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Brazing for aerospace applications — Qualification test for brazers and brazing operators — Brazing of metallic components

Brasage fort pour applications aérospatiales — Épreuve de qualification des braseurs et des opérateurs braseurs — Brasage fort des composants métalliques

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Foreword

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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 11745 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*.

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

Introduction

The application of this International Standard ensures that a qualification test can be carried out in accordance with a standard test specification on standard test pieces under standard conditions. A brazer or brazing operator qualification test properly passed in accordance with this International Standard ensures that the brazer or brazing operator concerned has proved possession of at least the minimum degree of manual skills and technical knowledge demanded by the state of the art.

Brazing for aerospace applications — Qualification test for brazers and brazing operators — Brazing of metallic components

1 Scope

This International Standard specifies a qualification test for brazers engaged in manual brazing of parts and brazing operators in aerospace construction.

NOTE 1 Success in the test is an essential precondition for the qualification of brazers (3.1) and brazing operators (3.2) in new production and repair work in aerospace. However, brazing equipment operators (3.3) need not be qualified according to this International Standard.

NOTE 2 This International Standard does not apply to general brazing applications covered by ISO 13585[3].

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 18279:2003, *Brazing — Imperfections in brazed joints*

ANSI/AWS B2.2, *Brazing procedure and performance qualification*

EN 4179:2009, *Aerospace series — Qualification and approval of personnel for non-destructive testing*

EN 12799, *Brazing — Non-destructive examination of brazed joints*

EN 13134, *Brazing — Procedure approval*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
brazer
person who performs the brazing in a manual operation and guides the heating means and ensures the introduction of the brazing filler material and verifies the braze joint configuration specified by the design

3.2
brazing operator
person who prepares the joint and sets up brazing equipment and thereby has direct influence on the brazed joint quality

NOTE Examples of brazing equipment are furnaces, salt baths, and induction equipment.

3.3
brazing equipment operator
person who only operates automatic brazing equipment and has no direct influence on the brazed joint quality

NOTE Examples of automatic brazing equipment are furnaces, salt baths and induction equipment that require no brazing operator intervention of the thermal process.

3.4
examiner
person appointed to verify compliance with the applicable standard

[ISO/TR 25901:2007[5], 2.119]

NOTE In certain cases, an external independent examiner is required. The acceptability of the examiner is at the discretion of the design or engineering authority.

3.5
examining body
organization appointed to verify compliance with the applicable standard

[ISO/TR 25901:2007[5], 2.120]

NOTE In certain cases, an external independent examining body is required. The acceptability of the examining body is at the discretion of the design or engineering authority.

3.6
design/engineering authority
organization that has the responsibility for the structural integrity or maintenance of airworthiness of the hardware and compliance with all relevant documents

[ISO 24394:2008[4], 3.7]

3.7
braze assembly
assembly of parts to be brazed with regard to fit-up procedures

NOTE Fit-up procedures can include precleaning and application of brazing filler material, stop-off material or flux.

3.8
brazing coordinator
person responsible and competent to perform brazing coordination

NOTE Different brazing coordinators can be required for different tasks.

4 Requirements for the brazing coordinator

The brazing coordinator shall be designated, in writing, as responsible for the brazer or brazing operator qualification test. The brazing coordinator shall have knowledge and experience relevant to the brazing process, and be acceptable to the responsible design authority or recognized examining body.

NOTE Example of relevant knowledge is International Welding Engineer (IWE) according to IIW IAB-002-2000/EWF-409[6].

The brazing coordinator may authorize another person to administer the brazer or brazing operator qualification test.

5 Conditions required for brazer and brazing operator qualification tests

Visual acuity (eyesight) shall be examined for near vision. Brazers and brazing operators shall have visual acuity of 20/30 or better in each eye, and shall be able to read the Jaeger No. 2 eye chart at 400 mm or to pass an equivalent test as specified by an optometrist. Corrected vision may be used to fulfil eye test requirements.

For torch brazing and titanium brazing, colour perception shall be examined, e.g. according to the Ishihara test.

Vision shall be tested to these requirements at least every two years.

6 Qualification test requirements

6.1 Brazing processes

This International Standard covers qualification testing for the following brazing processes with their reference numbers according to ISO 4063[2]:

— 911 infrared brazing;

— 912 flame brazing, torch brazing;

— 916 induction brazing;

— 918 resistance brazing;

— 919 diffusion brazing;

— 921 furnace brazing;

— 922 vacuum brazing;

— 923 dip-bath brazing;

— 924 salt-bath brazing.

