



STANDARD OVERHAUL PRACTICES MANUAL

REPAIR AND REFINISH OF HIGH STRENGTH STEEL PARTS

**PART NUMBER
NONE**

BOEING PROPRIETARY, CONFIDENTIAL, AND/OR TRADE SECRET

Copyright © 1995 The Boeing Company
Unpublished Work - All Rights Reserved

Boeing claims copyright in each page of this document only to the extent that the page contains copyrightable subject matter. Boeing also claims copyright in this document as a compilation and/or collective work.

This document includes proprietary information owned by The Boeing Company and/or one or more third parties. Treatment of the document and the information it contains is governed by contract with Boeing. For more information, contact The Boeing Company, P.O. Box 3707, Seattle, Washington 98124.

Boeing, the Boeing signature, the Boeing symbol, 707, 717, 727, 737, 747, 757, 767, 777, 787, Dreamliner, BBJ, DC-8, DC-9, DC-10, KC-10, KDC-10, MD-10, MD-11, MD-80, MD-88, MD-90, P-8A, Poseidon and the Boeing livery are all trademarks owned by The Boeing Company; and no trademark license is granted in connection with this document unless provided in writing by Boeing.

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

20-10-01

Page 1
Jul 01/2009



STANDARD OVERHAUL PRACTICES MANUAL

Revision No. 22
Jul 01/2009

To: All holders of REPAIR AND REFINISH OF HIGH STRENGTH STEEL PARTS 20-10-01.

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.

PART NUMBER NONE



STANDARD OVERHAUL PRACTICES MANUAL

Location of Change

Description of Change

NO HIGHLIGHTS

20-10-01

HIGHLIGHTS

Page 1

Jul 01/2009



STANDARD OVERHAUL PRACTICES MANUAL

Subject/Page	Date	Subject/Page	Date	Subject/Page	Date
TITLE PAGE					
O 1	Jul 01/2009				
2	BLANK				
20-10-01 TRANSMITTAL LETTER					
O 1	Jul 01/2009				
2	BLANK				
20-10-01 HIGHLIGHTS					
O 1	Jul 01/2009				
2	BLANK				
20-10-01 EFFECTIVE PAGES					
1	Jul 01/2009				
2	BLANK				
20-10-01 CONTENTS					
1	Nov 01/2006				
2	BLANK				
20-10-01 REVISION RECORD					
1	Jul 01/2005				
2	Jul 01/2005				
20-10-01 RECORD OF TEMPORARY REVISIONS					
1	Jul 01/2005				
2	Jul 01/2005				
20-10-01 INTRODUCTION					
1	Jul 01/2005				
2	BLANK				
20-10-01 SUBJECT					
1	Nov 01/2006				
2	Nov 01/2006				
3	Nov 01/2006				
4	Jul 01/2005				
5	Nov 01/2006				
6	BLANK				

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

20-10-01

EFFECTIVE PAGES

Page 1

Jul 01/2009



STANDARD OVERHAUL PRACTICES MANUAL

TABLE OF CONTENTS

<u>Paragraph Title</u>	<u>Page</u>
REPAIR AND REFINISH OF HIGH STRENGTH STEEL PARTS	1
INTRODUCTION	1
REPAIR INSTRUCTIONS	1
REFINISH INSTRUCTIONS	5

20-10-01

CONTENTS

Page 1

Nov 01/2006



STANDARD OVERHAUL PRACTICES MANUAL

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.

20-10-01

INTRODUCTION

Page 1

Jul 01/2005



STANDARD OVERHAUL PRACTICES MANUAL

REPAIR AND REFINISH OF HIGH STRENGTH STEEL PARTS

1. INTRODUCTION

- A. The procedures in this subject are applicable to high strength, low-alloy steel parts heat-treated above 180 ksi.
- B. These procedures are recommended to help prevent problems which could decrease the service life of the component.
- C. Be very careful when you repair high-strength steel parts. The strength is easily decreased by such incorrect repair practices as grinding too hot, machining with tools that are not sharp, incorrect feed settings, not sufficient cooling, defective plating, or damage during shop operations.

