

CHAPTER 28

MAIN ROTOR

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CHAPTER 28

MAIN ROTOR

28-00 Description

The main rotor has two all-metal blades mounted to the hub by coning hinges. The hub is mounted to the shaft by a teeter hinge. The coning and teeter hinges use self-lubricated bearings. Droop stops for the main rotor blades provide a teeter hinge friction restraint which normally prevents the rotor from teetering while starting or stopping. Pitch change bearings for each blade are enclosed in a housing at the blade root. The housing is filled with oil and sealed with an elastomeric boot. Each blade has a thick stainless steel spar at the leading edge which is resistant to corrosion and erosion. The skins are bonded to the spar approximately one inch aft of the leading edge. Blades must be refinished if the paint erodes to bare metal at the skin-to-spar bond line. Bond may be damaged if bond line is exposed.

28-10 Main Rotor Blades**WARNING**

Due to potentially destructive results, use of blade tape (anti-erosion tape) is prohibited.

A. Removal

Refer to Figure 28-1. Four people will be required to remove the blades. One person must support the blade approximately 2/3 its length from the root while another supports the root and removes or installs the attachment bolt.

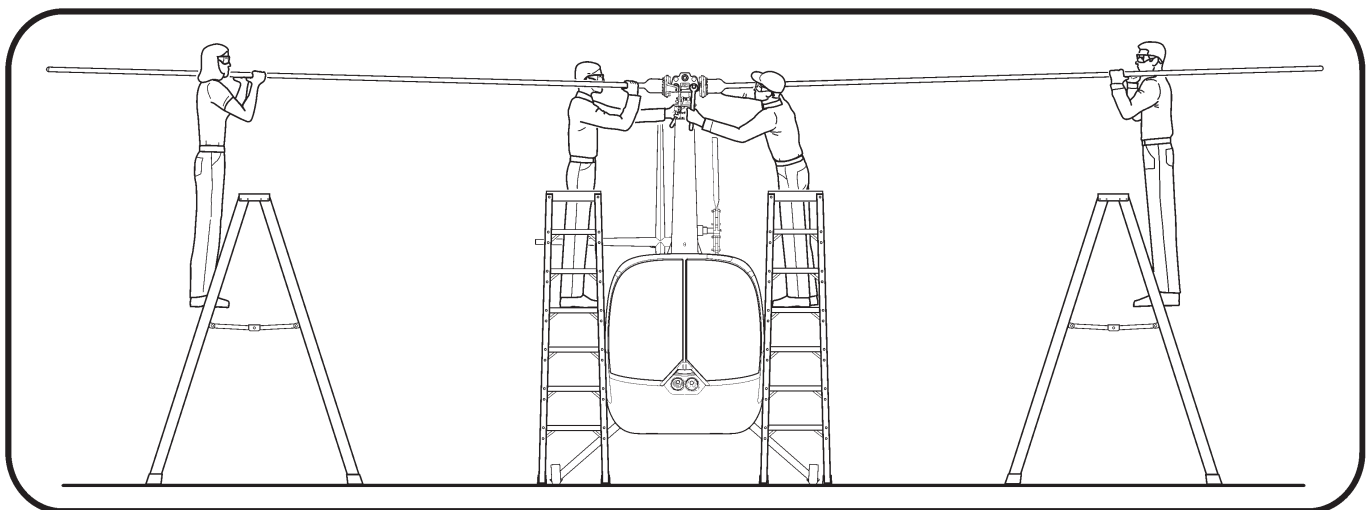


FIGURE 28-1 SUPPORTING MAIN ROTOR BLADES DURING BLADE REMOVAL OR INSTALLATION

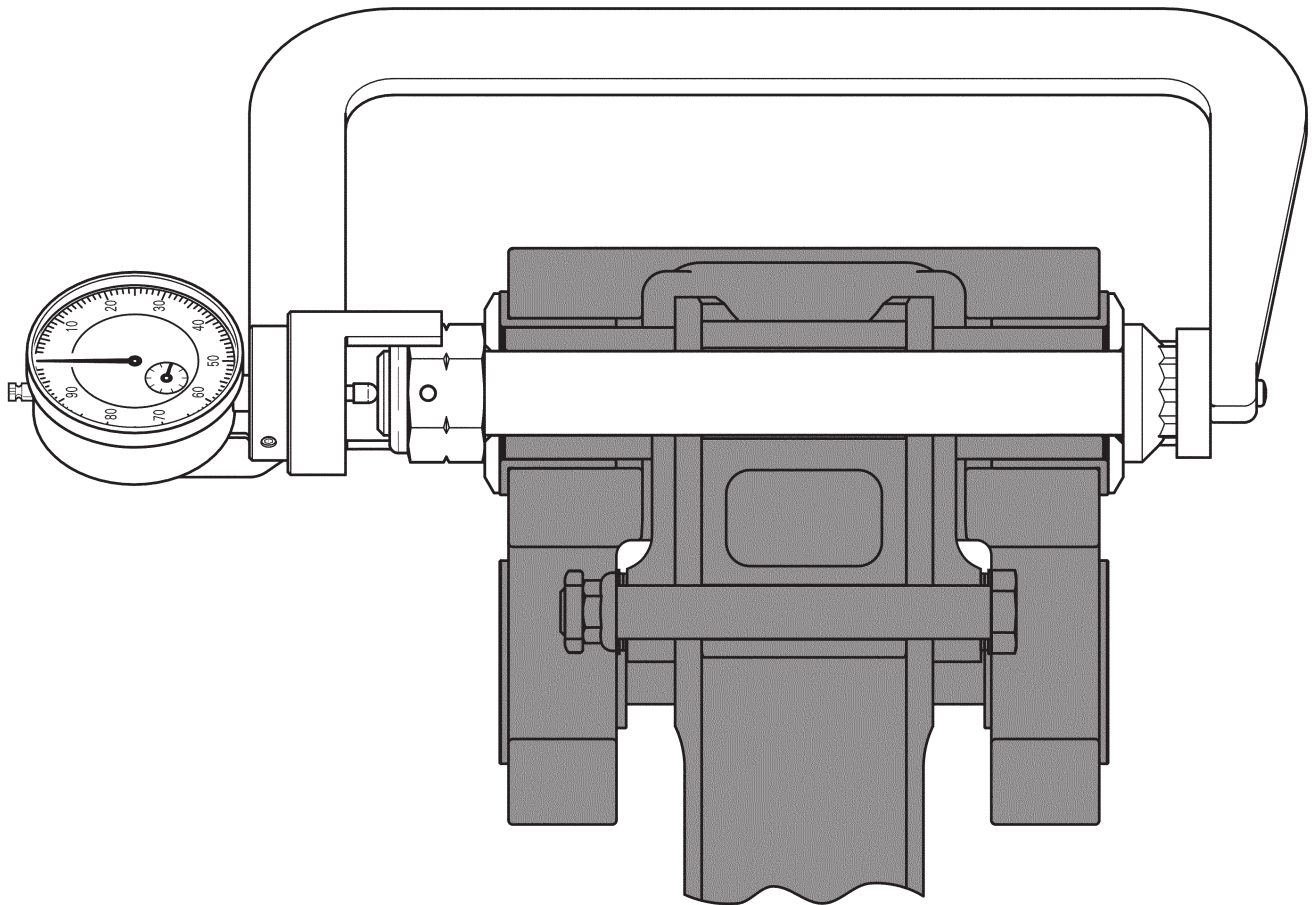


FIGURE 28-2 MEASURING BOLT STRETCH (SHOWN ON TEETER BOLT, BLADES REMOVED)

28-10 Main Rotor Blades (continued)**A. Removal (continued)**

1. Mark one main rotor blade and its corresponding hub location, pitch link, and retaining nut & bolt with "X" using a marker or grease pencil. Mark opposite blade and its hub location, pitch link, and retaining nut & bolt with "O".
2. Measure and record coning hinge axial gaps per Figure 28-7.
3. Remove hardware securing main rotor pitch links to blade pitch horns.
4. Remove cotter pins and loosen blade coning hinge retaining nuts until finger tight.

CAUTION

After removing one blade, support installed blade in a level position until it is removed.

5. Remove nut, thrust washer, and trailing-edge shims (if used) from one blade. Cone blade as required to position spindle tusk off of droop stop. Supporting blade at root, rotate pitch horn down, and remove hinge bolt and thrust washer.

CAUTION

Do not drop journals (inside hub bearings) which can slide out when removing blade bolt.

NOTE

Blade installation hardware is specific to each blade, each blade's leading and trailing edge, and each blade's location in hub. It is good practice after blade removal to install hardware in hub finger tight exactly as removed.

6. Place blade on a cushioned surface to prevent damage to skins.
7. Remove opposite blade per steps 5 and 6.

28-10 Main Rotor Blades (continued)**B. Installation****CAUTION**

R44-series helicopters must replace C016-2 and C016-5 main rotor blades with C016-7 main rotor blades per US Airworthiness Directive 2014-23-16. Installing C016-7 blades on carbureted R44 helicopters requires verifying certain components are installed or retrofitted per R44 SL-37 (current revision).

1. Check teeter hinge friction and adjust as required per § 28-32.
2. If coning hinge axial gap recorded during blade removal was beyond tolerance, or if corresponding hub bearing(s) or spindle was replaced, perform coning hinge journal and shim calculation per § 28-31.
3. Level hub and insert journals in hub bearings. Install thrust washer on blade bolt.
4. Insert main rotor blade spindle in hub and align spindle and journal bores. Cone blade as required to position tusk off of droop stop. Rotate pitch horn down and install hinge bolt at leading-edge side.

NOTE

A bolt may be inserted from trailing-edge side to align spindle and journal bores (it is pushed out as coning hinge bolt is installed).

5. Install trailing-edge shims (if used) and thrust washer. Apply light coat A257-9 anti-seize to bolt threads and nut face. Install nut finger tight.

NOTE

Do not allow anti-seize to contact journals, shims, or hub bearing areas. These areas must be clean and dry.

CAUTION

After installing one blade, support blade in a level position until opposite blade is installed.

