METRIC

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SUPERSEDING
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DEPARTMENT OF DEFENSE
STANDARD PRACTICE

PREPARATION OF ALUMINUM ALLOYS FOR SURFACE TREATMENT AND INORGANIC COATING

This document is inactive for new design.

AMSC N/A

AREA: MFFP

FOREWORD

1. This Military Standard is approved for use by the 309MXSG/MXRL, Department of the Air Force and is available for use by all Departments and Agencies of the Department of Defense.

2. This standard provides guidance on the procedures for preparation of aluminum alloys for surface treatments and inorganic coating for the Air Force repair process, acquisition and manufacture of parts and/or spare parts on landing gear of all military aircraft.

3. Beneficial comments, recommendations, additions, deletions, clarifications, etc. and any data that may improve this document should be sent to: 309MXSG/MXRL, Hill AFB, UT 84056-2609 or e-mailed to: 309MXSG/MXRL@hill.af.mil. Since contact information can change, verification of currency of this address information through ASSIST Online database at http://assist.daps.dla.mil.

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1. SCOPE

1.1 This standard describes the cleaning, activation and under-plating process, and material required for aluminum and aluminum alloys prior to applying inorganic coatings. It is intended that this standard be used in conjunction with other process documents, where the technical requirements are for the application of surface treatments and inorganic coatings on aluminum and aluminum alloys.

1.2 Classification. This standard covers the following cleaning methods and surface pre-treatment process.

1.2.1 Surface Cleaning. Clean surface in accordance with paragraph 5.1.

1.2.2 Surface Preparation. Prepare surface for anodizing and conversion coating in accordance with paragraph 5.2.

1.2.3 Preparation for Plating. Prepare for plating in accordance with paragraph 5.3.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified throughout this document. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of the documents cited, whether or not they are listed.

2.2 Government Documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, handbooks and commercial item descriptions form a part of this document to the extent specified herein. Unless otherwise specified the issues of these documents are those cited in the solicitation or contract.

COMMERCIAL ITEM DESCRIPTIONS:

A-A-55827	Chromium Trioxide, Technical
A-A-55828	Sulfuric Acid, Technical
A-A-59105	Nitric Acid, Technical
A-A-59563	Sodium Carbonate, Anhydrous, Technical
A-A-59456	Ferric Chloride, Anhydrous, Crystalline, Technical

DEPARTMENT OF DEFENSE SPECIFICATIONS:

MIL-Z- 291 (Inactive)	Zinc Oxide, Technical
MIL-A- 24641	Acid Hydrofluoric, Technical

DEPARTMENT OF DEFENSE STANDARDS:

MIL-STD-871 Electro-Chemical Stripping of Inorganic Finishes
(Inactive)

MIL-STD-1504 Abrasive Blasting
(Inactive)

(Copies of these documents are available online at http://assist.daps.dla.mil.online/start/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government Documents. The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, these issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D456 Caustic Soda, Anhydrous

ASTM D537 Standard Specification for Sodium Metasilicate

(Copies of these documents are available at www.astm.org or ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.)

2.4 Order of Precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document; however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS Not applicable.

4. GENERAL REQUIREMENTS

4.1 Materials and Equipment.

4.1.1 Materials. Materials used in preparing aluminum alloys for surface treatments and inorganic coating:

a. Ammonium Biflouride

b. Chromium Trioxide (A-A-55827)

c. Copper Cyanide

d. Ferric Chloride (A-A-59456)

e. Hydrofluoric Acid (MIL-A-24641)

f. Nitric Acid (A-A-59105)

g. Rochelle Salt

h. Sodium Bisulfate

i. Sodium Carbonate (A-A-59363)

j. Sodium Cyanide

k. Sodium Fluorosilicate

l. Sodium Gluconate

m. Sodium Hydroxide (ASTM D456)

n. Sodium Met silicate (ASTM D537)

o. Sulphuric Acid (A-A-55828)

p. Trisodium Phosphate

q. Zinc Oxide (MIL-Z-291 – Inactive)

4.1.2 Equipment.

a. Power Source. Either generated or rectified D.C. current may be used. Ripple value shall not exceed 10 percent as measured by dividing the root mean square of the A.C. voltage component by the D.C. voltage. This can be measured by using RMS A.C. voltage meter and dividing this value by the D.C. voltage. These requirements are to be taken across the anode and cathode bus at the tank.

b. Tanks. Tanks should be resistant to the operating temperature and the chemical environment. Tanks in which any electrolytic action takes place must be free of short circuits.

c. Temperature Control. Plating tanks to be operated at temperature other than room temperature shall be equipped with automatic temperature indicating and regulating devices.

d. Instrumentation. An ammeter shall be place in series with the plating tank cathode. The ammeter shall have sufficient shunts and switches to provide a full-scale reading equal to the maximum capacity of the power source, and an accuracy of plus or minus 10 percent of the current being measured.

e. Blast Equipment. A blast cabinet shall be located near the finishing line. Size of the cabinet shall be adequate to enclose the parts to be finished. Air lines shall be suitably trapped and filtered to prevent in-process contamination of the parts to be cleaned.

f. Bake Oven. A bake oven, if required, shall be located near the finishing line. The size of the oven shall be adequate to enclose the part to be finished. The oven shall be equipped with temperature indicating and regulating devices.

