AEROSPACE MATERIAL SPECIFICATION

AMS3414	REV. E

Issued 1948-05
Revised 2007-10
Reaffirmed 2013-07

Superseding AMS3414D

Flux, Aluminum Welding

RATIONALE

AMS3414E has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Form

This specification covers an aluminum welding flux in the form of powder.

1.2 Application

This flux has been used typically for gas welding aluminum and aluminum alloys at 1150 °F (621 °C) and over, 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 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 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.

AMS 4001 Aluminum Sheet and Plate, 0.12Cu (1100-0), Annealed

AMS 4006 Aluminum Alloy Sheet and Plate, 1.25Mn - 0.12Cu (3003-0), Annealed

AMS 4190 Welding Wire, Aluminum Alloy, 5.2Si (4043)

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS3414E

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM C 371 Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders

ASTM D 1193 Reagent Water

3. TECHNICAL REQUIREMENTS

3.1 Composition

3.1.1 Solids

Flux shall be a finely ground and uniformly blended mixture consisting primarily of chloride and fluoride salts of sodium and potassium, with other metallic salts of alkaline metals such as lithium, barium, strontium, or calcium as required to meet the required properties. Total impurities, including compounds of carbon, oxygen, sulfur, iron, or silicon shall not exceed 0.15 percent.

3.1.2 Water Content

Flux shall not contain more than 5% by weight of water.

3.2 Form

The flux shall be supplied in the form of a powder. A slight amount of agglomeration is acceptable provided the lumps can be readily broken into a powder not coarser than the remainder of the flux. The powder shall be finer than 100 mesh, determined in accordance with ASTM C 371 except wet sieving is not applicable.

3.3 Properties

Flux shall conform to the following requirements:

3.3.1 Paste Forming Ability

The product, when mixed with water or commercial grade methyl alcohol in the proportions of three parts flux powder to one liquid by weight, shall form a smooth paste free from coarse particles, which can be readily applied to metal surfaces.

3.3.2 Fusion Temperature

On heating, the flux shall melt at 1050 °F (566 °C) or lower. On cooling from 1100 °F (593 °C) or higher, the flux shall remain in the liquid state until the temperature drops below 1050 °F (566 °C).

3.3.3 Fusion Characteristics

The flux shall not intumesce or bubble excessively when heated to the fusion point and shall not produce a flame or smoke of sufficient intensity to obscure the work. The flux shall not produce toxic or suffocating fumes under normal conditions of use.

3.3.4 Flux Removability

Flux should be readily removable by water at 190 °F (88 °C) or hotter after being subjected to welding operations. Scrubbing with a nonmetallic brush to aid in flux removal is permitted. However, if the flux is not completely removed by the hot water, it will be acceptable if the remaining flux can be removed by immersion in any of the following solutions:

a. 10% by volume solution of commercial grade 42 °Be nitric acid to which not more than 0.25% by volume concentrated hydrofluoric acid has been added, for not more than 15 minutes at not higher than 100 °F (38 °C)

b. 10% by volume solution of concentrated sulfuric acid in water at not higher than 150 °F (66 °C) for not more than 10 minutes

c. up to a 50% by volume solution of 42 °Be nitric acid in water at room temperature for not more than 20 minutes

3.3.5 Fluxing Ability

Flux shall produce joints equal to or better than the quality of the joints produced with a control flux of the composition shown in Table 1.

TABLE 1 - CONTROL FLUX COMPOSITION

Ingredients	Percent by Weight of Solids
Potassium Chloride	44 ± 1
Sodium Chloride	30 ± 1
Lithium Chloride	14 ± 1
Sodium Fluoride	12 ± 1

3.4 Quality

Flux, as received by purchaser, shall be uniformly blended and free from foreign materials detrimental to usage of the flux.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The supplier of flux shall supply all samples for supplier's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the flux conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Solids content (3.1.1), water content (3.1.2), and form (3.2) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests

Paste forming ability (3.3.1), fusion temperature (3.3.2), fusion characteristics (3.3.3), flux removability (3.3.4), and fluxing ability (3.3.5) are periodic tests and shall be performed on the first lot (See 4.4) and thereafter at a frequency selected by the manufacturer unless frequency of testing is specified by the cognizant engineering organization.

4.3 Sampling and Testing

At least one randomly selected sample of flux from each lot. A lot shall be all flux produced in a single production run from the same batches of raw materials and presented for supplier's inspection at the same time.

4.3.1 Chemical Composition of Solids

Each lot shall be tested for composition using wet chemical analysis or spectrochemical methods. In case of dispute, chemical analysis by wet chemical methods shall be the basis for acceptance.

4.3.2 Water content shall be based on the difference in weight of a sample before and after heating to any temperature above 600 °F (316 °C) and 100 °F (38 °C) below the measured fusion temperature.

4.3.3 Form shall be tested on a sample of not less than 100 grams, taken from a randomly selected container in each lot.

4.3.4 Fusion Temperature

4.3.4.1 On Heating

A sample of flux, heated in an air oven to 1050 °F (566 °C) in a suitable container, shall completely fuse with no evidence of unmelted flux.

4.3.4.2 On Cooling

A sample of flux, heated in a suitable container to a temperature exceeding 1200 °F (649 °C) and cooled to 1050 °F (566 °C) or lower, shall remain a pourable liquid.

4.3.5 Fluxing Ability

4.3.5.1 Test Materials

Two sets of test panels, each set consisting of two pieces of aluminum sheet conforming to AMS 4001, AMS 4006, or equivalent, not thicker than 0.150 inch (3.81 mm), shall be used to form two square groove butt joints, each not less than 6 inches (152 mm) long. Surfaces shall be cleaned in preparation for welding by any convenient method. The filler metal used shall conform to AMS 4190.

4.3.5.2 Flux Application

For each test, both sets of test panels shall be welded. One test panel shall use the flux formulation to be tested, and the other shall use the formulation given in Table 1. Flux shall be thoroughly mixed with water or methyl alcohol to form a smooth paste, and shall be applied to both the filler metal and the face and root sides of the panels to be welded, using a swab, brush, or by dipping as applicable.

4.3.5.3 Welding

Each test joint shall be welded using a neutral oxyacetylene flame. The supplier's formulation shall show no more smoke and shall not obscure the work more than the flux formulation of Table 1.

4.3.5.4 Flux Removal

Excess welding flux shall be promptly removed after welding by scrubbing with a stiff bristle brush in water at 190 °F (88 °C) or warmer and/or by immersion in one of the flux removers shown in 3.3.4.

4.3.5.5 Examination

The weld shall be smooth and shall fair smoothly into the base metal on both the face and root sides, and shall not show pits or undue roughness on either the base metal or the weld. There shall be no slag, spatter, cracking, or visual porosity. At least three transverse metallographic cross-sections taken from the weld made with the supplier's flux shall be evaluated, and shall not show evidence of incomplete penetration or incomplete fusion. There shall be no slag or gas porosity of a size greater than 20% of the base metal thickness.

4.3.6 Completeness of Flux Removal

Prior to metallographic examination, the supplier's formulation test weld, after flux removal in accordance with 4.3.5.4, shall be immersed in a glass container of reagent water (See ASTM D 1193 Type IV) to which a few drops of nitric acid have been added. After soaking for not less than 30 minutes, remove the test weld and add a few drops of 5% silver nitrate to the liquid. If a white precipitate forms or if the solution becomes cloudy, the flux does not meet the flux removal requirements of 3.3.4.