STANDARD OVERHAUL PRACTICES MANUAL

LOW HYDROGEN EMBRITTLEMENT CADMIUM PLATING

PART NUMBER NONE

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STANDARD OVERHAUL PRACTICES MANUAL

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To: All holders of LOW HYDROGEN EMBRITTLEMENT CADMIUM PLATING 20-42-01.

Attached is the current revision to this STANDARD OVERHAUL PRACTICES MANUAL

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Location of Change	Description of Change
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TITLE PAGE					
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INTRODUCTION

1. General

A. The instructions in this manual tell how to do standard shop procedures during maintenance functions from simple checks and replacement to complete shop-type repair.

B. This manual is divided into separate sections:

(1) Title Page

(2) Transmittal Letter

(3) Highlights

(4) Effective Pages

(5) Contents

(6) Revision Record

(7) Record of Temporary Revisions

(8) Introduction

(9) Procedures

C. Refer to SOPM 20-00-00 for a definition of standard industry practices, vendor names and addresses, and an explanation of the True Position Dimensioning symbols used.

D. The data is general. It is not about all situations or specific installations. Use it as a guide to help you write minimum standards.

E. If the component overhaul instructions are different from the data in this subject, use the component overhaul instructions.

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STANDARD OVERHAUL PRACTICES MANUAL

LOW HYDROGEN EMBRITTLEMENT CADMIUM PLATING

1. INTRODUCTION

NOTE: Low hydrogen embrittlement cadmium-titanium plating per SOPM 20-42-02 is an optional and preferred procedure to this low hydrogen embrittlement cadmium procedure. But if the overhaul instructions specify low hydrogen embrittlement cadmium-titanium plating, and you cannot do it, you can always use this low hydrogen embrittlement cadmium plating as an alternative. Stylus cadmium plating per SOPM 20-42-10 is optional for local areas not larger than 72 square inches on components with no load applied during the plating procedure.

A. The data in this subject comes from Boeing Process Specification BAC5718 for low hydrogen embrittlement cadmium plating.

B. The data is general. It is not about all situations or specific installations. Use this data to help you write minimum standards. Equivalent procedures can be used.

C. This plating is usually used on low alloy steels, such as those heat-treated above 220 ksi. The plating makes a corrosion resistant layer that lets hydrogen ions come through from the metal when the part is subsequently baked.

D. Refer to SOPM 20-00-00 for a list of all the vendor names and addresses.

2. MATERIALS

A. Sodium Cyanide, 97% NaCN minimum with not more than 5 PPM by weight sulfides as sulfur or 10 PPM by weight chloroform extractable materials – Cyanogran M or Cyanobrick, V18873

B. Anodes, Cadmium – A-A-51126

C. Cadmium Oxide – A-A-50800

D. Sodium Hydroxide, Technical – O-S-598, 76% Na_2O

E. Sodium Dichromate Dihydrate, Technical – O-S-595

F. Wetting Agent – Nacconol 90G, V87570 (Replaces Nacconol 90F)

G. Filter Pads – Dynel Fabric or Polyethylene Fabric

H. Carbon Filter Aid – Nerofil B, V84441

I. Activated Charcoal – Norit A, V0AEA0

J. Sulfuric Acid, 66° Baume, Technical – O-S-809, Type 1

K. Maskant - Turco 522, V61102. Equivalent maskants can be used if organic plasticizers cannot be leached out by the plating solution

L. Filter Aid – Celite 501, V9K562

M. Chromic Acid – Technical, 0-C-303

3. SOLUTION PREPARATION AND CONTROL

A. Solution Preparation (Table 1)

(1) Clean the tank. Fill it half full with water.

(2) Add sodium hydroxide and sodium cyanide to get the concentrations shown in Table 1.

(3) Dissolve cadmium oxide into a portion of sodium cyanide solution.

(4) Fill the tank with water to the operating level.

(5) Completely dissolve all materials in the water.

(6) Add the cadmium anodes to the tank.

(7) Let the tank stand for 8-16 hours before you use the solution.

Table 1: Low Embrittlement Cadmium Solution

Material	Control Concentration
Cadmium (Metal)	6.5-7.5 oz/gal
Sodium Carbonate	8.0 oz/gal maximum
Sodium Hydroxide	3.5-5.0 oz/gal
Total Sodium Cyanide	20-28 oz/gal
Operating Temperature	70-85°F

B. Solution Control

(1) Be careful to keep organic contamination out of the plating solution. Organic materials in the plating solution will decrease or remove its low hydrogen embrittlement characteristic.

