STANDARD OVERHAUL PRACTICES MANUAL

HARD CHROME PLATING

PART NUMBER NONE

PUBLISHED BY BOEING COMMERCIAL AIRPLANES GROUP, SEATTLE, WASHINGTON, USA
A DIVISION OF THE BOEING COMPANY
PAGE DATE: Jul 01/2009

STANDARD OVERHAUL PRACTICES MANUAL

Revision No. 30
Jul 01/2009

To: All holders of HARD CHROME PLATING 20-42-03.

Attached is the current revision to this STANDARD OVERHAUL PRACTICES MANUAL

The STANDARD OVERHAUL PRACTICES MANUAL is furnished either as a printed manual, on microfilm, or digital products, or any combination of the three. This revision replaces all previous microfilm cartridges or digital products. All microfilm and digital products are reissued with all obsolete data deleted and all updated pages added.

For printed manuals, changes are indicated on the List of Effective Pages (LEP). The pages which are revised will be identified on the LEP by an R (Revised), A (Added), O (Overflow, i.e. changes to the document structure and/or page layout), or D (Deleted). Each page in the LEP is identified by Chapter-Section-Subject number, page number and page date.

Pages replaced or made obsolete by this revision should be removed and destroyed.

ATTENTION

IF YOU RECEIVE PRINTED REVISIONS, PLEASE VERIFY THAT YOU HAVE RECEIVED AND FILED THE PREVIOUS REVISION. BOEING MUST BE NOTIFIED WITHIN 30 DAYS IF YOU HAVE NOT RECEIVED THE PREVIOUS REVISION. REQUESTS FOR REVISIONS OTHER THAN THE PREVIOUS REVISION WILL REQUIRE A COMPLETE MANUAL REPRINT SUBJECT TO REPRINT CHARGES SHOWN IN THE DATA AND SERVICES CATALOG.

Location of Change	Description of Change
	NO HIGHLIGHTS

STANDARD OVERHAUL PRACTICES MANUAL

A = Added, R = Revised, D = Deleted, O = Overflow

TABLE OF CONTENTS

STANDARD OVERHAUL PRACTICES MANUAL

All revisions to this manual will be accompanied by transmittal sheet bearing the revision number. Enter the revision number in numerical order, together with the revision date, the date filed and the initials of the person filing.

Revision		Filed	
Number	Date	Date	Initials

Revision		Filed	
Number	Date	Date	Initials

Revision		Filed		Revision		Filed	
Number	Date	Date	Initials	Number	Date	Date	Initials

STANDARD OVERHAUL PRACTICES MANUAL

All temporary revisions to this manual will be accompanied by a cover sheet bearing the temporary revision number. Enter the temporary revision number in numerical order, together with the temporary revision date, the date the temporary revision is inserted and the initials of the person filing.
When the temporary revision is incorporated or cancelled, and the pages are removed, enter the date the pages are removed and the initials of the person who removed the temporary revision.

Temporary Revision		Inserted		Removed	
Number	Date	Date	Initials	Date	Initials

Temporary Revision		Inserted		Removed	
Date	Initials	Number	Date	Date	Initials

Temporary Revision		Inserted		Removed	
Number	Date	Date	Initials	Date	Initials

Temporary Revision		Inserted		Removed	
Date	Initials	Number	Date	Date	Initials

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.

HARD CHROME PLATING

1. INTRODUCTION

A. The data in this subject comes from Boeing Process Specification BAC5709. The airline has a copy of the Boeing Process Specification Manual.

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

C. Hard chrome plating done by this subject will agree with QQ-C-320, class 2 for steel parts heat treated below 220 ksi and MIL-STD-1501 for steel parts heat treated to 220 ksi and above. Other procedures which give the same results can be used as equivalents.

D. BAC5709 puts chrome plating into 4 classes. Class 1 is decorative chrome plating. Class 2 is hard chrome plating (or plating and grinding) to specified dimensions. Class 3 is the same as Class 2, but with a special pretreatment for a better bond of the plating. Class 4 is a special thin, hard plating with a minimum hardness of Rockwell C 67. If the overhaul instructions do not give the class, use Class 2. If the overhaul instructions refer to BMS 10-70, Type 1 or Type 2, use Class 4.

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

2. MATERIALS

NOTE: Equivalent substitutes can be used.

A. Plating Compound – Unichrome CR-110, V27201

B. Plating Compound – Unichrome CR-204, V27201

C. Plating Compound – Econochrome S, V71361

D. Plating Compound – Econochrome 40, V71361

E. Plating Compound – Econochrome 66, V71361

F. Sulfuric Acid – 66 degree Baume', Water White, 2.5 ppm Maximum Arsenic

G. Hydrochloric Acid – 20 degree Baume', Technical

H. Chromic Acid (Chromium Trioxide), Technical

I. Abrasives for Scouring

(1) Wyandotte F-1013 pumice detergent, V83339

(2) Pumice

(3) Abrasive paper, silicon carbide

(4) Tripoli powder

(5) Scotch Brite pads, No. 7448, silicon carbide, V76381

J. Anodes

(1) Lead, 4 to 7 percent tin

(2) Lead, 4 to 7 percent antimony

(3) Chemical Lead

(4) Nickel, 99% pure: rolled, depolarized, electrolytic grade or carbon-nickel cast and rolled. Optional: sulfur depolarized (SD) nickel chips

(5) Carbon

(6) Platinum wire, lead or lead-tin plated steel wire

K. Sodium Cyanide – 97% NaCN minimum, Plating Grade

L. Sodium Hydroxide – Flake or Granulated, Technical

M. Hydrofluoric acid, Technical

N. Nickel Chloride Hexahydrate, Technical

O. Ammonium bifluoride, Technical

P. Copper Sulfate ($CuSO_4.5H_2O$), Technical

Q. Barium Carbonate (BaCO3), Technical

3. PREPARATION OF SOLUTION

NOTE: The dilute standard, concentrated standard, and self-regulated high speed chromium plating solutions are alternates for each other.

