

MIL-STD-1501B(USAF)

NOTICE 1

14 DEC 1984

## MILITARY STANDARD

## CHROMIUM PLATING, LOW EMBRITTLEMENT, ELECTRODEPOSITION

TO ALL HOLDERS OF MIL-STD-1501B(USAF):

1. THE FOLLOWING PAGES OF MIL-STD-1501B(USAF) HAVE BEEN REVISED AND SUPERSEDED THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
iii	14 December 1984	iii	29 March 1978
iiia	14 December 1984	iii	29 March 1978
5	29 March 1978	(REPRINTED WITHOUT CHANGE)	
6	14 December 1984	6	29 March 1978
6a	14 December 1984	6	29 March 1978
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8	14 December 1984	8	29 March 1978

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-1501B(USAF) will verify that the page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or canceled.

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\*4.12 Type II Plating. For Type II plating a minimum of 0.05 millimeters (0.002 in) more chrome than desired shall be deposited (per surface). The excess shall be ground off to give the final dimension and surface finish desired. Steel parts heat treated to 1100 mega pascals or 112 kilograms force/millimeter squared (180,000 psi) and above shall be ground in accordance with MIL-STD-866. All ground chrome plated surfaces shall be fluorescent penetrant inspected (see 5.3.1). Chrome plated surfaces showing indications of abusive grinding (spiral, barber pole, circular, patch or linear crack patterns), spalling or blistering shall be cause for rejection of the parts.

## 5. DETAILED REQUIREMENTS

### 5.1 General notes

5.1.1 Prior to plating. Except for finish grinding operations, all machining, forming, welding and shot peening shall be completed prior to plating.

\*5.1.2 Baking. Parts shall be baked for stress relief before plating for four hours minimum at  $191 + 14^{\circ}$  celsius ( $375 + 25$  degrees F). Shot peening shall be performed before plating and after stress relieving.

\*5.1.3 Plating sequence. If chromium and cadmium are used in combination, the chromium shall be deposited first. When chrome plating is to be followed by cadmium plating, the 23 hour minimum bake period, required by 5.2.7, can be replaced by a four hour bake period at  $191 + 14$  degrees celsius ( $375 + 25^{\circ}$  F), provided the part is baked for 23 hours minimum after completion of the cadmium plating.

5.1.4 Storage of parts. Storage of parts between stress relief and cleaning shall be controlled to prevent contact with water or other corrosive materials. Parts shall be stored to permit free circulation of air around the parts.

5.1.5 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.

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

5.1.7 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. When gang plating (two or more like parts) care should be taken to assure a uniform division of current flow to each part by uniform tank spacing and meticulous cleaning and shaping of racking contact surfaces or by providing isolated controlled current paths to each individual part; amperage limits specified in 5.2.4.

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5.2 Plating procedure. The chromium plating procedure shall be as described below:

5.2.1 Step No. 1. Parts shall be vapor degreased.

5.2.2 Step No. 2. The preferred method of cleaning is by dry blasting using 80-180 grit aluminum oxide ( $Al_2O_3$ ) or silicon dioxide ( $SiO_2$ ) or garnet per MIL-STD-1504. Other nonembrittling cleaning processes can be used with the approval of the procuring activity. Elapsed time between completion of cleaning and Step No. 3 shall not exceed sixty minutes.

5.2.3 Step No. 3. Anodic etch 15.5 to 46.5 amps/decimeter squared (1 to 3A per sq. in.) for 30 seconds to 10 minutes. Etch in the following solution (preferred) or in the plating bath, 5.2.4:

Chromic Acid 224.7-299.6 gram/liter (30-40 oz/gal)  
Temperature 32 to 60 degrees C (90 to 140° F)

NOTE: Etching increases iron contamination in the plating bath, therefore, the use of solution 5.2.3 is recommended.

5.2.3.1 Alternate reverse etch solutions. A sulfuric acid or a sulfuric-hydrofluoric acid mixture can be used as an alternate (reverse etch solution) to the solution specified in 5.2.3. The conditions for the employment of either the sulfuric acid or the sulfuric-hydrofluoric acid mixtures are as follows:

a. Forty percent sulfuric acid.

(1) Operating range - 35-45 percent sulfuric acid by volume.

(2) Temperature - ambient.

(3) Current density - 15.5 to 46.5 amps/decimeter squared (1 to 3A per sq. in.), anodic.

(4) Time - 30-120 seconds.

b. Sulfuric-hydrofluoric acid.

(1) Operating range - sulfuric acid, 20-30 percent by volume; 70 percent hydrofluoric acid, 3-10 percent by volume.

(2) Temperature - ambient.