(2) Carbonate can be removed from the plating solution by any approved method that will keep contamination below the level shown in Table 1.

(3) Immediately after carbonate removal, adjust the solution back to the concentration limits shown in Table 1.

(4) Use filters as necessary to keep the plating solution clean. Use only the approved filtering systems, materials, and filtering aids.

(5) For hydrogen embrittlement control, do tests on the plating solution with a hydrogen detection instrument or with notched tensile specimens. Make these tests at least twice a week, on the day of plating if more than 3 days after the last hydrogen test, after each time the filter is recharged, and after each carbonate treatment. Refer to BAC5718 and BSS7321 for details.

(6) For all immersion rinse tanks, control the overflow rate to make sure that the maximum total dissolved solids are not more than 500 PPM at the time the parts are removed from the tank.

4. ANODES

NOTE: Steel anodes that are completely plated with cadmium, no copper or nickel strike allowed, are considered as cadmium anodes. The cadmium layer on the anodes must be continuous after plating of parts.

A. Because of the relatively low covering power (ability to plate in recessed areas) of the plating bath, special anoding will be necessary to plate recesses and inside diameter areas.

B. If the part configuration makes you use contour conforming internal or external anodes, these anodes must be of cadmium or corrosion resistant steel.

C. Where the ratio of hole depth to inside diameter is more than 1:1 for open holes or 0.5:1 for blind holes, use cadmium internal anodes.

5. PREPLATE TREATMENT

A. Before plating, stress relieve all low alloy and corrosion resistant steel parts per the applicable overhaul instructions. If no stress relief details are given, stress relieve per SOPM 20-10-02.

B. Manually solvent clean as necessary. Vapor degrease per SOPM 20-30-03. Make sure the parts are fully dry.

C. Abrasive blast per SOPM 20-30-03. Use only dry blasting procedures and abrasives.

D. Within 1 hour, cold water rinse for 1 minute maximum. (The parts can wait up to 6 hours before this rinse if they are covered with kraft paper within 1 minute after the abrasive blast.)

E. Within 1 minute after the rinse, start to plate the parts. If this is not possible, put the parts in cyanide holding bath (Table 2) until you are ready to plate the parts. The parts can stay in this bath up to 4 hours. Do not rinse these parts when you remove them from the bath.

Table 2: Cyanide Holding Bath

Material	Original Preparation	Control Concentration
Sodium Cyanide	0.31 lb/gal	4-5 oz/gal
Sodium Hydroxide	0.1 lb/gal	1-2 oz/gal
Operating Temperature	–	60-95°F

6. PLATING PROCEDURE

CAUTION: DO NOT STOP THE PLATING PROCEDURE OR SHUT OFF THE CURRENT UNTIL PARTS ARE READY FOR REMOVAL FROM THE TANK. REMOVE PARTS IMMEDIATELY WHEN YOU SHUT OFF THE PLATING CURRENT.

A. Put the parts in the plating bath and start to plate them.

B. For the first part plated with a given setup, you can stop the plating procedure and remove the part from the bath for thickness and coverage checks. But, after you make necessary adjustments to anode configuration, plating time and current, plate all of the other equivalent parts as a continuous operation. (Parts used for the adjustment can be stripped, baked, and plated per Paragraph 5.C. and on).

C. Continue plating for the time necessary to set the thickness specified by the overhaul instructions. See Table 3 for time selection of plating thickness.

Table 3: Time Selection for Plating

Current Density	Minimum Time to Plate 0.0005 Inch of Cadmium
50 amps/sq ft	6.1 minutes
60 amps/sq ft	5.1 minutes
70 amps/sq ft	4.3 minutes
80 amps/sq ft	3.8 minutes

D. Plating thickness and appearance

(1) Plate to the thickness specified in the overhaul instructions. If the thickness is not specified, plate to a 0.0005-inch minimum thickness.

(2) Unless specified by overhaul instructions or by Paragraph 6.D.(3), the specified thickness is applicable only to visible surfaces which can be touched with a 0.75-inch diameter ball, but the cadmium plating must be continuous.

(3) Unless specified by overhaul instructions, the minimum plating thickness is not necessary on inside diameter of hollow and tubular parts. The inside diameter surfaces must show a continuous layer of cadmium and must be plated for the time required to deposit 0.0005-inch plating per Table 3.

(4) The plating must be dull, granular and porous with a color from a dull gray to a frosty white. A bright, shiny, dense plating is a sign of a malfunction in the procedure that could cause embrittled parts. If you get plating with these properties, make hydrogen embrittlement tests on the plating bath. Refer to BAC5718 for details.

