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400 COMMONWEALTH DRIVE WARRENDALE PA 15096

# AEROSPACE MATERIAL SPECIFICATION

AMS 2672D
Superseding AMS 2672C

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## ALUMINUM BRAZING

1. SCOPE:

1.1 Purpose: This specification covers the engineering requirements for producing brazed joints using an aluminum alloy with melting point below that of the basis metal as the brazing filler metal.

1.2 Application: For joining aluminum and selected aluminum alloys. Not recommended for use on parts which will operate in service over 530°F (275°C) or where high strength joints are required over 370° (190°C), or on materials subject to eutectic melting from the brazing operation.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) 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 - Standards and Test Methods
AMS 2673 - Aluminum Molten Flux (Dip) Brazing
AMS 3412 - Flux, Aluminum Brazing
AMS 3416 - Flux, Aluminum Dip Brazing, 1090°F (588°C) Fusion Point
AMS 4054 - Aluminum Alloy Sheet, Clad One Side, (0.6Mg - 0.35Si - 0.28Cu (No. 21-0 Brazing Sheet)
AMS 4055 - Aluminum Alloy Sheet, Clad Two Sides, 0.6Mg - 0.35Si - 0.28Cu (No. 22-0 Brazing Sheet)
AMS 4184 - Filler Metal, Aluminum Brazing, 10Si - 4.0Cu (4145)
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: Shall be aluminum brazing alloy conforming to AMS 4184 or AMS 4185 except as specified in 3.3.3. Either alloy may be used for torch or furnace brazing; AMS 4185 shall be used for molten flux (dip) brazing.

3.1.2 Flux: Flux for torch brazing shall conform to AMS 3412; flux for furnace brazing shall conform to AMS 3412 or AMS 3416. The flux may be used dry or mixed with water or alcohol.

3.2 Equipment:

3.2.1 Torch Method: Torches, tips, regulators, and accessory equipment shall be appropriate for the thickness of the material being brazed.

3.2.2 Furnace Method: Furnaces shall be circulating-air type, maintained within ±10°F (±5°C) of a selected temperature within the range 900°F - 1200°F (480° - 650°C) by suitable controls.

3.2.3 Molten Flux (Dip) Method:

3.2.3.1 Pre-heat furnace shall be maintained within ±10°F (±5°C) of a selected temperature within the range 900°F - 1000°F (480° - 540°C).

3.2.3.2 Salt-bath furnace shall be a ceramic-type maintained within ±5°F (±3°C) of a selected temperature within the range 1050°F - 1200°F (565° - 650°C).

3.3 Preparation:

3.3.1 Surface Condition: The surfaces to be joined shall be clean prior to assembly. Cleaning should be by degreasing, alkaline cleaning, and deoxidizing to a surface resistance not higher than 100 ohms.

3.3.2 Fluxing: Unless otherwise specified, flux shall be applied so that surfaces to be joined are sufficiently coated to ensure the specified bond between the parts after brazing; if preplaced filler metal inserts are used, they shall also be coated with flux. Application of flux is not required when parts are to be joined by molten flux (dip) brazing.

3.3.3 Assembly: The parts to be joined shall be assembled so that clearances between mating surfaces are within specified tolerances. The assembly should be supported so that the parts will be in proper alignment after brazing. Sufficient filler metal shall be placed within, or in close proximity to, the joint except when parts to be joined are fabricated from clad brazing sheet such as AMS 4054 or AMS 4055 or when the filler metal is hand-fed during torch brazing. In the case of blind joints, the filler metal shall be placed within the joint.