A. Use distilled or deionized water if the regular water supply is more than the following maximums:

(1) 450 ppm maximum dissolved solids.

(2) 50 ppm maximum dissolved chlorides.

B. Chromium Plating Solution, Dilute Standard Bath

(1) Clean the tank. Then add two-thirds total amount of water.

(2) Add 200 pounds chromic acid for each 100 gallons of final solution.

(3) Fill tank with water to the operating level and mix fully.

(4) Operate the solution at a temperature of 110-140°F. (Class 1 plating), 120-140°F (Class 2 plating; 130-140°F is best). 130-140°F (Class 3 plating), or 120-130°F (Class 4 plating).

(5) Control the solution at 30-35 oz/gal chromic acid, CrO_3/SO_4 ratio of 85-115 to 1 (Class 1, 2, or 4) or 85-105 to 1 (Class 3), maximum of 0.53 oz/gal trivalent chromium, and maximum of 1.00 oz/gal iron.

NOTE: Do not add sulfuric acid on makeup. After the chromic acid is dissolved and diluted to the correct volume, analyze for sulfates and add sulfuric acid as necessary to adjust the chromate/sulfate ratio. For Class 1, 2, or 4 plating, to make the plating bond better and decrease chicken wire cracks, keep this ratio in the 95-100 to 1 range. For Class 3 plating, keep the ratio in the 90-95 to 1 range.

(6) Use anodes as necessary. Dummy plate to keep the anodes active, as indicated by a brown-black layer of lead peroxide. A bright yellow surface layer is a sign of lead chromate, which is passive and will decrease plating efficiency. Use auxiliary anodes as necessary to get a continuous plating thickness in recesses and corners. Remove and clean the anodes if the plating bath will not be used for a long time. Keep the anodes in a clean dry place until you use them again.

NOTE: A very dark colored bath is usually a sign of too high a chromate concentration, and frequently will occur with passive yellow anodes. This will cause unserviceable plating. To correct the bath you must dummy plate in it a long time, sometimes for days. Do not let organic materials such as solvents, greases, or dirty oily surfaces get into the bath because these break down the chromic acid into chromate ions.

(7) For Class 1, 2, or 4 plating plate at 1-4 asi (ferrous alloys) or 1-5 asi (aluminum and copper alloys). For Class 3, plate at 2-3 asi.

C. Chromium Plating Solution, Concentrated Standard Bath

(1) Clean the tank. Then add two-thirds total amount of water.

(2) Add 330 pounds chromic acid for each 100 gallons of final solution.

(3) Fill the tank with water to the operating level and mix fully.

(4) Operate solution at a temperature of 110-140°F for Class 1, 2, or 4, or 130-140°F for Class 3.

(5) Control the solution at 50-55 oz/gal chromic acid, the same CrO_3/SO_4 ratio as for the dilute bath above, maximum of 0.53 oz/gal trivalent chromium, and maximum of 1.00 oz/gal iron.

NOTE: Do not add sulfuric acid on makeup. After the chromic acid is dissolved and diluted to proper volume, analyze for chromates and add sulfuric acid as necessary to adjust the chromate/sulfate ratio. For Class 1, 2, or 4 plating, to make the plating bond better and decrease chicken wire cracks, keep this ratio in the 95-100 to 1 range. For Class 3 plating, keep the ratio in the 90-95 to 1 range.

(6) Use anodes as necessary.

(7) Plate at the same current densities as for the dilute bath above.

D. Self Regulating High Speed Unichrome CR-110 Bath

(1) Clean the tank. Then add two-thirds total amount of water. Adjust temperature to 120°F.

(2) Add 230 pounds of Unichrome CR-110 for each 100 gallons of final solution. Mix into solution for 2-3 hours.

(3) Fill the tank with water to operating level and mix fully.

(4) Operate the solution at 120-140°F (Class 1, 2, or 4 plating) or 130-140°F (Class 3 plating).

(5) Control the solution at 33.6-40.0 ounces of Unichrome CR-110 per gallon of water. Adjust with CR-204 or CR-110 added by the manufacturer's instructions. Mix the solution for 2-3 hours after makeup or additions.

NOTE: If you must remove a small amount of CR-204 or CR-110 from a large container, be sure to mix the contents of the container first to make sure the catalyst concentration is constant in all of the material.

(6) Use anodes as necessary.

(7) For Class 1, 2, or 4 plating, plate at 1-4 asi (ferrous alloys) or 1-5 asi (aluminum and copper alloys). For Class 3 plating, plate at 2-3 asi.

E. Econochrome S Bath

(1) Clean the tank. Then add two-thirds total amount of water. Adjust temperature to 125°F.

(2) Add 125 pounds of Econochrome S for each 100 gallons of final solution. Mix until fully dissolved.

(3) Fill the tank with water to the operating level and mix fully.