NOTE Other brazing processes not yet specified in ISO 4063[2] may be covered.

6.2 Material

The brazer or brazing operator qualification tests are performed according to the material groups specified below. A brazer or brazing operator qualification test is only valid for the material group applied in the qualification test. It does not include any other material group.

Material group A: Unalloyed steels, low-alloyed steels, high-alloyed ferritic steels.

Material group B: High-alloyed austenitic and martensitic steels, nickel and nickel alloys, cobalt alloys.

Material group C: Titanium and titanium alloys.

Material group D: Aluminium and aluminium alloys, magnesium and magnesium alloys.

Material group E: Materials that do not conform to material groups A to D (e.g. molybdenum, tungsten, copper alloys).

Qualification of material group B also qualifies material group A.

6.3 Material thickness

For the brazer qualification test only, a test brazement with parent material of nominal thicknesses t_1 and t_2 shall qualify brazements within a thickness range from 0,9t_1 to 1,1t_2, with $t_1 \leqslant t_2$.

6.4 Brazing position

For the brazer qualification test only, the test pieces (see 9.3.4) shall be brazed in the following brazing positions:

a) test pieces TP1 and TP3: flat flow (horizontal flow of braze filler material);

b) test piece TP2: vertical tube[1] axis (vertical upflow of braze filler material).

These brazing positions and flow directions qualify for any brazing position and any flow direction.

6.5 Filler material

For manual brazing, the range of qualification for brazing filler material application and liquidus temperatures are given in Tables 1 and 2.

Table 1 — Range of qualification for brazing filler material application

Test piece brazing filler material application	Range of qualification
manually or mechanically fed	manually or mechanically fed and preplaced
preplaced	preplaced

Table 2 — Range of qualification for brazing filler material liquidus temperatures

Test piece brazing filler material liquidus temperature	Range of qualification
$<$ 850 °C	$<$ 850 °C
$\geqslant$ 850 °C	All

7 Special qualification tests

7.1 General requirements

Any changes to the requirements defined in this International Standard are classified as special qualification tests.

As required by actual production, the brazing coordinator specifies test pieces with defined brazing processes and material thickness. A special qualification test only qualifies for brazing under the specific conditions represented by the qualification test.

If test methods are not in accordance with this International Standard, they shall be defined by the brazing coordinator. The brazing coordinator shall define additional test methods and also increase the quality requirements as defined by the design or engineering authority.

A special qualification test shall be marked in the designation with an “X”.

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

7.2 Special qualification tests for brazers

Examples are qualifications for:

a) brazing with special condition for restricted accessibility;

b) brazing on dissimilar material groups;

c) brazing on plated surfaces;

d) brazing performed on actual production parts;

e) application of filler material different to that specified for standard test pieces.

7.3 Special qualification tests for brazing operators

Examples are:

a) qualification for brazing on dissimilar material groups;

b) restriction to braze assembly work only;

c) restriction to brazing operation only (i.e. excluding braze assembly work);

d) brazing operator qualification performed on actual production parts.

8 Designation for qualification test

The designation of a brazer qualification test is composed in the sequence:

a) “brazer qualification test”;

b) number of this International Standard;

c) brazing process code number according to ISO 4063[2];

d) material group;

e) test piece thickness combination.

EXAMPLE 1 Qualification test for manual torch brazing (912) of steel, material group B, test piece thickness combination of t_1 with 1 mm and t_2 with 4 mm, qualifying any thickness combination between 0,9 mm and 4,4 mm, see 6.3:

Brazer qualification test ISO 11745 - 912 - B - 1 - 4

EXAMPLE 2 Qualification test for manual torch brazing (912) of steel, material group B, test piece thickness combination of t_1 with 1 mm and t_2 with 4 mm, qualifying any thickness combination between 0,9 mm and 4,4 mm, see 6.3. X indicates a special test (for examples see 7.2):

Brazer qualification test ISO 11745 - 912 - B - 1 - 4 - X

EXAMPLE 3 Qualification test for brazing operator, furnace brazing (921), material group B:

Brazing operator qualification test ISO 11745 - 921 - B