

Aerospace series — Welded and brazed assemblies for aerospace constructions — Weldability and brazeability of materials

**Part 002: Homogeneous assemblies
aluminium and aluminium alloys**

ICS 49.025.01

National foreword

This British Standard is the UK implementation of EN 4632-002:2008.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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**Aerospace series - Welded and brazed assemblies for
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aluminium alloys**

Série aérospatiale - Assemblages soudés et brasés pour
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matériaux - Partie 002 : Assemblages homogènes de
l'aluminium et des alliages d'aluminium

Luft- und Raumfahrt - Schweiß- und Lötverbindungen für
die Luft- und Raumfahrt - Schweißbarkeitsgrad und
Lötbarkeitsgrad von Werkstoffen - Teil 002: Gleichartige
Verbindungen Aluminium und Aluminiumlegierungen

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Foreword

This document (EN 4632-002:2008) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2008, and conflicting national standards shall be withdrawn at the latest by October 2008.

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1 Scope

This standard defines degrees of weldability and brazeability for materials or families of materials used in the aerospace industry.

It comprises a series of sheets, by materials or by material family which:

- indicate the main titles, the typical chemical composition and the main characteristics,
- contain recommendations for welding and brazing,
- indicate a degree of weldability or brazeability for a given process under defined conditions.
- indicate a value of the mechanical strength coefficient of the welded joint for each welding process, when it could be extracted from bibliographic references referring to it. The joint coefficient is expressed as a ratio of the tensile strength of the welded joint to the tensile strength of the base alloy.

It is applicable without restriction for the manufacturing of new parts or for repair.

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.

EN 485-1, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 1: Technical conditions for inspection and delivery.*

EN 485-2, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 2: Mechanical properties.*

EN 515, *Aluminium and aluminium alloys — Wrought products — Temper designations.*

EN 573-2, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 2: Chemical symbol based designation system.*

EN 573-3, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3: Chemical composition and form of products.*

EN 1011-4, *Welding — Recommendations for welding of metallic materials — Part 4: Arc welding of aluminium and aluminium alloys.*

EN 1706, *Aluminium and aluminium alloys — Castings — Chemical composition and mechanical properties.*

EN 2032-1, *Aerospace series — Metallic materials — Part 1: Conventional designation.*

EN 2726, *Aerospace series — Aluminium alloy AL-C42201 — T6 — Sand casting — $a \leq 20$ mm.* ¹⁾

EN 2728, *Aerospace series — Aluminium alloy AL-C42101 — T6 — Sand casting — $a \leq 20$ mm.* ¹⁾

EN 4632-001, *Aerospace series — Welded and brazed assemblies for aerospace constructions — Weldability and brazeability of materials — Part 001: General requirements.*

EN ISO 18273, *Welding consumables — Wire electrodes, wires and rods for welding of aluminium and aluminium alloys — Classification.*

¹⁾ Published as ASD Prestandard at the date of publication of this standard.

ANSI/AWS A5.10-80, *Specification for bare aluminum and aluminum alloy welding electrodes and rods.* ²⁾

ASTM/ANSI B209, *Standard specification for aluminum and aluminium alloy sheet and plate.*

SAE-AMS 4031, *Aluminum alloy, sheet and plate 6.3Cu - 0.30Mn - 0.18Zr - 0.10V - 0.06Ti (2219-0) annealed.* ³⁾

SAE-AMS 4191, *Aluminum alloy, welding wire 6.3Cu - 0.30Mn - 0.18Zr - 0.15Ti - 0.10V (2319).* ³⁾

SAE-AMS-QQ-A-250/30, *Aluminum alloy 2219, plate and sheet.* ³⁾

SAE-AMS-A-21180, *Aluminum-alloy casting, high strength.* ³⁾

3 Terms, definitions, symbols and abbreviations

For the purposes of this document, the terms and definitions given in EN 4632-001 apply.

PWHT: Post-Welding Heat Treatment

F: Foil

p: powder

w: wire

AFB: Air Furnace Brazing

FLB: Flame Brazing

VFB: Vacuum Furnace Brazing

4 Use of this standard

The index of material sheets contained in this standard, classified by family based on the main element used in the chemical composition and on the alloy structure, is given in Clause 6 in this standard.

The degree of weldability or brazeability to be used is the value indicated by the material sheet considered for the process chosen. In the operating cycle, choose thermal states that give the lowest degree in preference.

If two degrees are indicated, the responsible person must select the degree that is most appropriate for the definition of the assembly.

5 Updating this standard

See EN 4632-001.

2) Published by: AWS, 550 N.W. LeJeune Road, Miami, Florida 33126.

3) Published by: Society of Automotive Engineers, Inc. (SAE), 400 Commonwealth Drive, Warrendale, PA 15096-0001, USA.