(4) Operate the solution at 115-150°F (Class 1 plating), 120-140°F (Class 2 plating; 130-140°F is best), 130-140°F (Class 3) or 120-130°F (Class 4).

(5) Control the solution at 18-21 oz Econocrome S per gallon with a CrO3/66 ratio of 5.0-6.7 and a CrO_3/SO_4 ratio of 105-200 to 1 (125-155 to 1 is best) for Class 1, 2, or 4, or 85-105 to 1 for Class 3.

NOTE: The CrO_3/66 ratio is ounces per gallon of chromates to units per gallon of Econochrome 66, where 1 unit is 1.28 fluid ounce of Econochrome 66. For Class 1, 2, or 4 plating, to make the plating bond better and decrease chicken wire cracks, keep this ratio in the 95-100 to 1 range. For Class 3 plating, keep the ratio in the 90-95 to 1 range.

(6) Add sulfuric acid to bring sulfate within limits.

(7) For Class 1, 2, or 4 plating, plate at 1.0-4.5 asi. For Class 3 plating, plate at 2-3 asi.

F. Econochrome 40 Bath

(1) Clean the tank Then add two-thirds total amount of water.

(2) Add 205 pounds of Econochrome 40 for each 100 gallons of final solution, and mix until fully dissolved.

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

(4) Operate the solution at 115-150°F (Class 1 plating), 120-140°F (Class 2 plating; 130-140°F is best), 130-140°F (Class 3 plating) or 120-140°F (Class 4 plating).

(5) Control the solution at 18-40 ounces Econochrome 40 per gallon (28-32 oz/gal is best) with a CrO_3/66 ratio of 25-50 to 1 and a $CrO_3$3/SO_4 ratio of 75-200 to 1 (75-125 is best), for Classes 1, 2, or 4, or 85-105 to 1 for class 3.

NOTE: The CrO_3/66 ratio is ounces per gallon of chromates to units per gallon of Econochrome 66, where 1 unit is 1.28 fluid ounce of Econochrome 66. For Class 1, 2, or 4 plating, to make the plating bond better and decrease chicken wire cracks, keep this ratio in the 95-100 to 1 range. For Class 3 plating, keep the ratio in the 90-95 to 1 range.

(6) Add sulfuric acid to adjust the sulfate within limits.

(7) For Class 1, 2, or 4 plating, plate at 1.0-4.5 asi. For Class 3 plating, plate at 2-3 asi.

G. Sulfuric Acid Etch Solution

(1) Clean the tank. Then mix 10 gallons sulfuric acid and 90 gallons water for each 100 gallons final solution.

(2) Operate the solution at a temperature of 86°F maximum.

(3) Control the solution at 20.0-24.0 oz/gal sulfuric acid.

H. Chromic Acid Etch Solution

(1) Clean the tank. Then mix a solution of 30-50 ounces chromic acid for each gallon of final solution.

(2) Operate the solution at room temperature.

I. Cyanide Holding Solution

(1) Clean the tank. Then add one-half total amount of water.

(2) Add 31.0 pounds sodium cyanide for each 100 gallons of final solution. Stir until dissolved.

(3) Add 10.0 pounds sodium hydroxide for each 100 gallons of final solution. Add chemical slowly, or the solution will get too hot. Stir until dissolved.

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

(5) Operate the solution at room temperature.

(6) Control the solution at 4.0-5.0 oz/gal sodium cyanide and 1.0-2.0 oz/gal sodium hydroxide.

J. Sulfuric Acid - Hydrofluoric Acid Etch Bath

(1) Clean the tank. Then mix 25 gallons sulfuric acid, 4 gallons of 70% hydrofluoric acid, or 6.5 gallons of 45% hydrofluoric acid, or 46 pounds ammonium bifluoride, and 71 gallons of water for each 100 gallons of final solution.

NOTE: You can use other concentrations of hydrofluoric acid if you adjust the quantity of acid.

(2) Operate the solution at 60-100°F.

(3) Control the solution at 50-70 oz/gal sulfuric acid, 3-6 oz/gal fluoride, 1.5 oz/gal maximum dissolved iron.

K. Nickel Strike Bath

(1) Clean the tank. Then fill to three-quarter level with water.

(2) Add 200 pounds nickel chloride for each 100 gallons of final solution and stir until fully dissolved.

(3) Add 8.6 gallons hydrochloric acid for each 100 gallons of final solution and stir.

(4) Fill tank with water to operating level and stir.

(5) Operate the solution at 60-100°F.

(6) Control the solution at 30-35 oz/gal nickel chloride hexahydrate, 3.7-4.3 oz/gal HCl, and 1 oz/gal maximum dissolved iron. Make up a new bath when the maximum iron level is reached. Use nickel or carbon anodes, or both, as required to control the nickel concentration. Remove the nickel anodes if the bath will not be used for a long time.

L. Procedure to Decrease Sulfates in Chrome Plating Bath

(1) Use this procedure only when the usual controls do not decrease the sulfates.

(2) Before you add the barium carbonate powder, mix up the plating bath for a minimum of 1 minute.

(3) Slowly add barium carbonate over the surface of the bath. Continue to mix the bath for a minimum of 30 minutes. Do not use too much barium carbonate. One weight part of barium carbonate will remove 0.3 weight parts of sulfate ion.

(4) Turn off the agitation. Let the barium sulfate settle for a minimum of 4 hours.

(5) Carefully pump the liquid layer of the bath into a clean tank, but do not include the bottom layer of precipitates. Discard the layer of precipitate and clean the tank.

