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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2673D

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Superseding AMS 2673C

Brazing, Aluminum and Aluminum Alloys Molten Flux (Dip)

1. SCOPE:

1.1 Purpose:

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

1.2 Application:

This process has been used typically for joining aluminum and selected aluminum alloys.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

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2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 3415	Flux, Aluminum Dip Brazing, 1030 °F (554 °C) or Lower Liquidus
AMS 4063	Aluminum Alloy, Clad One Side, Sheet, 1.25Mn - 0.12Cu, (No. 11-0 Brazing Sheet), Annealed
AMS 4064	Aluminum Alloy, Sheet, Clad Two Sides, 1.25Mn - 0.12Cu, (No. 12-0 Brazing Sheet), Annealed
AMS 4185	Filler Metal, Aluminum Brazing, 12Si (4047)
AMS 4255	Aluminum Alloy, Clad One Side Sheet, 0.6Mg - 0.35Si - 0.28Cu (No. 21 Brazing Sheet), as Fabricated
AMS 4256	Aluminum Alloy Sheet, Clad Two Sides, 0.6Mg - 0.35Si - 0.28Cu (No. 22 Brazing Sheet), as Fabricated

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 1179	Fluoride Ion in Water
ASTM D 1193	Reagent Water

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

3.1.1 Filler Metal: Shall be aluminum brazing alloy conforming to AMS 4185 except as specified in 3.3.2.

3.1.2 Flux: Shall conform to AMS 3415 or other suitable flux.

3.2 Equipment:

3.2.1 Preheat Furnace: Shall be maintained within the range 900 to 1050 °F (482 to 566 °C).

3.2.2 Salt-Bath Furnace: Shall be a ceramic-type maintained within ±10 F (±6 C) degrees of a selected temperature within the range 1050 to 1200 °F (566 to 649 °C).

3.3 Preparation:

3.3.1 Surface Condition: Surfaces to be joined shall be clean prior to assembly. Cleaning should be by degreasing using a suitable solvent, alkaline cleaning, and deoxidizing, followed by a cold and a hot water rinse.

3.3.2 Assembly: Parts to be joined shall be assembled so that clearances between mating surfaces are within specified tolerances. The assembly shall be supported so that the parts will be in proper alignment throughout brazing. Jigs, fixtures, and clamps shall be fabricated from material that will not significantly contaminate the flux bath. Stop-off may be used provided it does not contaminate the molten flux bath. On closed assemblies, vent holes shall be provided as specified. Except when parts are fabricated from clad brazing sheet such as AMS 4063, AMS 4064, AMS 4255, or AMS 4256, the filler metal shall be positioned at one end of the joint. For a blind joint, filler metal shall be placed at the blind end when access permits. When specified, filler metal may be placed within the joint prior to assembly for brazing. When parts are made from clad sheet, the clad surface shall be in contact with the intended mating surfaces.

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

3.4 Joining:

Assembled details shall be preheated at a selected temperature within the range 900 to 1050 °F (482 to 566 °C) and transferred immediately into the molten flux bath. Temperature of the flux bath shall be maintained within ±10 °F (±6 °C) of the selected temperature. Time in flux bath should be determined by a pilot assembly to ensure complete filler metal penetration through the joint and limiting excessive alloying or erosion. Bath temperature shall be controlled to prevent incipient melting, excessive alloying of the joint, and excessive distortion.

3.4.1 Cooling: After brazing, assemblies shall be cooled in a manner which prevents cracks and minimizes internal stress, distortion, scaling, or oxidation. If solution heat treatment is to be performed in conjunction with brazing, cooling procedures may be revised accordingly.

3.5 Flux Removal:

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. The test of 3.6.5 shall be used to determine that flux has been adequately removed.

3.6 Properties:

Brazed parts shall conform to the following requirements:

3.6.1 Appearance: Examination of the visible joint edges shall show a complete line or ring of filler metal between component parts at both ends of the joint.

