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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

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 14, *Welding and brazing in aerospace*.

This second edition cancels and replaces the first edition (ISO 11745:2010), which has been technically revised. It also incorporates the Amendment ISO 11745:2010/Amd 1:2015.

The main changes are as follows:

— Clause 5: visual inspection aligned with ISO 24394;

— designation for filler material added;

— editorial revisions.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

Introduction

The application of this document 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 document 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 document specifies a qualification test for brazers engaged in manual brazing of parts and brazing operators in aerospace construction.

NOTE Success in the test is an essential precondition for the qualification of brazers and brazing operators in new production and repair work in aerospace. However, brazing equipment operators need not be qualified in accordance with this document.

This document does not apply to general brazing applications covered by ISO 13585.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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*

ISO 18490, *Non-destructive testing — Evaluation of vision acuity of NDT personnel*

EN 4179, *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*

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

NAS 410, *NAS certification & qualification of nondestructive test personnel*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
brazer
person who performs the brazing in a manual operation, guides the heating means, 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 a direct influence on the brazed joint quality

Note 1 to entry: 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 1 to entry: Examples of automatic brazing equipment are furnaces, salt baths and induction equipment that require no brazing operator intervention during the thermal process.

3.4
examiner
person who has been appointed to verify conformity to the applicable standard

Note 1 to entry: In certain cases, an external independent examiner can be required.

[SOURCE: ISO/TR 25901-1:2016, 2.5.29, modified — Definition revised.]

3.5
examining body
organization that has been appointed to verify conformity to the applicable standard

Note 1 to entry: In certain cases, an external independent examining body can be required.

[SOURCE: ISO/TR 25901-1:2016, 2.5.30, modified — Definition revised.]

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

Note 1 to entry: In the case of a welded product, the design authority is usually the organization that has responsibility for the engineering definition of the product. Examples of engineering definitions include drawings, 3D models and specifications for manufacturing.

[SOURCE: ISO 24394:2018, 3.8, modified — Definition revised and note to entry added.]

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

Note 1 to entry: Fit-up procedures can include precleaning and application of brazing filler material, stop-off material or flux.

3.8
brazing coordinator
person responsible for and competent to perform brazing coordination

Note 1 to entry: 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 shall be acceptable to the responsible design authority or recognized examining body.

NOTE An example of relevant knowledge is International Welding Engineer (IWE) in accordance with IIW IAB-002-2000/EWF-409.

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

The candidate shall provide documented evidence of satisfactory vision in accordance with the following requirements. Any limitations (e.g. visual aids when required to pass the eyesight test) shall be documented on the brazer or brazing operator test certificate. Any limitations in colour perception shall be evaluated by the brazing coordinator and shall be approved in writing.

Eyesight requirements shall be achieved by using one eye or both eyes. The candidate shall successfully achieve the near vision acuity and colour perception specified herein.

Eyesight tests shall be administered by competent personnel.

The method for testing near vision acuity shall be chosen from one of the following:

a) Jaeger No. 2 eye chart at approximately 400 mm;

b) Visus 0,8 at approximately 400 mm;

c) eyesight requirements of EN 4179/NAS 410 or ISO 18490.

NOTE The results of the three near-vision testing methods are not fully comparable.

Colour perception shall be examined by a suitable method, e.g. the Ishihara test.

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

Colour perception shall be tested to these requirements at least every five years.

6 Qualification test requirements

6.1 Brazing processes

This document covers qualification testing for the following brazing processes with their reference numbers in accordance with ISO 4063:

— 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.

Other brazing processes not specified in ISO 4063 may be covered.

6.2 Material

The brazer or brazing operator qualification tests are performed according to the following material groups. 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 of $0{,}9t_1$ to $1{,}1t_2$, with $t_1 \leq t_2$.

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 axis (vertical upflow of braze filler material).

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

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

6.5 Filler material

For the brazer qualification test only, the ranges of qualification for brazing filler material application and liquidus temperatures are given in Tables 1 and 2, respectively.

Table 1 — Range of qualification for brazing filler material application

Test piece brazing filler material application	Range of qualification
Manually or mechanically fed (MF)	Manually or mechanically fed and preplaced
Preplaced (PP)	Preplaced

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

Test piece brazing filler material liquidus temperature	Range of qualification
< 850 °C (LT)	< 850 °C

Table 2 *(continued)*

Test piece brazing filler material liquidus temperature	Range of qualification
≥ 850 °C (HT)	All

7 Special qualification tests

7.1 General requirements

Any changes to the requirements defined in this document 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 document, 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 authority.

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

7.2 Special qualification tests for brazers

Examples include qualifications for:

a) brazing with a 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 include:

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 or brazing operator qualification test is composed as follows:

a) "brazer qualification test" or "brazing operator qualification test" (as applicable);

b) the number of this document, i.e. ISO 11745;

c) brazing process code number in accordance with ISO 4063;

d) material group;