2. REPAIR INSTRUCTIONS

- A. To remove finish or plating, refer to SOPM 20-30-02.
- B. Machining and Grinding

CAUTION: REFER TO SOPM 20-10-04 FOR GRINDING OF CHROME PLATING.

- (1) Refer to SOPM 20-10-02 for applicable tools, feeds, speeds, and procedures for turning, milling, boring, drilling, reaming, broaching, and honing.
 - (2) Sudden changes in section size or surface direction on high strength steel parts usually are areas with sudden increases in stress level. Make all fillet or cutter runout radii as specified in the applicable overhaul instructions. When no radius is specified, use the data shown in Figure 1.
 - (3) Visual and surface temper etch examinations will help find damage caused during machining or grinding. Refer to SOPM 20-10-02 for requirements and procedures.
 - (4) Stress relief is a conservative practice that will decrease residual surface stresses that came into the metal during some metal removal operations. (But operations with unpowered hand tools, such as files or emery cloth, do not cause sufficient residual stresses to make stress relief necessary.) Stress relieve after the removal of all paint and metallic coatings. Refer to SOPM 20-10-02 for recommended times and temperatures for the different metals.
 - (5) Baking (or embrittlement relief baking) at 350-400°F is necessary after processes that could introduce hydrogen. A partial stress relief at 350-400°F is also necessary before stripping of some inorganic finishes, such as plating, per SOPM 20-30-02.
 - (6) Unless shown differently, magnetic particle examine per SOPM 20-20-01 to make sure there are no cracks or corrosion pits. When magnetic particle inspection is not recommended, as for in-field repairs or the repair of small areas on parts with installed bushings or bearings, you can fluorescent dye penetrant examine per SOPM 20-20-02.
- C. Shot Peening
 - (1) After etch examination, stress relief and magnetic particle examination, shot peen per SOPM 20-10-03:
 - (a) All repaired surfaces before you build them up with plating back to the design dimensions.
 - (b) All surfaces originally shot peened, if the part was stress relieved above 400°F after machining.
 - (c) All surfaces from which more than 0.002-inch material was removed from a shot peened part by any kind of machining.
 - (2) Give protection to threads and other close tolerance surfaces not to be shot peened.

20-10-01



STANDARD OVERHAUL PRACTICES MANUAL

- (3) Make sure the new shot peened surfaces run out smoothly into adjacent original shot peened surfaces, because fatigue can start at locations with sudden changes in shot peen coverage.
- (4) To make the shot peened surfaces smoother, you can hone or lap them to a maximum depth of 0.002 inch.
- (5) Shot peening is not necessary if the surfaces will be repaired only by honing to a maximum depth of 0.002 inch, or if the surfaces will be only refinished.

D. Polishing

CAUTION: IF THIS OPERATION MAKES SPARKS, IT IS THE SAME AS GRINDING. THEN THE POST-TREATMENTS OF STEP 2.B. ARE APPLICABLE.

- (1) Polish scratches out by hand with 240-grit or finer aluminum oxide abrasive cloth. Subsequent heat-treatment, shot peening and magnetic inspection is not necessary.

E. Honing

- (1) Honing of bores in steel parts is not necessary unless specified by the applicable overhaul instructions.
- (2) Refer to SOPM 20-10-02 for material removal requirements.
- (3) When you hone for bushing installation:
 - (a) To prevent bell-mouth bore shapes during honing of bores, a correct setting of stroke length and stroke position is necessary. On dead spots, use an overrun of one-third of the stone length, and keep two-thirds of the stone length inside the bore.
 - (b) Remove bell-mouth bore shapes with a smaller overrun than one-third.
 - (c) Correct a barrel-shaped bore with a larger stroke length and overrun.
 - (d) For bores with a length-to-diameter ratio less than 1.00, hone with a stone length smaller than the bore diameter, and use an overrun of only one fourth of the stone length. Use a high axial stone speed, with a circumferential speed the same as for longer bores.

