INTERNATIONAL STANDARD

ISO 9606-1

Second edition
2012-07-15

Qualification testing of welders — Fusion welding —

Part 1: **Steels**

Épreuve de qualification des soudeurs — Soudage par fusion

Partie 1: Aciers

Reference number
ISO 9606-1:2012(E)

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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.

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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].

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*

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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]

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

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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)

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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”.

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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

4.3.4 For bend tests

A minimum tensile elongation after fracture required by the material specification
d diameter of the former or the inner roller
t_s 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);

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