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Qualification test of welders - Fusion welding for aluminum and aluminum alloys

铝及铝合金熔化焊焊工技能评定

(ISO 9606-2:2004, Qualification test of welders - Fusion welding - Part 2: Aluminum and aluminum alloys, MOD)

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Standardization Administration of PRC.

Table of Contents

Qualification test of welders - Fusion welding for aluminum and aluminum alloys

1 Scope

This standard specifies the requirements for qualification of welders for fusion welding of aluminum and aluminum alloys.

To ensure that the exam is suitable for different product types, regions, and testing organizations, this standard provides a set of technical rules for systematic qualification.

This standard focuses on qualifying the skills of the welder to manually operate the welding tongs, welding guns, welding torches, and thereby produce a weld of acceptable quality.

This standard applies to manual welding and semi-automatic welding methods.

2 Normative references

The provisions in following documents become the provisions of this standard through reference in this standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this standard; however, parties who reach an agreement based on this standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 2653 Bend test methods on welded joints (GB/T 2653-2008, ISO 5173:2000, IDT)

GB/T 3323 Radiographic examination of fusion welded joints in metallic materials

GB/T 3375 Welding terminology

GB/T 5185 Welding and allied processes - Nomenclature of processes and reference numbers (GB/T 5185-2005, ISO 4063: 1998, IDT)

GB/T 16672 Welds - Working positions - Definitions of angles of slope and rotation (GB/T 16672-1996, ISO 6947:1993, IDT)

GB/T 19866 Specification and qualification of welding procedures for

sl - Single-layer welding;

ss - Single-sided welding.

5 Main parameters and range of qualification

5.1 General

The qualification of welder is based on the main parameters. This standard determines the scope of approval for each main parameter. Except as described in 5.7 and 5.8, all test pieces shall be welded using the main parameters. If the welder is engaged in welding outside the range of qualification, a new qualification test is required. The main parameters are:

a) Welding processes;

b) Type of test piece (plate and tube);

c) Type of weld (butt weld and fillet weld);

d) Base metal;

e) Welding consumables;

f) Size (base metal's thickness and tube's outer diameter);

g) Welding position;

h) Weld details (welding with backing, single-sided welding, double-sided welding, single-layer welding, multi-layer welding).

5.2 Welding processes

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 (combined welding method) or by two or more separate qualification tests. Table 1 provides the ranges of qualification for single welding process and multi-welding process against the butt weld.

For the welding process 141, if the current is changed from DC to AC and vice versa, it needs a new qualification test.

l_2 - Length of test plate;

t - Thickness of test piece (plate thickness or wall thickness);

z - Dimension of weld leg;

$0.5t \leq \alpha \leq 0.7t$.

Figure 4 -- Test piece's dimensions for fillet weld of tube/plate

6.3 Welding conditions

Welder's qualification test shall be carried out in accordance with pWPS or WPS as defined in GB/T 19867.1.

Welding during the qualification test shall meet the following requirements:

a) The welding time of the test piece shall be consistent with the welding time under normal production conditions;

b) The test piece shall have at least one stop and one re-start in the root run and in the capping run and be identified in length to be examined;

c) Any post-welded heat treatment required in the pWPS or WPS can be omitted unless bend or tensile tests are required;

d) Identification of the test piece;

e) The welder may, only with the permission of the examiner or examining body, remove minor imperfections by grinding or planing, except on the surfaces.

6.4 Testing method

Each completed weld shall be tested in the as-welded condition as specified in Table 9.

The additional tests specified in Table 9 shall be carried out after passing the visual inspection.

When using permanent backing in the qualification test, it shall be removed prior to destructive testing.

In order to clearly show the weld, it shall be prepared and etched on one side of the macro specimen, polishing is generally not required.

When radiographic testing of butt welds made by welding process 131 (MIG welding) is undertaken, it shall be supplemented by either two additional bend tests (one face and one root or two side bends) or two fracture tests (one face

7 Acceptance requirements for test pieces

The test piece shall be evaluated in accordance with the acceptance requirements specified in the corresponding imperfection type.

Prior to any testing, it shall make the following inspections:

- All splashes are removed;
- No grinding has been performed on the root and the face side of the weld (as per 6.3);
- The stop and restart in the root run and in the capping run are identified (as per 6.3);
- The profile and dimensions are acceptable.

Unless otherwise specified, the acceptance requirements for imperfections found by the test method in accordance with this standard shall be evaluated in accordance with the provisions of GB/T 22087. If the imperfections are within the quality level B as specified in GB/T 22087, a welder is qualified, except for the following imperfections, such as the excess weld metal (butt weld), excessive convexity (fillet weld), excessive throat thickness and excessive penetration, for which level C shall apply.

Bend test specimens shall not reveal any one single flaw greater than 3 mm in any direction. Flaws appearing at the edges of a test specimen during testing shall be ignored in the evaluation, unless there is evidence that cracking is due to incomplete penetration, inclusion slag or other flaw.

If the imperfection in the welder’s test piece exceeds the permitted maximum specified, then the welder fails the test.