4.2 Racking. Sufficient contact area and pressure shall be provided to carry the current without overheating. Racking should be performed at the most convenient step prior to plating.

4.3. Masking. Sections or areas of the part that are not to be finished will be masked off. Plug and masking materials, which do not contaminate the finishing bath shall be used. Masking should be performed at the most convenient step prior to finishing.

4.4 Handling of Parts. After the parts have been cleaned, they will be handled in such a manner; white gloves, etc, that will ensure a minimum of contamination.

4.5 Finish. The finish of the part shall be controlled by the application specification.

4.6 Re-processing. Parts rejected for defective finish and require stripping and re-coating, shall include all the steps of this specification. Parts shall be stripped in accordance with MIL-STD-871.

5. DETAILED REQUIREMENTS

5.1 Surface Cleaning.

5.1.1 Alkaline Cleaners. Alkaline clean in one of the following solutions or equivalent.

5.1.1.1 Alkaline Cleaner Number 1:

a.	Sodium Hydroxide	3.75 – 11.25 g/l (3 – 5 oz/gal)
b.	Trisodium Phosphate	7.5 – 22.5 g/l (1 – 3 oz/gal)
c.	Sodium Metasilicate	22.5 – 37.5 g/l (3 – 5 oz/gal)
d.	Temperature	52 - 57˚C (125 - 135˚F)
e.	Time	one to two (1 to 2) minutes

5.1.1.2 Alkaline Cleaner Number 2:

a.	Trisodium Phosphate	22.5 – 37.5 g/l (3 – 5 oz/gal)
b.	Sodium Carbonate	7.5 – 22.5 g/l (1 – 3 oz/gal)
c.	Temperature	52 – 57˚C (125 – 135˚F)
d.	Time	one to two (1 – 2) minutes

5.1.2 Alkaline Etch. Remove scale, corrosion, carbon, etc in the following inhibited alkaline etch or equivalent:

5.1.2.1 Etching Solution.

a. Sodium Hydroxide	3.75 – 11.25 g/l (0.5 – 1.5 oz/gal)
b. Trisodium Phosphate	30.0 – 90.0 g/l (4 – 12 oz/gal)
c. Sodium Carbonate	7.5 – 45.0 g/l (1 – 6 oz/gal)
d. Sodium Gluconate	22.5 g/l (30.0 oz/gal) minimum
e. Temperature	52 - 57˚C (125 – 135˚F)
f. Time	two (2) minutes maximum

5.1.3 Smut Removal. Remove smut in the following solutions or equivalent:

5.1.3.1 De-Smut Number 1:

a. Nitric Acid	60 – 80% by volume
b. Hydrofluoric Acid	15 – 20% by volume
c, Temperature	ambient
d. Time	30 seconds approximately

5.1.3.2 De-Smut Number 2:

a. Nitric Acid	40 – 60% by volume
b. Temperature	ambient
c. Time	30 seconds approximately

5.1.3.3 De-Smut Number 3:

a. Nitric Acid	40-60% by volume
b. Sulphuric Acid	20 – 30% by volume
c. Ammonium Biflouride	105 – 135 g/l (14 – 18 oz/gal)
d. Temperature	ambient
e. Time	30 seconds approximately

5.1.3.4 De-Smut Number 4:

a.	Chromic Acid	4.5 – 7.5 g/l (0.7 – l.0 oz/gal)
b.	Sodium Bisulfate	120 – 128 g/l (16 – 17 oz/gal)
c.	Sodium Fluorosilicate	7.5 – 10 g/l (1.0 – 1.25 oz/gal)
d.	Temperature	ambient
e.	Time	10 – 15 minutes

5.2 Surface Preparation for Anodizing/Conversion Coating:

a. Step Number 1: Vapor Degrease.

b. Step Number 2: Alkaline Clean.

c. Step Number 3: Rinse thoroughly in clean water. The rinse water temperature should be ambient.

d. Step Number 4: (Optional) Alkaline Etch.

e. Step Number 5: (Omit if Step 4 was not performed.) Rinse thoroughly in clean water. The rinse water temperature should be ambient.

f. Step Number 6: Remover Smut.

g. Step Number 7: Rinse thoroughly in clean water. The rinse water temperature should be ambient.

h. Step Number 8: Anodize or conversion cost immediately.

