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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2670G

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Superseding AMS 2670F

Submitted for recognition as an American National Standard

COPPER BRAZING

1. SCOPE:

1.1 Purpose: This specification covers the engineering requirements for producing brazed joints using copper as the brazing filler metal.

1.2 Application: Primarily for joining carbon steels, low-alloy steels, and corrosion and heat resistant steels and alloys. Not recommended for use on parts which will operate in service over 1000°F (538°C) or requiring high strength joints for service over 700°F (371°C), or on materials subject to undesirables carbide precipitation during cooling from the brazing temperature.

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 following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

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

2.1.1 Aerospace Material Specifications:

AMS 2418 - Copper Plating,
AMS 2424 - Nickel Plating, Low Stressed Deposit
AMS 2635 - Radiographic Inspection
AMS 3430 - Brazing Filler Metal, Paste, Copper Water Thinning
AMS 4500 - Copper Sheet, Strip and Plate, Soft Annealed
AMS 4501 - Copper Sheet, Strip and Plate, Oxygen Free, Light Cold Rolled
AMS 4701 - Copper Wire, 99.95 (Cu + Ag), Annealed
AMS 4740 - Copper Powder, 99 min Cu, As Fabricated

2.2 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.2.1 Military Standards:

MIL-STD-453 - Inspection, Radiographic
MIL-STD-2073-1 - DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

3.1.1 Filler Metal: Shall be copper conforming to AMS 4500, AMS 4501, Ø AMS 4701, or AMS 4740, or copper paste conforming to AMS 3430. Alternatively, copper plating conforming to AMS 2418 not extending beyond the intended joint and fillet area may be used.

3.1.2 Flux: Paste or liquid flux shall not be used, unless permitted by purchaser.

3.2 Equipment: Furnaces with suitable protective atmosphere, as defined in 3.3, Ø shall be used for brazing. Alternatively, induction heating using a protective atmosphere in a jacket surrounding the work may be used. Where brazing is concurrent with heat treatment, the pyrometry requirements of the applicable heat treatment specification shall be applicable.

3.3 Atmospheres: Brazing shall be conducted in any of the following atmospheres:

3.3.1 Argon of not less than 99.99% purity and dew point not higher than -35°F (-37°C).

3.3.2 Hydrogen of not less than 99.99% purity and dew point not higher than Ø -25°F (-30°C). Hydrogen derived from dissociated ammonia is not permitted.

3.3.3 Any mixture of hydrogen and argon, each conforming to 3.3.1 or 3.3.2, may be used.

3.3.4 Vacuum with absolute pressure not higher than 20 micrometers mercury. A Ø partial vacuum may be used by backfilling with argon or hydrogen, each conforming to 3.3.1 or 3.3.2, to suppress copper evaporation.

3.3.5 Atmosphere other than those listed in 3.3.1 to 3.3.4 may be used when authorized in writing by purchaser, provided such atmospheres will not cause scaling, carburization or decarburization, nitriding, or other undesirable surface effects, and all other technical requirements are met.

3.4 Preparation:

3.4.1 Surface Condition: The surfaces to be joined shall be clean prior to assembly.

3.4.1.1 Plating: For base metals containing a specified minimum or range of Ø aluminum and/or titanium surfaces to be brazed and adjacent areas not exceeding 1/4 inch (6.4 mm) from the joint may be nickel plated 0.0001 - 0.0006 inch (2.5 - 15 µm) thick using nickel plating in accordance with AMS 2424 or copper plating in accordance with AMS 2418. When used, copper plate thickness shall be not less than 0.0001 inch (2.5 µm) but may be as thick as necessary to provide filler metal.

3.4.2 Fluxing: When use of a flux is permitted, flux shall be applied to the joint areas of parts.

3.4.3 Assembly:

3.4.3.1 Clearances: Tight or interference fit is preferred. Where not Ø specified, joint gap shall be within the range of 0.002 inch (0.05 mm) clearance to 0.002 inch (0.05 mm) interference. For joints where copper plating is used as the source for filler metal, interference fits are required.