3.3.3.1 Tack welding for fixturing shall be used only when specified or permitted by purchaser.

3.3.3.2 On closed assemblies, vent holes shall be provided as specified.

3.4 Procedure:

3.4.1 Joining: Unless otherwise specified, joining shall be effected by torch, furnace, or molten flux (dip) heating; when joining is effected by molten flux heating, the requirements of AMS 2673 shall be met. Parts shall be heated, preferably rapidly, until the filler metal melts and joints are formed. In torch brazing, parts shall be held at heat until clean filler metal is visible, when joint configuration permits, at the end of the joint opposite that at which the filler metal was introduced, but further heating shall be kept to a minimum. In furnace and molten flux brazing, the brazing temperature and time at heat necessary to form joints shall be preestablished such that when parts are removed from their respective heat sources, clean filler metal is visible, when joint configuration permits, at the end of the joint opposite that at which the filler metal was introduced. The temperature to which parts are heated for brazing shall be controlled so that incipient melting of the parts does not occur.

3.4.1.1 Torch Method: The assembly shall be heated locally in the joint area using a reducing flame, taking care not to overheat the parent metal. Sufficient filler metal shall be introduced to the joint. When desirable, flow of filler metal may be restricted by employing a paste compound of sodium fluoride and water.

3.4.1.2 Furnace Method: Sufficient filler metal shall be preplaced in the joints. Preheating to approximately 400°F (205°C) is recommended to remove the water in the flux. Time necessary to obtain acceptable joints should be established through use of a pilot assembly. Flow of brazing alloy may be restricted as in 3.4.1.1.

4.3.1.3 Dip Method: Assembled details shall be preheated to 1000°F ± 10 (540°C ± 5), and transferred immediately to the dip bath furnace and slowly immersed in the flux. Temperature of the flux bath shall be maintained within ±5°F (±3°C) of the selected temperature. Time in the flux bath should be determined by a pilot assembly.

3.4.2 Cooling: After brazing, assemblies shall be cooled in such a manner as to prevent cracks and minimize internal stress, distortion, scaling, and 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 material below drawing tolerances. A suitable test, such as the lack of a typical chloride precipitate in a 5% aqueous solution of silver nitrate on the cleaned and rinsed part, shall be used to determine that flux has been adequately removed. Failure to pass this test shall require additional flux removal treatment.

3.6 Properties: Brazed parts shall conform to the following requirements:

3.6.1 Appearance: Visual examination of joints shall show a generous fillet of filler metal between component parts at the end of the joint at which the filler metal was introduced and, when practical, shall show at least a metallic stain of filler metal at the opposite end of the joint, to indicate complete penetration of filler metal through the joint.

3.6.1.1 Pinholes, voids, or filler-metal skips extending into faying surfaces of the joint are not acceptable and shall require rework of an assembly. Unless otherwise specified, the aggregate area of surface defects shall not exceed 10% of the surface of the respective braze fillet.

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

3.6.1.3 Overheating of the base metal resulting in blisters on the parent metal is not acceptable.

3.6.1.4 No residual flux shall be permitted on surfaces of the assembly.

3.6.2 Coverage: Unless otherwise specified, the area joined by the filler metal 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 provided the excess filler metal does not interfere with the function of the completed assembly.

3.6.3 Proof Test: When specified, any part from a lot shall pass a proof test. Standards for 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 foreign materials and from imperfections detrimental to performance of assemblies.

3.7.1 Fillets presenting a surface, after cleaning, similar to a cast surface are acceptable.

3.7.2 The presence of unmelted filler metal in a joint is unacceptable.

3.7.3 Melting or erosion of the parent metal surface adjacent to the brazed joint shall be limited to a maximum of 5% of parent metal thickness and 15% cumulative of the braze length.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of brazed assemblies shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the processing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to all technical Ø requirements of this specification are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical Ø requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of brazed parts to a purchaser, 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.

4.2.2.1 For direct 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.

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.

4.3.1 Coverage: Three assemblies per lot.

4.3.2 Proof Test: One assembly per lot, when specified.

4.3.3 Flux Removal Test: As required to ensure that all assemblies are free of residual flux but not less than once each working shift.

4.4 Approval:

4.4.1 Sample assemblies 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 tests on production assemblies shall be essentially equivalent to those on the approved samples.