SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS2675 | REV. H

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Superseding AMS2675G

Brazing, Nickel Alloy Filler Metal

RATIONALE

AMS2675H expands and clarifies the role of the cognizant engineering organization (sections 3 and 4, numerous paragraphs).

1. SCOPE

1.1 Purpose

This specification covers the requirements forproducing brazed joints in parts made of steels, iron alloys, nickel alloys, and cobalt alloys by use of nickel alloy filler metal.

1.2 Application

This process has been used typically for joints requiring high strength and corrosion and oxidation resistance up to 1200 °F (649 °C), but usage is not limited to such applications.

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 724-776-4970 (outside USA), www.sae.org.

AMS2403 Plating, Nickel, General Purpose

AMS2424 Plating, Nickel, Low-Stressed Deposit

AMS2750 Pyrometry

AMS4775 Nickel Alloy, Brazing Filler Metal, 73Ni - 0.75C - 4.5Si - 14Cr - 3.1B - 4.5Fe, 1790 to 1970 °F (977 to 1077 °C) Solidus-Liquidus Range

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2.2 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME B46.1 Surface Texture, Surface Roughness, Waviness and Lay

3. TECHNICAL REQUIREMENTS

3.1 Materials

3.1.1 Filler metal shall conform to AMS4775, unless otherwise specified See 8.2.

3.1.2 Flux

Paste or liquid fluxes shall not be used, unless permitted by the cognizant engineering organization.

3.2 Equipment

Furnaces, with suitable protective atmospheres as defined in 3.3, shall be used for brazing unless electrical induction, electrical resistance heating, or other method is permitted by the cognizant engineering organization. Where brazing is concurrent with heat treatment, the pyrometry requirements of the applicable heat treatment specification shall be applied. Otherwise, pyrometry shall be in accordance with AMS2750.

3.3 Atmospheres

Acceptable furnace atmosphere for brazing shall be as follows:

3.3.1 Hydrogen of not less than 99.99% purity and dew point not higher than -25 °F (-32 °C).

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

3.3.3 Mixtures of argon and hydrogen in any proportions, the hydrogen purity being as specified in 3.3.1, the argon purity being as specified in 3.3.2, and the dew point of the mixture being not higher than -35 °F (-37 °C).

3.3.4 Vacuum of 5 x 10^{-3} Torr or better (lower pressure). Back-fill to a higher pressure may be achieved with a non-oxidizing atmosphere (See 3.3.2 or 3.3.3).

3.4 Preparation

3.4.1 Surface Condition

The surfaces to be joined shall be clean prior to assembly. See 8.5.

3.4.2 Nickel Plating

Unless otherwise specified, joints shall be prepared as noted in Table 1 by nickel plating in accordance with AMS2403 or AMS2424.

TABLE 1 - NICKEL PLATING THICKNESS REQUIREMENTS FOR FURNACE ATMOSPHERE

Alloy	Nickel Plating Thickness Inch (µm) Vacuum	Nickel Plating Thickness Inch (µm) Non-Oxidizing Gas
Precipitation Hardenable Iron Alloys	0.0001 to 0.0006 (2.5 to 15)	0.0004 to 0.0006 (10 to 15)
Precipitation Hardenable Nickel Alloys		
(a)Ti + Al content under 4% nominal	0.0001 to 0.0006 (2.5 to 15)	0.0004 to 0.0006 (10 to 15)
(b)Ti + Al content 4% nominal or greater	0.0001 to 0.0006 (2.5 to 15)	0.0008 to 0.0012 (20 to 30)
Non-precipitation Hardenable Nickel Alloys with Ti + Al content under 1% nominal	Optional to 0.0006 (15), max	0.0001 to 0.0006 (2.5 to 15)
All other Alloys	Optional to 0.0006 (15), max	Optional to 0.0006 (15), max

3.4.2.1 Unless otherwise specified, nickel plating on areas other than the faying surface and adjacent fillet is optional and may be incomplete.

3.4.3 Assembly

The parts to be joined shall be assembled so that the clearances between mating surfaces are within specified tolerances. When joint tolerances are not specified, the joint clearance shall be 0.001 to 0.004 inch (25 to 102 µm). See 8.2. When permitted by the cognizant engineering organization, tack welding may be used to facilitate assembly. The assembly shall be supported so that the parts will be in proper alignment throughout the brazing process. Sufficient filler metal shall be placed at one end of the joint. In the case of blind joints, the filler metal shall be preplaced at the blind end of the joint.

