

MIL-STD-1503A(USAF)

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MILITARY STANDARD

PREPARATION OF ALUMINUM ALLOYS FOR
ELECTROPLATING



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MIL-STD-1503A(USAF)

DEPARTMENT OF THE AIR FORCE

Washington DC 20330

PREPARATION OF ALUMINUM ALLOYS FOR ELECTROPLATING

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MILITARY STANDARD

PREPARATION OF ALUMINUM ALLOYS FOR
ELECTROPLATING

1. SCOPE

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

2. REFERENCED DOCUMENTS

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

SPECIFICATIONSFederal

O-H-795	Hydrofluoric Acid, Technical
O-N-350	Nitric Acid, Technical
O-S-571	Sodium Carbonate, Anhydrous Technical
O-S-598	Sodium Hydroxide, Technical
O-S-604	Sodium Metasilicate, Technical
O-S-809	Sulfuric Acid, Technical

Military

MIL-Z-291	Zinc Oxide, Technical
MIL-F-14580	Ferric Chloride, Anhydrous, Crystalline, Technical

STANDARDSMilitary

MIL-STD-871	Electro-Chemical Stripping of Inorganic Finishes
MIL-STD-1504	Abrasive Blasting

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

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3. DEFINITIONS (Not Applicable)

4. GENERAL REQUIREMENTS

4.1 Materials and equipment.

4.1.1 Materials. Materials used in preparing aluminum alloys for electroplating are as follows:

- a. Ammonium Bifluoride
- b. Copper Cyanide
- c. Ferric Chloride (MIL-F-14580)
- d. Hydrofluoric Acid (O-H-795)
- e. Nitric Acid (O-N-350)
- f. Rochelle Salt
- g. Sodium Carbonate (O-S-571)
- h. Sodium Cyanide
- i. Sodium Hydroxide (O-S-598)
- j. Sodium Metasilicate (O-S-604)
- k. Sulfuric Acid (O-S-809)
- l. Trisodium Phosphate
- m. Zinc Oxide (MIL-Z-291)

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 an RMS A.C. Voltage Meter and dividing this value by the D.C. Voltage. These measurements 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 shorts.

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

d. Instrumentation. An ammeter shall be placed 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 ± 10 percent of the current being measured.

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e. Blast equipment. A blast cabinet shall be located near the plating line. Size of the cabinet shall be adequate to enclose the parts to be plated. 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 plating line. The size of the oven shall be adequate to enclose the parts to be plated. The oven shall be equipped with temperature indicating recording and regulating devices.

4.2 Finish. The finish of the plated part shall be controlled by the plating application specification.

4.3 Reprocessing. Parts rejected for defective plating, requiring stripping and replating, shall include all of the preplating steps of this specification. Parts shall be stripped in accordance with MIL-STD-871.

4.4 Reclaimed materials. Reclaimed materials shall be utilized to the maximum extent possible within the quality limits required by this document and to fulfill compliance with the Resource Conservation/Recovery Act of 1976 (Public Law 94-580, dated 21 Oct 76).

5. DETAILED REQUIREMENTS

5.1 General notes.

5.1.1 Prior to plating. Prior to plating all machining, forming, welding and shot peening shall be complete.

5.1.2 Time between steps. Unless otherwise specified, parts shall not be allowed to dry between steps.

5.1.3 Handling of parts. After the parts have been cleaned, they shall be handled in such a manner (white gloves, etc) that will assure a minimum of contamination.

5.1.4 Masking. Sections or areas of a part that are not to be plated shall be masked off. Plug and masking materials which do not contaminate the plating bath shall be used. Masking should be performed at the most convenient step prior to plating.

5.1.5 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.

5.2 Plating procedure. The preparation for plating procedure shall be as follows:

5.2.1 Step number 1. Parts shall be vapor degreased. No minimum elapsed time shall elapse between this operation and the cleaning operation of 5.2.2.

5.2.2 Step number 2. Clean by abrasive blasting per MIL-STD-1504. Using 80-180 grit aluminum oxide, vapor blast, or garnet abrasive blast. Elapsed time between this step and step number 3 not to exceed sixty minutes.

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5.2.3 Step number 3. Alkaline clean in one of the following solutions or equivalent.

