
**Aeronavtika - Varjeni in trdo spajkani sestavi za konstrukcije v aeronavtiki -
Varilnost in spajkalnost materialov - 001. del: Splošne zahteve**

Aerospace series - Welded and brazed assemblies for aerospace constructions -
Weldability and brazeability of materials - Part 001: General requirements

Luft- und Raumfahrt - Schweiß- und Lötverbindungen für die Luft- und Raumfahrt -
Schweißbarkeitsgrad und Lötbarkeitsgrad von Werkstoffen - Teil 001: Allgemeines

Série aérospatiale - Assemblages soudés et brasés pour constructions aérospatiales -
Soudabilité et brasabilité des matériaux - Partie 001 : Généralités

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This European Standard was approved by CEN on 7 March 2008.

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Foreword

This document (EN 4632-001:2008) 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of an identical text or by endorsement, at the latest by October 2008, and conflicting national standards shall be withdrawn at the latest by October 2008.

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Introduction

This standard is the Part 001 of a series of standards about welded and brazed assemblies for aerospace constructions.

1 Scope

This standard defines weldability and brazeability degrees for metallic materials used in aerospace construction, for processes and techniques involving welding and brazing but excluding soldering.

It also defines rules to be observed to determine the degree of weldability and brazeability.

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

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 ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers* (ISO 4063:1998)

EN 515, *Aluminium and aluminium alloys — Wrought products — Temper designations* (EN 515:2008)

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

EN 10052, *Vocabulary of heat treatment terms for ferrous products*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in Publications on Welding and Welding Applications and issued by the International Council of the French Language and the following apply.

3.1 Weldability

3.1.1

concept of weldability

it is considered that a metallic material is weldable to a given degree, by a given process and for a given application type, when it can be used to produce a weld provided that precautions corresponding to this degree are taken, and if the characteristics and consequences of the presence of the weld satisfy the required properties chosen as the basis for a judgement

3.1.2**weldability degrees**

weldability of materials is evaluated according to the following four degrees:

- degree 1: material with very good weldability for which no special precautions are necessary. To be used in preference.
- degree 2: material with good weldability but which may require special precautions when welding (for example preheating, low advance speed, etc.).
- degree 3: material with poor weldability requiring development for each part type and which may involve manufacturing uncertainties. Not to be recommended.
- degree 4: material with very bad weldability. To be avoided.

3.2 Brazeability**3.2.1****concept of brazeability**

it is considered that a metallic material is brazeable to a given degree, by a given process and for a given application type, when it can be used to produce brazing or a brazed-diffused joint, provided that precautions corresponding to this degree are taken, and if the characteristics and consequences of the presence of the brazing satisfy the required properties chosen as the basis for a judgement

3.2.2**brazeability degrees**

brazeability of materials is evaluated according to the following four degrees:

- degree 1: material with very good brazeability for which no special precautions are necessary. To be used in preference.
- degree 2: material with good brazeability but which may require special precautions when brazing (for example electrolytic nickel flash before brazing, etc.).
- degree 3: material with poor brazeability requiring development for each part type and which may involve manufacturing uncertainties. Not to be recommended.
- degree 4: material with very bad brazeability. To be avoided.

3.3 Processes**3.3.1****welding and brazing**

the purpose of a welding operation is to make the material to be assembled continuous. In the case of a metallic material, continuity has to be achieved for the structure, but this does not necessarily imply homogeneity of the chemical composition (case of "heterogeneous" welds or brazing). The result of the operation is called a weld when two previously distinct parts are assembled together. If the operation is restricted to the addition of extra material to a part, it is called filling.

A weld may be made without any external filler material (case of resistance welding, etc.), or with filler material. For metallic materials, a filler metal with a grade similar to that of the base metal (homogeneous weld) or different to the base metal (heterogeneous weld) may be used. In the case of a filler metal, the weld may be made in a single pass (one single pass of the heat source and the filler metal) or in several passes.

Two major process categories can be distinguished:

- 1) welding or filling processes, with fusion of the edges of parts to be joined due to the thermal effect,
- 2) assembly, brazing or diffusion welding processes, for which the production temperature is less than the solidus temperature of parts to be joined; in this case, intermetallic diffusion phenomena are preponderant:
 - diffusion welding when the operation takes place in the solid phase;
 - brazing, when a liquid phase is obtained using a filler metal or is created in situ by metallurgical reaction.