6. Install opposite blade per steps 3 thru 5.
7. Tighten nut on coning hinge bolt until journals and thrust washer are firmly seated. Loosen nut until both thrust washers can be freely rotated.
8. Refer to Figure 28-2. Install MT122-6 main rotor bolt stretch tool on hinge bolt. Zero dial indicator by rotating dial face and lock dial. Remove tool.

28-10 Main Rotor Blades (continued)**B. Installation (continued)**

9. Using wrenches with at least 600 ft-lb torque capacity, tighten nut until drilled holes in nut and bolt align. Install MT122-6 tool and measure bolt stretch:
 - a. If bolt stretch is between 0.020–0.022 inch, remove tool and install a new cotter pin wet with approved primer (chromate primer preferred).
 - b. If bolt stretch is not between 0.020–0.022 inch, remove old nut and old bolt and install a new bolt and a new nut. Stretch new bolt per § 23-33, and drill new nut and bolt per § 28-34. Install a new cotter pin wet with approved primer (chromate primer preferred).

WARNING

Do not under-stretch or over-stretch teeter or coning hinge bolts to obtain proper clamping force. Under-stretching or over-stretching can cause failure.

10. Install hardware securing main rotor pitch link to pitch horn. Standard torque hardware per § 23-32 and torque stripe per Figure 2-1.

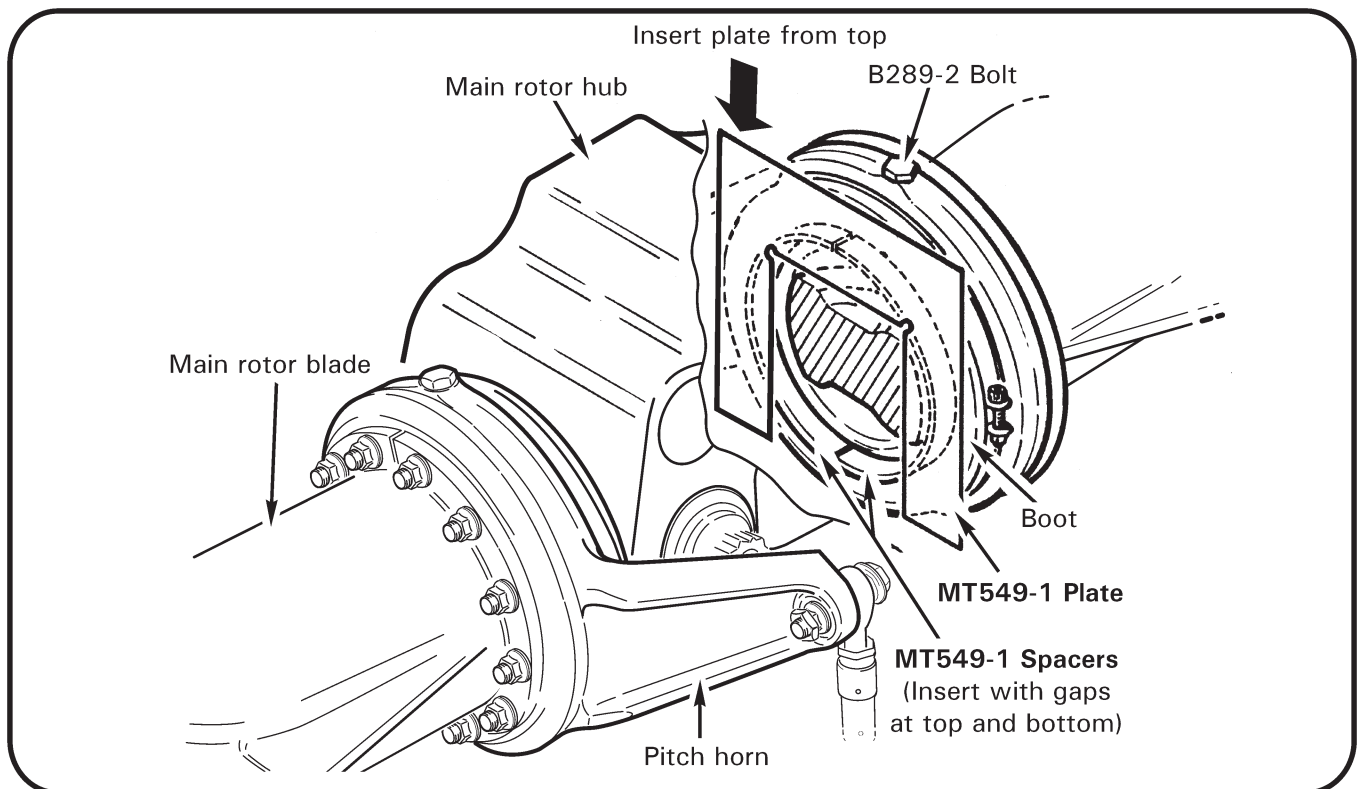


FIGURE 28-3 ADJUSTING BOOT CLEARANCE

28-10 Main Rotor Blades (continued)**B. Installation (continued)**

11. Perform steps 7 thru 10 on opposite blade. If different blades are being installed or if blade pitch bearing housing has recently been serviced perform steps 12 thru 16.
12. Position cyclic and collective controls mid-travel and apply frictions.
13. Refer to Figure 28-3. Insert two MT549-1 spacers between hub and blade boot with gaps at top and bottom. Spacers should fit in recess of boot. Hold spacers in place against boot and insert MT549-2 plate from top between hub and spacers. Push plate down until it contacts spindle.
14. Remove bottom B289-2 bolt from pitch horn and allow oil to flow. Place a finger over hole as soon as oil flow decreases to a drip to prevent air from being sucked inside pitch bearing housing.
15. Remove finger from hole and quickly install bolt. Special torque bolt per § 23-33 and torque stripe per Figure 2-1.
16. Remove plate and spacers. Repeat on opposite blade.
17. Track and balance main rotor blades per § 10.230.

CAUTION

When fitting a replacement main rotor blade(s), remove both main rotor blade tip covers after initial run-up and clean out debris.

28-11 Blade Boots**A. Removal**

1. Remove main rotor blades per § 28-10.
2. Place a suitable drain container below pitch horn. Remove two B289-2 bolts and drain fluid.
3. Remove outer boot clamp and hold boot back to expose inner boot clamp. Remove inner clamp and peel boot from spindle. Boot inner portion may be sealed to spindle with B270-1 sealant.
4. As required, use a plastic scraper and vacuum cleaner to remove old B270-1 sealant from spindle area to be covered by boot inner lip. Avoid contaminating spindle bearings with old sealant.

WARNING

Use only plastic scrapers to remove old sealant; chemical removal is prohibited.

B. Installation**NOTE**

C156-1 (Black) blade boots are standard; C156-2 (grey) boots are optional for use in sub-freezing temperatures.

1. Visually inspect and verify boot is undamaged. Carefully stretch new boot over spindle.
2. Solvent-clean surfaces clamped by boot inner lip. Properly position boot inner lip; install C165-1 (inner) clamp assembly and tighten clamp to 2.850 ± 0.005 inch outside diameter. Rotate spindle and verify adequate clearance between clamp assembly and pitch horn.

NOTE

When installing inner clamp, ensure that shoulder of boot inner lip is not wedged beneath clamp or clamp may loosen in service. Inspect boot interior and verify no cuts or punctures.

3. Stretch boot outer lip over pitch horn flange. Rotate spindle and align pitch horn bolt hole with spindle bolt hole per Figure 28-4. Install C165-2 (outer) clamp assembly and tighten clamp. Verify security.
4. Fill root fitting per § 28-12.

