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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2670H

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Superseding AMS 2670G

Submitted for recognition as an American National Standard

(R)

Brazing, Copper

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:

This process has been used typically for joining carbon steels, low-alloy steels, and corrosion and heat resistant steels and alloys. It is 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), but usage is not limited to such applications.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in 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.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.1 SAE Publications:

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

AMS 2418 Plating, Copper
AMS 2424 Plating, Nickel, 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, Oxygen Free, 99.95 (Cu + Ag), Annealed
AMS 4740 Copper Powder, 99.0 Cu, Minimum, As Fabricated

2.2 ASTM Publications:

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

ASTM E 1742 Radiographic Examination

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

3.1.1 Filler Metal: Shall be copper conforming to AMS 4500, AMS 4501, 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 atmospheres, as defined in 3.3, 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 -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 microns mercury. A 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 of this specification 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 aluminum and/or titanium, surfaces to be brazed and adjacent areas not exceeding 1/4 inch (6.4 mm) from the joint may be plated 0.0001 to 0.0006 inch (2.5 to 15 µm) thick, using nickel plating in accordance with AMS 2424. As an alternative copper plating in accordance with AMS 2418 may be used; 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 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 that they will be in proper alignment after brazing. 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 surfaces to be joined. For all other cases, filler metal shall be preplaced at only one end of the joint except as permitted in 3.4.3.3.1. For blind joints, the filler metal shall be placed at the blind end of the joint and electroplated filler metal shall not be used.

3.4.3.3.1 Shims or filler metal may be preplaced within the joint when authorized by purchaser.

3.5 Procedure:

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

3.5.2 Cooling: After brazing, assemblies shall be cooled so 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, the residues of flux, if used, shall 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 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 Rebrazing:

Parts may be rebrazed a maximum of two times using the original brazing process and time and temperature cycle. Braze filler metal may be added at the original location of filler metal preplacement, or if the joint is subjected to nondestructive examination such as radiography, ultrasonic examination or proof test, to any area of the joint, provided there is evidence of satisfactory wetting and flow at that area of the joint.

3.8 Properties:

Brazed parts shall conform to the following requirements:

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

3.8.2 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 acceptable to purchaser.

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

3.8.2.2 The presence of unflowed filler metal is not acceptable.

3.8.3 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 processor.

3.9 Quality:

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor of brazed assemblies shall supply all samples for processor's tests and shall be responsible for performance of all required tests. When parts are to be tested, such parts shall be supplied by the purchaser. 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 preproduction tests and shall be performed prior to or on the initial shipment of brazed parts to a purchaser, when any change in material and/or processing requires approval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

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 the same equipment without breakdown of setup and presented for processor's inspection at one time.

4.3.1 Visual: Each assembly.

4.3.2 Coverage:

4.3.2.1 When coverage is determined destructively by tear test or metallographic 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 radiography in accordance with AMS 2635 or ASTM E 1742 or ultrasonic inspection of the joints in accordance with a procedure specified by purchaser; test frequency shall be agreed upon by purchaser and processor. 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 proof tested in accordance with 3.8.3 and 4.3.3.