3.6.1.1 The total accumulated length of any pinhole, void, or filler metal skip, extending into the joint, shall not exceed 10% of the total length of the fillet. Individual pinholes, voids, or filler metal skips shall not exceed 3/32 inch (2.4 mm).

3.6.1.2 Cracks in filler metal or parent metal are not acceptable.

3.6.1.3 Overheating resulting in blisters on the base metal or eutectic melting is not acceptable.

3.6.1.4 Residual flux is not permissible on surfaces of the assembly.

3.6.2 Coverage: Unless otherwise specified, the area joined by filler metal shall be not less than 80% of the area of the mating portions of the assembly, determined by a method acceptable to purchaser.

3.6.3 Proof Pressure Test: When specified, any part from a lot shall pass a proof pressure test. Standards for acceptance and method of test shall be specified by purchaser.

3.6.4 Melting or Erosion: Shall not cause thinning of the parent metal surface adjacent to the brazed joint in excess of 5% of the parent metal thickness and 15% cumulative of the braze length.

3.6.5 Halide Test: Testing shall be conducted to ensure that residual flux has been removed. If the test indicates flux residue, the assemblies shall be subjected to additional cleaning and testing until flux removal is complete. In case of dispute, the procedure of 3.6.5.1 and/or 3.6.5.2 shall be used.

3.6.5.1 Chlorides: Rinse the test area with 40 to 50 ml of hot [approximately 180 °F (82 °C)] deionized or distilled water. Collect rinse water in a 100 mL beaker and add 3 to 5 drops of concentrated nitric acid (specific gravity 1.42) and 2 to 3 mL of 10% silver nitrate solution. Stir the contents of the beaker and allow to stand for five to ten minutes. A resultant solution as clear as a blank of distilled or deionized water treated in the same manner as the rinsings indicates the absence of chlorides. A white-to-gray precipitate or turbidity indicates the presence of residual flux.

3.6.5.2 Fluorides: Rinse the test area with approximately 200 ml of hot [approximately 180 °F (82 °C)] ASTM D 1193, Type IV, water. Collect rinse water in a 250 mL beaker. Use approximately 200 mL of ASTM D 1193, Type IV, water as a blank or comparison sample. Test both samples in accordance with ASTM D 1179. A higher concentration of fluoride in the rinse water than in the blank or comparison sample indicates the presence of fluoride-containing residual flux.

3.7 Quality:

Brazed joints shall be sound, clean, free of unmelted filler metal in the joint, and free from other imperfections detrimental to performance of brazed joints. Filler metal in excess of that required for the joint is acceptable provided it does not interfere with form, fit, or function of the completed assembly.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor of brazed assemblies shall supply all test specimens for processor's tests and shall be responsible for performing all required tests. Parts, when required for test, shall be supplied by purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that processing conforms to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Flux removal (3.5), appearance (3.6.1), coverage (3.6.2), and quality (3.7) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Proof pressure test (3.6.3), when specified, and melting or erosion (3.6.4) are periodic tests and shall be performed at a frequency selected by the processing vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of brazed parts to a purchaser, when a change in material and/or processing requires reapproval by the cognizant engineering organization (see 4.4.2), and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

4.3.1 For Acceptance Tests: Shall be as shown in Table 1. A lot shall be all assemblies of the same part number brazed in a continuous operation and presented for processor's inspection at one time.

TABLE 1 - Sampling for Acceptance Testing

Number of Parts in Lot	Quantity and Appearance	Non-Destructive Tests	Destructive Tests
1 to 6	All	3	0
7 to 15	All	4	0
16 to 40	All	4	0
41 to 110	All	5	1
111 to 300	All	6	2
301 to 500	All	7	3
501 to 700	All	8	5
701 to 1200	All	10	7
Over 1200	All	15	10

4.3.2 For Preproduction Tests: One joint shall be destructively examined for braze coverage and for evidence of overheating or other deleterious effects.

4.4 Approval:

4.4.1 The process and control procedures, a preproduction sample brazed part, or both, whichever is specified, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 The processor shall make no change to materials, processes, or control factors from those on which approval was based, unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization could affect the properties or performance of the brazed parts.