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Second edition
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Brazing — Qualification testing of brazers and brazing operators

Brasage fort — Essais de qualification des braseurs et des opérateurs braseurs en brasage fort

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Foreword

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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).

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This document 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 13585:2012), which has been technically revised.

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The main changes compared to the previous edition are as follows:

— brazing processes, in accordance with ISO 4063:2009, covered by this document, have been moved to the scope;

— Clause 3 has been updated and additional terms have been defined;

— additional symbols and abbreviated terms have been added to Clause 4;

— Clause 5 has been significantly revised and updated including clarifications on brazing operator qualification;

— material grouping has been moved to new Annex E;

— Clause 6 has been updated to refer to ISO or technically equivalent standards;

— the period of validity and prolongation of qualifications has been revised to 5 years in Clause 9.

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.

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Brazing — Qualification testing of brazers and brazing operators

1 Scope

This document specifies requirements for qualification testing of brazers and brazing operators for metallic materials.

This document gives general provisions on quality requirements for brazing (see Annex A).

This document applies to the following brazing processes according to ISO 857-2 and ISO 4063:2009 with local and global heating:

— 911 Infrared brazing;

— 912 Flame brazing, torch brazing;

— 913 Laser beam brazing;

— 914 Electron beam brazing;

— 916 Induction brazing;

— 918 Resistance brazing;

— 919 Diffusion brazing;

— 921 Furnace brazing;

— 922 Vacuum brazing;

— 923 Dip-bath brazing;

— 924 Salt-bath brazing;

— 925 Flux bath brazing;

— 926 Immersion brazing;

— 972 Arc weld brazing.

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This document is not applicable to personnel operating brazing equipment who do not have any direct influence on the quality of the brazed joint, for example, personnel performing exclusively loading/unloading the brazing unit or just initiating the brazing cycle in automatic brazing.

The principles of this document can be applied to other brazing processes and brazing of materials not listed.

This document does not apply to brazing for aerospace applications covered by ISO 11745.

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 857-2, *Welding and allied processes — Vocabulary — Part 2: Soldering and brazing processes and related terms*

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ISO 4063:2009, *Welding and allied processes — Nomenclature of processes and reference numbers*

ISO 17672, *Brazing — Filler metals*

ISO 17779, *Brazing — Specification and qualification of brazing procedures for metallic materials*

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

ISO/TR 25901-1, *Welding and allied processes — Vocabulary — Part 1: General terms*

EN 12797, *Brazing — Destructive tests of brazed joints*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 857-2, ISO/TR 25901-1 and the following 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
brazing
joining process using *filler metal* (3.12) with a liquidus temperature above 450 °C

[SOURCE: ISO 857-2:2005, 3.1.2.]

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3.2
brazer
person who holds and manipulates the device for heating the brazing area by hand

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Note 1 to entry: The brazer verifies compliance with the pBPS or BPS prior to and during brazing.

3.3
brazing operator
person who controls or adjusts brazing parameters for *mechanized brazing* (3.5) or sets up brazing parameters for *automatic brazing* (3.6)

Note 1 to entry: The brazing operator verifies compliance with the pBPS or BPS prior to and during the brazing cycle.

3.4
manual brazing
brazing (3.1) where the required brazing conditions are maintained by hand

3.5
mechanized brazing
brazing (3.1) where the required brazing conditions are maintained by mechanical or electronic means but can be manually varied during the process

3.6
automatic brazing
brazing (3.1) in which all operations are performed without *brazing operator* (3.3) intervention during the process

Note 1 to entry: Manual adjustment of brazing variables by the brazing operator during brazing is not possible.

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3.7
brazing procedure specification
BPS
document that has been qualified and provides the required variables of the brazing procedure to ensure repeatability during production brazing

3.8
preliminary brazing procedure specification
pBPS
document containing the required variables of the brazing procedure which is not yet qualified

3.9
manufacturer
workshop or site (or both) which is (are) under the same technical and quality management

3.10
examiner
person who has been appointed to verify compliance with 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]

3.11
examining body
organization that has been appointed to verify compliance with 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]

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3.12
filler metal
added metal applied to brazed joints

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Note 1 to entry: Filler metal can be in the form of wire, inserts, powder, pastes, foil, etc.

3.13
flux
non-metallic material which, when molten, promotes wetting by removing existing oxide or other detrimental films from the surfaces to be joined and prevents their re-formation during the joining operation

[SOURCE: ISO 857-2:2005, 3.2.2]

3.14
test piece
brazed assembly which is used for testing purposes

3.15
test specimen
part or portion cut from the *test piece* (3.14) in order to perform specified destructive testing

[SOURCE: ISO/TR 25901-1:2016, 2.2.1.6]

4 Symbols and abbreviated terms

t material thickness

L overlap length

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D outside pipe diameter

T product type pipe

P product type plate

BJ butt joint

LJ lap joint

TJ T-joint

FF face fed

PP pre-placed

H horizontal flow

VU vertical up flow

VD vertical down flow

Where the full wording is not used, the symbols listed above and brazing process reference numbers in Clause 1 shall be used when completing the qualification test certificate (see Annexes B and C).