3.4.4 Fluxing

When use of paste or liquid flux is permitted, flux shall be applied to the joint areas of parts. Gaseous hydrogen fluoride pre-cleaning/fluxing may be performed, when permitted by the cognizant engineering organization.

3.5 Procedure

3.5.1 Joining

Parts shall be heated in equipment as in 3.2 using an atmosphere as in 3.3 and held at temperature until the filler metal melts and the joint is formed. The brazing temperature shall be from 25 to 200 °F (14 to 111 °C) above the liquidus for the filler metal used. After the filler metal melts, heating may be prolonged to aid diffusion.

3.5.2 Cooling

After brazing, assemblies shall be cooled in a manner and at a rate that will prevent cracks and minimize internal stress, distortion, scaling, and decarburization. Cooling from the brazing temperature to below the scaling temperature shall be performed in one of the atmospheres described in 3.3. If heat treating (hardening) is to be executed 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 paste or liquid fluxes, if used, shall be removed from the parts by a method not injurious to the specified surface finish.

3.6.2 Heat Treatment

Where heat treatment is required and the heat treatment temperature is below 1780 °F (971 °C), such heat treatment shall follow the brazing operations or, when permitted by the cognizant engineering organization, may be performed during the post-braze cool down process.

3.7 Properties

Brazed parts shall conform to the following requirements:

3.7.1 Appearance

Examination of visible joint edges shall show a complete line or ring of filler metal between component parts.

3.7.2 Coverage

The area joined by filler metal shall not be less than 80% of the area of the mating portions of the assembly, determined by a nondestructive or destructive method permitted by the cognizant engineering organization.

3.7.3 Proof Test

When specificed by the cognizant engineering organization, parts shall be proof tested using a presssure test method permitted by the cognizant engineering organization.

3.8 Quality

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

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

3.8.2 The presence of unmelted filler metal is not acceptable.

3.8.3 Erosion of the base metal shall not exceed 20% of the thinnest member or 0.002 inch (51 µm), whichever is less when measured visually and during destructive examination.

3.8.4 Unless otherwise specified, the depth of diffusion of solid substitution alloying elements (e.g., chromium, nickel, cobalt, tungsten) at the joint shall not exceed 0.004 inch (102 µm), measured from the original base metal surface.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The brazing facility shall supply all samples for processor's tests and shall be responsible for performance of all required tests. Where actual or simulated parts are required for processor's tests, such parts 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 the requirements of this specification.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Tests for all technical requirements in section 3 with the exception of depth of diffusion (3.8.4) are acceptance tests and shall be performed on parts, or specimens representing parts when permitted herein from each lot. See 4.3.4.

4.2.2 Periodic Tests

Destructive examination for braze coverage (3.7.2), for erosion (3.8.3) and for depth of diffusion (3.8.4) are periodic tests and shall be performed at a frequency established by the processor unless frequency of testing is specified by the cognizant engineering organization.

4.2.3 Preproduction Tests

All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of brazed parts to a purchaser and when the cognizant engineering organization requires confirmatory testing .

4.3 Sampling for Testing

4.3.1 Acceptance Tests

Test samples shall be randomly selected from all parts in the lot. A lot shall be all parts of the same part number, brazed in the same equipment in a continuous series of operations (3.4.3 through 3.6) and presented for processor's inspection at one time. Unless the cognizant engineering organization specifies a sampling plan, the minimum number of samples shall be as shown in Table 2.

TABLE 2 - SAMPLING FOR ACCEPTANCE TESTS

Number of Parts in Lot	Quality and Appearance	Nondestructive Coverage
Up to 7	All	3 or all*
8 to 15	7	4
16 to 40	10	4
41 to 110	15	5
111 to 300	25	6
301 to 500	35	7
Over 500	50	8
		*Whichever is less

4.3.1.1 Sampling for destructive coverage testing shall be specified by the cognizant engineering organization.

4.3.1.2 Proof Test

As specifed by the cognizant engineering organization.

4.3.2 Periodic Tests

Sample quantity for periodic tests shall be at the discretion of the processor unless otherwise specified by the cognizant engineering organization or herein.

4.3.3 Preproduction Tests

One or more joints shall be destructively examined for braze coverage, erosion, depth of diffusion, and for evidence of surface contamination, carburization, decarburization, or other deleterious effects.