(6) Send the removed chrome plating solution through a filter and back into the cleaned tank.

(7) Make an analysis of the plating solution and adjust the concentrations as necessary.

4. PLATING SOLUTION SLUDGE REMOVAL

A. Remove sludge from the self-regulating high speed chromium plating solution (Paragraph 3.D.) as follows:

(1) Heat the solution to 150°F.

(2) Stir the solution to put the sludge back into the solution.

(3) Let the bath settle for at least 30 minutes.

(4) Siphon off all but a few inches of the solution into a clean tank, heated if possible.

(5) Manually remove the sludge and the remaining solution from the plating tank.

(6) Fully clean the plating tank.

(7) Put the siphoned-off solution back in the plating tank.

(8) Adjust the solution to the correct concentration with Unochrome CR-110 plating compound added per Paragraph 3.D.(5).

(9) Heat solution to a temperature of 135-145°F.

(10) Add 5 pounds Unichrome CR-204 plating compound for each 100 gallons of solution, as you stir, until no more plating compound will dissolve. Too much of this plating compound is not a problem for the bath.

(11) Adjust solution temperature to 120-140°F.

B. Remove sludge from the other plating solutions with a filter and an acid proof filter pump, or siphon off the liquid into a clean holding tank and remove the sludge manually from the plating tank.

C. Use a 5-micron filter to remove fine particulate matter when you siphon off the solution and when you put it back in the plating bath.

5. PREPARATION OF PARTS

A. General

(1) Unless specified by the overhaul instructions, surfaces to be Class 2 or 3 plated must have a 63 microinch finish or smoother.

(2) Unless specified by overhaul instructions, the surfaces to be Class 4 plated must be smooth, without defects that will not let the part be serviceable. All important surfaces to be Class 4 plated must have a 32-microinch finish or smoother.

(3) Unless specified, do not chrome plate until all base-metal heat treatment and mechanical operations (machining, brazing, welding, forming, perforating, etc.) have been completed.

(4) Some ferrous alloy parts heat treated 160 ksi and above must be stress relieved before plating. Refer to Paragraph 5.B. for details.

B. Before you plate, stress relieve low alloy and corrosion-resistant steel parts per the overhaul instructions. Where no stress relief details are given, stress relieve per SOPM 20-10-02.

6. PLATING PROCESSES

A. General

(1) Unless specified, the plating thickness must be 0.003 inch minimum for Class 2 and 3, and 0.0003-0.0005 inch for Class 4. The maximum plating thickness is 0.015 inch.

(2) See Table 1 to help you make estimates of time necessary for a specified plating thickness. Actual plating rates could be smaller or larger by 50% or more from these values because of anodes or plating solutions.

Table 1: Nominal Plating Rates

	NOMINAL PLATING RATE (INCH/HR) AT 130°F		
CURRENT DENSITY (ASI)	DILUTE STANDARD BATH	CONCENTRATED STANDARD BATH	SRHS AND ECONOCHROME BATHS
1	0.0003	0.0002	0.0004
2	0.0009	0.0007	0.0012
3	0.0015	0.0012	0.0020
4	0.0021	0.0018	0.0028
5	0.0029	0.0023	0.0036

(3) Surfaces must be water-break-free after they were in a processing solution or rinse, unless after vapor degreasing, solvent cleaning, or emulsion cleaning. A water-break-free surface is a surface which keeps a continuous water film for at least 30 seconds after they were sprayed or put into clean water cooler than 100°F. Clean parts again if they get water breaks.

(4) You can temporarily stop the current during plating to measure dimensions with Procedure 1 or 2, as follows:

(a) Procedure 1

1) Decrease the current to zero amperes.

2) Remove the part and measure the dimensions. Keep the part wet with the chrome plating solution while the part out is of the bath.

3) Put the part back in the bath in 5 minutes or less.

4) Let the part get back to solution temperature with the current off for 10 minutes.

5) Anodic etch in plating bath at 1-2 asi for 30 seconds to 1 minute.

6) Apply cathodic current at 5-60 asf (0.03-0.42 asi) for 10 minutes.

7) Slowly increase the current to the specified plating density and continue plating.

(b) Procedure 2

1) Decrease the current to zero amps but do not turn the power off.

2) Remove the part from the bath and measure the dimensions. If the part is touched or rinsed, keep it wet with water or the chrome plating solution. If the part is not touched or rinsed, you can let the solution dry on the part.

3) Put the part back in the bath at zero amps in 5 minutes or less.

4) Let the parts soak for 2-5 minutes at zero amps with the power on.

5) Increase the current to the specified current density in the next 5-10 minutes and continue plating.

(5) If you must temporarily stop the current, use one of these procedures to reactivate and continue plating:

(a) Procedure 1 (preferred)

1) Vapor degrease, alkaline clean, solvent clean, or emulsion clean (SOPM 20-30-03).

2) Continue with Paragraph 6.A.(4)(a)4) or Paragraph 6.A.(4)(b)5) above.

(b) Procedure 2 (optional)

1) Vapor degrease, alkaline clean, solvent clean, or emulsion clean (SOPM 20-30-03).

2) Electrolytically clean with Endox 214 (BAC5625 Solution 21)

a) Put the parts in the Endox 214 solution. Set the voltage at 4-6 volts DC and periodic reverse clean, 15 seconds anodic and 5 seconds cathodic, for 3 minutes. End with an anodic cycle for 10-20 seconds.

b) Remove the parts and visually examine the surface. Remove visible contamination with fine silicon carbide abrasive paper or a gray Scotch-Brite pad wet with the Endox 214 solution.

