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Welding for aerospace applications — Qualification test for welders and welding operators — Fusion welding of metallic components

AMENDMENT 1

Soudage pour applications aérospatiales — Épreuve de qualification pour soudeurs et opérateurs — Soudage par fusion des composants métalliques

AMENDEMENT 1

Reference number
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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.

Amendment 1 to ISO 24394:2008 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*.

This corrected version of ISO 24394/Amd.1:2012 incorporates an updated Table 1, in which "x" replaces "—" for $D > 26$ mm in:

a) TP1, PF row, butt weld columns PA and PF;

b) TP2, PF row, fillet weld column PF;

c) TP3, PF row, butt weld columns PA, PE, and PF.

Requests for official interpretations of any aspect of this amendment 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.

Welding for aerospace applications — Qualification test for welders and welding operators — Fusion welding of metallic components

AMENDMENT 1

Page 1, Clause 2

Delete footnotes 1) and 2) and their citations from ISO 4063 and ISO 6947.

Page 3, 4.1.1

Add the following paragraph at the end of the subclause.

> The welding coordinator of the plant or the fabricator shall select from Table 2 the test piece as required for the production work on which the welder is to be employed. Two complementary specific test pieces (TP5 and TP6) may also be chosen as defined in 4.4 and 4.8.1.

Page 3, 4.1.3

Delete this subclause.

Page 5, Table 1

Replace the existing table with that on p. 3.

Page 6, 4.8.2

Delete ".", add ";" at the end of "g)" and add h).

h) qualification for welding positions that are not covered by Table 1.

Page 8, 5.1

Replace the first paragraph with the following:

The candidate shall provide documented evidence of satisfactory vision in accordance with the following requirements.

d) Near-vision acuity shall permit reading of Times New Roman N5 maximum size or equivalent font types (Times New Roman of 5 points vertical height where 1 point = 1/72 in ≡ 0,35 mm) at not less than 30 cm with at least one eye, corrected or uncorrected. This test shall be conducted with a minimum of six single spaced random capital characters.

e) Colour perception shall be examined, e.g. according to the Ishihara test.

Page 8, 5.2

Replace the second and third sentences and the note with the following:

The welding coordinator shall have knowledge and experience relevant to the welding process, and be acceptable to the responsible design authority or recognized examining body. The welding coordinator may authorize another person to administer the welder or welding operator qualification test.

NOTE 1 Example of relevant knowledge is International Welding Engineer (IWE) according to IIW IAB-252-11.[5]

NOTE 2 The person responsible for welder and welding operator qualification tests can differ from the person responsible for implementing 4.1.1

Page 10, Table 2

In column 2, row "TP1", add the following at the end of footnote [a].

— for materials susceptible to cracking, the welding sequence may be altered.

Page 15, Clause 9

Replace the fourth paragraph with the following.

The person authorized to conduct the welder's qualification test shall decide if and when a new test can be taken. If the welder or welding operator fails the test, the candidate shall have additional training and/or practice.

Page 15, Clause 11

Add the following final paragraph.

Qualifications to previous revisions of this International Standard remain valid within the limits given in the preceding.

Page 16, clause 12

Replace the third paragraph with the following.

For requalification tests, actual production parts may be used to replace test pieces, if they are consistent with the requirements of the welding process, the material group and testing as identified in the respective initial qualification test, e.g. requirements given in Table 1 and Table 3.

Page 17–18, Table A.1

Replace the existing Table with that on pp. 4–5.

Pages 19–20, Table A.2

In the "**Unacceptable imperfections**" column, row 8, "Spatter", add a superscript [e]. Insert the following footnote at the bottom of the footer row.

[e] Spatter may be acceptable on welding processes or materials where it cannot be avoided. In such cases, the acceptability is at the discretion of the welding coordinator.

Page 30,before the bibliography

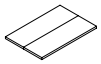
Insert Annex F, which appears on p. 6.