5.3 Surface Preparation for Plating.

a. Step Number 1: Parts shall be vapor degreased. No minimum elapsed time shall elapse between this operation and the cleaning operation.

b. Step Number 2: Clean by abrasive blasting per MIL-STD-1504; using 60 – 180 grit aluminum oxide, vapor blast or garnet abrasive blast. Elapsed time between this step and step number 3 should not to exceed sixty (60) minutes.

c. Step Number 3: Alkaline clean.

d. Step Number 4: Rinse thoroughly in clean water. The rinse water temperature should be ambient.

e. Step Number 5: Remove smut.

f. Step Number 6: Rinse thoroughly in clean water. The rinse water temperature should be ambient.

g. Step Number 7: Zinc immersion plate with moderate part agitation in the following solution:

Sodium Hydroxide	450 – 525 g/l (60 – 70 oz/gal)
Zinc Oxide	75 – 97.5 g/l (10 – 13 oz/gal)
Ferric Chloride Hex hydrate	0.75 – 0.97 g/l (0.10 – 0.13 oz/gal)
Rochelle salt	7.5 – 9.75 g/l (1.0 – 1.3 oz/gal)
Temperature	21 – 27 ˚C (70 - 80˚F)
Time	30 – 60 seconds

h. Step Number 8: Rinse thoroughly in clean water. The rinse water temperature should be ambient.

i. Step Number 9: Remove zincates using solution 4.1.3.2 (De Smut Number 2) or equivalent.

j. Step Number 10: Rinse thoroughly in clean water. The rinse water temperature should be ambient.

k. Step Number 11: Zinc immersion plate in the zinc immersion solution, paragraph 5.3.7 for 30 – 40 seconds. It is essential that the immersion time in the zincates solution be closely controlled to prevent formation of an extremely heavy coating. The proper coating will be smooth and continuous and in some cases, can be achieved without the use of Step Number 7 through 10. Repeat step number 7 through 10 until the desired coating is obtained.

l. Step Number 12: Rinse thoroughly in clear water. The rinse water temperature should be ambient.

m. Step Number 13: (Optional) Copper strike at 2.5A/dm^2 (24A/ft^2) for approximately 3 minutes, then reduce the current to 1.25A/dm^2 (12A/ft^2) for 10 to 15 minutes. Apply voltage so that current will flow upon the immersion of parts. Copper strike in the following solution:

Copper Cyanide	37.5 – 45 g/l (5 – 6 oz/gal)
Sodium Cyanide	45 – 52.5 g/l (6 – 7 oz/gal)
Sodium Carbonate	30 – 60 g/l (4 – 8 oz/gal)
Rochelle Salt	30 – 60 g/l (4 – 8 oz/gal)
Free Sodium Cyanide	1.3 – 3.75 g/l (0.2 – 0.5 oz/gal)
Temperature	38 - 54˚C (100 - 130˚F)

NOTE: Optional low pH (10.2 – 10.5) bath solutions may also be used.

n. Step Number 14: Rinse thoroughly in clean water. The rinse water temperature should be ambient.

o. Step Number 15: Immediately immerse in the plating bath and plate per the application specification. Make electrical connections to the part outside the plating tank. Apply voltage so that the current will flow upon the immersion of parts.

NOTE: Some plating deposits such as silver and gold will require an immediate deposit of nickel between the plating strike and the plating deposit to prevent migration.

p. Inspection. Inspection shall be in accordance with the applicable plating specification and the requirements of the process standard.

5.4 Quality Control.

5.4.1 Quality Control Responsibility. The responsible quality control department shall enforce all requirements of this standard. Inspection to meet requirements shall be performed with such frequency as deemed necessary by the quality control department to assure compliance with the standard.

5.4.2 Process Controls. Solutions and equipment shall be checked periodically and maintained in accordance with the requirements of this process standard.

5.4.3 Adhesion. Parts can be tested for adhesion by plating them in boiling water for one hour. The parts shall show no blisters or separation of the undercoat from the base material at their common interface(s).

5.4.4. Castings. All sealed castings shall be pressure checked after plating. Parts which are found to leak shall be resealed.

5.4.5 Caution (or Warning). The procedures specified herein utilize materials listed in the Department of Labor (DOL) Occupational, Safety and Health Standards as “Toxic and Hazardous Substances.” Personnel exposure to these materials must be limited to those values specified in Section 2.1.2 of CFR 1910.1000 (OSHA Standard).

6. NOTES
(This section contains information of a general or explanatory nature that may be helpful, but not mandatory.)

6.1 Intended use. This standard provides guidance on the process and procedure for preparation of aluminum alloys for surface treatment and inorganic coating during the Air Force repair process on the landing gear of all military aircraft. It is a standard that is used primarily by the Air Force at Hill Air Force Base.

6.2 Subject term (key word) listing.

Alkaline
Equipment
Materials

Smut Removal
Surface Preparation

6.3 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

CONCLUDING MATERIAL

Custodian:
Air Force – 70

Preparing Activity:
Air Force – 70

Project: MFFP-0730-000

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, verification of currency of the information above utilizing ASSIST Online database at: http://assist.daps.dla.mil.