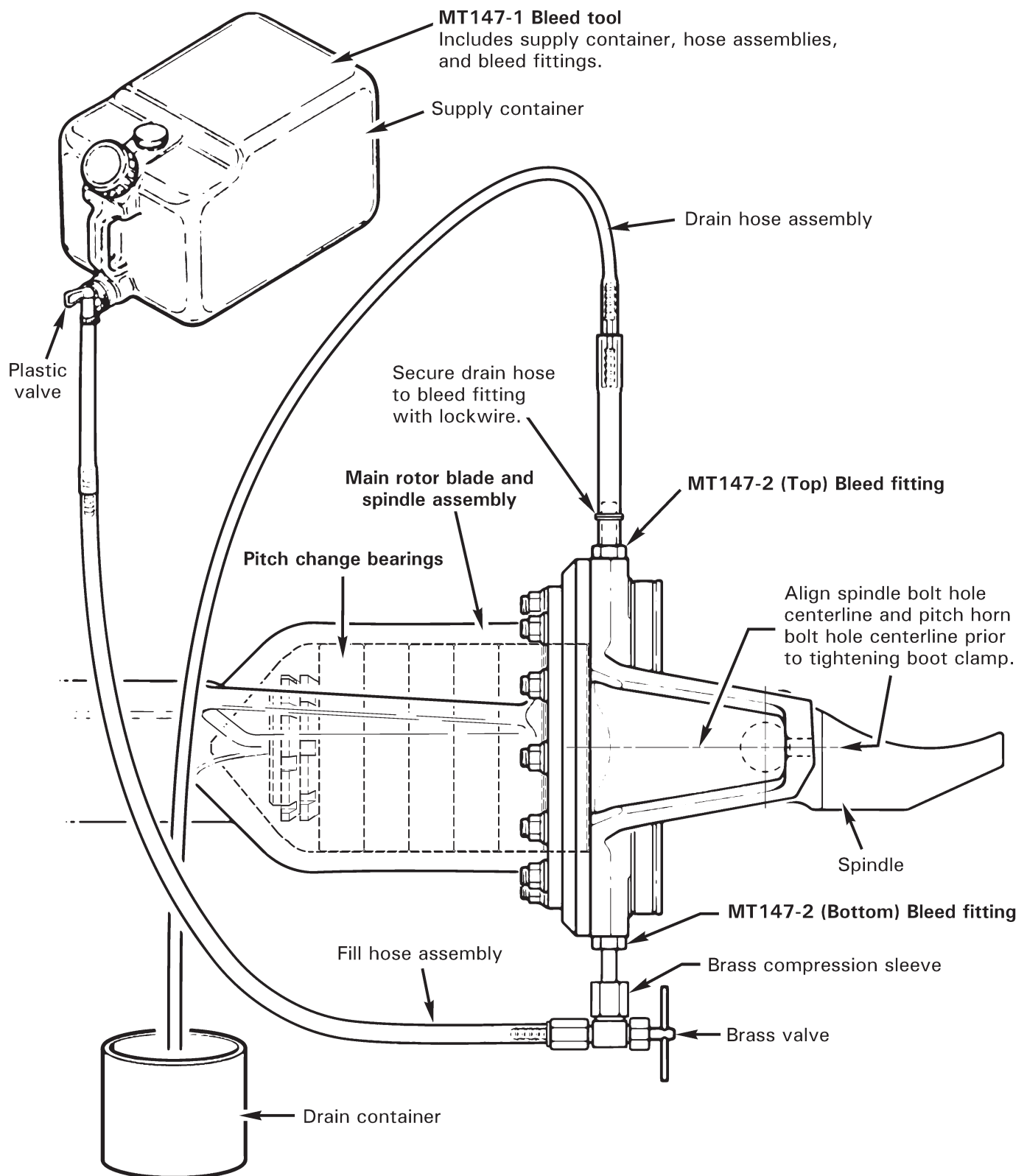


FIGURE 28-4 FILLING PITCH BEARING HOUSING

28-12 Filling Pitch Bearing Housing**NOTE**

MT147-1 Main rotor blade spindle air bleed tool includes supply container, hose assemblies, and bleed fittings.

WARNING

Refer to Safety Data Sheets (SDS) and observe precautions when working in proximity to hazardous materials.

1. Remove main rotor blades per § 28-10.
2. Refer to Figure 28-4. Place a suitable drain container below main rotor pitch horn. Remove two B289-2 bolts from pitch horn and drain fluid.
3. Install MT147-2 bleed fittings into pitch horn openings. Attach drain hose assembly to (top) bleed fitting, secure with two wraps of lockwire. Position drain hose into drain container.
4. Place supply container with sufficient A257-4 fluid approximately 3 feet above spindle. Route fill hose assembly into drain container and open brass valve. Open supply container plastic valve and purge air from fill hose. Close valves.
5. Connect brass valve to (bottom) bleed fitting by tightening brass compression sleeve.
6. Open valves and fill spindle housing until no air bubbles are visible in drain hose assembly. Massage spindle boot, oscillate spindle, and raise blade tip up & down to remove trapped air.
7. Remove drain hose assembly and (top) bleed fitting, and install B289-2 bolt. Roll the blade over. After five minutes, inspect the boot for leaks. If no leaks are found, close valves, remove fill hose assembly brass valve and (bottom) bleed fitting, and install other bolt.
8. Special torque B289-2 bolts per § 23-33 and torque stripe per Figure 2-1.
9. Repeat steps for opposite blade.

28-20 Main Rotor Hub**A. Removal**

1. Remove main rotor blades per § 28-10.
2. Refer to Figure 28-7. Mark rotor hub using a grease pencil, tape, or soft marker as follows:
 - a. Indicate nut side of teeter bolt.
 - b. Indicate chord arm side of drive shaft.
3. If same hub will be installed, measure teeter hinge friction per Figure 28-9 and record value.
4. Remove cotter pin, nut, C152 thrust washers, C117 shims, C106 journals, and bolt. Rotate hub as required and remove hub. Do not drop thrust washers or journals.
5. Reinstall bolt, thrust washers, shims, journals, and nut in rotor hub exactly as removed.

CAUTION

Main rotor chordwise balance is adjusted using C106 journals and C117 shims. If assembly stack-up is altered, an out-of-balance condition can occur.

B. Installation

1. Clean and dry teeter hinge hardware using approved solvent per § 23-70. Inspect journals and thrust washers for chipping of chrome plating, corrosion, and/or wear grooves extending through chrome plating (0.0006 inch maximum wear). Replace journal or thrust washer if any of these conditions exist.
2. If teeter hinge friction recorded during hub removal was less than 5 ft-lb or more than 20 ft-lb, if teeter hinge hub bearing(s) was replaced, or if previous installation information is unavailable, perform teeter hinge journal and shim calculation per § 28-31.
3. Refer to Figure 28-7. Line up mark on hub with chord arm on drive shaft. Install teeter hinge bolt, thrust washers, shims, and journals (if previous installation information is available, install parts exactly as removed).

28-20 Main Rotor Hub (continued)**B. Installation (continued)**

4. Coat nut face and bolt threads with A257-9 anti-seize compound, install and tighten nut, then loosen nut until both thrust washers can be freely rotated. Ensure journals do not “pinch” droop stops and fully contact drive shaft.

WARNING

Do not allow anti-seize compound to contaminate drive shaft, journals, shims, or thrust washer inner faces. Contamination prevents proper joint clamp-up and may cause failure.

5. Refer to Figure 28-2. Install MT122-6 main rotor bolt stretch tool on teeter bolt. Zero dial indicator by rotating dial face and lock dial. Remove tool.
6. Using wrenches with at least 600 ft-lb torque capacity, tighten nut until drilled holes in nut and bolt align. Install MT122-6 tool and measure bolt stretch:
 - a. If bolt stretch is between 0.020–0.022 inch, remove tool and verify correct teeter hinge friction per § 28-32. Adjust teeter hinge friction as required.
 - b. If bolt stretch is not between 0.020–0.022 inch, remove old nut and old bolt and install a new bolt and a new nut. Stretch new bolt per § 23-33 and verify correct teeter hinge friction per § 28-32. Adjust teeter hinge friction as required. Drill new nut and bolt per § 28-34.

WARNING

Do not under-stretch or over-stretch teeter or coning hinge bolts to obtain proper clamping force. Under-stretching or over-stretching can cause failure.

7. Install a new cotter pin wet with approved primer (chromate primer preferred; refer to § 23-75.

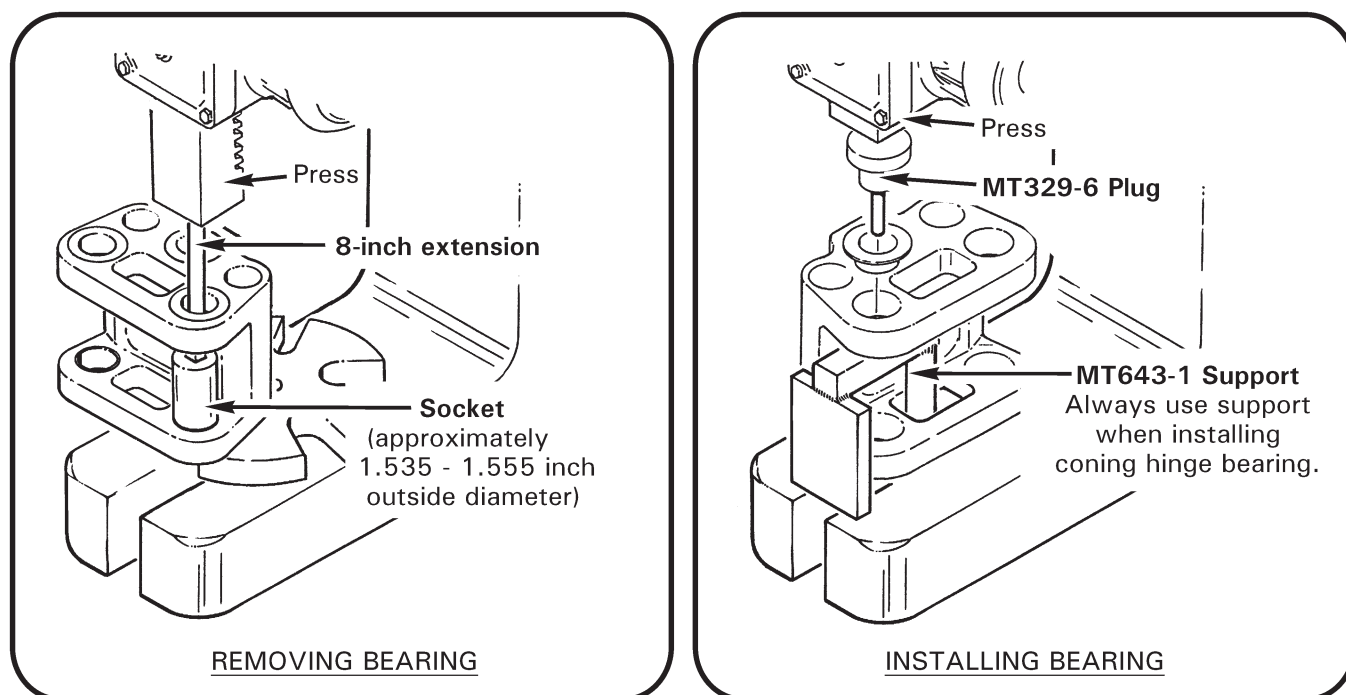


FIGURE 28-5 MAIN ROTOR HUB BEARING REPLACEMENT

28-21 Bearing Replacement

1. Remove main rotor hub per § 28-20.
2. Refer to Figure 28-5. Verify tooling surfaces are smooth to avoid damaging hub and bearings. Press bearing(s) from hub using a socket (approximately 1.535–1.555 inch outside diameter) and an 8-inch extension; alternately, press bearing(s) from hub using MT329-6 (Rev H or subsequent) with MT329-10 tube.
3. Visually inspect hub bearing bore(s) per § 28-22 step 3a.

NOTE

Do not allow primer to contact bearing's Teflon liner.

4. Verify bearing mating surfaces are smooth and clean and apply light coat of approved primer (chromate primer preferred; refer to § 23-75). If visible, orient coning hinge bearing's Teflon liner seam toward top of hub. While primer is wet, press in new bearing using MT329-6 plug (and MT643-1 support if replacing coning hinge bearing) until bearing flange is completely seated against hub.
5. Using a syringe, seal between bearing's outboard flange and hub and bearing's inboard edge and hub with small fillet of approved primer.

