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26 June 1970
SUPERSEDING
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MILITARY SPECIFICATION

FLUX, ALUMINUM AND ALUMINUM ALLOY, GAS WELDING

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

* 1.1 This specification covers one grade of flux for use in the gas welding of aluminum and aluminum alloys.

* 2. APPLICABLE DOCUMENTS

2.1 The following documents of issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-A-250/8	Aluminum Alloy, 5052, Plate and Sheet
QQ-R-566	Rods, Welding, Aluminum and Aluminum Alloys
RR-S-366	Sieve, Standard for Testing Purposes
PPP-B-636	Box, Fiberboard

Military

MIL-W-45562	Welding and Soldering Equipment, Supplies and Accessories, Packaging of

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes

FSC 3439

STANDARDS

Military (Continued)

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-755	Labels Containing Symbols for Packages and Containers for Hazardous Industrial Chemicals and Materials

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

* 2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

ASTM E8	Methods of Tension Testing of Metallic Materials

(Copies may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

* 3.1 Materials. The materials used in the preparation of the flux shall be of high quality in accordance with the requirements of this specification.

* 3.2 Chemical composition. The flux shall be primarily metallic chlorides with the addition of metallic fluorides. The metallic constituents shall be primarily sodium and potassium. The presence of barium or calcium as metallic elements of the halogen salts shall be allowed. The lithium and fluorine contents shall be not less than 1.75 percent and 5.0 percent, respectively. The ratio of potassium to sodium from the metallic chlorides shall be not less than 2 to 1. Total impurities including compounds of carbon, oxygen, sulphur, iron, or silicon shall not exceed 0.15 percent.

3.3 Condition. The flux shall be anhydrous.

* 3.3.1 Deterioration. The flux shall not show any signs of deterioration provided the original seal of container is unbroken.

* 3.4 Fineness. The flux shall be of such fineness as to completely pass a 100 mesh screen.

* 3.5 Performance. The aluminum and aluminum alloy welding flux shall be capable of being equal or better in performance to that of a control flux when subjected to the performance test specified herein. The flux shall be capable of permitting production of satisfactory butt joint and single-pass welds on applicable aluminum and aluminum alloys when used in conjunction with aluminum and aluminum alloy welding rods conforming to QQ-R-566.

* 3.5.1 When mixed with water in the proportions of 3 parts by weight of flux to 1 by weight of water, or alcohol, unless contrary to the suppliers' instructions, with or without a suitable wetting agent as desired, the flux shall form a smooth paste, free from coarse particles, which can easily be applied to a metal surface. On heating, the flux shall melt at 1050° F or lower, a temperature below the fusion point of the metal, and form a viscous slag which floats on the molten metal in the fusion zone. On cooling from 1100° F or higher, the flux shall remain in the liquid state until the temperature drops to 1050° F or lower. The slag formed on cooling shall be able to be separated from the weld metal by proper post-weld cleaning procedures. The flux shall not intumesce excessively when heated to the fusion point. The flux, during use, shall not produce a flame or smoke of sufficient intensity as to obscure the work. At operating temperatures or when heated to and held at the fusion point for 30 minutes, the flux shall be free from deterioration products impairing its operating characteristics.

* 3.5.2 The flux shall have acceptable fusibility and fluxing characteristics so that joints between aluminum and aluminum alloy sections welded with the flux shall not show the presence of pits or undue roughness on either the base or weld metal. The flux shall fuse and protect the reverse side of a single pass butt weld in sheet material from oxidation.

3.5.3 Flux removal. Flux adhering to the welded assemblies shall be readily removed by water at 190° F or hotter. Sections may also be cleaned by a 20- to 30-minute immersion in a cold 10 percent sulphuric acid bath, by a 5- to 10-minute immersion in a 5 percent sulphuric acid bath held at 150° F, or by a 10- to 20-minute immersion in a cold, 10 to 50 percent nitric acid bath. Acid cleaning shall be followed by a hot or cold water rinse. Completeness of removal of flux shall be verified by test (see 4.5.3.4).