3) Do Paragraph 6.A.(5)(b)2)a) again.

4) Water rinse for 5-7 minutes. Do not let the parts dry.

5) Make electrical connections. Set the rectifier at zero volts and put the parts into the chrome plate solution. Let the parts soak 5-7 minutes.

6) Increase the current to the specified current density in the next 5-10 minutes and continue to plate.

(6) The bare part surface or the chrome plated surface can be polished, buffed, lapped, honed, or ground to get the specified surface finish and dimensions. Obey these precautions:

(a) Polish or buff only with soft polishing or buffing wheels, 50-grit or finer abrasive, and light pressure on the surface. Do not let local areas of Class 2 or 3 plated parts become hotter than the stress relief temperature. Do not let Class 4-plated parts get too hot to hold with bare hands.

(b) Grind the chrome plate per SOPM 20-10-04, but do not grind the Class 4 chrome plate. This is a special thin dense chrome plate which is applied to get the specified dimensions directly, without subsequent mechanical procedures.

B. Ferrous Alloys

(1) Stress relieve per Paragraph 5.B., if necessary.

(2) Shot peen per SOPM 20-10-03, if necessary.

(3) Vapor degrease, solvent clean, or emulsion clean per SOPM 20-30-03.

(4) For parts to be Class 1, 2, or 4 plated:

(a) As an option for steels heat treated below 180 ksi, alkaline clean per SOPM 20-30-03 and rinse, then clean with specified abrasives, or dry abrasive blast per SOPM 20-30-03.

(b) If rust or scale is present

1) Parts below 180 ksi: Clean and descale per SOPM 20-30-03.

2) Parts above 180 ksi: Abrasive clean per SOPM 20-30-03, grind or polish if required. If you grind the parts, stress relieve them again.

(5) For steels to be Class 3 plated, dry abrasive blast, with 80-120 grit aluminum only, per SOPM 20-30-03. As an option for Class 3 plating less than 0.0007 inch thick on surfaces 32-microinch finish or smoother, lightly sand the surfaces, or polish them. If more masking is necessary, after you apply the masks, manually solvent clean the unmasked areas with MEK, acetone, or BMS 11-7 solvent per SOPM 20-30-03.

(6) If plating must wait more than 10 minutes for wet parts:

(a) Put parts in cyanide holding solution for a maximum of 4 hours.

(b) Cold water rinse. If a water-break-free surface does not occur, do Paragraph 6.B.(4) or Paragraph 6.B.(5) again.

(7) If plating must wait more than two hours for abrasive cleaned parts or more than 16 hours for polished parts, make sure there are no signs of corrosion, dirt, or discoloration after you use one of these two procedures:

(a) Hold the parts at ambient conditions for a maximum of six hours in a clean area with protection from dust and fumes.

(b) Put the parts in cyanide holding solution (Solution 11 of BAC5625 or BAC5751) for a maximum of four hours.

(8) For Class 1, 2, or 4 plating on corrosion resistant steel, nickel and cobalt based alloys, and other heat resistant alloys, do Paragraph 6.B.(8)(a), Paragraph 6.B.(8)(b), or Paragraph 6.B.(8)(c); then do Paragraph 6.B.(8)(d).

(a) Nickel strike anodically in nickel strike bath for up to 2 minutes at 30-35 asf. Follow immediately with cathodic current for 3-4 minutes at 10-15 asf.

(b) Anodic etch in plating bath at 1-2 asi for 30 seconds to 5 minutes.

(c) Cathodically treat in sulfuric acid bath at 5-6 volts for 2-3 minutes at room temperature.

(d) Cold water rinse (100°F maximum).

(9) For Class 3 plating (and optionally for Class 2 plating) on PH or low alloy steels:

(a) Put the part in sulfuric-hydrofluoric acid etch solution with current off.

(b) Activate anodically at 3-4 asi (3-6 asi for PH steels) for 60-70 seconds.

(c) Cold water rinse.

(d) Examine the surfaces. A uniform brown to black smut will be on steel, but no change will occur on nickel plate, nickel alloys, or PH steels. The smut on low alloy steel is necessary for a good bond of the chrome plating.

(e) Keep surfaces wet and move the parts to the plating bath within 7 minutes.

(10) For Class 3 plating (and optionally for Class 2 plating) on nickel-based alloys

(a) Air-water-pumice blast (BAC5748 Type 2, Class 2), then

(b) Periodic reverse treat in Endox 214 (BAC5625 Solution 21) at 4-7 volts. Start anodic for 15-20 seconds. The anodic cycle time must be longer than the cathodic cycle time. Always end on the anodic cycle. Continue to periodic reverse treat for 2-10 minutes or until surfaces are water-break-free.

(c) Cold water rinse for a minimum of 2 minutes.

(11) Put the parts in the plating bath, with the current off, for 1-10 minutes as necessary to heat the parts to the temperature of the solution. As an option, strike at 3-5 asi for 30-90 seconds. Reduce current to the correct range and plate to get the specified thickness, as follows:

(a) For Class 2, plate at the density specified for the solution you use. Adjust the current density to make allowance for the solution temperature. A lower temperature requires a lower current density.

(b) For Class 3 plating, decrease the current to 2-3 asi and plate to the specified thickness.