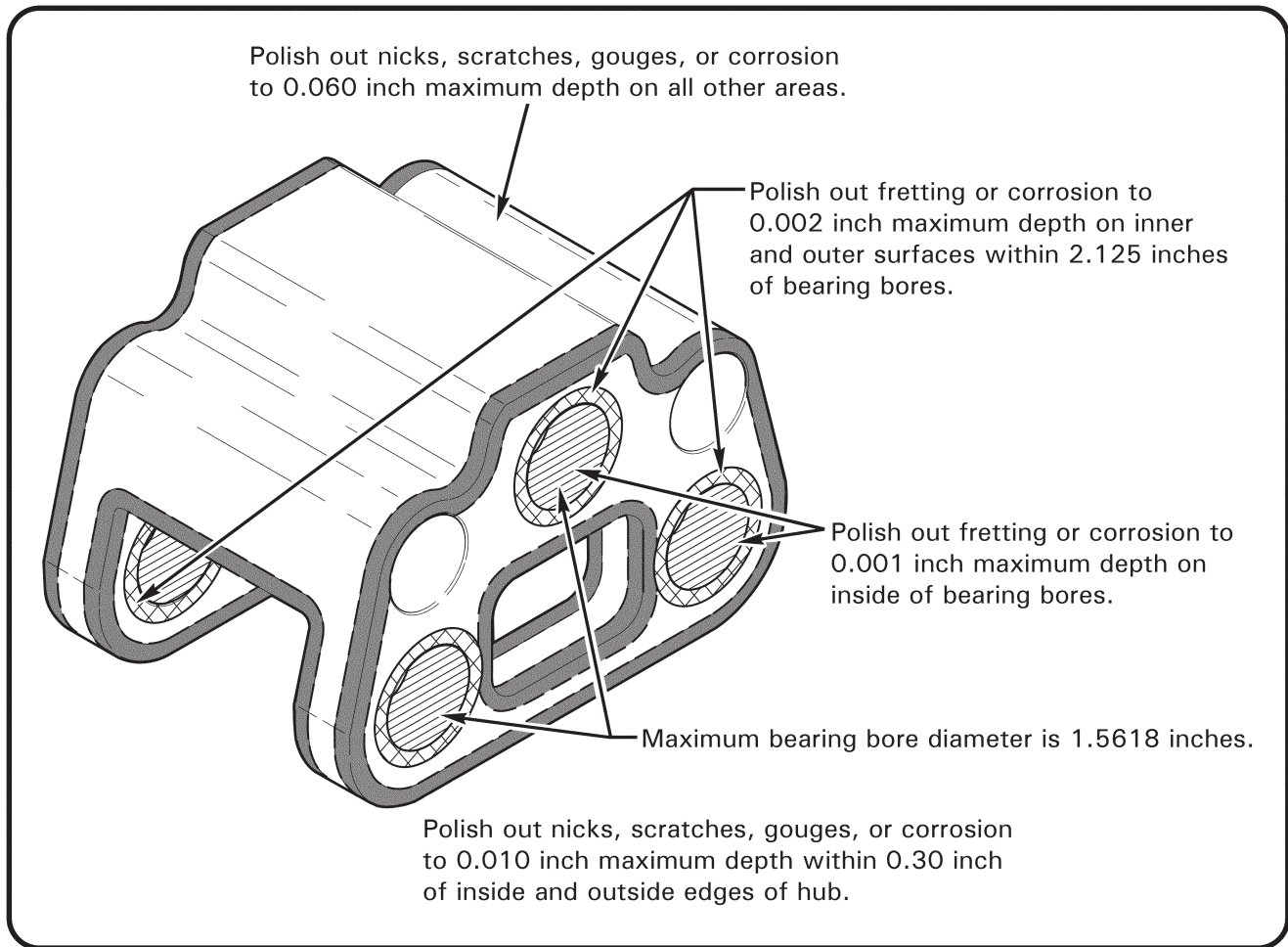


FIGURE 28-6 MAIN ROTOR HUB REPAIR LIMITS

28-22 Inspection and Repair

1. Remove main rotor hub bearings per § 28-21 steps 1 thru 4.
2. Remove hub paint by plastic or baking soda media blasting.
3. Refer to Figure 28-6 If required, polish surfaces using 320-grit or finer aluminum-oxide abrasive paper to 0.25 inch minimum blend radius.
 - a. Visually inspect hub bearing bores and verify no scoring, scratches, or other obvious damage. Polish out fretting or corrosion to 0.002 inch maximum depth on inner and outer surfaces within 2.125 inches of bearing bores. Polish out fretting or corrosion to 0.001 inch maximum depth on inside of bearing bores; maximum bearing bore diameter is 1.5618 inches.
 - b. Visually inspect all other areas of hub for obvious damage. Polish out nicks, scratches, gouges, or corrosion to 0.010 inch maximum depth within 0.30 inch of inside and outside edges of hub. Polish out nicks, scratches, gouges, or corrosion to 0.060 inch maximum depth on all other areas.

28-22 Inspection and Repair (continued)

4. Fluorescent penetrant inspect hub per § 23-42.
5. Prime hub per § 23-60.
6. Install bearings per § 28-21 steps 4 and 5.
7. Mask bearings and topcoat hub assembly per § 23-60.
8. When top coat has sufficiently cured, remove masking.

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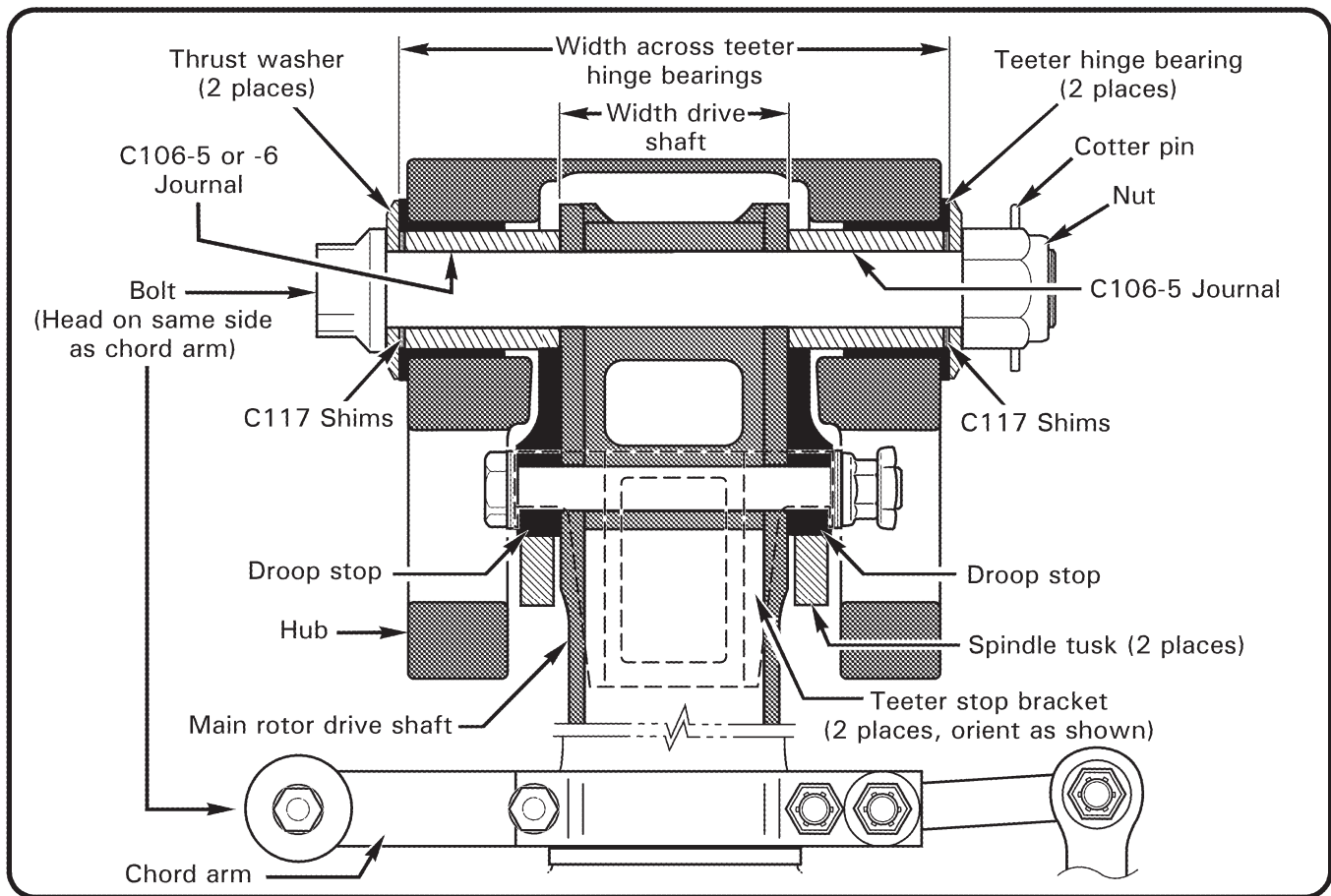


FIGURE 28-7 TEETER HINGE (HUB INSTALLATION)

