

ALUMINUM MOLTEN FLUX (DIP) BRAZING

1. SCOPE:

1.1 Purpose: This specification covers the engineering requirements for producing brazed joints of aluminum and aluminum alloys by immersion in molten flux bath.

1.2 Application: Primarily for joining aluminum and selected aluminum alloys.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

- AMS 2350 - Standard and Test Methods
- AMS 3415 - Flux, Aluminum Dip Brazing 1030°F Fusion Point
- AMS 3416 - Flux, Aluminum Dip Brazing 1090°F (588°C) Fusion Point
- AMS 4045 - Aluminum Alloy Sheet, Clad Two Sides, 0.60Mg - 0.35Si - 0.28Cu,
(No. 22-0 Brazing Sheet)
- AMS 4054 - Aluminum Alloy Sheet, Clad One Side, 0.60Mg - 0.35Si - 0.28Cu,
(No. 21-0 Brazing Sheet)
- AMS 4063 - Aluminum Alloy Sheet, Clad One Side, 1.25Mn - 0.12Cu,
(No. 11-0 Brazing Sheet)
- AMS 4064 - Aluminum Alloy Sheet, Clad Two Sides, 1.25Mn - 0.12Cu,
(No. 12-0 Brazing Sheet)
- AMS 4185 - Filler Metal, Aluminum Brazing, 12Si(4047)

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2.2 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.2.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

3.1.1 Filler Metal: When required, shall be aluminum brazing alloy conforming to AMS 4185.

3.1.2 Flux: Shall conform to either AMS 3415 or AMS 3416.

3.2 Equipment:

3.2.1 Preheat Furnace: Shall be maintained within $+10^{\circ}\text{F}$ ($+5^{\circ}\text{C}$) of a selected \emptyset temperature within the range $900^{\circ} - 1050^{\circ}\text{F}$ ($480^{\circ} - 565^{\circ}\text{C}$).

3.2.2 Salt-Bath Furnace: Shall be a ceramic-type maintained within $+10^{\circ}\text{F}$ ($+5^{\circ}\text{C}$) of a selected temperature within the range $1050^{\circ} - 1200^{\circ}\text{F}$ ($565^{\circ} - 650^{\circ}\text{C}$).

3.3 Preparation:

3.3.1 Surface Condition: Surfaces to be joined shall be cleaned prior to assembly. Cleaning shall include controlled alkaline solution dip, cold water rinse, acid brightener dip, cold water rinse, and hot water rinse, unless otherwise specified.

3.3.2 Assembly: Parts to be joined shall be assembled so that clearances between \emptyset mating surfaces are within tolerances specified on drawing. Assembly should be supported so that the parts will be in proper alignment after brazing. Jigs, fixtures, and clamps shall be fabricated from material that will not significantly contaminate the flux bath. On closed assemblies, vent holes shall be provided as specified. Sufficient brazing filler alloy shall be positioned within, or in close proximity to the joint except when parts to be brazed are fabricated from clad brazing sheet such as AMS 4054, AMS 4055, AMS 4063, or AMS 4064.

3.3.3 Tack Welding: Shall be used only when specified or permitted by purchaser. \emptyset

- 3.4 Joining: Assembled details shall be preheated at a selected temperature
Ø within the range 900° - 1050°F (480° - 565°C) and transferred immediately into the flux bath. Temperature of the flux bath shall be maintained within +10°F (+5°C) of the selected temperature. Time in flux bath should be determined by a pilot assembly. Bath temperature shall be controlled within the specified temperature range to prevent incipient melting, excessive alloying of the joint, and excessive distortion.
- 3.4.1 Cooling: After brazing, assemblies shall be cooled in such a manner as to
Ø prevent cracks and minimize internal stress, distortion, scaling, or oxidation. If solution heat treatment is to be done in conjunction with brazing, cooling procedures may be revised accordingly.
- 3.5 Post Treatment: After brazing and cooling, flux shall be removed by a method which is not injurious to the surface finish and which will not remove metal below the drawing tolerances. A suitable test, such as the lack of chloride precipitate in a drop of 5% silver nitrate solution on a cleaned and rinsed part, shall be used to determine that adequate removal of flux has been obtained. Failure to pass flux removal treatment shall require additional flux removal treatment.
- 3.6 Properties: Brazed parts shall conform to the following requirements:
- 3.6.1 Appearance: Visual examination shall show braze filler metal at all
Ø surfaces of the joint, indicating proper flow through the joint.
- 3.6.1.1 Pinholes, voids, or filler metal skips extending into faying surfaces
Ø of the joint are not acceptable.
- 3.6.1.2 Cracks in filler metal or parent metal are not acceptable.
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- 3.6.1.3 Overheating of the base metal resulting in blisters or eutectic
Ø melting is not acceptable.
- 3.6.1.4 Residual flux is not permissible on surfaces of the assembly.
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- 3.6.2 Coverage: Unless otherwise specified, the area joined by filler metal
Ø shall be not less than 80% of the area of the mating portions of the assembly, determined by a method agreed upon by purchaser and vendor.
- 3.6.2.1 Filler metal in excess of that required for the joint is acceptable
Ø provided the excess metal does not interfere with the function of the completed assembly.
- 3.6.3 When specified, any part from a lot shall pass a proof test. Standards of
Ø acceptance and method of test shall be as agreed upon by purchaser and vendor.

3.7 Quality: Brazed joints shall be sound, clean, and free from imperfections detrimental to performance of assemblies.

3.7.1 The presence of unmelted filler metal in a joint is not acceptable.
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3.7.2 Evidence of eutectic melting or excessive alloy penetration of the parent metal is not acceptable. Method for evaluation shall be as agreed upon by purchaser and vendor.
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4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of brazed assemblies shall supply all samples for vendor's test and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that processing conforms to the requirements of this specification.
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4.2 Classification of Test: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests and shall be performed prior to or on the first-article shipment of a brazed assembly to a purchaser, on each lot, when a change in material or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.
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4.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.
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4.3 Sampling: Shall be not less than the following: a lot shall be all assemblies of the same part number brazed in a continuous operation and presented for vendor's inspection at one time.
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4.3.1 Coverage: Three assemblies per lot.
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4.3.2 Proof Test: One assembly per lot, when specified.
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4.3.3 Flux Removal: As required to ensure that all assemblies are free of residual flux but not less than once each working shift.
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4.4 Approval:

4.4.1 Sample parts brazed to the requirements of this specification and the vendor's facilities and procedures shall be approved by purchaser before parts for production use are supplied, unless such approval be waived by purchaser. Results of test on production parts shall be essentially equivalent to those on the approved samples.
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