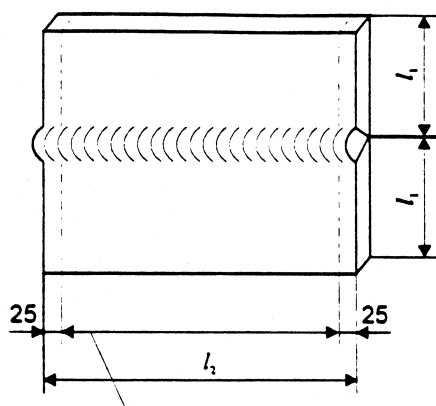
For plate thickness  $\geq 12$  mm, the transverse bend tests can be substituted by two side bend tests in accordance with EN 910.

For pipes, the number of the additional fracture or transverse bend test specimens to processes 13 (except the flux cored wires) or 311, using the radiographic examination, 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).

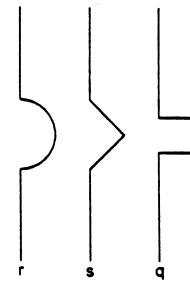
For pipe diameter  $\leq 25$  mm, the bend or fracture tests may be replaced by a notched tensile test of the complete test piece (example is given in figure 8).

Holes (shown in figure 8) shall avoid stop and start positions.

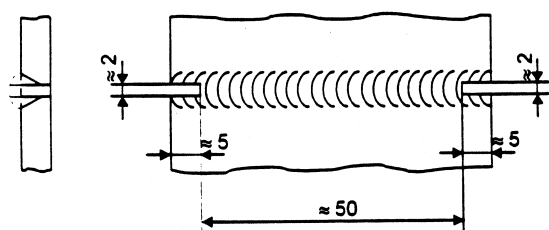
Dimensions in millimetres



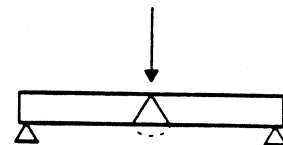
a) Sectioning into an even-numbered quantity of test specimens



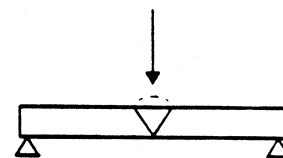
b) Notch profiles according to EN 1320



c) Inspection length of the test specimen



d) Fracture testing, face side



e) Fracture testing, root side

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

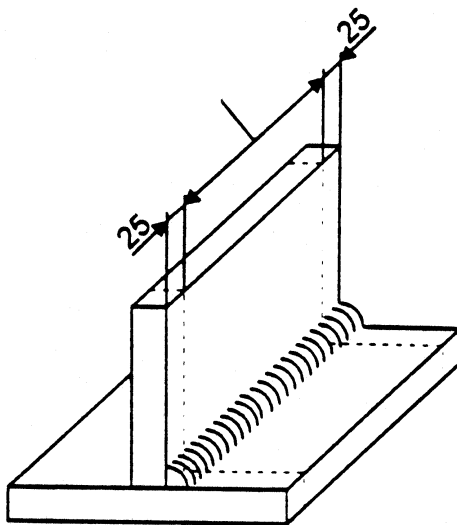
NOTE: In addition, the test specimen may be longitudinally notched in the centre of the weld of the tension side in order to achieve a fracture in the weld of the specimen.

### 6.5.3 Fillet weld on plate

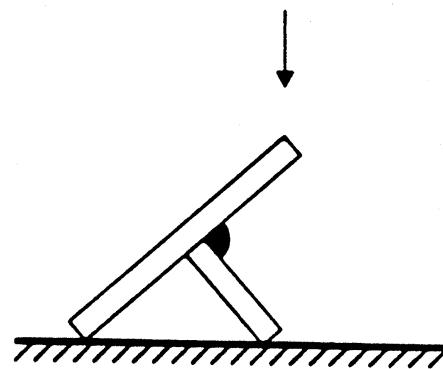
For fracture tests according to EN 1320 the test piece can be cut, if necessary, into several test specimens (see figure 6a). Each test specimen shall be positioned for breaking as shown in figure 6b, and examined after fracture.

