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Qualification test of welders - Fusion welding - Part 2: Aluminium and aluminium alloys (ISO 9606-2:2004)

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Prüfung von Schweißern - Schmelzschweißen - Teil 2: Aluminium und Aluminiumlegierungen (ISO 9606-2:2004)

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Epreuve de qualification des soudeurs - Soudage par fusion - Partie 2 : Aluminium et alliages d'aluminium (ISO 9606-2:2004)

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English version

Qualification test of welders - Fusion welding - Part 2: Aluminium and aluminium alloys (ISO 9606-2:2004)

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This European Standard was approved by CEN on 23 September 2004.

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

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Foreword

This document (EN ISO 9606-2:2004) has been prepared by Technical Committee CEN/TC 121 “Welding”, the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 44 “Welding and allied processes”.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2005, and conflicting national standards shall be withdrawn at the latest by June 2005.

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 287-2:1992.

This series of standards consists of the following parts, under the general title *Qualification test of welders — Fusion welding*:

- EN 287-1: Steels
- EN ISO 9606-2: Aluminium and aluminium alloys
- EN ISO 9606-3: Copper and copper alloys¹⁾
- EN ISO 9606-4: Nickel and nickel alloys¹⁾
- EN ISO 9606-5: Titanium and titanium alloys, zirconium and zirconium alloys¹⁾

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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.

¹⁾ The general title of these document is *Approval testing of welders - Fusion welding*

Introduction

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

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

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

The qualification test can be used to qualify a welding procedure and a welder provided that all the relevant requirements, e.g. test piece dimensions, are satisfied (see EN ISO 15614-2).

Qualifications in accordance with EN 287-2 or ISO 9606-2 existing at the date of publication of this document are, at the end of their period of validity, to be interpreted in accordance with the requirements of this standard.

Requests for official interpretations of any aspect of this standard should be directed to the Secretariat of ISO/TC 44/SC 11 via your national standards body, a complete listing which can be found at www.iso.org.

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1 Scope

This document specifies the requirements for qualification of welders for fusion welding of aluminium and aluminium alloys.

This document provides a set of technical rules for systematic qualification of welders which are independent of product type, location and examiner/examining body.

When qualifying welders, the emphasis is placed on the welder's ability to manually manipulate the welding torch and thereby produce a weld of acceptable quality.

The welding processes referred to in this document include those fusion welding processes which are designated as manual or partly mechanized welding. It does not qualify fully mechanized and automated welding processes (see EN 1418 or ISO 14732).

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 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 1321, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds.*

EN 1418:1997, *Welding personnel — Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials.*

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

EN 30042, *Arc-welded joints in aluminium and its weldable alloys — Guidance on quality levels for imperfections (ISO 10042:1992).*

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

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).*

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 15614-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 2: Arc welding of aluminium and its alloys (ISO 15614-2:2004).*

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

NOTE A list of ISO Standards conforming to these EN Standards is given in Annex ZB.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 15607:2003 and EN 1418:1997 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 may 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 may 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 document qualifies the following manual or partly mechanized welding processes (reference numbers of welding processes for symbolic representation are listed in EN ISO 4063):

- 131 metal inert gas welding (MIG welding);
- 141 tungsten inert gas arc welding (TIG welding);
- 15 plasma arc welding.

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

4.3 Abbreviations

4.3.1 For test pieces

<i>a</i>	design throat thickness
BW	butt weld
<i>D</i>	outside pipe diameter
FW	fillet weld
<i>l</i> ₁	length of test piece
<i>l</i> ₂	half width of test piece
<i>l</i> _f	examination length
P	plate ²⁾
<i>s</i>	weld metal thickness for butt welds only (plate thickness or pipe wall thickness for single process)
<i>s</i> ₁	weld metal thickness for welding process 1
<i>s</i> ₂	weld metal thickness for welding process 2
<i>t</i>	material thickness of test piece (plate or wall thickness)
<i>t</i> ₁	material thickness of test piece for welding process 1
<i>t</i> ₂	material thickness of test piece for welding process 2
T	pipe ³⁾
<i>z</i>	leg length of fillet weld.

4.3.2 For welding consumables

nm	no filler metal
S	solid wire/rod

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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

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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 processes;
- product type (plate and pipe);
- type of weld (butt and fillet);
- material groups;

2) The word "plate" alone or in combination is used to mean "wrought plate" and "flat extruded bars".

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

- e) welding consumables;
- f) dimensions (material thickness and outside pipe diameter);
- g) welding positions;
- h) weld details (backing, single side welding, both side welding, single layer, multi layer).

5.2 Welding processes

Welding processes shall be as defined in ISO 857-1 and listed in 4.2.

Each test usually qualifies only one welding process. A change of welding process requires a new qualification test. 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 processes joint for butt welds are given in Table 1.

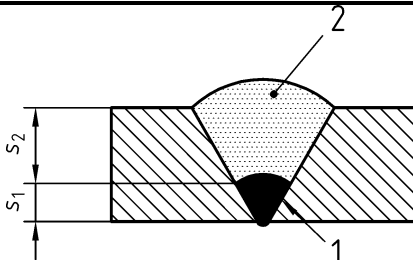
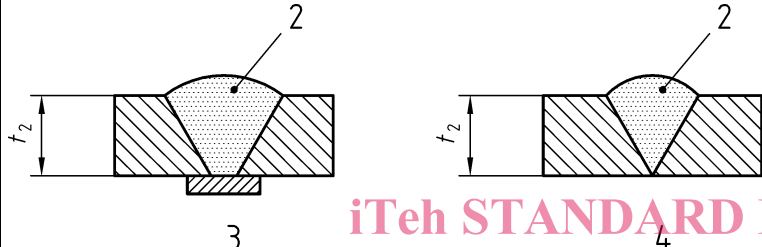
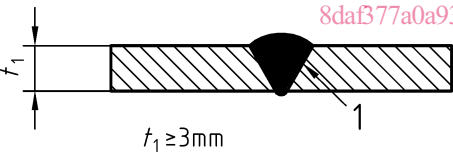
For welding process 141 a change in current from direct current to alternating current and vice versa requires a new qualification test.

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

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

5.3 Product type

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

- a) welds in pipes, outside pipe diameter $D > 25$ mm, qualify welds in plates;
- b) welds in plates qualify 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 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 qualify 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 $\geq 60^\circ$ and the same range of qualification as in Tables 1 to 7. 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, finishing welding of castings, preheating.

NOTE For finishing welding of castings a test piece according to prEN ISO 15614-4:2003, Figures 1 and 2, may be applied.

5.5 Material groups

5.5.1 Aluminium and aluminium alloy groups of parent material

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

5.5.2 Range of qualification

The welding of any one parent material in a group confers qualification on the welder for the welding of all other parent material 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.

A test piece between materials of groups 21 to 23 with materials of groups 24 or 25 qualifies any dissimilar joint obtained from any combination between materials from groups 21 to 23 with materials from groups 24 or 25. Any dissimilar joint with the material of group 26 requires a specific qualification test.