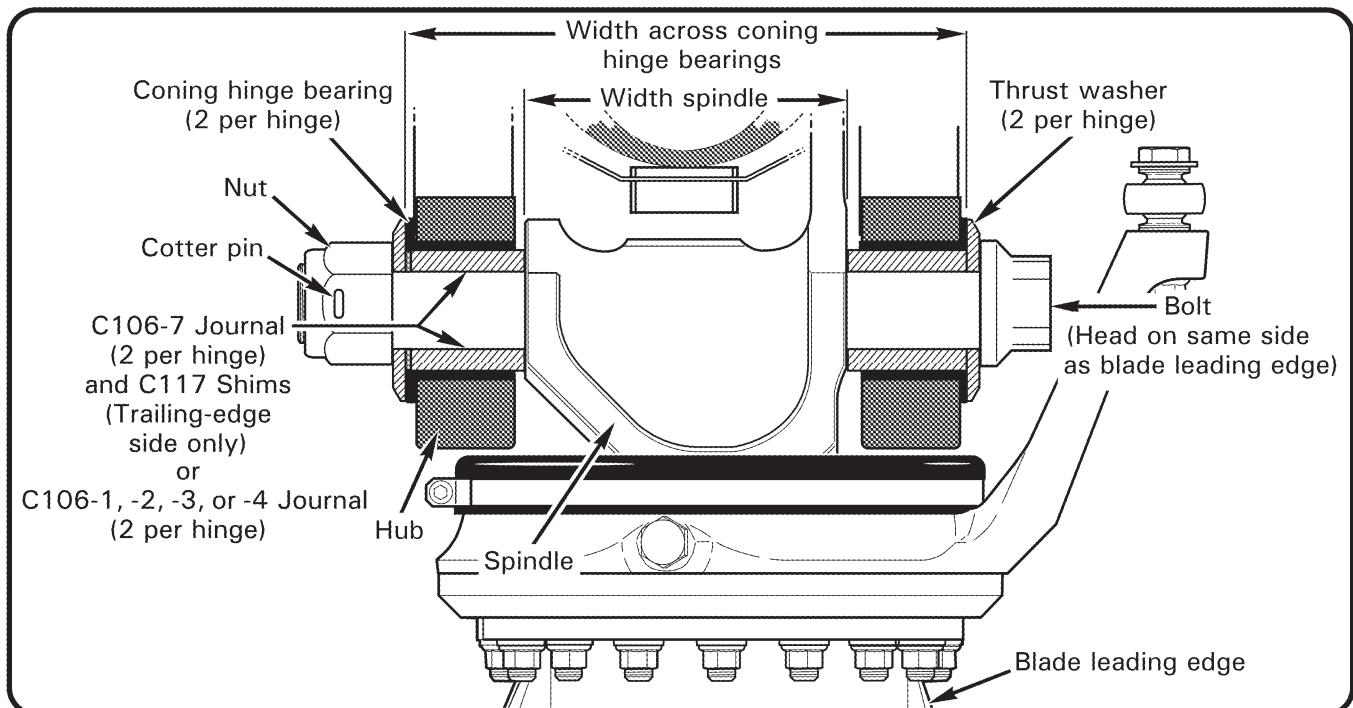


FIGURE 28-8 CONING HINGE (BLADE INSTALLATION; VIEW LOOKING DOWN)

28-30 Main Rotor Assembly28-31 Journal and Shim Calculations

Refer to Table 28-1 and Figures 28-7 and 28-8.

A. Teeter Hinge Calculation

1. Measure main rotor hub width across the teeter hinge bearing faces: _____ in.
2. Subtract measured width of C251 driveshaft at teeter hinge bolt hole: – _____ in.

Calculated empty space: = _____ in.

3. Use one C106-5 or C106-6 journal and a selection of C117 shims to create a combined length of approximately 1.835 inches. Use as many different size shims as possible. Place thrust washer, shims, and journal under teeter bolt head; shims must be placed between thrust washer and journal.

Subtract combined measured thickness of selected journal and shims: – _____ in.

Difference: = _____ in.

4. Subtract measured length of C106-5 journal to be used on nut-side: – _____ in.

Difference: = _____ in.

CAUTION

Initial teeter hinge hardware stack-up must be adjusted to 0.005/0.008 inch greater than calculated empty space. A smaller initial stack-up could damage thrust washers and hub bearings during installation.

5. To accommodate dimensional change due to clamping force, add: + 0.005/
0.008 in.

/

Initial C117 shim stack between nut-side journal & thrust washer: = _____ in.

6. Adjust shim stack as required to meet teeter hinge friction requirements (5–20 ft-lb; 8–12 ft-lb is ideal). Use as many different size shims as possible to facilitate head shifting during balancing.

C106 Journal Lengths		
<u>Part No.</u>	<u>Length</u>	<u>Location</u>
C106-1	1.300 in.	Coning hinge, no shims
C106-2	1.305 in.	Coning hinge, no shims
C106-3	1.310 in.	Coning hinge, no shims
C106-4	1.315 in.	Coning hinge, no shims
C106-5	1.775 in.	Teeter hinge (two, or one + C106-6 per hinge), shims
C106-6	1.815 in.	Teeter hinge (none, or one + C106-5 per hinge), shims
C106-7	1.284 in.	Coning hinge (two per hinge), shims

C117 Shim Sizes		
<u>Part No.</u>	<u>Thickness</u>	<u>Location (Between thrust washer and journal)</u>
C117-8	0.012 in.	Teeter hinge; Coning hinge trailing-edge side
C117-9	0.015 in.	Teeter hinge; Coning hinge trailing-edge side
C117-10	0.020 in.	Teeter hinge; Coning hinge trailing-edge side
C117-11	0.025 in.	Teeter hinge; Coning hinge trailing-edge side

TABLE 28-1 C106 JOURNAL LENGTHS AND C117 SHIM SIZES

28-31 Journal and Shim Calculations (continued)**B. Coning Hinge Calculation**

1. Measure main rotor hub width across the coning hinge bearing faces: _____ in.
2. Subtract measured width of blade spindle at coning hinge bolt hole: – _____ in.
Calculated empty space: = _____ in.

CAUTION

Initial coning hinge hardware stack-up must be adjusted to 0.012/0.016 inch greater than calculated empty space. A smaller initial stack-up could damage thrust washers and hub bearings during installation.

3. To accommodate dimensional change due to clamping force, add: + 0.012/
0.016 in.
/
Sum: = _____ in.
4. Perform step a or step b:
 - a. Subtract combined measured length of (2) C106-7 journals from Sum: – _____ in.
Initial C117 shim stack between trailing-edge journal &
thrust washer: = _____ in.
 - b. Select a combination of C106-1, -2, -3, or -4 journals whose combined measured lengths equal Sum. The same journal dash number must be used under the head of both coning hinge bolts to maintain symmetry.
5. Adjust journal combination or shim stack as required to meet coning hinge axial gap requirement per Figure 28-8 and to maintain teeter friction requirement as follows: It must be possible to manually cone each blade without teetering the hub when blades are held up off the droop stops and lifted at tip.

