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Preskušanje varilcev - Talilno varjenje - 1. del: Jekla

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

Prüfung von Schweißern - Schmelzschweißen - Teil 1: Stähle

Epreuve de qualification des soudeurs - Soudage par fusion - Partie 1 : Aciers

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Prüfung von Schweißern - Schmelzschweißen - Teil 1: Stahl

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Foreword

This document (EN 287-1:2004) 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of an identical text or by endorsement, at the latest by September 2004, and conflicting national standards shall be withdrawn at the latest by September 2004.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.

This document supersedes EN 287-1:1992.

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

— *Part 1: Steels*

— *Part 2: Aluminium and aluminium alloys*

Annexes A, B, C and D are informative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

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

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

The principle of this standard is that a qualification test qualifies the welder not only for the conditions used in the test, but also for all joints which are considered 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, are satisfied.

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

1 Scope

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

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

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

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

2 Normative references

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

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

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

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

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

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

EN ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2003).*

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

EN ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials — General rules (ISO 15607:2003).*

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

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

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

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

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 15607:2003 and the following apply.

3.1
welder
person who holds and manipulates the electrode holder, welding torch or blowpipe by hand

3.2
examiner
person who has been appointed to verify compliance with the applicable standard

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

3.3
examining body
organization that has been appointed to verify compliance with the applicable standard

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

3.4
backing
material placed at the reverse side of a joint preparation for the purpose of supporting molten weld metal

3.5
root run
in multi layer welding, the run(s) of the first layer deposited in the root

3.6
filling run
in multi layer welding, the run(s) deposited after the root run(s) and before the capping run(s)

3.7
capping run
in multi layer welding, the run(s) visible on the weld face(s) after completion of welding

3.8
weld metal thickness
thickness of the weld metal excluding any reinforcement

4 Symbols and abbreviated terms

4.1 General

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

4.2 Reference numbers of welding processes

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

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

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

4.3 Abbreviations

4.3.1 For test pieces

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

4.3.2 For consumables

nm	no filler metal
A	acid covering
B	basic covering or electrode core - basic
C	cellulosic covering
M	electrode core - metal powder
P	electrode core - rutile, fast freezing slag
R	rutile covering or electrode core – rutile, slow freezing slag
RA	rutile-acid covering
RB	rutile-basic covering
RC	rutile-cellulosic covering
RR	rutile-thick covering
S	solid wire/rod
V	electrode core - rutile or basic / fluoride
W	electrode core - basic / fluoride, slow freezing slag
Y	electrode core - basic / fluoride, fast freezing slag
Z	electrode core - other types

4.3.3 For other weld details

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

4.3.4 For bend tests

A	minimum tensile elongation required by the material specification
d	diameter of the former or the inner roller

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

t_s thickness of the bend test specimen

5 Essential variables and range of qualification

5.1 General

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

— welding process,

— product type (plate and pipe),

— type of weld (butt and fillet),

— material group,

— welding consumable,

— dimension (material thickness and outside pipe diameter),

— welding position,

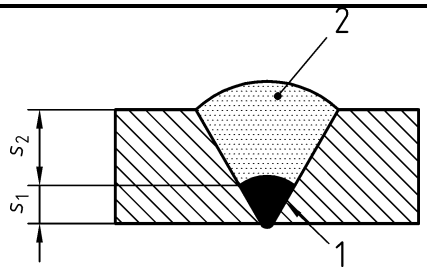
— weld detail (backing, single side welding, both side welding, single layer, multi layer, leftward welding, rightward welding).