F. Corrosion Removal

- (1) Remove corrosion by machining per Paragraph 2.B. or localized blending per Paragraph 2.H.
- (2) Abrasive blasting must not be used, because it does not remove active corrosion at the bottom of corrosion pits.

G. Repair of Shaft with Shoulders

- (1) Some repairs to an outside diameter let you make a relief at an adjacent shoulder to make grinding easier. The diameter of this relief must not be smaller than the repair diameter for the shaft given in the applicable overhaul instructions.

H. Local Blends to Remove Defects

- (1) Refer to SOPM 20-10-02 for instructions about hand-powered and portable hand-held power tools.
- (2) Local blends must not decrease the cross-sectional area or section thickness more than permitted by the overhaul instructions.
- (3) Make the blend radii the maximum possible that will agree with local part geometry, minimum area removal requirements and the overhaul instructions.
- (4) The surface finish of the blend area must be the same as or smoother than that of the adjacent base metal.

20-10-01

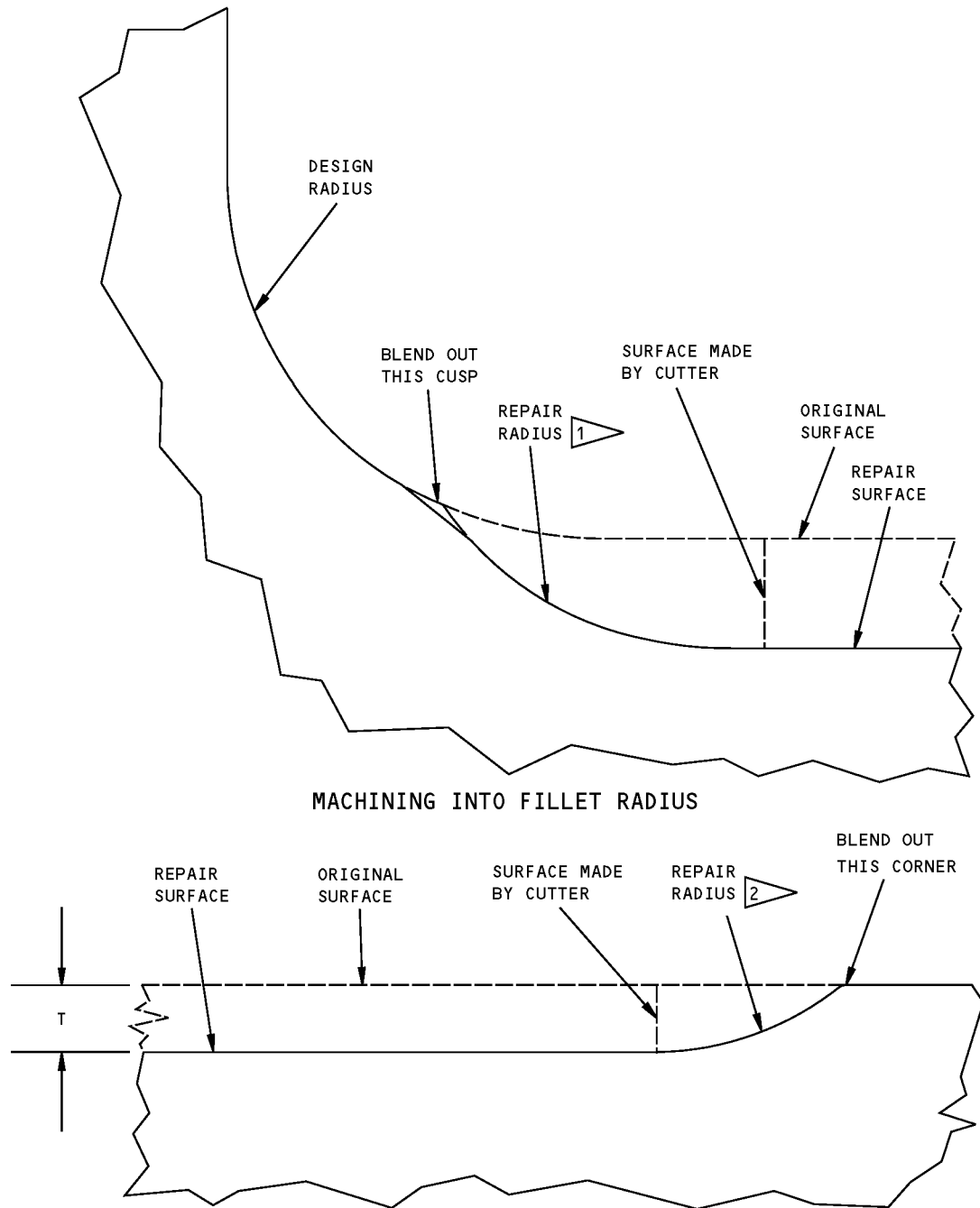


STANDARD OVERHAUL PRACTICES MANUAL

- (5) The repaired area must be shot or flap peened.
- (6) Refinish the repaired area to agree with the finish on adjacent area and these steps, as applicable:
 - (a) If the part is removed from all other parts, remove all of the plating from the part before blending. Then refinish per overhaul instructions.
 - (b) If the part is installed but the load on it is removed, such as on the landing gear from which weight is removed by jacking up the airplane, stylus cadmium plate the repair area per SOPM 20-42-10. Then apply a minimum of two layers of BMS 10-11, Type 1 primer and one layer of BMS 10-11 enamel.