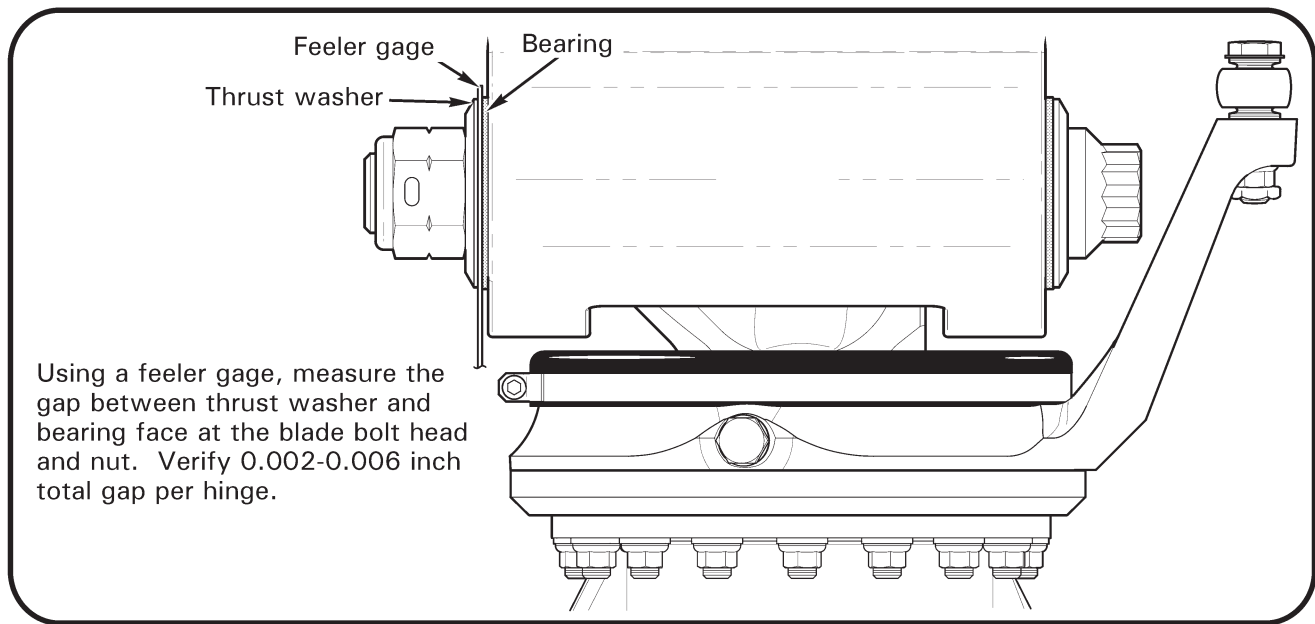


FIGURE 28-9 MEASURING CONING HINGE AXIAL GAP

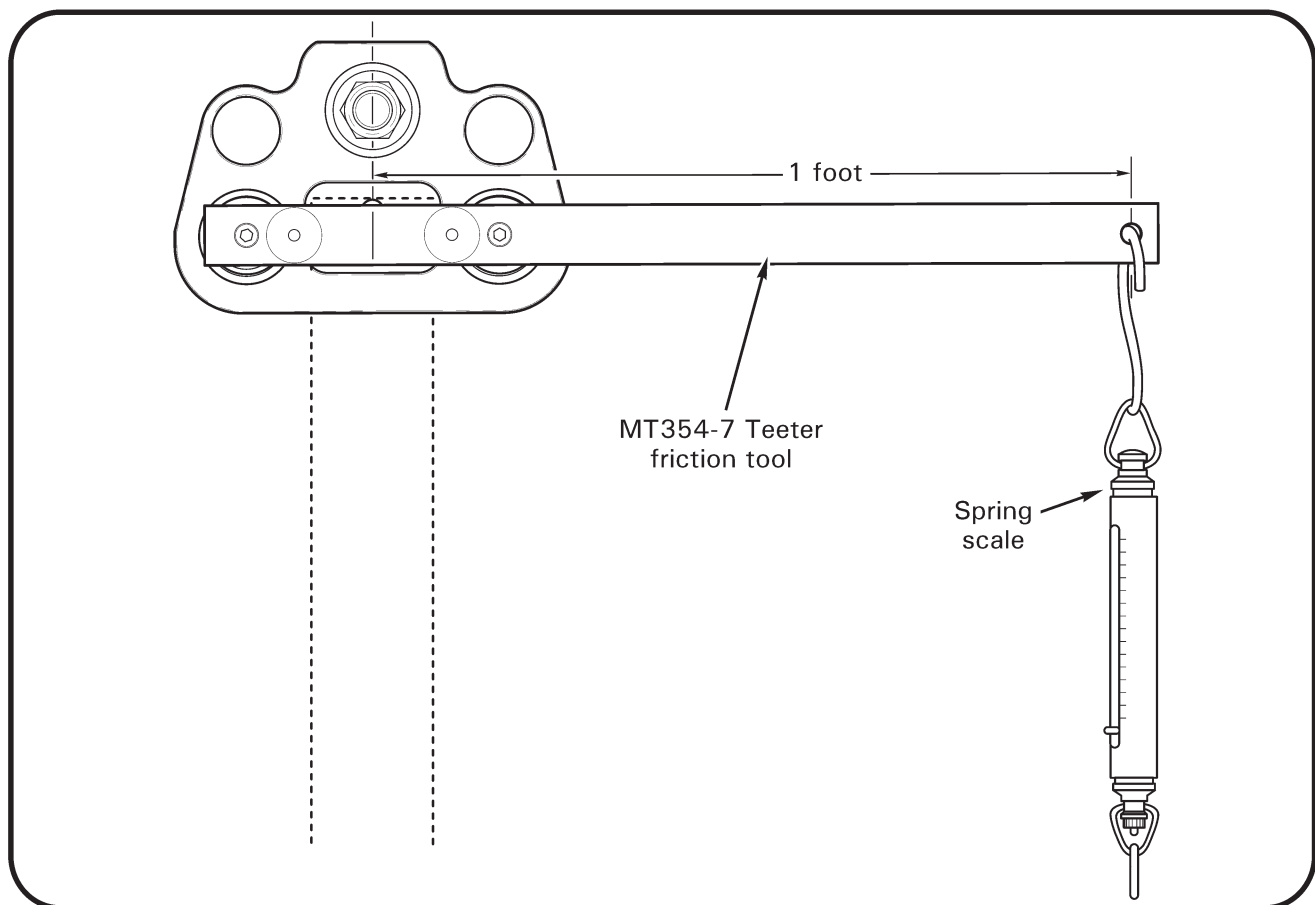


FIGURE 28-10 MEASURING TEETER HINGE FRICTION

28-32 Adjusting Hinge Friction**A. Teeter Hinge Friction Adjustment**

1. Remove main rotor blades per § 28-10.
2. Refer to Figure 28-7 and Table 28-1. Remove cotter pin, nut, thrust washer, and nut-side C117 shims. Adjust teeter hinge friction by changing nut-side shim stack thickness in small increments; reducing shim stack thickness increases friction, increasing shim stack thickness reduces friction. Install shims, thrust washer, and nut.
3. Refer to Figure 28-10. While torquing teeter hinge bolt per § 23-33, check teeter hinge friction frequently. To check friction, install MT354 teeter friction tool into coning hinge bearings on one side of main rotor hub and measure moving force (not breakaway force) required to teeter main rotor hub with a spring scale.

NOTE

Do not exceed 20 ft-lb teeter friction. If bolt cannot be torqued per § 23-33 without exceeding friction limit, increase shim stack thickness per step 2.

4. Install a new bolt and nut per § 28-20.

B. Coning Hinge Friction Adjustment

1. Refer to Figure 28-8 and Table 28-1. Remove cotter pin, nut, thrust washer, and nut-side C117 shims (or journal). Adjust coning hinge friction by changing nut-side shim stack thickness (or journal length) in small increments; reducing shim stack thickness (or using a shorter journal) increases friction, increasing shim stack thickness (or using a longer journal) reduces friction. Coning hinge friction is zero when there is a measurable axial gap per Figure 28-7. Install shims (or journal), thrust washer, and nut.
2. Install a new bolt and nut per § 28-20, steps 7 thru 9. Repeat steps for opposite blade.
3. Check coning hinge friction by lifting blades until spindle tusks clear droop stops. Hold one blade level and cone opposite blade. Rotor hub may not teeter as blade is coned. Repeat check on opposite blade.
4. Using a feeler gage, measure gap between thrust washers and bearing faces at coning hinge bolt head and nut. Verify 0.002–0.006 inch total gap per hinge.
5. Drill nut and bolt per § 28-34. Install a new cotter pin wet with approved primer (chromate primer preferred; refer to § 23-75).

28-33 Shifting the Main Rotor Hub

1. Remove cotter pin, nut, thrust washer, and nut-side C117 shims.
2. Have two people cone the main rotor blades. Push out teeter hinge bolt with another bolt.
3. Move or exchange existing shims from one side of hub to the other as indicated by main rotor balance chart (refer to § 10.230).
4. Install teeter hinge bolt per § 28-20.

28-34 Drilling Main Rotor Hub Bolts**NOTE**

Protect hub from damage due to chuck contact by wrapping chuck and/or covering hub edge with several layers of tape.

New bolts and nuts must be installed and bolts stretched per § 23-33 prior to drilling.

Using a six-inch long 0.156-inch diameter Cobalt twist-drill and cutting oil, drill a hole through nut and bolt using an accessible pre-drilled hole in nut. The MT569-2 drill guide assembly will facilitate drilling a perpendicular hole. If a pre-drilled hole is inaccessible, completely loosen nut, slightly rotate bolt to favorable position, then special torque per § 23-33. Protect adjacent area from drilling debris.

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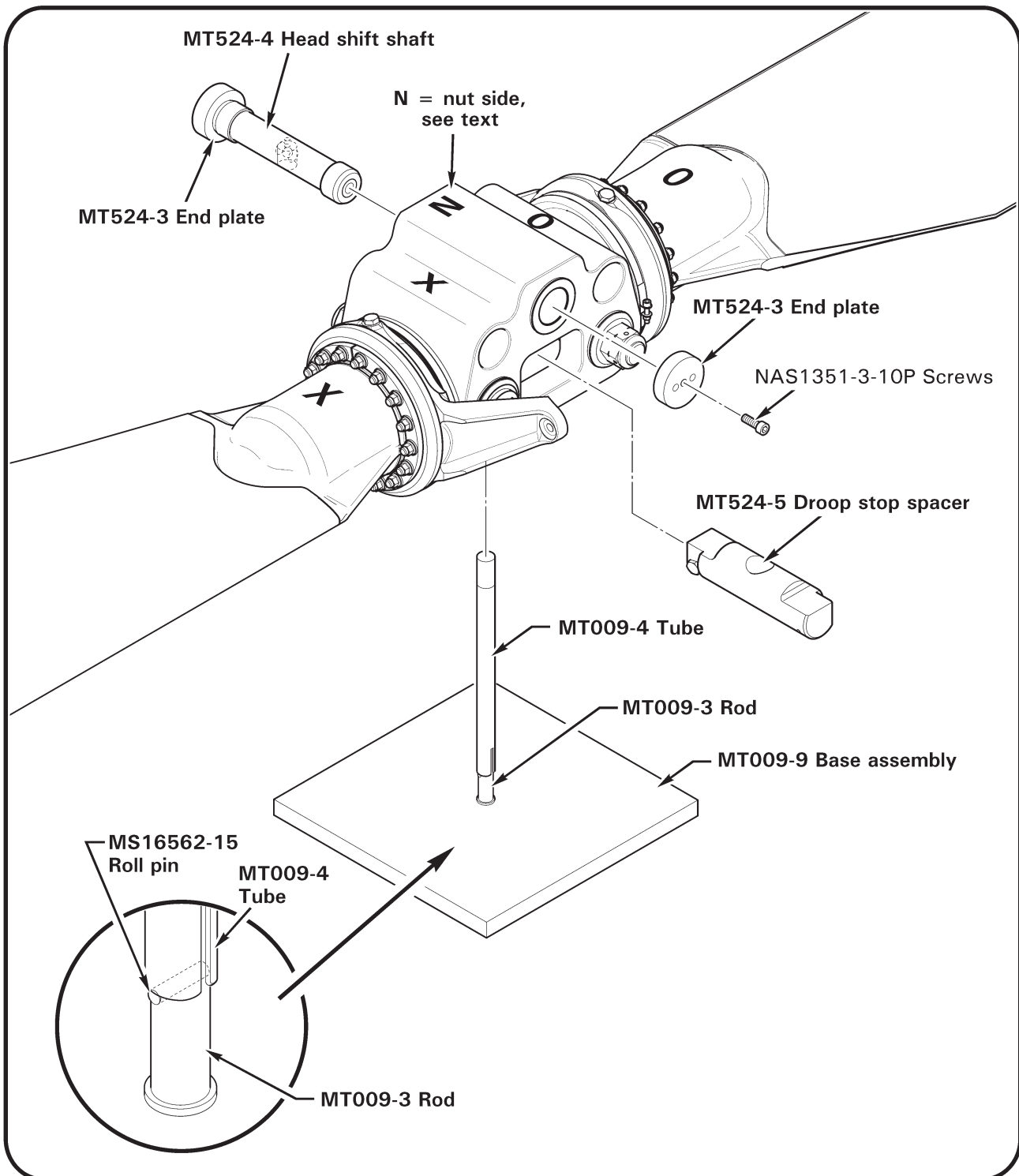


FIGURE 28-11A MT524-2 MAIN ROTOR STATIC BALANCE FIXTURE ASSEMBLY

28-35 Static Balance**CAUTION**

Ensure surfaces contacting blade skins and trailing edges are sufficiently cushioned to prevent blade damage.