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

Dimensions in millimetres



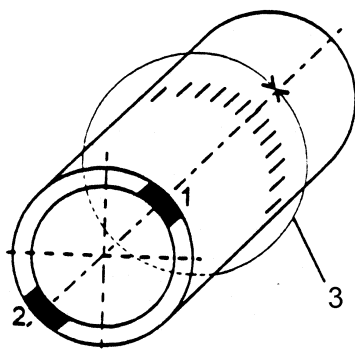
a) Inspection length of the fillet welds



b) Fracture testing  
(The specimen may be notched longitudinally in the centre of the weld if necessary.)

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

Dimensions in millimetres



a) Sectioning into at least two test specimens  
(for position PC)

**Key**

3 Inspection length of the test piece

Position 1:

For one root fracture or one root transverse bend or one side bend test specimen

Position 2:

For one face fracture or one face transverse bend or one side bend test specimen

**Key**

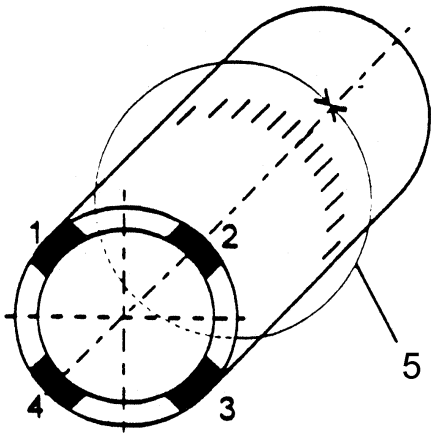
5 Inspection length of the test piece

Position 1 + 3:

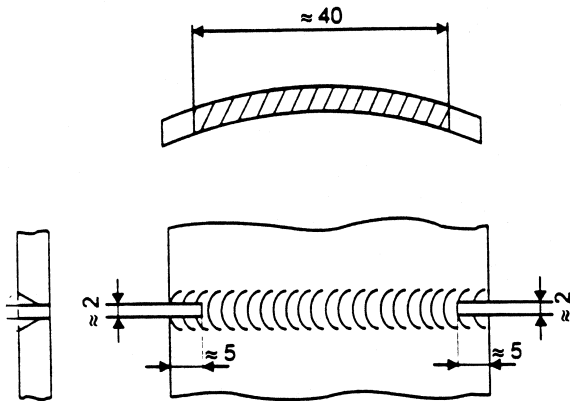
Each position one root fracture or one root transverse bend or one side bend test specimen

Position 2 + 4:

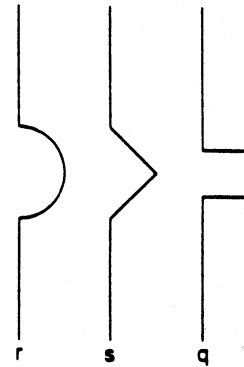
Each position one face fracture or one face transverse bend or one side bend test specimen



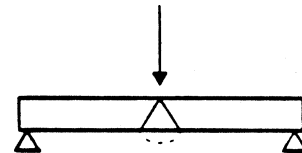
b) Sectioning into at least four test specimens



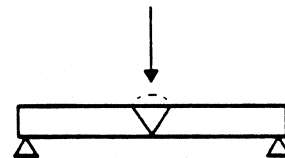
c) Inspection length of the test specimen



