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Qualification testing of welders — Fusion welding —

Part 1: Steels

Épreuve de qualification des soudeurs — Soudage par fusion —

Partie 1: Aciers

(Revision of first edition of ISO 9606-1:1994 and ISO 9606-1:1994/Amd.1:1998)

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Contents

	Page
Foreword	v
Introduction.....	vi
1 Scope.....	3
2 Normative references.....	3
3 Terms and definitions	4
4 Symbols and abbreviated terms	6
4.1 General	6
4.2 Reference numbers of welding processes	6
4.3 Abbreviations.....	5
4.3.1 For test pieces	5
4.3.2 For consumables.....	7
4.3.3 For other weld details	7
4.3.4 For bend tests.....	6
5 Essential variables and range of qualification	6
5.1 General	6
5.2 Welding processes.....	8
5.3 Product type.....	9
5.4 Type of weld.....	10
5.5 Filler material	10
5.5.1 Filler material groups.....	10
5.5.2 Range of qualification.....	10
5.6 Welding consumables.....	11
5.7 Dimensions	12
5.8 Welding positions.....	13
5.9 Weld details.....	14
6 Examination and testing.....	15
6.1 Examination	15
6.2 Test pieces	16
6.3 Welding conditions.....	19
6.4 Test methods	20
6.5 Test piece and test specimen	20
6.5.1 General	20
6.5.2 Butt weld in plate and pipe.....	20
6.5.3 Fillet weld on plate	22
6.5.4 Fillet weld on pipe	24
6.6 Test record.....	24
7 Acceptance requirements for test pieces.....	24
8 Re-tests.....	25
9 Period of validity.....	25
9.1 Initial qualification.....	25
9.2 Confirmation of the validity.....	25
9.3 Revalidation of qualification	25
9.4 Revocation of qualification	26
10 Certificate	26
11 Designation	26
Annex A (informative) Welder's qualification test certificate	28

Annex B (informative) Job knowledge	29
B.1 General	29
B.2 Requirements	29
B.2.1 Welding equipment	29
B.2.2 Welding process	30
B.2.3 Parent metals	30
B.2.4 Welding consumables	30
B.2.5 Safety precautions	31
B.2.6 Welding sequences/procedures	31
B.2.7 Joint preparation and weld representation	31
B.2.8 Weld imperfections	32
B.2.9 Welder qualification	32
Annex C (informative) FW/BW test assembly option	33

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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 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

Annexes A, B and C of this part of ISO/DIS 9606-1 are for information only.

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 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 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).

At the end of its period of validity, the existing and valid qualification of a welder in accordance with the requirement of a national standard may be revalidated according to this International standard. The range of qualification shall 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 International Standard defines 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/examining body.

When qualifying welders, the emphasis is placed on the welder's 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 automatic welding processes (see 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 referred document (including any amendments) applies.

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

ISO 3834-1:2005 *Quality requirements for fusion welding of metallic materials – Part 1: Criteria for the selection of the appropriate level of quality requirements*

ISO 3834-2:2005 *Quality requirements for fusion welding of metallic materials – Part 2: Comprehensive quality requirements*

ISO 3834-3:2005 *Quality requirements for fusion welding of metallic materials – Part 3: Standard quality requirements*

ISO 3834-4:2005 *Quality requirements for fusion welding of metallic materials – Part 4: Elementary quality requirements*

ISO 3834-5:2005 *Quality requirements for fusion welding of metallic materials – Part 5: Documents with which it is necessary to conform to claim conformity to the quality requirements of ISO 3834-2, ISO 3834-3 or ISO 3834-4*

ISO/TR 3834-6:2007 *Quality requirements for fusion welding of metallic materials – Part 6: Guidelines on implementing 3834*

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/DIS 9606-1.3: (E)

ISO 6947, *Welds — Working positions — Definitions of angles of slope and rotation*

ISO 9000:2005 *Quality management systems — Fundamentals and vocabulary*

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

ISO 15607:2003 *Specification and approval of welding procedures for metallic materials — General rules*

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

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

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

ISO 17636, *Non-destructive examination of welds — Radiographic examination of welded joints*

ISO 17637, *Non-destructive examination of fusion welds — Visual examination*

ISO 17639, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds*

ISO 17640, *Non destructive examination of welds — Ultrasonic examination of welded joints*

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

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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]

3.2

manufacturer

person or organization that is responsible for the welding production

[ISO15607]

3.3

examiner

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

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

[ISO/TR 25901]

3.4

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.

[ISO/TR 25901]

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]

3.10**root run**

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

[ISO/TR 25901]

3.11**filling run**

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

[ISO/TR 25901]

3.12**capping run**

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

[ISO/TR 25901]

3.13**weld metal thickness**

thickness of the weld metal excluding any reinforcement

[ISO/TR 25901]

3.14**leftward welding**

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

[ISO/TR 25901]

3.15**rightward welding**

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

[ISO/TR 25901]

3.16

branch connection

joint of two parts one of which is tubular and the main axis of which are at an angle different than 180°

[ISO/TR 25901]

3.17

fillet weld

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

[ISO/TR 25901]

3.18

verification

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

[ISO 9000]

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

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

- 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 MIG welding with solid wire electrode;
- 131-D metal inert gas welding (MIG welding) with short circuiting transfer;
- 131-G metal inert gas welding (MIG welding) with globular transfer;
- 131-S metal inert gas welding (MIG welding) with spray transfer;
- 131-P metal inert gas welding (MIG welding) with pulsed transfer;
- 135 MAG welding with solid wire electrode;
- 135-D metal active gas welding (MAG welding) with short circuiting transfer;
- 135-G metal active gas welding (MAG welding) with globular circuiting transfer;
- 135-S metal active gas welding (MAG welding) with spray transfer;
- 135-P metal active gas welding (MAG welding) with pulsed transfer;
- 136 MAG welding with flux cored electrodes;
- 138 MAG welding with metal cored electrode;
- 141 TIG welding with solid filler material;
- 143 TIG welding with tubular cored filler material;
- 145 TIG welding using reducing gas and solid filler material (wire/rod);
- 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

<i>a</i>	design throat thickness
BW	butt weld
<i>D</i>	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
<i>s</i>	weld metal thickness or fused metal thickness in butt welds
<i>t</i>	material thickness of test piece (plate or wall thickness)
s_1	material thickness of test piece for welding process 1
s_2	material thickness of test piece for welding process 2
T	pipe ¹⁾
<i>z</i>	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

fb	flux backing
ph	preheating
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

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

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

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 welder qualification a new qualification test is required. The essential variables are:

- welding process(es)
- product type (plate and pipe),
- type of weld (butt and fillet),
- filler material group,
- welding consumable,
- dimension (material thickness and outside pipe diameter),
- welding position,
- weld detail (backing, gas backing, consumable insert, backing flux, 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 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 4).

TIG welding process 141 to TIG welding process 145 or vice versa shall not require requalification.

When qualifying the process on 131D or 135D this shall also qualify for 131G, 131S, 131P or 135G, 135S, 135P 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 weld material thickness for each welding process used and for the multi process joint for butt welds are given in Tables 1 and 5).