EN 4632-001:2008 (E)**3.4 Technical terms****3.4.1****light alloy**

aluminium or magnesium based alloy

3.4.2**structural state**

state of the crystalline metal structure resulting from an appropriate treatment

3.4.3**fabrication**

execution of welding operations on new parts or parts being repaired

3.4.4**base material/metal**

material or metal from which elementary parts are made

3.4.5**elementary part**

single element that will be assembled with other elements to form a part

3.4.6**part - product**

assembly composed of several assembled elementary parts

3.4.7**annealing at ambient temperature**

heat treatment, sometimes called maturation on light alloy

3.4.8**super alloy**

nickel or cobalt based alloy resistant to high temperatures

3.4.9**super-refractory**

metal or alloy based on W, Ta and Mo

3.4.10**heat treatment**

treatment that will confer the required structural state and properties on the base material (see Clause 4, Symbols, codes and abbreviations)

3.5 General terms**3.5.1****manufacturer**

person who makes or fabricates and assembles elements or sub-assemblies to make assemblies from them

3.5.2**supplier**

person or holder of a contract or an order that he has accepted, and who makes a commitment to the customer to execute the services defined in the contract or the order

3.5.3**operator**

person who carries out welding operations using a mechanized or automated process

3.5.4**production**

set of parts delivered within a given time period

3.5.5**recuperation**

act that consists of making a new part that was considered to be outside acceptable criteria initially or during its normal manufacturing and inspection cycle, acceptable. Recuperation may include a very wide variety of operations such as acceptance in waiver, reworking of the part, etc.

3.5.6**repairer**

supplier in the repair activity domain

3.5.7**repair**

making a part that has been degraded during operation conform

3.5.8**series**

identical parts that are started in a same manufacturing campaign

3.5.9**competent services**

specialized service within a company with specific tasks, for example:

- design office,
- quality service,
- laboratory,
- methods office.

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3.5.10**official monitoring services**

approved government authorities or organizations responsible for checking the conformity of materials with the definition file

4 Symbols, codes and abbreviations**4.1 Process classification**

The classification given below shows the coding according to standard EN ISO 4063 and the abbreviations for each process. The code is used in preference on drawings. See Tables 1 and 2.

Table 1

Welding or filling processes with melting	Code	Abbreviation
<i>with simple melting</i>		
– gas (torch)	3	–
• oxyacetylene	311	OA
• other gasses	–	–
– electric arc	–	–
• coated electrodes	111	SMA
• TIG	141	TIG
• MIG	131	MIG
• MAG	135	MAG
• with plasma: high current	15	PAW
micro plasma	–	MPAW
– by electron beam	51	EBW
• under primary vacuum	511	EBWVP
• under secondary vacuum	511	EBWVS
– by laser beam	52	LW
• solid laser	521	SLW
• gas laser	522	GLW
<i>with melting and pressure</i>		
– by electric resistance	2	–
• spot welding	21	RSW
• roller welding	22	RSEW
• spark welding	24	RFW
– with rotating arc	185	MAW

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Table 2

Assembly or filling processes with intermetallic diffusion	Code	Abbreviation
welding in solid phase		
– by friction	42	–
• controlled	–	CDFW
• inertial	–	IFW
– by "friction stir" (friction with a rotating tool)	–	FSW
– by diffusion	45	DW
– by explosion	441	EW
• under vacuum ^a	9131 ^a	VFB ^a
• in furnace at atmospheric pressure ^a	9132 ^a	ATFB ^a
• in air furnace ^a	9133	AFB ^a
• by induction	916	IB
• under vacuum ^a	9161 ^a	VIB ^a
• in furnace at atmospheric pressure	9162 ^a	ATIB ^a
• gas (torch)	912	FLB
• resistance	918	RB
• salt bath	915	SB
– welding-brazing	97	–
• electric arc	972	ABW
• electron beam	–	EBBW
• laser	–	LBW
• gas (torch)	971	GBW
– diffusion brazing (in furnace)	919	DB
^a Not coded EN ISO 4063.		

4.2 Abbreviations

H	:	solution treatment and quenching (See EN 10052)
T	:	tempering, structural hardening, aging
Ha	:	homogenization annealing
No	:	normalization
An	:	annealing
Sz	:	sub-zero treatment
Sr	:	stress relieving
w	:	wire
p	:	powder
tp	:	transfert tape
F	:	foil
PM	:	alloy produced by powder metallurgy