* 3.6 Workmanship. The flux shall be in powder form, finely ground and uniformly blended, and free from all substances which might adversely affect its serviceability. The flux shall not harden while stored in the containers. A slight amount of agglomeration is permissible provided the lumps can be readily broken with the fingers into a powder no coarser than the remainder of the material.

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

* 4.2 Quality conformance inspection. Conformance of the aluminum and aluminum alloy welding flux to the requirements of this specification shall be determined by means of quality conformance inspection. The quality conformance inspection shall consist of an examination for acceptability of quality control methods used by the manufacturer, examining and testing the quality conformance samples for all the requirements of this specification, and an examination of the sample of filled containers for conformance to the packaging, packing, and marking requirements.

* 4.3 Sampling.

* 4.3.1 Lot size. For the purpose of examination and tests, a lot shall consist of one production batch (see 6.3) and shall be offered for delivery under a contract or order.

* 4.3.2 Sampling for examination of filled containers. A random sample of filled containers shall be selected in accordance with MIL-STD-105 at Inspection Level I and Acceptable Quality Level of 2.5 percent defective to verify all requirements of this specification in regard to fill, closure, packaging, packing, marking, workmanship, and other requirements not involving tests.

* 4.3.3 Sampling for tests. From each lot of material offered for delivery, two or more 4 ounce samples of the material shall be selected at random for the quality conformance lot acceptance tests of 4.5.

* 4.4 Quality conformance examination.

* 4.4.1 Product. Samples selected in accordance with 4.3.2 shall be visually examined for conformance to the requirements of material (see 3.1), condition (see 3.3), deterioration (see 3.3.1) and workmanship (see 3.6).

* 4.4.2 Packaging and packing. Packaging and packing markings shall conform to the requirements of Section 5 of this specification.

* 4.5 Quality conformance tests.

* 4.5.1 Chemical composition. The samples selected in accordance with 4.3.3 shall be tested using suitable standard wet chemical or spectrographic methods to determine conformance to the requirements of 3.2. In case of dispute, the chemical analysis by wet chemical methods shall be the basis for acceptance. If the sample fails to conform to the requirements of 3.2, the lot shall be rejected.

* 4.5.2 Fineness. The samples selected in accordance with 4.3.3 shall be tested for fineness by sieve analysis. Attach a bottom pan to a number 100 U. S. Standard sieve conforming to RR-S-366. Place a 100 gram portion of the sample on the sieve, cover and shake for 15 minutes by hand or mechanically by means of a shaker geared to produce 285 to 315 gyrations and 140 to 160 taps of the striker per minute. The number 100 U. S. Standard sieve shall be examined for the presence of flux retained on the mesh screen to determine conformance to the requirements of 3.4.

* 4.5.3 Performance.

* 4.5.3.1 Specimen test panels. Test panels, approximately 6 inches by 4 inches, with a thickness not greater than 5/32 inch, shall be prepared from aluminum sheet metal, such as alloy 5052, conforming to QQ-A-250/8, or any other suitable alloy for a square groove butt joint along the 6 inch side. Surfaces to be welded shall be as free as possible from oil, grease and oxide film. Oil and grease may be removed chemically by dipping or wiping the test plates with a mildly alkaline solution or a hydrocarbon solvent. Oxide films may be removed mechanically by wire brushing with a stainless steel brush, scraping, filing or grinding. The test panels shall be welded from one side only in the flat position using rods of classes 5652, 4043, 5356, or 5556 conforming to QQ-R-566. Welding should be done as soon as practical after cleaning and oxide removal operations.

* 4.5.3.2 Flux application. The flux shall be thoroughly mixed with water or alcohol in accordance with the supplier's instructions to form a suitable paste of proper consistency (see 6.5). Distilled water should be used for mixing. If no mixing instructions are stated, the flux should be mixed in the proportion of 3 parts of flux to 1 part of water by weight. The paste shall be applied to both the welding rod and the surfaces to be welded by dipping or with a small swab or brush. The flux should be used sparingly. Panels shall be welded using the test flux. Similar joints using the control flux detailed in 4.5.3.3 shall be made.

* 4.5.3.3 Control flux. The composition of the control flux shall conform to Table I and fineness indicated in 3.4.