(3) Current density - 31.0 to 62.0 amps/decimeter squared (2 to 4A per sq. in.), anodic.

(4) Time - 60-90 seconds.

5.2.4 Step No. 4. Chromium plate at 15.5 to 46.5 amps/decimeters squared (1 to 3A per sq. in.) to the required

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thickness. When feasible, apply voltage so that the current will flow upon immersion of parts. Chromium plate in the following solution:

- a. Chromic Acid 224.7-269.6 gram/liter (30-36 oz/gal)
- b. Sulfuric Acid 2.247-2.696 gram/liter (.30-.36 oz/gal)
- c. Trivalent Chrome 4 grams per liter (g/l) max
- d. Iron 5 grams per liter (g/l) max
- e. Ratio Chromic Acid/Sulfuric Acid 80/1 to 120/1
- f. Temperature 52 to 60 degrees Celsius (125 to 140°F)

5.2.5 Step No. 5. Rinse parts in cold water and inspect for defects and adequate buildup. If undersize, return to plating tank and continue plating. If plating is adequate, remove masking and racking, and clean as necessary.

5.2.6 Step No. 6. Rinse all parts in hot water and blow dry with compressed air. Elapsed time between completion of plating and start of baking, step number 7, shall not exceed four hours.

\*5.2.7 Step No. 7. Bake all parts heat treated to 1100 megapascals or 112 kilograms force/millimeters squared (180,000 psi) and above for twenty three hours minimum, at  $191 \pm 14$  degrees celsius ( $375 \pm 25^{\circ}\text{F}$ ) (see 5.1.3).

5.3 Inspection. Inspection shall be in accordance with the inspection and tests in QQ-C-320 and this standard.

\*5.3.1 Penetrant inspection. The parts shall be cleaned and inspected for the requirements of paragraphs 4.8, 4.9, 4.10 and 4.12 in accordance with MIL-I-6866, Type I, Method A, B or C using material per MIL-I-25135 Group VI. Penetrant penetration time will be 20 minutes minimum.

5.4 Process controls. Solutions used in the plating process shall be checked periodically and maintained in accordance with the requirements of this process standard.

\*5.5 Qualification embrittlement test. The vendor shall demonstrate his ability to provide chromium plate which meets the requirements of 4.5 as follows:

a. Four round notched 4340 steel specimens from four separate heats, heat treated to a tensile strength of 1590 to 1710 megapascals (260,000 to 280,000 psi) shall be prepared. The configuration shall be in accordance with Figure 8 of ASTM standard E8 for round specimens. Specimens shall have a 60 degree V-notch located approximately at the center of the gauge length. The cross section area at the root of the V-notch shall be approximately equal to half the area of the full cross section area of the specimen's reduced section. The V-notch shall have a  $0.254 \pm 0.00127$  millimeter ( $0.010 \pm 0.0005$  in) radius of curvature at the base of the notch.

b. During plating the specimens shall be mounted symmetrically on a rack by themselves. All areas of the rack except the contact area shall be coated with a suitable maskant. An ammeter, having a sensitivity of 0.5 amperes or better shall be connected to the specimen rack and the cathode bar. The specimen shall be plated at two amperes per square inch for three hours. The specimen shall be baked for twenty-three hours at  $191 \pm 14^{\circ}$  celsius ( $375 \pm 25^{\circ}\text{F}$ ) within four hours of removal from the bath.

c. The specimens will be subjected to 200 hours of static loading at 75 percent of the ultimate notched tensile strength. The test shall be considered passed if all four specimens meet the requirements of 4.5.

d. Upon successful completion of the static load test, one of the notched tensile specimens shall be sectioned across the notch parallel to the axis of the specimen. Photomicrographs shall be taken of the notched area and examined for complete coverage of the notch (use 80-100x magnification).

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5.6 Process control embrittlement acceptance test. The process control embrittlement acceptance test shall be as follows:

a. Two standard specimens of the type noted in 5.5a shall be plated per 5.5b in conjunction with the plating of items. The specimens shall be subjected to a sustained load test of 75 percent of the ultimate notch tensile strength of the material for 200 hours minimum and shall meet the requirements of 4.5. Failure of any one of the specimens shall constitute failure of the test, and production shall cease until the cause of failure is determined and the bath requalified. Acceptance of items completed after the last successfully completed acceptance test shall be withheld until the extent and cause of failure have been determined.

b. The test for embrittlement shall be conducted as often as deemed necessary with a maximum interval of every ninety (90) calendar days. If the embrittlement test has not been performed in the ninety (90) days preceeding the processing of a material batch the bath must be qualified in accordance with 5.5.

5.7 Asterisks. The margin of this standard is 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.

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