1. Refer to Table 28-1. Assemble main rotor blade & spindle assembly to main rotor hub by selecting a combination of C106-7 coning hinge journals and C117 coning hinge shims to obtain total axial clearance between 0.002–0.006 inch.
2. Install nuts (dry); tighten nuts on hinge bolts until journals and thrust washers are firmly seated (snug). Measure gaps between thrust washers and hub bearing faces per Figure 28-8; verify total axial clearance at each hinge is between 0.002–0.006 inch.
3. Refer to Figure 28-11A. Install MT524-2 main rotor static balancing fixture assembly in hub as shown. Hoist main rotor assembly and position on MT009-9 base assembly.
4. Refer to Figure 28-11B. Verify blade pitch angles are approximately equal with pitch horns adjusted as shown. If blade pitch angles are not equal, then pitch horn(s) are not correctly installed.
5. Place a spirit level chordwise (parallel with teeter and coning hinges) atop main rotor hub. Level by adjusting NAS1351-3-10P screws.

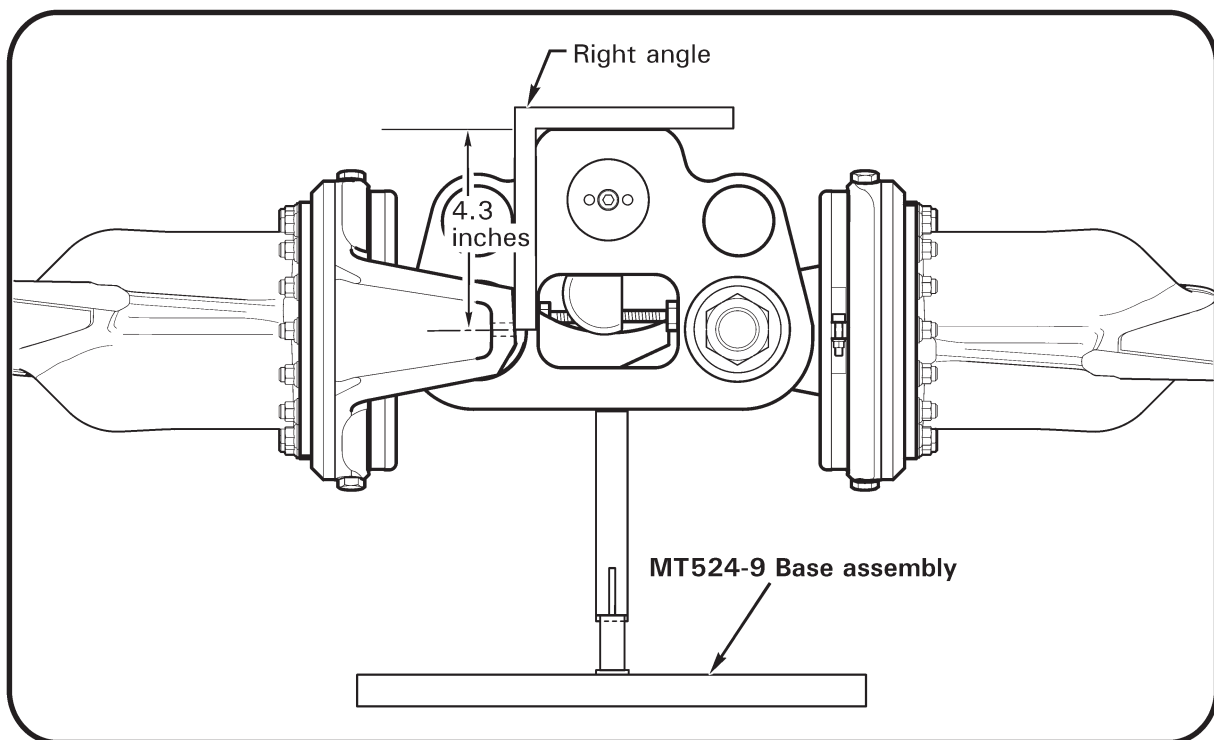


FIGURE 28-11B EQUALIZING BLADE PITCH

28-35 Static Balance (continued)

6. Refer to Figure 28-11C. Insert depth micrometer (or calipers) thru (either) hole of MT524-3 end plate until dowel contacts MT524-4 shaft and mark dowel at edge of end plate; repeat on opposite side of hub. Determine side of hub with smaller measured distance and mark top of hub with letter "N" to indicate nut-side of teeter hinge bolt.
7. Place a spirit level spanwise (perpendicular to teeter and coning hinges) atop main rotor hub. Place tip cover, tip cover attach screws, and two A722-4 screws as close to blade tip as possible. Level rotor system by adding C298 balance strips, NAS1149F0332P washers, and/or NAS1149F0363P washers as required. Final balance to be within one NAS1149F0332P washer.
8. Apply light coat A257-9 anti-seize to threads and install screws securing tip weights to blade; special torque screws to 40 in.-lb. Apply light coat A257-9 anti-seize to threads and install screws securing tip cover to blade; special torque screws to 40 in.-lb. Recheck spanwise and chordwise balance.
9. Conspicuously mark rotor assembly with colored "X" and "O" on hub, blade roots, and coning bolts (consistent marking on each side of hub) as reference for correct assembly on helicopter. Disassemble main rotor assembly.