d) Notch profiles according to EN 1320



e) Fracture testing, face side

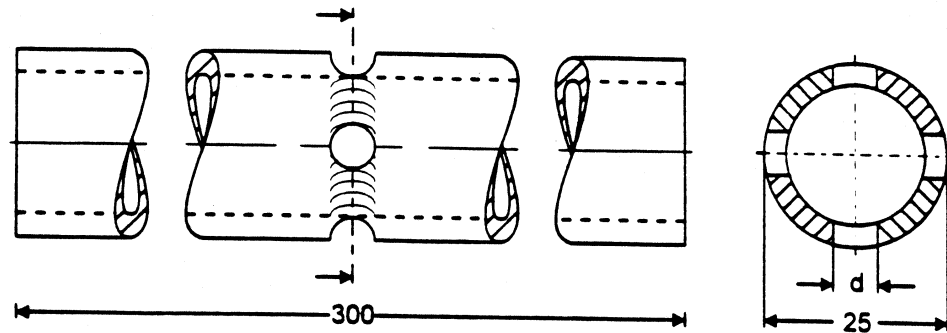


f) Fracture testing, root side

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

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

For  $t \geq 1,8$  mm:  $d = 4,5$  mm  
For  $t < 1,8$  mm:  $d = 3,5$  mm

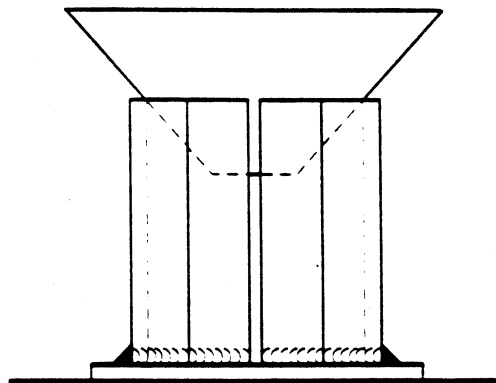


**Figure 8 – Example for notch tensile test for pipe test piece diameter  $\leq 25$  mm**

NOTE: In circumferencial direction notches according to figure 7d, possibilities s and q, are also permitted.

#### 6.5.4 Fillet weld on pipe

For fracture tests in accordance with EN 1320, the test piece shall be cut into four or more test specimens and fractured (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 in accordance with EN 1321 is used, at least four test specimens shall be taken equally spaced around the pipe.

#### 6.6 Test report

All tests have to be carried out as required in this standard, the results of which have to be documented and reported.

## 7 Acceptance requirements for test pieces

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

For visual examination the check points are the following:

- 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 25817. A welder is approved if the imperfections are within quality level B in EN 25817, 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  $\geq 3$  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 shall not be approved.

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

## 8 Re-tests

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

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

If it is established that failure is due to metallurgical or other extraneous causes that cannot 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 approval

The validity of the welder's approval starts from the date of welding of the test piece, provided that the required tests are satisfactory.

### 9.2 Confirmation of the validity

A welders approval is valid for a period of two years provided that the relevant certificate is confirmed at six months intervals by the welding coordinator or by the responsible personnel of the employer, and that all the following conditions are fulfilled:

- a) The welder has welded without an interruption for a period of six months in the range of approval of his approval test.
- b) There shall be no specific reason to question the welder's skill.

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

### 9.3 Prolongation

The validity of the approval on the certificate may be prolonged for further periods of two years, provided that the production welds made by the welder have been of the required quality and there shall be no specific reason to question the welders skill and knowledge and one of the following conditions are fulfilled:

a) non-destructive examination (e.g. radiographic or ultrasonic) or destructive testing (e.g. fracture or bend) shall have been performed on a minimum of two production welds during the previous six months;

or

b) the company can demonstrate that it maintains full and complete and traceable records (e.g. in accordance with EN 729) of the work carried out by the welder and that regular testing of the welders work has demonstrated that it is of the required quality.

The examiner or examining body shall verify compliance with the above conditions and sign the prolongation.

## 10 Certificate

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

The certificate shall be issued under the sole responsibility of the examiner or examining body and shall contain all information detailed in annex A. The format of this annex A is recommended to be used as the welder's approval test certificate. If any other form of welder's approval test certificate is used, it shall contain the information required in annex A.

In general for each test piece a separate certificate shall be issued.

In order to show the range of approval for a welder in production on the certificate, two approval tests for plate welders and up to four approved tests for pipe welders may be verified as long the same process and parent material was used for both welder approval tests. Examples for this practice may be:

- butt weld and fillet weld;
- 2 butt weld test pieces with different plate thickness;
- 2 pipe butt weld test pieces with different wall thickness and/or different pipe diameter.

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

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

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

## 11 Designation

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

- a) the number of this standard;
- b) the essential variables:
  - 1) welding processes: refer to 4.2, 5.2 and EN ISO 4063;
  - 2) type of the product: plate (P), pipe (T), refer to 4.3;
  - 3) weld type: butt weld (BW), fillet weld (FW), refer to 5.7;
  - 4) material group: refer to annex D;
  - 5) consumable: refer to 5.4 and table 3;
  - 6) dimension of test piece: thickness of weld deposit (s) and pipe diameter (D), refer to 5.5;
  - 7) welding positions: refer to 5.8 and EN ISO 6947;
  - 8) weld details: refer to table 7.