(c) For Class 4 plating, plate at a current density and temperature that gives the necessary hardness, usually at high current density and lower temperature. Too thick a plating will have decreased bond strength and an increased risk of chicken wire cracks.

(12) Cold water rinse (100°F maximum), followed by hot water rinse (above 130°F), if necessary to help dry the parts.

(13) Remove maskants and dry with clean, moisture-free compressed air.

(14) Bake parts within 10 hours per Paragraph 7..

C. Aluminum and Aluminum Alloys

(1) Prepare parts for plating per SOPM 20-42-04. Do not let the part dry after the last rinse of the preparation procedure.

(2) Put the parts in the plating bath, with power off, for 1-10 minutes as necessary to heat the parts to the temperature of the solution. Then strike at 3-5 asi for 30-90 seconds. Then plate at the same current density as given above for steels, to get the specified plating thickness. Adjust the current density to make allowance for the solution temperature. A lower temperature goes with a lower current density.

(3) Cold water rinse (100°F maximum), followed by hot water rinse (above 130°F), if necessary to help dry the parts.

(4) Dry parts and remove maskants.

(5) Bake parts within 10 hours per Paragraph 7..

D. Copper and Copper Alloys

(1) Prepare the surface per Cleaning of Copper and Copper Alloys in SOPM 20-30-03.

(2) Put the parts in the plating bath, with power off, for 1-10 minutes as necessary to heat the parts to the temperature of the solution. Then strike at 3-5 asi for 30-90 seconds. Then plate at the same current density as given above for steels, to get the specified plating thickness.

(3) Rinse. Hot water (above 130°F) can be used to help dry the parts.

(4) Dry with clean, moisture free compressed air and remove maskants.

(5) Bake beryllium-copper alloy parts within 10 hours per Paragraph 7..

7. POST-PLATE BAKING

A. Within 10 hours after the plating, or within 24 hours after you first apply plating current to the part, whichever is shortest, bake applicable parts per Table 2, unless specified differently by the overhaul instructions. One bake can be used for more than one chrome plating operation on the part, if the bake starts within 24 hours after you first apply plating current to the part.

B. If the part must be chrome plated longer than 24 hours, you must remove the part from the bath in time to start the bake by the 24-hour time limit. After this bake, reactivate the part (Paragraph 6.A.(4) or (5) above), and then continue the plating process. A new set of 10-hour and 24-hour time limits starts when you again apply the plating current. If the part must be plated longer, be sure to remove it from the bath to start another bake by the new 24-hour time limit. Continue as necessary until the plating is completed, then bake the part within the final 10-hour or 24-hour limit.

C. When the part will be later cadmium or cadmium titanium plated, the bake can be:

(1) stopped after 6 hours to let you grind and do more plating. A minimum 6 hour bake between each plating cycle is necessary. After the last plating cycle, bake as necessary for the requirements of the last plating deposited, or to complete the minimum bake requirement for chrome plating, whichever is longer.

(2) not done until after the cadmium or cadmium titanium plating operation, if you are sure to start the bake within 24 hours after you first applied the chrome plating current to the part. The bake and application of post chromate treatment and primer (if applicable) must be completed before you start to grind.

Table 2: Post-Plate Bake Requirements

Metal	Heat Treat	Bake *[1]*[2]
Ferrous alloys, except threaded parts	Below 180 ksi	Not Required
Ferrous alloy parts with external threads	160-220 ksi	3 hours minimum at 350-400°F
Ferrous alloys, but not *[3]	180-220 ksi	3 hours minimum at 350-400°F
	Above 220 ksi	12 hours minimum at 350-400°F
Ferrous alloys *[3]	ALL	Not Required
Carburized, and 440A, B, C steels	ALL	5-8 hours at 250-300°F
Aluminum alloy	ALL	1 hour at 175-225°F, or 1 hour in boiling water

Table 2: Post-Plate Bake Requirements (Continued)

Metal	Heat Treat	Bake *[1]*[2]
Beryllium-copper alloy	ALL	3 hours at 350-400°F
Other copper alloys	ALL	Not Required

*[1] Applies to parts whose thickest part section is 1 inch or less. For thicker parts, increase the minimum baking time 1/4 hour for each additional half inch of part thickness. Note that the thickest part section applies only to the areas to be chrome plated.

*[2] Baking time is the total cumulative time beginning when coldest work zone temperature is above the minimum bake temperature given.