6 Index of aluminium and aluminium alloy sheets

6.1 Index by material family

- family 1000: sheet 7.1
- family 2000: sheets 7.2 to 7.7
- family 5000: sheets 7.8 and 7.9
- family 6000: sheet 7.10
- family 7000: sheets 7.11 and 7.12
- foundry alloys family: sheet 7.13

6.2 Numeric index

Sheet	Material
7.1	1050A - 1060
7.2	2001
7.3	2014
7.4	2017A
7.5	2024
7.6	2219
7.7	2618A
7.8	5056A, 5083, 5086, 5182, 5456
7.9	5754
7.10	6005A, 6013, 6016, 6056, 6060, 6061, 6063, 6081, 6082, 6181
7.11	7020, 7051
7.12	7050, 7075, 7175, 7475
7.13	Al Si 7 Mg 0,3 and Al Si 7 Mg 0,6

7 Material sheets

7.1

Designation:

EN 573-2 : EN AW-1050A; EN AW-1060

Old designation : A5, A6

EN 2032-1 : AL-P1050A; AL-P1060

ISO : Al 99,5; Al 99,6

Other standards :

Typical composition:

See EN 573-3.

Grade	Al	Si	Fe	Cu	Mn	Mg	Zn	Ti
1050A	base	≤ 0,25	≤ 0,40	≤ 0,05	≤ 0,05	≤ 0,05	≤ 0,07	≤ 0,05
1060	base	≤ 0,25	≤ 0,35	≤ 0,05	≤ 0,03	≤ 0,03	≤ 0,05	≤ 0,05

Structure:

Without structural hardening

Particular characteristics:

Recommendations for welding and filling with EN AW-1050A and EN AW-1060

Process	Thickness range in mm	State before welding	PWHT	Degree of weldability	Joint coefficient	Comments and bibliographic references []
OA	—	O or H111	none	1	—	—
TIG	≤ 2	O or H111	none	1	1	Filler metal same grade 1050 or 1080 [45]
EBW	—	O or H111	none	1	1	—
RSEW, RSW	—	O or H111 or H24	none	2	—	—

7.2

Designation:

EN 573-2 : EN AW-2001
 Old designation : AU6 MGT
 EN 2032-1 : AL-P2001-
 ISO : Al Cu 5,5 Mg Mn
 Other standards :

Typical composition:

See EN 573-3.

Grade	Al	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Ni	Zr
2001-	base	≤ 0,20	≤ 0,20	5,2 to 6,0	0,15 to 0,50	0,20 to 0,45	≤ 0,10	≤ 0,10	≤ 0,20	≤ 0,05	≤ 0,05

Structure:

With structural hardening

Particular characteristics:

Recommendations for welding and filling with EN AW-2001

Process	Thickness range in mm	State before welding	PWHT	Degree of weldability	Joint coefficient	Comments and bibliographic references []
EBW	≤ 1	T4	T	2	—	Micro-porosity in the weld [49]
		T6	none	2	—	No porosity Area with large grains in the base metal
	≤ 8	T4	T	2	—	Micro-porosity in the weld [49]
		T6	none	2	—	No porosity
	≤ 30	T4	T	2	—	No porosity [49]
		T6	none	2	—	
RSEW, RSW	—	T6	—	2	—	—

7.3

Designation:

EN 573-2 : EN AW-2014

Old designation : AU4 SG

EN 2032-1 : AL-P2014-

ISO : Al Cu 4 Si Mg

Other standards:

Typical composition:

See EN 573-3.

Grade	Al	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Ni
2014-	base	0,50 to 1,2	≤ 0,7	3,9 to 5,0	0,40 to 1,2	0,20 to 0,8	≤ 0,10	≤ 0,25	≤ 0,15	≤ 0,10

Al	Ti + Zr	
base	≤ 0,20	only for extruded or forged products with agreement between supplier and customer

Structure:

With structural hardening

Particular characteristics:

Recommendations for welding and filling with EN AW-2014

Process	Thickness range in mm	State before welding	PWHT	Degree of weldability	Joint coefficient	Comments and bibliographic references []
OA	–	–	–	4	–	–
TIG	–	–	–	4	–	–
EBW	≤ 1	T4	T4	2	–	Porosity in the weld
		T6	none	2	–	No porosity and area with large grains in the base metal [50]
	≤ 8	T4	T6	2	–	Micro-porosity
		T6	none		–	No porosity [50]
	≤ 30	T4	T6	2 to 3	–	No porosity [50]
		T6	none	2 to 3		
RSEW, RSW	–	T6	–	2	–	–
FSW	≤ 22	T6	none	2	–	[43]
	≤ 6,35	T651	none	2	0,68	[44]