* 4.5.3.4 Flux removal. The excess welding flux shall be promptly removed after welding by vigorously scrubbing with a stiff bristle brush under running water at 190° F or hotter for 5 minutes (see 6.6). The weld shall then be tested to determine

if the flux has been properly removed by leaching the welded area with distilled water. To the leach water, a few drops of nitric acid and a few drops of 5 percent silver nitrate shall be added. If a white precipitate is formed in an amount greater than that formed in an equal volume of standard sodium chloride solution (equivalent to 125 ppm as chloride) treated in a like manner, the flux removal is not complete. The standard sodium chloride solution shall be prepared by weighing 0.2061 ±0.0010 grams of sodium chloride which has been dried for 2 hours at 225° F. The sodium chloride shall be dissolved in distilled water and diluted to 1 liter at 70° F in a volumetric flask.

TABLE I

CONTROL FLUX

Compound	Percent By Weight
Potassium Chloride (KCl)	44
Sodium Chloride (NaCl)	30
Lithium Chloride (LiCl)	14
Sodium Fluoride (NaF)	12

* 4.5.3.5 Evaluation. The performance test shall be evaluated with respect to the requirements of 3.5 and the subparagraphs thereof. The fluxing properties shall equal or exceed those of the control flux (see 4.5.3.3) during this test. The surfaces of welds made with the test flux and also the adjacent base metal shall be examined visually. The weld bead shall be smooth, free of slag, excessive spatter, cracking, and surface porosity. The ability of the flux to remove oxide from the surface of the metal shall be noted in particular.

* 4.5.3.6 Macro-examination. When specified in the contract or order, specimens shall be removed transverse to the weld for macro-examination. The assembly shall be sectioned to provide a minimum of three coupons in the polished and etched condition for examination at 10 X magnification. The macro surface being visually examined shall be evaluated for porosity, gas pockets, cracking, incomplete penetration, incomplete fusion, and the presence of other weld defects. Each cross section shall exhibit neither crack nor lack of fusion. The maximum size defect shall be less than 10 percent of the thickness of the weld.

* 4.6 Rejection and retest. Where test results indicate the quality conformance test sample is not in conformance for fineness, workmanship, condition or chemical composition with the requirements of this specification or to be inferior in any respect to the control flux, the entire lot of flux represented shall be rejected and no retests shall be allowed.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be Level A or C as specified (see 6.2).

5.1.1 Level A.

* 5.1.1.1 Unit containers. Aluminum and aluminum alloy welding flux shall be unit packaged in 4-ounce, 8-ounce, 1-pound or 5-pound quantities net weight, as specified (see 6.2). Unit containers shall be glass or polyethylene bottles, wide mouth type of standard commercial design. Containers shall be equipped with closures which shall provide an effective vapor barrier and shall neither affect nor be affected by the contents.

* 5.1.1.2 Intermediate packaging. Unless otherwise specified, forty-eight unit packages of 4-ounce quantities, twenty-four unit packages of 8-ounce quantities, twelve unit packages of 1-pound quantities, or 4 unit packages of 5-pound quantities shall be intermediate packaged in containers conforming to PPP-B-636, Grade W5c, Cushioning and cushioning material shall be provided in accordance with MIL-W-45562 to prevent movement and damage within the container. All center and edge seams and manufacturer's joints shall be waterproofed with tape in accordance with the container specification or appendix thereto.

* 5.1.2 Level C. The aluminum and aluminum alloy welding flux shall be packaged in accordance with Level C requirements of MIL-W-45562 to afford the minimum degree of protection necessary to prevent deterioration or damage during shipment under normal environmental conditions and commercial modes of transportation.

* 5.2 Packing. Packing shall be Level A, B, or C as specified (see 6.2).

* 5.2.1 Level A. Aluminum and aluminum alloy welding flux, packaged as specified, shall be packed for overseas shipment in accordance with MIL-W-45562.

* 5.2.2 Level B. Aluminum and aluminum alloy welding flux packaged as specified, shall be packed for domestic shipment in accordance with MIL-W-45562.

* 5.2.3 Level C. Aluminum and aluminum alloy welding flux that requires overpacking by the carrier shall be packed in exterior type shipping containers in a manner that will insure safe transportation at the lowest rate to the point of delivery, and shall meet as a minimum, the requirements of the rules and regulations applicable to the mode of transportation selected.