5 Essential variables and range of qualification

5.1 General

The qualification of brazers, (see 5.3) and brazing operators, (see 5.4) is based on essential variables in accordance with Table 1. For each essential variable, a range of qualification is defined and brazing outside that range of qualification requires a new qualification test.

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Table 1 — Essential variables for brazer and brazing operator qualification

Essential variable	Brazer	Brazing operator
Brazing process number in accordance with ISO 4063:2009	X	X
Product type: T or P	X	—
Type of joint: BJ, LJ or TJ	X	—
Parent material group(s) in accordance with Annex E	X	—
Brazing filler metal classification in accordance with ISO 17672	X	—
Brazing filler application, FF or PP	X	X
Dimensions: *t*, *D*, *L*	X	—
Filler metal flow direction: H, VU or VD	X	—
Type of equipment	—	X

NOTE There can be other variables that the manufacturer deems to be essential in certain applications, e.g. constraint on access for the torch, purging gas, etc., which need separate qualification (see Annex D).

The brazer or brazing operator who undertakes the brazing procedure test satisfactorily in accordance with this document is qualified provided that the relevant testing requirements of this document are met.

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5.2 Brazing process

Each qualification test qualifies only one brazing process (see Clause 1). A change of brazing process requires a new qualification test.

When applicable, the furnace atmosphere is limited to the same type of atmosphere, e.g. reducing or inert, carburizing or decarburizing, and hydrogen or disassociated ammonia, as used in the test.

For brazing processes where fuel gases apply, the qualification is limited to the same type of fuel gas and flame as used in the test.

5.3 Brazer qualification

5.3.1 Product type

Manual brazing of one product type qualifies for other product types in accordance with Table 2.

Table 2 — Range of qualification for product type

Dimensions in millimetres

Product type for test piece	Range of qualification
Plate	Plate and pipe
Pipe $D \leq 100$	Pipe
Pipe $D > 100$	Pipe and plate

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5.3.2 Type of joint

Range of qualification for type of joint is given by Table 3.

Table 3 — Range of qualification for type of joint

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Type of joint in test piece	Range of qualification
Butt joint	Butt joint
Lap joint	Lap joint
T-joint	T-joint

5.3.3 Parent material group(s)

In order to minimize the number of brazer qualification tests, parent materials are assigned to M-number groupings (see Annex E).

The parent material used in the brazer qualification test qualifies the brazer for brazing of all other parent materials within the same M-number grouping (see Table 4).

Parent materials that do not appear in Annex E, require separate qualification and only qualify that material.

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Table 4 — Range of qualification for parent material

Test piece material (see Annex E)	Range of qualification[a,b]
100, 110, 120, 170	100, 110, 120, 170
130, 140, 150, 160, 180	130, 140, 150, 160, 180
200, 210, 220	200, 210, 220
300, 310, 320, 330, 340, 350, 360	300, 310, 320, 330, 340, 350, 360
400, 410, 420, 430	400, 410, 420, 430
500	500
600	600
700	700
800	800

[a] For a test piece material used for brazer qualification, the brazer is qualified to braze all materials and all combinations of materials given in the same row.

[b] When test piece material from two rows are used for brazer qualification, the brazer is qualified to braze all material combinations in each row and combinations between those rows.

5.3.4 Filler metals and brazing filler application

The brazing filler metal type, based on its class in accordance with ISO 17672 or other standards that provide equivalent technical conditions, qualifies other filler metal types within the same class.

One filler metal form (for example from preformed ring to paste) only qualifies for the same form.

A test with a flux classified in accordance with ISO 18496, or other standards that provide equivalent technical conditions, only qualifies for brazing within that same classification.

The brazing filler metal application qualifies for other filler metal applications in accordance with Table 5.

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Table 5 — Range of qualification for brazing filler application

Test piece brazing filler application	Range of qualification
Face fed	Face fed, Pre-placed
Pre-placed	Pre-placed

NOTE Face fed", also known as "applied to the mouth of the joint", can be manually or mechanically fed while brazing.

5.3.5 Dimensions

The brazer qualification test of brazed joints is based on the material thickness, outside pipe diameter and overlap length. The ranges of qualification are specified in Table 6.

For dissimilar material thicknesses of test pieces, the range of qualification is based on the thickness of each plate (or pipe).

It is not intended that material thicknesses or outside pipe diameters should be measured precisely, but rather the general philosophy behind the values given in Table 6 should be applied.

For test pieces of different outside pipe diameters and parent material thicknesses, the brazer is qualified to:

— the larger diameter and below (see Table 6);

— twice the larger parent material thickness and below (see Table 6).

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