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

Designation examples are shown in annex B.



**Annex A (informative)**

**Welder approval test certificate**

Designation(s): .....

.....

.....

WPS - Reference:

Examiner or examining body - Reference No.:

Welder's Name:

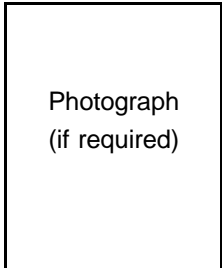
Identification:

Method of identification:

Date and place of birth:

Employer:

Code/Testing Standard:



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

	Weld test details	Range of approval
Welding process		
Plate or pipe		
Joint type		
Material group(s)		
Consumable/Designation		
Shielding gases		-----
Auxiliaries (e.g. backing gas)		
Thickness of weld deposit (mm)		
Pipe outside diameter (mm)		
Welding position		
Weld details		

Type of test	Performed and accepted	Not required
Visual examination		
Radiographic examination		
Magnetic particle/penetrant examination		
Macro examination		
Fracture test		
Bend test		
Notch tensile		
Additional tests*)		

Name, date and signature:

Examiner or examining body:

Date of issue:

Location:

Validity of approval until:

\*) Append separate sheet if required

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

Date	Signature	Position or title

Prolongation for approval by employer/coordinator for the following 6 month (refer to 9.2)

Date	Signature	Position or title

## Annex B (informative)

### Designation examples

#### B.1 Example 1 – Single process

Welder approval EN ISO 9606-1 111 P BW 2 B s08 PF bs

Explanation			Range of approval
111	Welding process	manual metal arc welding	111
P	Plate		P, T (D ≥ 500 mm)
BW	Butt weld		BW
2	Material group according to CR ISO/TR 15608	group 2: thermomechanically treated fine grain steels	1, 2, 3, 9.1, 11
B	Consumable	basic covered electrode for root run(s) basic covered electrode for other runs	B all types of covering
s08	Dimension of test piece	weld deposit thickness: 8,0 mm	s = 3 mm to 16 mm
PF	Welding position	butt weld on plate, vertical up	PA, PF (plate, pipe D ≥ 500 mm)
bs	Weld details	welding from both side	ss mb, bs

#### B.2 Example 2 – Single process

Welder approval EN ISO 9606-1 311 T BW 1 nm s02 D20 PA ss nb

Explanation			Range of approval
311	Welding process	oxy-acetylene welding	311
T	Pipe		T
BW	Butt weld		BW
1	Material group according to CR ISO/TR 15608	group 1: low-carbon alloyed steels	1, 2, 3, 9.1, 11
nm	Consumable	no filler metal	nm
s02 D20	Dimension of test piece	weld deposit thickness: 2,0 mm pipe diameter: 20 mm	s = 2 mm to 3 mm D = 20 mm to 40 mm
PA	Welding position	butt weld on pipe, rotating pipe, horizontal axis, flat	PA
ss nb	Weld details	single-side welding without backing, leftward welding	ss nb, ss mb leftward

### B.3 Example 3 – Multi-process

**Welder approval EN ISO 9606-1 141 T BW 4 S s03 D168,3 PF ss nb**

**Welder approval EN ISO 9606-1 111 T BW 4 RB s10 D168,3 PF ss mb**

In addition to the designations of the two separate welding processes it may be useful to make a combined designation for the multi-process joint as follows:

**Welder approval EN ISO 9606-1 141/111 T BW 4 S/RB s3/10 D168,3 PF ss nb/mb**

Explanation			Range of approval
141/111	Welding process (root ≈ 3 mm)	TIG-welding / manual metal arc welding	141, 111, 141/111
T	Pipe		T, P
BW	Butt weld		BW
4	Material group according to CR ISO/TR 15608	group 4: chromium-molybdenum (CrMo) alloyed steels	1, 2, 3, 4, 5, 6, 7, 9.1, 11
S RB	Consumable	solid rod for root run(s) rutile-basic covered electrodes for other runs	S, M all typed of R and A covering
s03 s10 D168,3	Dimension of test piece	wall thickness: 13,0 mm: ≈ 3 mm weld deposit thickness for 141 root run ≈ 10 mm weld deposit thickness for 111 filling and capping runs pipe diameter: 168,3 mm	141/111: s ≥ 5 mm 141: s = 3 mm to 6 mm 111: s = 3 mm to 20 mm D ≥ 84 mm
PF	Welding position	butt weld on pipe, fixed pipe, horizontal axis, vertical up	PA, PF
ss nb ss mb	Weld details	single-side welding without backing for 141 root run(s) single-side welding with backing for 111 filling and capping run(s)	ss nb, ss mb, bs ss mb, bs