Page 30, Bibliography

Add the following entry:

[1] IAB-252-11, *IIW guideline for international welding engineers, technologists, specialists and practitioners — Personnel with qualification for welding coordination — Minimum requirements for the education, examination and qualification*. Available (viewed 2012-10-11) at: http://www.iiwelding.org/WorkingUnits/QCMB_IAB/Documents/IAB-252r1-11-SV00-Guideline-for-Personnel-with-Qualification-for-Welding-Coordination-SV.pdf

Table 1 — Range of qualification for welding positions

Test piece (see Table 2)	Welding position of test piece according to ISO 6947:2011	Qualified welding position														
		Plate or tube D > 26 mm									Tube D ≤ 26 mm					
		Butt weld				Fillet weld					Butt weld			Fillet weld		
		PA	PC	PE	PF	PA	PB	PC	PD	PF	PA	PC	PF	PB	PD	PF
 TP1	PA	x	—	—	—	—	—	—	—	—	x[a]	—	—	—	—	—
	PC	x	x	—	—	—	—	—	—	—	—	x [a]	—	—	—	—
	PE	x	x	x	—	—	—	—	—	—	—	—	—	—	—	
	PF	x	—	—	x	—	—	—	—	—	—	—	—	—	—	—
 TP2	PA	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—
	PB	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—
	PC	—	—	—	—	x	x	x	—	—	—	—	—	—	—	—
	PD	—	—	—	—	x	x	—	x	—	—	—	—	—	—	—
	PF	—	—	—	—	x	x	—	—	x	—	—	—	—	—	—
 TP3	PA	—	—	—	—	—	—	—	—	—	x[bc]	—	—	—	—	—
	PC	x	x	—	—	—	—	—	—	—	—	x[c]	—	—	—	—
	PF	x	—	x	x	—	—	—	—	—	x[c]	—	x[c]	—	—	—
 TP4	PB	—	—	—	—	(x)	(x)	—	—	—	—	—	—	x[c]	—	—
	PD	—	—	—	—	(x)	(x)	—	(x)	—	—	—	—	x [c]	x[c]	—
	PF	—	—	—	—	(x)	(x)	—	—	(x)	—	—	—	x[c]	—	x[c]

x indicates those welding positions for which the welder is qualified.

(x) indicates those welding positions for which the welder is qualified for welding on tube D > 26 mm, but not on plate.

— indicates those welding positions for which the welder is not qualified.

NOTE 1 Plate or sheet qualification in the PA position also qualifies for welding tubing with D > 26 mm in the PA position.

NOTE 2 Test pieces on tube do not qualify for sheet/plate. Tube welds do not contain weld start and stop points that are required for sheet or plate welds.

[a] Only applicable for longitudinal weld on a tube.

[b] Only applicable for a rotating tube with the torch in welding position PA.

[c] The qualification is valid for any tube of outer diameter equal to or larger than the outer diameter of the test piece.

Table A.1 — Required dimensions and permissible deviations of form

Dimensions in millimetres

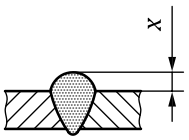
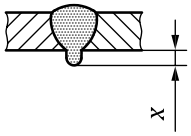
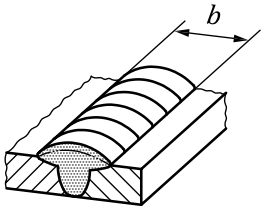
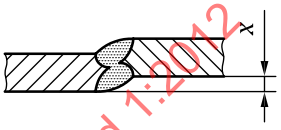
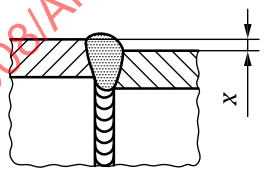
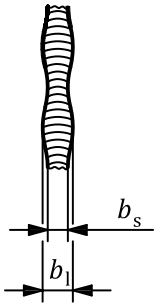
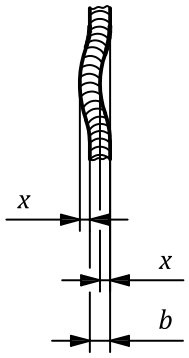
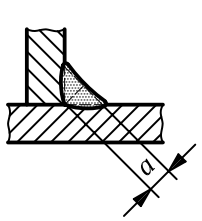
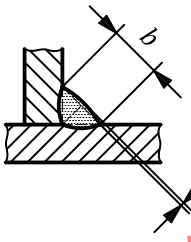
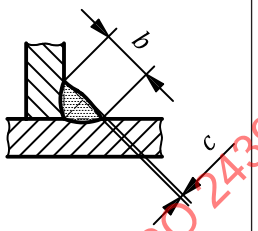
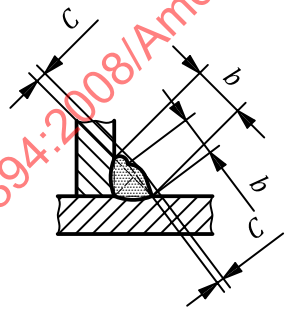
Imperfection[a]	Excess weld metal/ excess penetration 502/504		Weld width of face side 5212		Linear misalignment 5071/5072
Illustration[a]	502  504 				5071  5072 
Material group	A B C E	D	A B C E	D	A B C D E
Determination	$x = 0{,}6t + 0{,}6$ mm[b]	$x = 0{,}2t + 1{,}8$ mm[b]	$b = 1{,}8t + 5$ mm	$b = 2t + 6$ mm	$x = 0{,}1t + 0{,}3$ mm or $x =$ 0,5 mm, whichever is less
Test piece thickness, t[c]	max.	max.	max.	max.	max.
0,4	0,9	1,9	5,7	6,8	0,3
0,5	0,9	1,9	5,9	7,0	0,3
0,6	1,0	2,0	6,1	7,2	0,3
0,8	1,1	2,0	6,4	7,6	0,4
1,0	1,2	2,0	6,8	8,0	0,4
1,2	1,4	2,1	7,2	8,4	0,4
1,5	1,5	2,1	7,7	9,0	0,4
1,6	1,6	2,2	7,9	9,2	0,5
1,8	1,7	2,2	8,2	9,6	0,5
2,0	1,8	2,2	8,6	10,0	0,5
2,5	2,1	2,3	9,5	11,0	0,5
3,0	2,4	2,4	10,4	12,0	0,5