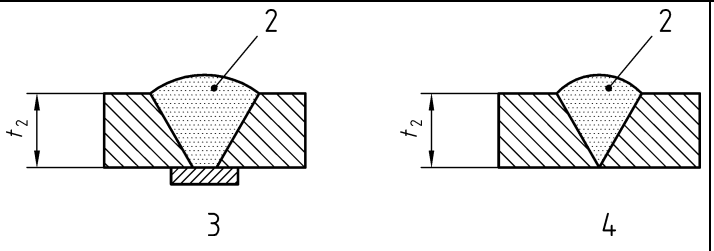
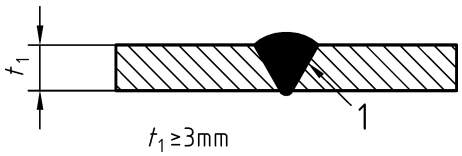
5.2 Welding processes

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

Each qualification test normally qualifies only one welding process. A change of welding process requires a new qualification test. Exceptions are the changes of solid wire S (welding process 135) to metal core wire M (welding process 136) or vice versa which do not require a new qualification test (see Table 3). However, it is permitted for a welder to be qualified for two or more welding processes by welding a single test piece (multi process joint) or by two or more separate qualification tests. The ranges of qualification for each welding process used and for the multi process joint for butt welds are given in Table 1 (see also Table 4).

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

Welding process used for the test piece	Thickness range	
	Single process joint	Multi process joint
 **Key** 1 Welding process 1 (nb) 2 Welding process 2 (mb)	according to Table 4 for welding process 1: $t = s_1$ for welding process 2: $t = s_2$	according to Table 4 with $t = s_1 + s_2$

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

5.3 Product type

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

a) welds in pipes, outside pipe diameter D > 25 mm, cover welds in plates;

b) welds in plates cover welds in pipe:

— of outside pipe diameter $D \geq 150$ mm, for welding positions PA, PB and PC;

— of outside pipe diameter $D \geq 500$ mm, for all welding positions.

5.4 Type of weld

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

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

b) in cases where the majority of work is fillet welding, the welder shall also be qualified by an appropriate fillet welding test; in cases where the majority of work is butt welding, butt welds qualify fillet welds;

c) butt welds in pipes without backing qualify branch connections with an angle ≥ 60° and the same range of qualification as in Tables 1 to 8. For a branch weld the range of qualification is based on the outside pipe diameter of the branch;

d) for applications where the type of weld cannot be qualified by means of either a butt or fillet weld test then a specific test piece should be used to qualify the welder, e.g. branch connection.

5.5 Material groups

5.5.1 Steel groups of parent material

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

5.5.2 Range of qualification

The welding of any one metal in a material group confers 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 material group 8 or 10 (see Table 2), all combinations with 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 9.1	9 9.2 + 9.3	10	11
1.1, 1.2, 1.4	X	–	–	–	–	–	–	–	–	–	–	–	–
1.3	X	X	X	X	–	–	–	–	–	X	–	–	X
2	X	X	X	X	–	–	–	–	–	X	–	–	X
3	X	X	X	X	–	–	–	–	–	X	–	–	X
4	X	X	X	X	X	X	X	X	–	X	–	–	X
5	X	X	X	X	X	X	X	X	–	X	–	–	X
6	X	X	X	X	X	X	X	X	–	X	–	–	X
7	X	X	X	X	X	X	X	X	–	X	–	–	X
8	–	–	–	–	–	–	–	–	X	–	X	X	–
9 9.1	X	X	X	X	–	–	–	–	–	X	–	–	X
9 9.2 + 9.3	X	–	–	–	–	–	–	–	–	–	X	–	–
10	–	–	–	–	–	–	–	–	X	–	X	X	–
11	X	X	–	–	–	–	–	–	–	–	–	–	X

[a] Material group according to CR ISO 15608.

Key

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

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

5.6 Welding consumables

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

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

Table 3 — Range of qualification for welding consumables [a]

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

[a] Abbreviations see 4.3.2.

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

Key

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

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

5.7 Dimensions

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

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

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

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

— Set on: The material thickness and outside pipe diameter of the branch;

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

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

1) the thinnest and thickest material thickness qualified in accordance with Table 4;

2) the smallest and largest outside pipe diameter qualified in accordance with Table 5.