#### B.4 Example 4 – Combined test (e.g. for pressure vessels production)

Welder approval EN ISO 9606-1 141 T BW 8 S s02 D17,0 PF/PC ss nb

Welder approval EN ISO 9606-1 141 T BW 8 S s05 D60,0 PF/PC ss nb

Explanation			Range of approval
141	Welding process	TIG-welding	141
T	Pipe		T, P
BW	Butt weld		BW
8	Material group according to CR ISO/TR 15608	group 8: austenitic steels	8, 10
S	Consumable	solid rod	S, M
s02 D17,0	Dimension of test pieces 1 and 2	weld deposit thickness: 2,0 mm pipe diameter: 17,0 mm	s= 2 mm to 10 mm D ≥ 17 mm
s05 D60,0	Dimension of test pieces 3 and 4	weld deposit thickness: 5,0 mm pipe diameter: 60,0 mm	
PF PC	Welding position	2 butt welds on pipe, fixed pipe, horizontal axis, vertical up 2 butt welds on pipe, fixed pipe, vertical axis, transversal	PA, PC, PF, PE, H-L045
ss nb	Weld details	single-side welding without backing for root run (gas backing according to WPS)	

#### B.5 Example 5 – Combined test (e.g. for ship and steel building production)

Welder approval EN ISO 9606-1 135 P BW 3 B s15 PF ss nb

Welder approval EN ISO 9606-1 135 P FW 3 B s15 PD ml

Explanation			Range of approval
135	Welding process	MAG-welding	135
P	Plate		P, T (D ≥ 500 mm)
BW FW	Butt and fillet weld		BW, FW
3	Material group according to CR ISO/TR 15608	group 3: quenched and tempered steel with yield strength > 360 N/mm <sup>2</sup>	1, 2, 3, 9.1, 11
B	Consumable	basic flux cored wire	B, R, P, V, W, Y, Z
s15	Dimension of test pieces 1 and 2	weld deposit thickness: 15 mm	s = 3 mm to 20 mm
PF PD	Welding position	1 butt weld on plate, vertical up 1 fillet weld on plate, horizontal overhead	PA, PB, PC, PD, PE, PF (plate, pipe D ≥ 500 mm)
ss nb ml	Weld details	single-side welding without backing for root run multi layer technique for fillet weld	

## **Annex C (informative)**

### **Job knowledge**

#### **C.1 General**

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

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

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

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

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

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

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

#### **C.2 Requirements**

##### **C.2.1 Welding equipment**

###### **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 <sup>2)</sup>**

###### **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.

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<sup>2)</sup> The numbers refer to EN ISO 4063.

### **C.2.2.3 Shielded metal-arc welding (114, 13, 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)**

- 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 Consumables**

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

### **C.2.5 Safety and accident prevention**

#### **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 procedures**

- 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 Edge preparation and weld representation**

- a) Conformance of weld preparation to 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 approval**

