
**Qualification testing of welders — Fusion
welding —**

**Part 1:
Steels**

Épreuve de qualification des soudeurs — Soudage par fusion

Partie 1: Aciers
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Contents

Page

Foreword	iv
Introduction.....	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Reference numbers, symbols and abbreviated terms.....	4
4.1 General	4
4.2 Reference numbers of welding processes	4
4.3 Symbols and abbreviated terms	4
5 Essential variables and range of qualification	6
5.1 General	6
5.2 Welding processes.....	7
5.3 Product type.....	8
5.4 Type of weld.....	9
5.5 Filler material grouping.....	9
5.6 Filler material type.....	10
5.7 Dimensions	11
5.8 Welding positions.....	13
5.9 Weld details.....	15
6 Examination and testing	15
6.1 Examination	15
6.2 Test pieces	16
6.3 Welding conditions	18
6.4 Test methods	18
6.5 Test piece and test specimen	19
6.6 Test report.....	23
7 Acceptance requirements for test pieces	23
8 Re-tests.....	24
9 Period of validity.....	24
9.1 Initial qualification	24
9.2 Confirmation of the validity	24
9.3 Revalidation of welder qualification	24
9.4 Revocation of qualification	24
10 Welder's qualification test certificate	25
11 Designation	25
Annex A (informative) Welder's qualification test certificate	27
Annex B (informative) Job knowledge.....	28
Annex C (informative) FW/BW test assembly option	31
Bibliography.....	32

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 9606-1 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 11, *Qualification requirements for welding and allied processes personnel*.

This second edition cancels and replaces the first edition (ISO 9606-1:1994), which has been technically revised. It also incorporates the Amendment ISO 9606-1:1994/Amd 1:1998.

ISO 9606 consists of the following parts, under the general title *Qualification testing of welders — Fusion welding*:

- Part 1: Steels
- Part 2: Aluminium and aluminium alloys
- Part 3: Copper and copper alloys
- Part 4: Nickel and nickel alloys
- Part 5: Titanium and titanium alloys, zirconium and zirconium alloys

Requests for official interpretations of any aspect of this part of ISO 9606 should be directed to the Secretariat of ISO/TC 44/SC 11 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

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 International Standard depends on the welding techniques and conditions used, in which uniform rules are complied with and standard test pieces are used.

The principle of this International Standard is that a qualification test qualifies a welder not only for the conditions used in the test, but also for all other conditions which are considered easier to weld in accordance with this International Standard. It is presumed that the welder has received 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 ISO 15614-1^[11]).

All new qualifications shall be in accordance with each part of this International Standard from its date of issue.

At the end of its period of validity, existing qualification tests of welders in accordance with the requirement of a national standard may be revalidated according to this International Standard. This is providing that the technical intent of this International Standard is satisfied. It is necessary for the new range of qualification to be interpreted in accordance with the requirements of this International Standard.

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Qualification testing of welders — Fusion welding —

Part 1: Steels

1 Scope

This part of ISO 9606 specifies the requirements for qualification testing of welders for 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 or examining body.

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

The welding processes referred to in this part of ISO 9606 include those fusion-welding processes which are designated as manual or partly mechanized welding. It does not cover fully mechanized and automated welding processes.

NOTE For such processes, see ISO 14732[10], 9606-1:2012
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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.

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

ISO 3834-2, *Quality requirements for fusion welding of metallic materials — Part 2: Comprehensive quality requirements*

ISO 3834-3, *Quality requirements for fusion welding of metallic materials — Part 3: Standard quality requirements*

ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers*

ISO 5173, *Destructive tests on welds in metallic materials — Bend tests*

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

ISO 6947, *Welding and allied processes — Welding positions*

ISO 9017, *Destructive tests on welds in metallic materials — Fracture test*

ISO/TR 15608, *Welding — Guidelines for a metallic material grouping system*

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

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

ISO 17636 (all parts), *Non-destructive testing of welds — Radiographic testing*

ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints*

ISO/TR 25901:2007, *Welding and related processes — Vocabulary*

3 Terms and definitions

For the purposes of this part of ISO 9606, 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, 2.428]

3.2

manufacturer

person or organization responsible for the welding production

[ISO 15607:2003,^[12] 3.23]

3.3

examiner

person appointed to verify compliance with the applicable standard

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

[ISO/TR 25901:2007, 2.119]

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3.4

examining body

organization appointed to verify compliance with the applicable standard

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

[ISO/TR 25901:2007, 2.120]

3.5

material backing

backing using material for the purpose of supporting molten weld metal

3.6

gas backing

backing using gas primarily for the purpose of preventing oxidation

3.7

flux backing

backing using flux primarily for the purpose of preventing oxidation

NOTE In submerged arc welding, flux backing may also reduce the risk of a weld pool collapse.