* 5.3 Markings. In addition to any special markings required by the contract or order (see 6.2), interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129 and as detailed in 5.3.1 and 5.3.2. In

addition to the markings specified in MIL-STD-129, each container shall have affixed a warning label of appropriate size to Class 3 of MIL-STD-755 or shall be lithographed or stenciled with a reasonable likeness thereof. Under "contains" shall be inserted the appropriate materials (such as sodium fluoride, lithium chloride, etc.) (see 6.4).

* 5.3.1 Unit containers. All unit containers (see 5.1.1.1) shall be labeled and marked with the following information:

FLUX: ALUMINUM AND ALUMINUM ALLOY WELDING
Specification MIL-F-6939B
Stock Number
Quantity (net weight of contents)
Metals for which flux is suitable
Methods of mixing and application
Name of manufacturer
Lot number (manufacturer's batch number)
Date of manufacture (month/year)
Contract or order number

* 5.3.2 Shipping containers. Each package shall be durably and legibly marked with the following information in such a manner that the markings will not be damaged when the packages are opened.

FLUX: ALUMINUM AND ALUMINUM ALLOY WELDING
Specification MIL-F-6939B
Stock Number
Quantity
Name of contractor (if different from manufacturer)
Contract or order number
Name of manufacturer
Date of manufacture (month/year)
Lot number (manufacturer's batch number)

6. NOTES

* 6.1 Intended use. The aluminum and aluminum alloy welding flux is intended to protect the molten weld metal from oxidation when gas welding processes are used in the thermal joining of most of the wrought and some of the cast aluminum alloys.

* 6.2 Ordering data. Procurement documents should state the following:

(a) Title, number and date of this specification

(b) Macro-examination of welded specimens (see 4.5.3.6).

(c) Quantity desired in pounds.

(d) Whether Level A or Level C packaging is required (see 5.1).

(e) Quantity of unit containers (see 5.1.1.1).

(f) Different quantity of unit containers for intermediate packaging, if necessary (see 5.1.1.2).

(g) Whether Level A, Level B or Level C packing is required (see 5.2).

(h) Additional marking, if necessary (see 5.3).

* 6.3 Batch. A batch is defined as that quantity of material which has been subjected to some unit chemical or physical mixing process intended to make the final product substantially uniform.

* 6.4 Toxicity. Sodium fluoride is irritating to nose and eyes, poisonous, and causes nausea, vomiting and weakness. The maximum allowable concentration of sodium fluoride in an atmosphere of a dust, vapor or fume, which, if exceeded for appreciable periods can cause damage to the health of exposed welders is 0.2 to 2.5 milligrams per cubic meter. Lithium chloride is toxic. Ingestion or inhalation of this material causes blurring of vision, muscular weakness and marked tremors.

* 6.5 Containers for flux paste. The paste, made by adding water or alcohol to the flux, should be kept in glass or earthenware vessels. If necessary to use a metal container, one of aluminum or stainless steel is preferred. Steel, copper or brass containers shall not be used as these metals tend to contaminate the mixture.

* 6.6 Precautions. In order to prevent deterioration of the flux which is hygroscopic, containers should remain open only as long as necessary. Immediately after welding, excess flux should be completely removed by a thorough cleaning with hot running water and a bristle brush to prevent corrosive action (see 4.5.3.4). In production, some welding operators prefer the acid treatment or steam cleaning to remove the flux effectively.

* 6.7 Changes from previous issues. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - AT
Navy - AS
Air Force - 11

Preparing activity:
Navy - AS
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Review activities:
Army - WC, GL, AV
Navy - AS, OS, YD
Air Force - 84

User activities:
Army - EL, MI, MU, ME
Navy - None
Air Force - None

NOTICE - Review/user information is current as of this document. For future coordination of changes to this document, draft circulation should be based on the information in the current Federal Supply Classification Listing of DOD Standardization Documents.

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

MIL-F-6939B FLUX, ALUMINUM AND ALUMINUM ALLOY, GAS WELDING

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO *(If "yes", in what way?)*

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity - Optional)*

DATE

DD FORM 1 JAN 66 1426 REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

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