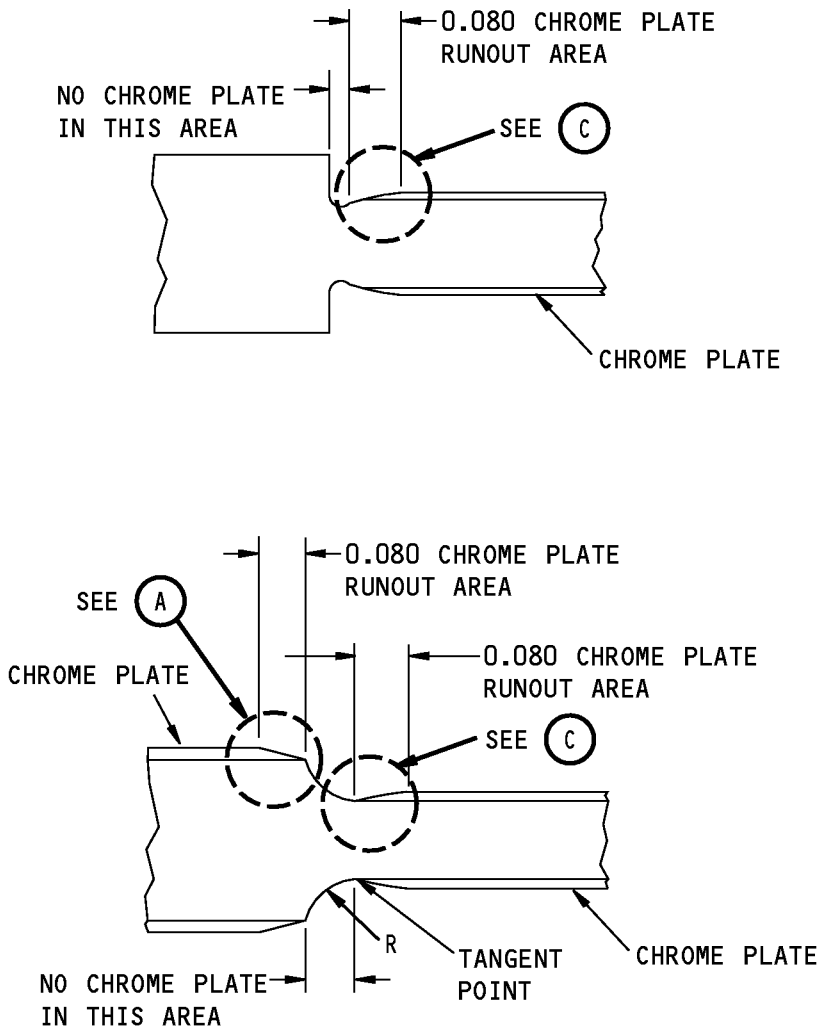
*[3] A286 and 300 Series CRES, nickel alloys 625 and 718, PH steels below 180 ksi without external threads, and 17-7PH (CH 900 condition).

8. CHROME PLATE RUNOUT

A. The chrome plate runout area is that area of the chrome plated surfaces where the chrome plating thickness changes from the required thickness to zero. The specified runout is necessary to be sure the plating area is correct and to give clearance for grinding (when applicable) and masking materials.

B. Make the runout during the plating operation with special electrodes, a current robbing procedure, or metal tape and shields, to get a gradual runout without a bead or a square edge.

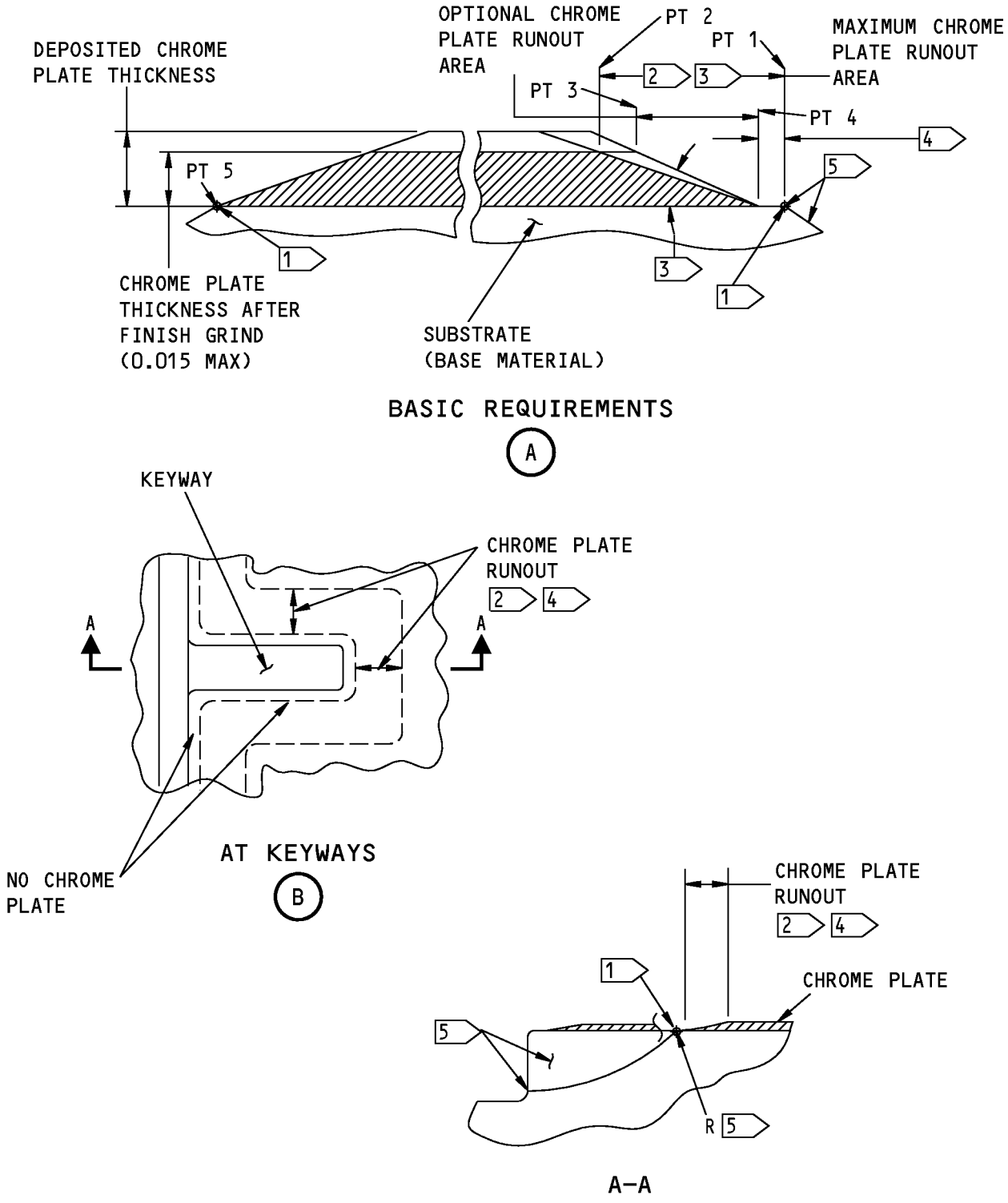
C. Unless specified by the overhaul instructions, make the chrome plating runout 0.080 inch wide at the edges of the plated area (Figure 1).



