



AEROSPACE MATERIAL SPECIFICATION

AMS2673™**REV. F**

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Revised 2022-08

Superseding AMS2673E

Brazing, Aluminum and Aluminum Alloys Molten Flux (Dip)

RATIONALE

AMS2673F results from a Five-Year Review and update of this specification with the addition of ordering information, added reference to destructive testing to coverage (3.6.2), reworded and clarified chlorides (3.6.5.1) and fluorides (3.6.5.2) to state the same requirements as in AMS2472, changed flux removal to halide test in acceptance tests (4.2.1), deleted destructive coverage test from periodic testing (4.2.2) as it is a required acceptance test, added suspension of periodic testing per general agreement, added note 2 to Table 1 sampling for acceptance testing that requires sampling to be agreed upon when lot sizes are less than 40, and revised dimensions and properties statement to reflect that some SI units are primary (8.4).

NOTICE

ORDERING INFORMATION: The following information shall be provided to the brazing processor by the purchaser.

1. Purchase order shall specify not less than the following:

- AMS2673F
- Quantity of pieces to be brazed
- Method for determining area joined by filler metal (3.6.2)
- Standards for acceptance and method of test when proof test is required (3.6.3)

2. Parts manufacturing operations such as heat treating, forming, joining and media finishing can affect the condition of the substrate for brazing, or if performed after brazing, could adversely affect the brazed part. The sequencing of these types of operations should be specified by the cognizant engineering organization or purchaser and is not controlled by this specification.

1. SCOPE

1.1 Purpose

This specification covers the 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.

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For more information on this standard, visit
<https://www.sae.org/standards/content/AMS2673F/>

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 that 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 cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS3415	Flux, Aluminum Dip Brazing, 1030 °F (554 °C) or Lower Liquidus
AMS4063	Aluminum Alloy, Clad One Side, Sheet, 1.25Mn - 0.12Cu (No. 11-0 Brazing Sheet), Annealed
AMS4064	Aluminum Alloy, Clad Two Sides Sheet, 1.25Mn - 0.12Cu (No. 12-0 Brazing Sheet), Annealed
AMS4185	Filler Metal, Aluminum Brazing, 12Si
AMS4255	Aluminum Alloy, Clad One Side Sheet, 0.6Mg - 0.35Si - 0.28Cu (No. 21 Brazing Sheet), As Fabricated
AMS4256	Aluminum Alloy, Clad Two Sides Sheet, 0.6Mg - 0.35Si - 0.28Cu (No. 22 Brazing Sheet), As Fabricated
AS7766	Terms Used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D1179 Fluoride Ion in Water

ASTM D1193 Reagent Water

3. TECHNICAL REQUIREMENTS

3.1 Materials

3.1.1 Filler metal shall be aluminum brazing alloy conforming to AMS4185 except as specified in 3.3.2.

3.1.2 Flux shall conform to AMS3415 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) 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 free from water breaks prior to assembly. See 8.2.

3.3.2 Assembly

Clearances between mating surfaces of detail parts to be brazed shall be held 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 AMS4063, AMS4064, AMS4255, or AMS4256, the filler metal shall be positioned at one end of the joint. Filler metal shall be placed at the blind end of each blind joint when accessible. 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 the cognizant engineering organization.

3.4 Joining

Assembled details shall be preheated in a furnace to an established 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) degrees of a temperature established so as to preclude incipient melting, excessive alloying of the joint, and distortion in excess of dimensional requirements. Time in flux bath should be established using a pilot assembly in order to ensure complete filler metal penetration through the joint and limiting excessive alloying or erosion.

3.4.1 Cooling

After brazing, assemblies shall be cooled in a manner that prevents cracks and minimizes internal stress, distortion, scaling, and 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 that is not injurious to the surface finish and that 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 assemblies 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 (within braze filler), or filler metal skip (no presence of braze filler), 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 nondestructive and/or destructive method acceptable to the cognizant engineering organization.

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 as specified.

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)] ASTM D1193, Type IV water. Collect rinse water in a 100 mL beaker and add three to five 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 5 to 10 minutes. A solution as clear as a blank of ASTM D1193, Type IV water treated in the same manner as the rinse water 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 D1193, Type IV, water. Collect the rinse water in a 200 mL beaker. Using two 100 mL Nessler, or equivalent, color comparison tubes, pour 100 mL of rinse water into one tube and 100 mL of ASTM D1193, Type IV, water, into the other as a blank. Treat the water in the two tubes in accordance with ASTM D1179, Method B, or use an equivalent colorimetric method. Allow the color to develop. A color in the rinse water deeper than that of the blank indicates the presence of 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

Appearance (3.6.1), coverage as agreed upon (3.6.2), halide (3.6.5), and quality (3.7) are acceptance tests and shall be performed on brazed assemblies sampled from each lot. See 4.3.1.

4.2.2 Periodic Tests

Proof pressure testing when specified (3.6.3) and melting or erosion (3.6.4) are periodic tests and shall be performed at a frequency established by the processor unless frequency of testing is specified.

4.2.2.1 Periodic testing may be suspended in any test period when parts are not processed; however, preproduction testing may be required by the cognizant quality organization upon resumption of processing.

4.2.3 Preproduction Tests

All property verification tests (3.6) are preproduction tests and shall be performed prior to or on the initial shipment of brazed assemblies to the purchaser and when purchaser requires confirmatory testing.

4.3 Sampling for Testing

4.3.1 Acceptance Tests

Acceptance test samples shall be randomly selected from all parts or assemblies in the lot. 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. Unless the cognizant engineering organization provides a sampling plan, the minimum number of samples shall be as shown in Table 1.

Table 1 - Sampling for acceptance testing

Number of Parts in Lot	Quantity and Appearance	Coverage Non-Destructive Tests	Coverage Destructive Tests
1 to 6	All	3 or all ⁽¹⁾	(2)
7 to 15	All	4	(2)
16 to 40	All	4	(2)
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

NOTES:

(1) Whichever is less.

(2) When there are 40 or less parts in the lot, sampling shall be agreed upon between the processor and the cognizant engineering organization.

4.3.2 Periodic Tests

Sample quantities shall be selected at the discretion of the processor, unless otherwise specified by the cognizant engineering organization.

4.3.3 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 If the processor makes a change to any material, process, or control factor from that which was used for approval, all preproduction tests shall be performed, and the results submitted to the cognizant engineering organization for process reapproval unless the change is approved by the cognizant engineering organization. A significant change is one that, in the judgment of the cognizant engineering organization could affect the properties or performance of the brazed parts.