Table A.1 *(continued)*

Imperfection[a]	Weld width deviation[d]	Weld track deviation		Throat thickness[e]		
Illustration [a]		 **Deviations from the intended weld track shall be smooth and uniform on the face side of the weld.**		  **desirable fillet weld profiles**   **acceptable fillet weld profiles**		
Material group	A B C D E	A B C E	D	A B C D E	A B C E	D
Determination	$x = \left[2(b_l - b_s)\right] / (b_l + b_s)$	x = 0,25 b_{max}[f]		a = 0,7 t	a = 0,4t + 2 mm	a = 0,4 t + 3,1 mm
Test piece thickness, [c]	max.	max.	max.	min.	max.	max.
0,4	25 %	1,4	1,7	0,3	2,1	3,2
0,5		1,5	1,8	0,4	2,1	3,2
0,6		1,5	1,8	0,4	2,2	3,4
0,8		1,6	1,9	0,6	2,4	3,5
1,0		1,7	2,0	0,7	2,4	3,5
1,2		1,8	2,1	0,8	2,5	3,6
1,5		1,9	2,2	1,1	2,6	3,7
1,6		2,0	2,3	1,1	2,7	3,8
1,8		2,1	2,4	1,3	2,8	3,9
2,0		2,2	2,5	1,4	2,8	3,9
2,5		2,4	2,8	1,8	3,0	4,1
3,0		2,6	3,0	2,1	3,2	4,3

a Ordinal number according to ISO 6520-1 given, where available.

b In case of misalignment, determination is to be made from the outermost surface.

c For fillet mating parts of non-uniform thicknesses, the smaller thickness shall be taken as reference.

d b_l is the largest measured weld width and b_s is smallest measured weld width.

e Convexity C of a weld or individual surface bead b shall not exceed the following value:

weld width of face side or individual surface bead, b	convexity, C
$b \leq 8$ mm	≤1,6 mm
8 mm < b < 25 mm	≤3 mm
$b \geq 25$ mm	≤5 mm

f See column "Weld width of face side" for values of b_{max}.

Annex F
(informative)

How to use Table 1

F.1 General

When using Table 1, the user shall only move in the vertical or horizontal direction and not diagonally.

F.2 Example 1

It is intended to perform production welding plate to tube D > 26 mm with fillet welds produced in position PF. This situation is marked by a circle in Table F.1. To achieve the required qualification, the user shall find the relevant field in the same column which is marked with (observe the footnotes). This operation results in two options.

Option A:

Test piece 2 in PF position.

Option B:

Test piece 4 in PF position.

NOTE For dimensional requirements on test piece 4, see Table 2.

Depending on the availability of test piece material and also taking into consideration other production work, users have the choice of picking the most suitable option for their purposes.

F.3 Example 2

When having achieved a qualification per option B with test piece 4, outer diameter of 20 mm in PF position, which other qualifications are included?

Answer: All qualifications given in the same line shown for test piece 4 are included, which are:

— fillet welds in the PA, PB and PF position on tubes with outer diameter greater than 26 mm;

— fillet welds in PB and PF position on tubes with outer diameter from 20 mm up to 26 mm.

Fillet welds are on tube to tube and tube to plate.

See Table F.2.