The corresponding acceptance criteria for non-destructive testing shall make reference to the relevant standards, all destructive and non-destructive testing shall be carried out in accordance with the prescribed procedures.

8 Re-tests

If any test fails to comply with the requirements of this document, the welder shall be given the opportunity to repeat the qualification test.

If it is established that failure is due to metallurgical or other extraneous causes that cannot be directly attributed to the welder’s lack of skill, it shall allow an additional qualification test.

9 Period of validity

9.1 Initial qualification

The welder's qualification is valid from the date of welding of the test pieces, providing that the required tests have been carried out and acceptable test results are available.

9.2 Confirmation of the validity

The welder’s qualification test certificate issued is valid for a period of 2 years. This is providing that the welding coordinator or the responsible personnel of the employer can confirm that the welder has been working within the initial range of qualification. This shall be confirmed every 6 months.

9.3 Prolongation of qualification

The welder’s qualification test certificates in accordance with this document can be prolonged every 2 years by an examiner/examining body.

Before prolongation of the certification takes place, the requirements of 9.2 needs to be satisfied and also the following conditions need to be confirmed:

a) All records and evidence used to support the prolongation are completely traceable and identifies the welding procedure specification (WPS) that have been used in production;

b) Evidence used to support prolongation shall include the report for the testing of the internal imperfections (radiographic testing or ultrasonic testing) or for destructive testing (facture or bends), wherein at least two testing is made during the previous six months. Evidence relating to prolongation needs to be retained for a minimum of 2 years;

c) The weld shall meet the qualification acceptance level as specified in clause 7;

d) The test results mentioned in 9.3b) shall demonstrate that the welder meets all original test requirements.

Note: See Appendix D for examples of parameters to be confirmed and traced.

10 Certificate

If the welder has successfully passed the skill test, a certificate shall be awarded. All relevant test conditions shall be recorded on the certificate.

The welder's qualification certificate shall be issued solely by the examining body and shall include the contents listed in Appendix A. It is recommended to use the format of Appendix A as a qualification certificate for a welder qualified. If any other format of welder's qualification certificate is used, the certificate must contain the content required by Appendix A.

In principle, a welder's qualification certificate shall be issued for each test piece.

If a welder has welded multiple test pieces, it can also be summarized on a welder's qualification certificate in accordance with its scope of application. Except for the examples described in 5.7, only one of the following main parameters is allowed to be changed:

- The type of weld;

- The welding position;

- The thickness of base metal.

The welder's qualification certificate shall avoid ambiguity.

It shall use "qualified" or "not assessed" to indicate the actual skills assessment and professional knowledge test (see Appendix A).

Any changes to the test's main parameters beyond the scope of qualification require new test and qualification.

11 Qualified designation for welder's qualification test

The designation of a welder qualification shall comprise the following items:

a) The number of this standard;

b) Main parameters

1) Welding process: refer to 4.2, 5.2 and GB/T 16672;

2) Type of specimen: plate (P), tube (T), refer to 4.3.1 and 5.3;

3) Type of weld: butt weld (BW), fillet weld (FW), refer to 5.4;

4) Group of material: see 5.5;

5) Welding consumables: see 5.6;

6) Dimension of specimen: material thickness t and outer diameter of the tube, see 5.7;

Appendix C

(Normative)

Job knowledge

C.1 General

It is recommended to conduct a job knowledge test for the welder, but it is not mandatory.

If job knowledge test is carried out, it shall be recorded on the welder's qualification certificate.

This Appendix outlines the job knowledge that welders shall master to ensure they follow the procedures and comply with the common practices. This Appendix only specifies the overall objectives or categories of job knowledge, which are only the most basic requirements.

Job knowledge test can be conducted in one of the following ways (or a combination of these):

a) Written test (multiple choices);

b) Oral test based on a set of written questions;

c) Computer test;

d) Demonstration/observation testing in accordance with a written set of criteria.

The test of job knowledge is limited to the matters related to the welding process used in the test.

C.2 Requirements

C.2.1 Welding equipment

a) Identification and assembly of essential components and equipment;

b) Type of welding current;

c) Correct connection of welding circuit.

C.2.2 Welding process

a) Type and size of electrode;

b) Identification of shielding gas and flow rate;

c) Type, size and maintenance of nozzles/contact tips;

d) Protection of the welding arc from draught;

e) Selection and limitation of the transfer mode of molten metal.

C.2.3 Base metal

a) Identification of material;

b) Preheating mode and control;

c) Control of inter-pass temperature.

C.2.4 Welding consumables

a) Identification of welding consumables;

b) Storage, handling and conditions of the filler material for welding;

c) Selection of correct size;

d) Cleanliness of electrodes and filler wire;

e) Control of wire spooling;

f) Control and monitoring of gas flow rates and quality.

C.2.5 Safety precautions

a) Establishment and removal of safety devices;

b) Safety control of welding fumes;

c) Personal protection;

d) Fire;

e) Welding in confined spaces;

f) Knowledge of the welding environment;

g) Environment with a high risk of electric shock;

h) Arc radiation;

i) Effect of scattered arc light;

j) Safe storage, handling and use of compressed gas;

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