3.8

consumable insert

filler material that is placed at the root of the joint before welding to be completely fused into the root

3.9**layer**

stratum of weld metal consisting of one or more runs

[ISO/TR 25901:2007, 2.209]

3.10**root run****root pass**

⟨multi-layer welding⟩ run(s) of the first layer deposited in the root

[ISO/TR 25901:2007, 2.310]

3.11**filling run**

⟨multi-layer welding⟩ run(s) deposited after the root run(s) and before the capping run(s)

[ISO/TR 25901:2007, 2.132]

3.12**capping run**

⟨multi-layer welding⟩ run(s) visible on the weld face(s) after completion of welding

[ISO/TR 25901:2007, 2.57]

3.13**deposited thickness**

thickness of the weld metal excluding any reinforcement

3.14**leftward welding**

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

[ISO/TR 25901:2007, 2.210]

3.15**rightward welding**

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

[ISO/TR 25901:2007, 2.302]

3.16**branch joint**

joint of one or more tubular parts to the main pipe or to a shell

3.17**fillet weld**

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

[ISO/TR 25901:2007, 2.131]

3.18**verification**

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

[ISO 9000:2005,^[5] 3.8.4]

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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 part of ISO 9606 covers the following manual or partly mechanized welding processes (reference numbers of welding processes for symbolic representations are listed in ISO 4063):

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 (wire/rod)
142	autogenous TIG welding
143	TIG welding with tubular cored filler material (wire/rod)
145	TIG welding using reducing gas and solid filler material (wire/rod)
15	plasma arc welding
311	oxyacetylene welding

See ISO/TR 25901 and ISO 857-1 for the definition of manual and partly mechanized welding.

NOTE The principles of this part of ISO 9606 can be applied to other fusion welding processes.

4.3 Symbols and abbreviated terms

4.3.1 For test pieces

a	design throat thickness
BW	butt weld
D	outside pipe diameter
FW	fillet weld
l_1	length of test piece
l_2	half-width of test piece
l_f	examination length
P	plate
s	deposited thickness or fused metal thickness in butt welds
t	material thickness of test piece (plate or wall thickness)

s_1	deposited thickness of test piece for welding process 1
s_2	deposited thickness of test piece for welding process 2
T	pipe ¹⁾
z	leg length of fillet weld

4.3.2 For filler materials

nm	no filler material
----	--------------------

The symbol for type of covering or core is based on those given in various International Standards on filler materials.

03	rutile basic covering
10	cellulosic covering
11	cellulosic covering
12	rutile covering
13	rutile covering
14	rutile + iron powder covering
15	basic covering
16	basic covering
18	basic + iron powder covering
19	limenite covering
20	iron oxide covering
24	rutile + iron powder covering
27	iron oxide + iron powder covering
28	basic + iron powder covering
45	basic covering
48	basic covering
A	acid covering
B	basic covering or electrode core — basic
C	cellulosic covering
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

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

M	metal cored electrode or metal powder
P	electrode core — rutile, fast-freezing slag
S	solid wire electrode — solid 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

fb	flux backing
bs	welding from both sides
ci	consumable insert
lw	leftward welding
mb	material backing
gb	gas backing
ml	multi-layer
nb	welding with no material backing
rw	rightward welding
sl	single layer
ss	single side welding

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4.3.4 For bend tests

<i>A</i>	minimum tensile elongation after fracture 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

4.3.5 Types of arc welding

MAG	metal active gas
MIG	metal inert gas
TIG	tungsten inert gas

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. If the welder has to weld outside the range of welder qualification, a new qualification test is required. The essential variables are:

- welding process(es);
- product type (plate or pipe);

- type of weld (butt or fillet);
- filler material group;
- filler material type;
- dimension (material thickness and outside pipe diameter);
- welding position;
- weld detail(s) (material backing, gas backing, flux backing, consumable insert, single side welding, both side welding, single layer, multi-layer, leftward welding, rightward welding).

The parent material group(s) and subgroup(s), in accordance with ISO/TR 15608, that are used in the test shall be recorded on the welder's qualification test certificate.

5.2 Welding processes

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

Each test normally qualifies only one welding process. A change of welding process requires a new qualification test.

Exceptions are as follows:

- a change from solid wire electrode 135 to a metal cored electrode 138, or vice versa, does not require requalification (see Table 5);
- a change from solid wire electrode 121 to a tubular cored electrode 125, or vice versa, does not require requalification (see Table 5);
- welding with 141, 143 or 145 qualifies for 141, 142, 143 and 145, but 142 only qualifies for 142;
- qualifying the welder for dip (short-circuit) transfer mode (131, 135 and 138) shall qualify him for other transfer modes, but not vice versa.

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 for each welding process used and for the multi-process joint for butt welds are given in Tables 1 and 6.