 - (c) If the part is installed and the load cannot be removed, paint the repair area with a minimum of two layers of BMS 10-11, Type 1 primer and one layer of BMS 10-11 enamel. This primer and enamel on areas without cadmium plating is not a permanent finish and must be kept on until the part can be refinished per Paragraph 2.H.(6)(b).

20-10-01

STANDARD OVERHAUL PRACTICES MANUAL



1 THIS REPAIR RADIUS MUST BE MINIMUM OF 0.75 TIMES THE DESIGN RADIUS.

2 THIS REPAIR RADIUS MUST BE THE LARGER OF 15 TIMES T, OR 1.0 INCH.

MACHINING CYLINDRICAL OR FLAT PARTS

Machining Guidelines
Figure 1

20-10-01

**STANDARD OVERHAUL PRACTICES MANUAL****3. REFINISH INSTRUCTIONS**

- A. Refer to these subjects, as applicable, for removal of the original finish and the different types of plating :
- (1) SOPM 20-30-02, Stripping of Protective Finishes
 - (2) SOPM 20-42-05, Bright Cadmium Plating (for parts heat-treated up to 220 ksi)
 - (3) SOPM 20-42-01, Low Hydrogen Embrittlement Cadmium Plating
 - (4) SOPM 20-42-02, Low Hydrogen Embrittlement Cadmium-Titanium Alloy Plating (for parts heat-treated above 220 ksi)
 - (5) SOPM 20-42-03, Hard Chrome Plating
 - (6) SOPM 20-42-09, Electrodeposited Nickel Plating
- B. Baking after Plating
- (1) As an alternative to the baking instructions given in each applicable plating subject, one bake is permitted when the part gets two or more plating operations (other than nickel plating), if the time between the first and the last plating operation is not more than 8 hours (steel parts heat-treated up to 220 ksi), or 3 hours (steel parts heat-treated above 220 ksi).
 - (2) Magnetic particle examine the part per SOPM 20-20-01 after baking.
- C. Unless plated to final dimensions, grind chrome plated parts per SOPM 20-10-04.

20-10-01