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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2667D

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Submitted for recognition as an American National Standard

Superseding AMS 2667C

SILVER BRAZING
For Small Pressurized Fittings

1. SCOPE:

1.1 Purpose:

This specification covers the engineering requirements for producing brazed joints between flexible metal hose, pressure fittings, pipe and tube joints, and similar parts, such as bellows and rigid end fittings where one end of the joint is not accessible for inspection, and the properties of such joints. Parts are usually made of austenitic corrosion and heat resistant steels but may be carbon or low-alloy steels or copper alloys.

1.2 Application:

This process has three types, depending upon maximum intended service temperature:

Type I 600 °F (316 °C) maximum service temperature
Type II 400 °F (204 °C) maximum service temperature
Type III 800 °F (427 °C) maximum service temperature

1.2.1 If a type is not specified, Type 1 shall be supplied.

1.2.2 Maximum operating pressures will vary with part geometry and should be specified by purchaser.

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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.

1.3.1 Warning: Numerous scientific studies have determined that cadmium presents a health hazard to persons who are exposed to it.

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.

AMS 3410 Flux, Silver Brazing
AMS 3411 Flux, Silver Brazing, High Temperature
AMS 4768 Brazing Filler Metal, Silver, 35Ag - 26Cu - 21Zn - 18Cd, 1125 - 1295 °F (607 - 702 °C) Solidus-Liquidus Range
AMS 4769 Filler Metal, Silver Brazing, 45Ag - 24Cd - 16Zn - 15Cu, 1125 - 1145 °F (607 - 618 °C) Solidus-Liquidus Range
AMS 4770 Filler Metal, Silver Brazing, 50Ag - 18Cd - 16.5Zn - 15.5Cu, 1160 - 1175 °F (627 - 635 °C) Solidus-Liquidus Range
AMS 4771 Brazing, Filler Metal, Silver, 50Ag - 16Cd - 15.5Zn - 15.5Cu - 3.0Ni, 1170 - 1270 °F (632 - 688 °C) Solidus-Liquidus Range
AMS 4772 Brazing Filler Metal, Silver, 54Ag - 40Cu - 5.0Zn - 1.0Ni, 1325 - 1575 °F (718 - 857 °C) Solidus-Liquidus Range

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

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

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

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

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3. TECHNICAL REQUIREMENTS:

3.1 Materials:

3.1.1 (R) Flux: For Types I and II, shall conform to AMS 3410. For Type III, flux shall conform to AMS 3411. Other fluxes may be used if approved by purchaser.

3.1.2 Filler Metal:

3.1.2.1 (R) Type I: Shall conform to AMS 4768 or AMS 4771. AMS 4771 shall be used for brazing austenitic corrosion and heat resisting steels.

3.1.2.2 (R) Type II: Shall conform to AMS 4769, AMS 4770, or AMS 4771. For austenitic corrosion resistant steels, AMS 4771 shall be used.

3.1.2.3 (R) Type III: Shall conform to AMS 4772.

3.2 Preparation:

The surfaces to be joined shall be clean prior to assembly. Surfaces shall not be highly polished.

3.3 Procedure:

3.3.1 (R) Fluxing: Flux, as specified in 3.1.1, shall be applied so that the surfaces to be joined are completely coated. Flux should not be used on hose covered with wire braid or wire cloth because of the wicking action of the cloth or braid and the resulting difficulty of removal. Where this is unavoidable by part design, fluxes used shall be free from chlorides and fluorides.

3.3.2 (R) Assembly: The parts shall be assembled so that the clearances between mating surfaces will produce optimum coverage by filler metal without appreciable running on surfaces outside the boundaries of the joint area. Optimum joint clearances for silver brazing are in the range of 0.001 to 0.004 inch (0.025 to 0.10 mm). Sufficient filler metal shall be placed within, or in close proximity to, the joint. The assembly should be supported so that the parts will be in proper alignment after brazing.