(5) Stains because of the bake or the rinse are acceptable.

(6) After plating, do not brush, polish, or brighten the layer.

E. Cold water rinse for 5 minutes (maximum). Continue with post-plate treatment, Paragraph 7.

F. When the plating bath is first started or was temporarily shut down, we recommend you plate some test panels with this procedure before you plate parts.

(1) Use test panels of low carbon cold rolled steel, 4 by 6 inches by 0.040 inch thick.

(2) Cadmium plate the test panels with this procedure. Chromate treat two of the panels.

(3) Examine the test panels.

(a) The plating layer must have no blisters, pits, nodules or signs of burns.

(b) The plating must be smoothly continuous and agree with the thickness and appearance requirements of Paragraph 6.D.

(4) Make a check of the bond of the plating layer by one of these two steps:

(a) Scrape the plated surface with a knife to expose the base metal. Examine the scraped area at 4 diameters magnification to see how the plating came off. If the plating was bonded and tore off, it was satisfactory. If plating pieces came off as flakes without a bond to the surface, it was not satisfactory.

(b) Bend the test panel 180° over a 0.040 -inch diameter. Examine at 4 diameters magnification for signs of separation of the cadmium plating from the base metal. The plating was satisfactory if cracks occur in the cadmium plate deposit or base metal but do not result in peeling, blistering or flaking of the plate layer.

7. POST PLATE TREATMENT

A. When post plate chromate treatment is not specified in applicable overhaul instructions:

(1) Rinse parts in chromic acid solution for 0.5-2.0 minutes. (To make the chromic acid solution, mix 34 pounds of chromic acid with 100 gallons of water. Control this solution at 4.1-6.9 oz/gal concentration and 65-95°F.)

(2) Cold water rinse 0.5-5.0 minutes.

(3) Air dry at 160°F maximum.

(4) Within 8 hours after plating, bake the parts per the overhaul instructions or per Table 4. This bake is not necessary for corrosion resistant steels A-286 or 300-series; or for 15-5PH, 17-4PH, 17-7PH below 180 ksi.

(5) Continue with Paragraph 7.C.

Table 4: Post Plate Baking

Material	Heat Treatment	Baking Requirement	
		Time	Temperature
All	Above 180 ksi	23 hrs minimum	350-400°F

Table 4: Post Plate Baking (Continued)

Material	Heat Treatment	Baking Requirement	
		Time	Temperature
Carburized Parts and 400-Series CRES	All Heat Treats	5-8 hours	250-300°F

B. When post plate chromate treatment is specified by overhaul instructions:

(1) (Optional). Rinse parts in chromic acid solution for 0.5-2.0 minutes. (To make the chromic acid solution, mix 34 pounds of chromic acid with 100 gallons of water. Control the solution at 4.1-6.9 oz/gal concentration and 65-90°F).

(2) (Optional). Cold water rinse 0.5-5.0 minutes.

(3) Air dry at 160°F maximum.

(4) Within 8 hours, bake the parts per the overhaul instructions or per Table 4. This bake is not necessary for corrosion resistant steels A-286 or 300 series; or for 15-5PH, 17-4PH, 17-7PH below 180 ksi.

NOTE: If the overhaul instructions specify chromate treatment, and Ultrachromate 300 will be used, you can chromate treat before the hydrogen embrittlement bake as an option. But the resistance to corrosion will be better if you bake first, and then do the chromate treatment.

(5) Put the parts in chromate treatment solution per Table 5, or an equivalent chromate treatment solution as given in BAC5718. The parts must hang freely to let all areas become wet with the solution. If the Table 5 solution is used, keep the parts in the solution for 10 seconds maximum.

(6) Remove the parts and let them drain a short time.

(7) Rinse the parts in hot water, 160°F maximum, for 0.5-2.0 minutes.

C. Magnetic particle examine when specified by the overhaul instructions. Solvent clean the parts. Examine the quality of the plating per Paragraph 6.D.

D. If applicable, apply primer and enamel. Do this as quickly as possible after plating, as a precaution against contamination or damage to the plating.

Table 5: Chromate Treatment Solution

Material	Original Preparation	Control Concentration
Sodium Dichromate	165 lbs/100 gal	24-30 oz/gal
Nacconol 90F or 90G	6 oz/100 gal	–
Sulfuric Acid	1 gal/100 gal	pH 0.65-1.0
Operating Temperature	–	65-95°F