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

## Annex D (normative)

### Grouping of steels according to CR ISO/TR 15608

**Table D.1 – Grouping system of steels according to CR ISO/TR 15608  
(only main groups)**

Group	Type of steel
1	Steels with a specified minimum yield strength $R_{eH} \leq 460 \text{ N/mm}^2$ <sup>a</sup> and with analysis in %: C $\leq 0,25$ Si $\leq 0,60$ Mn $\leq 1,70$ Mo $\leq 0,70^b$ S $\leq 0,045$ P $\leq 0,045$ Cu $\leq 0,40^b$ Ni $\leq 0,5^b$ Cr $\leq 0,3$ (0,4 for castings) <sup>b</sup> Nb $\leq 0,05$ V $\leq 0,12^b$ Ti $\leq 0,05$
2	Thermomechanically treated fine grain steels and cast steels with a specified minimum yield strength $R_{eH} > 360 \text{ N/mm}^2$
3	Quenched and tempered steels and precipitation hardened steels except stainless steels with a specified minimum yield strength $R_{eH} > 360 \text{ N/mm}^2$
4	Low vanadium alloyed Cr-Mo-(Ni) steels with Mo $\leq 0,7 \%$ and V $\leq 0,1 \%$
5	Cr-Mo steels free of vanadium with C $\leq 0,35 \%$ <sup>c</sup>
6	High vanadium alloyed Cr-Mo-(Ni) steels
7	Ferritic, martensitic or precipitation hardened stainless steels with C $\leq 0,35 \%$ and 10,5 % $\leq$ Cr $\leq 30 \%$
8	Austenitic steels
9	9.1 Nickel alloyed steels with Ni $\leq 3,0 \%$
	9.2 Nickel alloyed steels with 3,0 % $<$ Ni $\leq 8,0 \%$
	9.3 Nickel alloyed steels with 8,0 % $<$ Ni $\leq 10,0 \%$
10	Austenitic ferritic stainless steels (duplex)
11	Steels covered by group 1 <sup>d</sup> except 0,25 % $<$ C $\leq 0,5 \%$
<p>a In accordance with the specification of the steel product standards, <math>R_{eH}</math> may be replaced by <math>R_{p0,2}</math> or <math>R_{10,5}</math>.</p> <p>b A higher value is accepted provided that Cr + Mo + Ni + Cu + V <math>\leq 0,75 \%</math>.</p> <p>c "Free of vanadium" means not deliberately added to the material.</p> <p>d A higher value is accepted provided that Cr + Mo+ Ni + Cu + V <math>\leq 1 \%</math>.</p>	

NOTE: The subgroups 1.1 to 1.4, 2.1, 2.2, 3.1 to 3.3, 4.1, 4.2, 5.1 to 5.4, 6.1 to 6.4, 7.1 to 7.3, 8.1 to 8.3, 10.1, 10.2, 11.1 and 11.2 are included in CR ISO/TR 15608.



**Annex ZA** (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

### Comparison between EN standards and ISO standards, where the number is not identical

EN standard	ISO standard	Title of the ISO standard
EN 499	ISO 2560	Covered electrodes for manual arc welding of mild steel and low alloy steel – Code of symbols for identification
EN 571-1	–	–
EN 729-1	ISO 3834-1	Quality requirements for welding – Fusion welding of metallic material – Part 2: Comprehensive quality requirements
EN 729-2	ISO 3834-2	Quality requirements for welding – Fusion welding of metallic material – Part 2: Comprehensive quality requirements
EN 729-3	ISO 3834-3	Quality requirements for welding – Fusion welding of metallic material – Part 3: Standard quality requirements
EN 729-4	ISO 3834-4	Quality requirements for welding – Fusion welding of metallic material – Part 4: Elementary quality requirements
EN 758	ISO/NP 17632	Welding consumables – Tubular cored electrodes for metal arc welding with and without a gas shield of non alloy and fine grain steels – Classification
EN 910	ISO/DIS 5173	Destructive tests on welds in metallic materials – Bend test (Revision of ISO 5173:1981 and ISO 5177:1981)
EN 970	ISO/NP 17637	Non-destructive examination of fusion welds – Visual examination
EN 1290	ISO/NP 17638	Non-destructive examination of welds – Magnetic particle examination of welds
EN 1320	ISO/DIS 9017.3	Destructive tests on welds in metallic materials – Fracture test
EN 1321	ISO/NP 17639	Destructive tests on welds in metallic materials – Macroscopic and microscopic examination of welds
EN 1435	ISO/NP 17636	Non-destructive examination of welds – Radiographic examination of welded joints
EN 1712	–	–
EN 1714	ISO/NP 17640	Non destructive examination of welds – Ultrasonic examination of welded joints
EN 22553	ISO 2553	Welded, brazed and soldered joints – Symbolic representation on drawings
EN 25817	ISO 5817	Arc-welded joints in steel – Guidance on quality levels for imperfections