3.3.3 (R) Joining: Shall be accomplished by electrical induction, molten filler metal, or neutral flame torch heating, unless a specific method of heating is specified. The method of heating for brazing should be selected with care to avoid damaging previously applied supplementary coatings; e.g., hose assemblies having silver plated coupling nuts should not be brazed by immersion in molten filler metal. Parts shall be heated until the filler metal melts and the joint is formed. Further heating shall be held to a minimum. Overheating shall be avoided.

3.3.3.1 (R) Silver brazing by torch method shall be performed only by operators who have been qualified, by a procedure acceptable to purchaser, to braze the metals specified for each assembly.

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3.3.4 Cooling: After brazing, but prior to handling, assemblies shall be cooled for sufficient time to allow the filler metal to solidify and in such a manner as to prevent cracks and minimize internal stress, distortion, and scaling.

3.3.5 Flux Removal: After brazing and cooling, flux shall be removed by a method not injurious to the specified surface finish. The tests of 3.4.3 shall be used to determine that flux has been adequately removed.

3.4 Properties:

Brazed parts shall conform to the following requirements:

3.4.1 (R) Coverage: Visual examination of joints shall show an adequate fillet of filler metal at the end of the joint at which the filler metal was introduced. Surface and subsurface voids in the brazed joint are acceptable provided pressure and leak test requirements are met.

3.4.1.1 (R) Parts shall be visibly free from flux residue.

3.4.1.2 (R) The presence of unflowed filler metal is unacceptable.

3.4.2 Tests:

3.4.2.1 (R) Proof Tests: When specified by purchaser, any part from a lot shall pass a proof test. Where no proof test procedure is specified, the proof pressure of production parts shall be 75% of the average burst pressure of not less than three preproduction samples or as specified by purchaser. Proof pressure testing may be done pneumatically or hydrostatically at room temperature.

3.4.2.2 (R) Burst Pressure Tests: When specified by purchaser, any part from a lot shall pass a burst pressure test. The burst pressure shall be the maximum pressure sustained without noticeable leakage.

3.4.2.3 (R) Leak Tests: Any part from a lot shall sustain an internal pressure of not less than 90% of the proof pressure without leakage, unless another leak test pressure is specified by purchaser. Leak tests shall be done pneumatically with the assembly held under still, clear water for not less than 5 minutes.

3.4.3 (R) Halide Tests: Test shall be conducted on brazed assemblies to ensure that residual halide containing flux has been removed. If the flux is known not to contain chlorides, tests for chloride need not be made; if the flux is known not to contain fluorides, the test for fluorides need not be made. If tests indicate the presence of halides, parts shall be subjected to additional cleaning and testing procedures until removal is complete. Test methods are not specified, but in case of dispute, the following test methods shall apply:

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3.4.3.1 Chlorides: Rinse the test area with 40 - 50 mL of hot (approximately 180 °F (82 °C)) ASTM D 1193, Type IV, water. Collect rinse water in a 100 mL beaker and add 3 - 5 drops of concentrated nitric acid (sp gr 1.42) and 2 - 3 mL of 10% silver nitrate solution. Stir the contents of the beaker and allow to stand 5 - 10 minutes. A solution as clear as a blank of ASTM D 1193, Type IV, 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.

3.4.3.2 Fluorides: Rinse the test area with approximately 200 mL of hot (approximately 180 °F (82 °C)) ASTM D 1193, Type IV, water. Collect the rinse water in a 250 mL beaker. Using two 100 mL Nessler or equivalent color comparison tubes, pour 100 mL of the rinsings into one tube and 100 mL of ASTM D 1193, Type IV, water into the other as a blank. Treat the water in the two tubes in accordance with ASTM D 1179, 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.

3.5 Quality:

3.5.1 Brazed joints shall be sound, clean, and free from foreign materials and from imperfections detrimental to usage of the brazed joints.

3.5.2 (R) Surfaces of assemblies shall be free from pitting, burning, and from excessive filler metal that interferes with form, fit, or function.

4. QUALITY ASSURANCE PROVISIONS:

4.1 (R) 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. 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 (R) Acceptance Tests: Tests for all technical requirements except burst pressure tests are acceptance tests and shall be performed on each lot.

4.2.2 (R) 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 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.

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