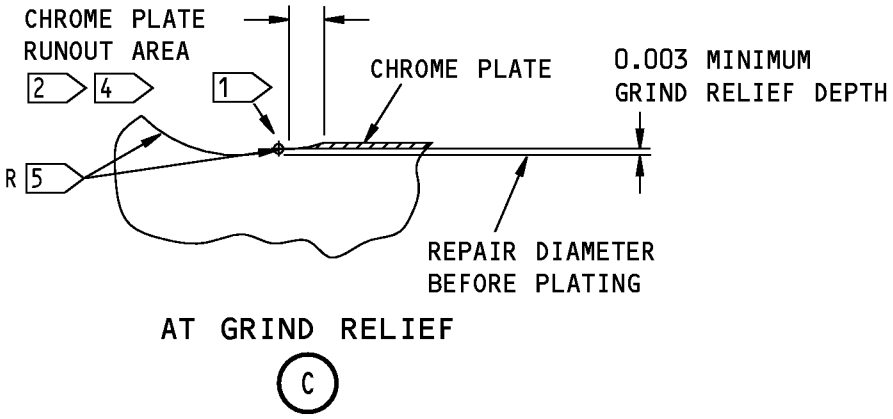
TYPICAL CHROME PLATE APPLICATIONS

D55122 S0000161081_V2

Chrome Plate Runout Details
Figure 1 (Sheet 1 of 4)



Chrome Plate Runout Details
Figure 1 (Sheet 2 of 4)



1650336 S0000296107_V1

Chrome Plate Runout Details
Figure 1 (Sheet 3 of 4)

ALL DIMENSIONS ARE IN INCHES

1 THE CIRCLE-CROSS SYMBOL IDENTIFIES A BLEND RADIUS TANGENT POINT OR A CHAMFER INTERSECT POINT

2 USUALLY, THE CHROME PLATE MUST RUN OUT WITHIN 0.080 INCH MAXIMUM. BUT IF THE CHROME PLATED DISTANCE (POINTS 1 TO 5) IS 0.24 INCH OR LESS, THE RUNOUT DISTANCE MUST BE BETWEEEN POINTS 1 AND 2, OR OPTIONALLY BETWEEN POINTS 3 AND 4

3 THE RUNOUT TAPER MUST BE SMOOTH (63 MICROINCH OR SMOOTHER, AND 20 DEGREES MAXIMUM SLOPE) ON ANY SURFACE ON WHICH AN ELASTOMERIC SEAL SLIDES DURING ASSEMBLY OR OPERATION

4 RUNOUT AREAS WITHOUT CHROME PLATE MUST HAVE THE SAME FINISH AS SPECIFIED BY THE OVERHAUL INSTRUCTIONS FOR THE ADJACENT AREA

5 THE CHROME PLATE MUST NOT RUN INTO OR GO BEYOND THE RADIUS TANGENT POINT OR THE CHAMFER INTERSECT POINT. TRANSITIONS OF A RADIUS OR CHAMFER MUST BE SMOOTH, WITH NO SHARP EDGE OR CUSP, AND THE SURFACE FINISH MUST AGREE WITH OVERHAUL INSTRUCTIONS

1650364 S0000296109_V1

Chrome Plate Runout Details
Figure 1 (Sheet 4 of 4)

9. QUALITY CONTROL

A. The plating must be smooth, fine grained, bonded tightly to the base metal, and have no blisters, pits, nodules, porosity, excessive edge buildup, or signs of burns. No signs of cracks which can be seen by the unaided eye are permitted. This includes chicken wire cracks. Small color changes because of the bakes or rinses are acceptable.

B. To be sure your plating procedure makes plating bonded tightly to the base metal, do a chisel test or a bend test on a sample. Use the chisel test on class 3 plating. Use the chisel test or the bend test on class 2 plating. Refer to BAC5709 for details.

C. Hardness of class 2 and 3 plating must be Rc 55 or more. Hardness of class 4 must be Rc 67 or more. Refer to BAC5709 for test details.

D. For class 3 plating, analyze the bath for chromic acid and sulfate concentrations a minimum of one time per week while the bath is in operation.

E. Do tests on samples at regular intervals to be sure of the plating quality. If the interval is not specified by this procedure or in BAC5709, use an interval that agrees with standard industry practices, your experience with the procedure, and to make sure you can find parts that could have bad plating. If BAC5709 gives a formula to calculate the interval, use it for your basic quality control plan.

F. Do tests for hydrogen embrittlement on the chrome plating you made

(1) When you make a new chrome plating bath

(2) When you replace more than 30% of a chrome plating bath

(3) When you add barium carbonate to the chrome plating bath to remove sulfates. Refer to BAC5709 for details.