5.2.3.1 Alkaline cleaner number 1.

- a. Sodium Hydroxide - 3.75-11.25g/l (0.5-1.5oz/gal)
- b. Trisodium Phosphate - 7.5-22.5g/l (1-3oz/gal)
- c. Sodium Metasilicate - 22.5-37.5g/l (3-5oz/gal)
- d. Temperature - 52-57°C (125-135°F)
- e. Time one to two minutes

5.2.3.2 Alkaline cleaner number 2.

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

5.2.4 Step number 4. Rinse thoroughly in clean water. The rinse water temperature should be ambient.

5.2.5 Step number 5. De Smut in one of the following solutions or equivalent:

5.2.5.1 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

5.2.5.2 De Smut number 2.

- a. Nitric acid - 40-60% by volume
- b. Temperature - Ambient
- c. Time - 30 seconds approximately

5.2.5.3 De Smut number 3.

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

5.2.6 Step number 6. Rinse thoroughly in clean water. The rinse water temperature should be ambient.

5.2.7 Step number 7. Zinc immersion plate with moderate part agitation in the following solution:

- a. Sodium Hydroxide - 450.0-525g/l (60-70oz/gal)
- b. Zinc Oxide - 75-97.5g/l (10-13oz/gal)
- c. Ferric Chloride Hexahydrate - 0.75-0.97g/l (0.10-0.13oz/gal)
- d. Rochelle Salt - 7.5-9.75g/l (1.0-1.3oz/gal)
- e. Temperature - 21-27°C (70-80°F)
- f. Time - 30-60 Seconds

5.2.8 Step number 8. Rinse thoroughly in clean water. The rinse water temperature should be ambient.

5.2.9 Step number 9. Remove zincate using solution 5.2.5.2 (De Smut number 2) or equivalent.

5.2.10 Step number 10. Rinse thoroughly in clean water. The rinse water temperature should be ambient.

5.2.11 Step number 11. Zinc immersion plate in the zinc immersion solution, 5.2.7 for 30 to 45 seconds. It is essential that the immersion time in the zincate solution be closely controlled to prevent formation of an extremely heavy coating. The proper coating will be smooth and continuous and, in some case, can be achieved without the use of Steps number 7 through 10. Repeat Steps number 7 through 10 until the desired coating is obtained.

5.2.12 Step number 12. Rinse thoroughly in clean water. The rinse water temperature should be ambient.

5.2.13 Step number 13. (OPTIONAL) Copper strike at 2.5A/dm² (24A/ft²) for approximately 3 minutes then reduce the current

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to $1.25\text{A}/\text{dm}^2$ ($12\text{A}/\text{ft}^2$) for 10 to 15 minutes. Apply voltage so that current will flow upon the immersion of parts. Copper strike in the following solution:

- a. Copper Cyanide - 37.5-45g/l(5-6oz/gal)
- b. Sodium Cyanide - 45-52.5g/l(6-7oz/gal)
- c. Sodium Carbonate - 30-60g/l(4-8oz/gal)
- d. Rochelle Salts - 30-60g/l(4-8oz/gal)
- e. Free Sodium Cyanide - 1.5-3.75g/l(0.2-0.5oz/gal)
- f. Temperature - 38-54°C(100-130°F)

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

5.2.14 Step number 14. Rinse thoroughly in clean water. The rinse water temperature should be ambient.

5.2.15 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 intermediate deposit of nickel between the copper strike and the plating deposit to prevent migration.

5.3 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 used in the plating process 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 placing 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).

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

5.5 Caution (or warning). The procedures specified herein utilize materials listed in 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 29 CFR 1910.1000 (OSHA Standards).

Custodian:
Air Force - 99

Preparing activity:
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Project Number: MFFP-F142

SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 22-R255
<p>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.</p>		
SPECIFICATION <i>MIL-STD-1303A</i>		
ORGANIZATION		
CITY AND STATE		CONTRACT NUMBER
MATERIAL PROCURED UNDER A <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT		
<p>1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?</p> <p>A. GIVE PARAGRAPH NUMBER AND WORDING.</p>		
B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES		
2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID		
<p>3. IS THE SPECIFICATION RESTRICTIVE?</p> <p><input type="checkbox"/> YES <input type="checkbox"/> NO (If "yes", in what way?)</p>		
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

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