3.4.3.2 Fixturing: Self fixturing is desirable. Parts shall be supported so Ø that they will be in proper alignment after brazing. Arc tack welding is prohibited. No form of welding on tube assemblies is permitted unless authorized in writing by purchaser.

3.4.3.3 Filler Metal Preplacement: Electroplated copper may be on one or both Ø surfaces to be joined. For all other cases, filler metal shall be preplaced at one end of the joint only. For blind joints, non-electroplated filler metal.

3.5 Procedure:

3.5.1 Joining: Parts shall be heated, in equipment defined in 3.2, using an Ø atmosphere defined in 3.3, to a selected temperature within the range 2000° - 2100°F (1093° - 1149°C), held at the selected temperature within ± 25°F (± 14°C) until the copper melts.

3.5.2 Cooling: After brazing, assemblies shall be cooled in such a manner as to prevent cracks and minimize internal stress, distortion, scaling, and decarburization. Cooling from the brazing temperature to below the scaling temperature shall be done in one of the atmospheres described in 3.3. If hardening is done in conjunction with brazing, cooling procedures may be revised accordingly.

3.6 Post Treatment:

3.6.1 Flux Removal: After brazing and cooling, residues of flux, if used, shall Ø be completely removed from the parts by a method not injurious to the specified surface finish.

3.6.2 Heat Treatment: For martensitic steels, where heat treatment is required Ø and the normal heat treatment temperature for the base metal is less than 1980°F (1082°C), such heat treatment shall be conducted in a separate operation after cooling from the brazing temperature.

3.7 Properties: Brazed parts shall conform to the following requirements:
Ø

3.7.1 Appearance: Examination of all visible joint edges shall show a complete Ø line or ring of copper between component parts at both ends of the joint.

3.7.2 Coverage: The area joined by copper shall be not less than 80% of the area of the mating portions of the assembly. Method for determination shall be as agreed upon by purchaser and vendor.

3.7.2.1 Surfaces of parts shall be free from excessive filler metal that Ø interferes with form, fit, or function.

3.7.2.2 The presence of unflowed filler metal is not acceptable.
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3.7.3 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.

3.8 Quality: Brazed joints, as received by purchaser, shall be sound, clean and free from foreign materials and from imperfections detrimental to performance of brazed joints.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of brazed assemblies shall supply Ø 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 processing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for all technical requirements are acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests for all technical requirements are Ø 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 as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 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, contracting officer, or request for procurement.

4.3 Sampling and Testing: 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 Visual: Each assembly. Ø

4.3.2 Coverage:.

4.3.2.1 When coverage is determined destructively by tear test or metallographic Ø examination, test frequency shall be not less than one part per lot or one part per 100 parts brazed, whichever is more frequent.

4.3.2.2 When coverage is determined non-destructively, as for example, by Ø radiography in accordance with AMS 2635 or MIL-STD-453, or ultrasonic inspection of the joints in accordance with a procedure specified by purchaser; test frequency shall be agreed upon by purchaser and vendor. Failure of any part shall be cause for 100% inspection of the lot.

4.3.2.3 Examination for braze internal coverage may be waived when parts are Ø proof tested in accordance with 3.7.3 and 4.3.3.

4.3.3 Proof Test: When a proof test is required, any part shall pass a proof Ø test. Standards for acceptance and method of test shall be as agreed upon by purchaser and vendor. Failure of any part to pass proof test requirements shall be cause for 100% testing of the lot.

4.3.4 For preproduction testing, at least one joint shall be destructively examined for braze coverage and for evidence of surface contamination due to carburization, decarburizing, nitriding, or other deleterious effects.

4.4 Approval:

4.4.1 Sample assemblies, brazed in accordance with specified requirements, Ø and/or vendor's facilities, procedures, and control methods used in processing parts shall be approved by purchaser before parts for production use are supplied. Results of tests on production assemblies shall be equivalent to those on approved samples.