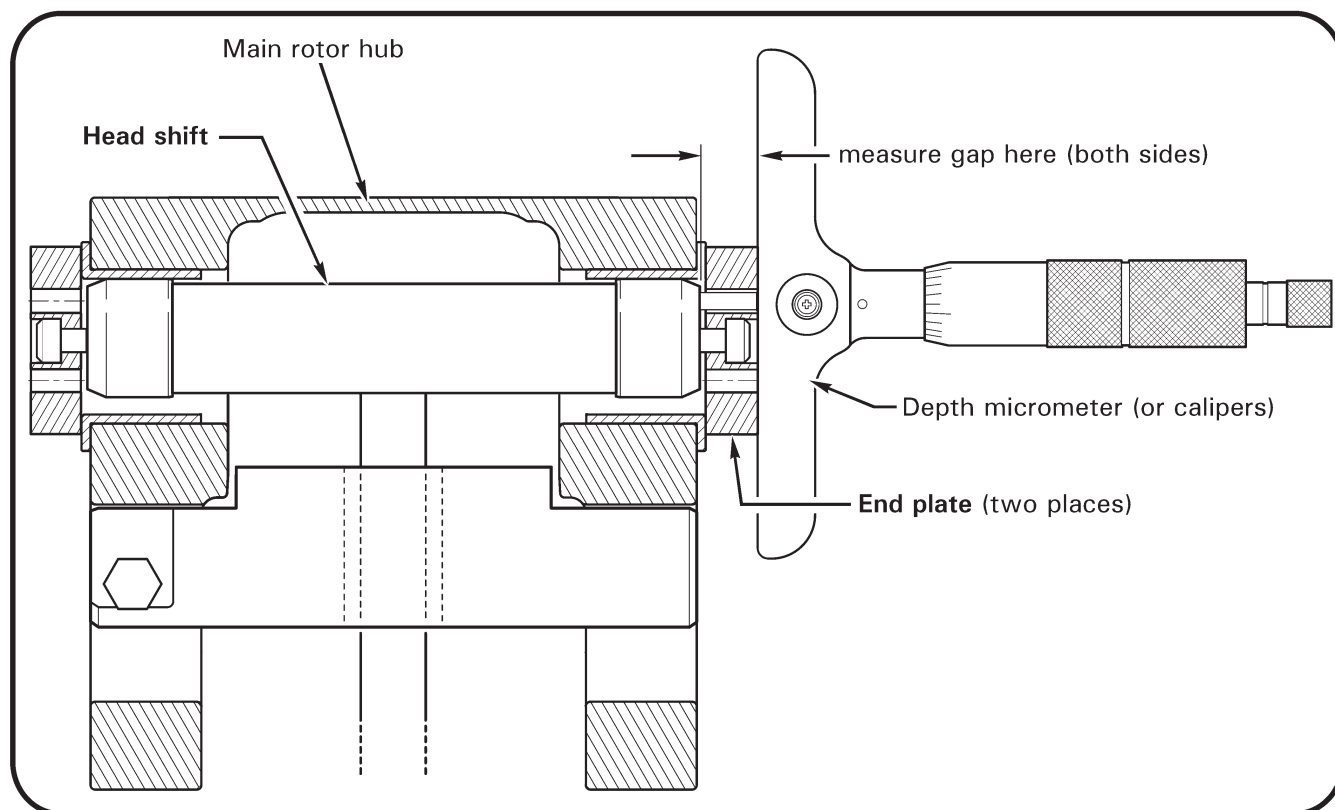


FIGURE 28-11C MEASURING GAP BETWEEN THRUST WASHER AND HUB BEARING

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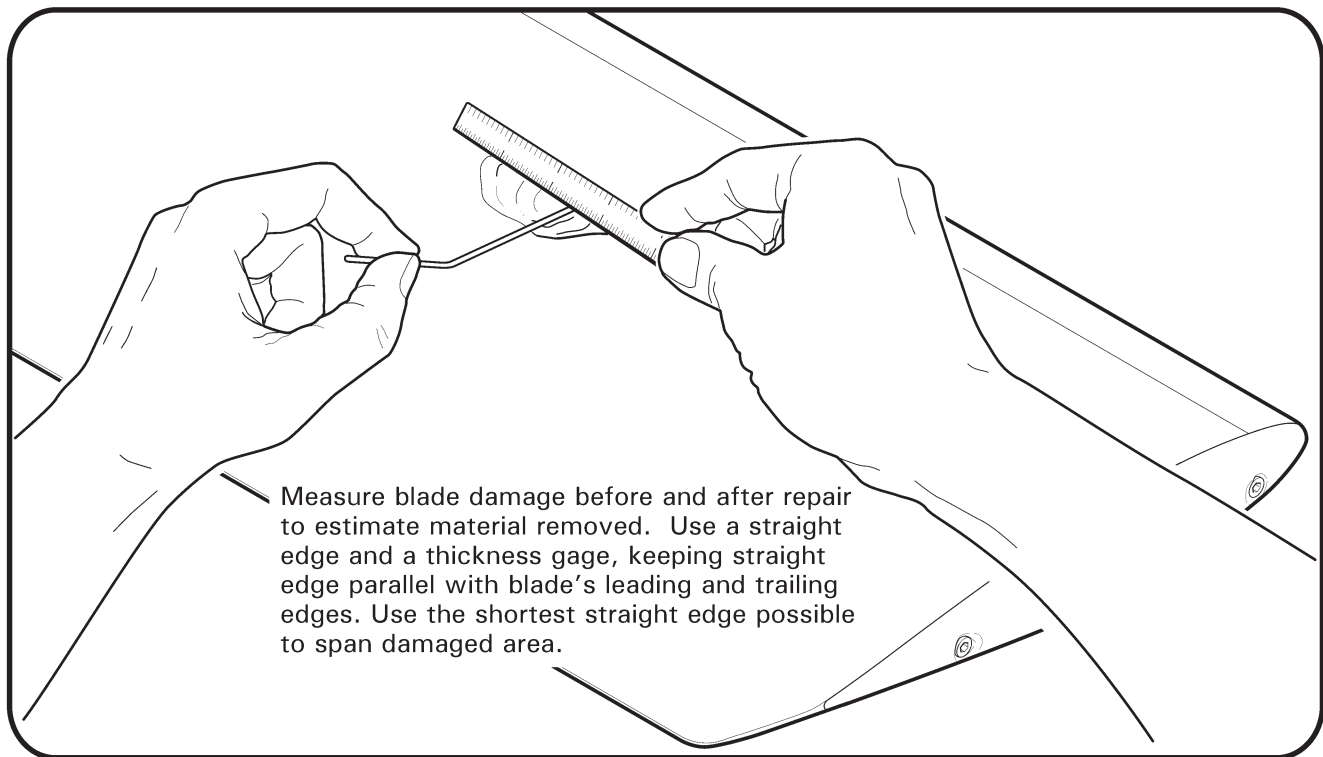


FIGURE 28-12 MEASURING MAIN ROTOR BLADE DAMAGE

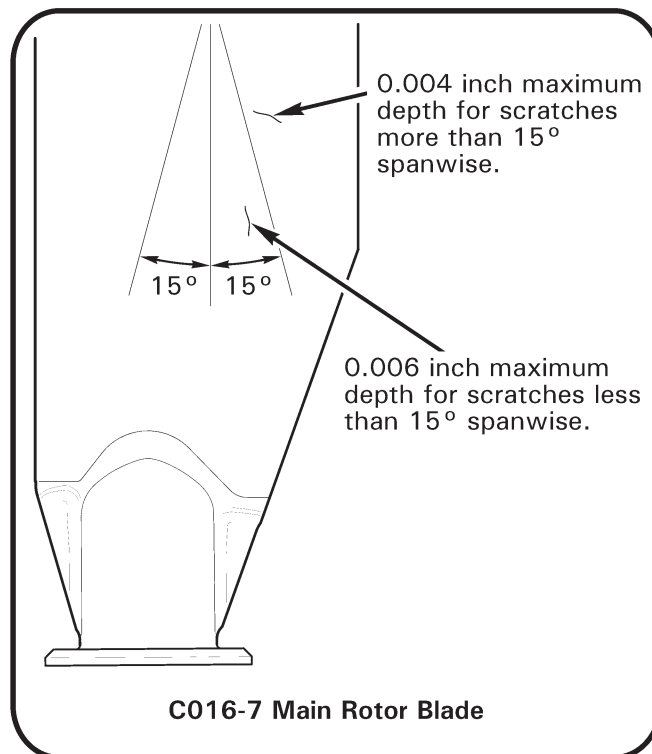


FIGURE 28-13 SCRATCH LIMITS

28-40 Inspection of Main Rotor Blades**NOTE**

Main rotor blades are 14 CFR § 27.602 critical parts. Notify RHC Technical Support when voids exceeding the limits specified in the instructions below are found, providing blade serial number, helicopter serial number, time in service for the rotor blade, and location and size of the voids that exceed the limits.

NOTE

The inspection criteria in this section applies to blade damage that occurs after blade manufacturing (including shipping and handling and time in service). Damage after blade manufacturing usually exhibits paint scuffing, scratches, or freshly-exposed metal in the form of scratches in the finish. If a blade manufacturing irregularity is suspected, contact [RHC Technical Support](#).

CAUTION

A blade may be repaired more than one time. However, in no case can more than the maximum material be removed or the maximum dent depth be exceeded in any one location.

CAUTION

Any blade that encounters inspection-penetrant (dye or fluorescent) of a blade bond joint is scrap.

A. Measuring Damage

1. Refer to Figure 28-12. Measure blade damage using a straight edge and a thickness gage. Keep straight edge parallel with the leading and trailing edges.
2. If blades are installed on the helicopter, measure damage using the shortest straight edge possible to span damaged area. Using a straight edge of excessive length will cause a false reading due to natural droop of the blade.

B. Measuring Material Removed After Repair

1. Use calipers or micrometers and compare measurements before and after repair to estimate amount of material removed.
2. Use a straight edge and thickness gage to measure repaired areas less than 2 inches across in the blade skins and spar.

28-41 Scratches and Corrosion on Blade Skins and Doublers

1. Refer to Figure 28-13. Damage may not exceed the following limits after rework:

C016-7 Blades:

- a. 0.004 inch maximum depth for scratches more than 15° from spanwise axis.
- b. 0.006 inch maximum depth for scratches less than 15° from spanwise axis.
- c. 0.012 inch maximum corrosion between RS 174.0 and RS 198.0.
- d. 0.008 inch maximum corrosion between RS 124.0 and RS 174.0.
- e. 0.006 inch maximum corrosion between RS 58.0 and RS 124.0.
- f. 0.010 inch maximum corrosion between RS 18.7 and RS 58.0.

2. Refer to § 28-50 for repair procedures for damage within limits. Polish out damage by hand with 0.10 inch blend radius.

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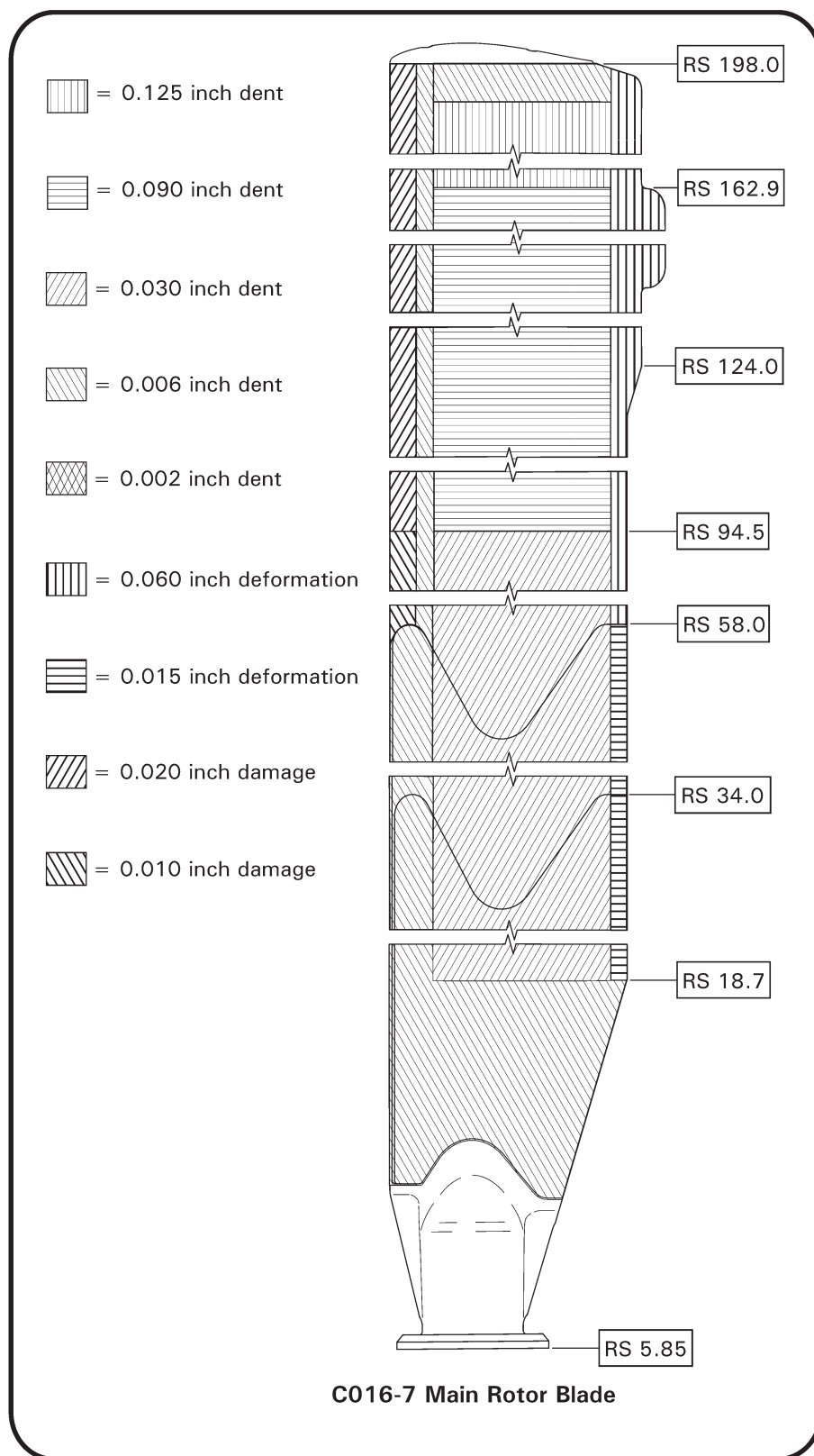


FIGURE 28-14 DENTS AND LOCAL DEFORMATIONS

28-42 Dents and Local Deformations**CAUTION**

Tap-test dented areas in honeycomb using an AN970-4 washer or 1965-or-later U.S. quarter dollar coin in good condition. If any voids are found associated with dents, contact [RHC Technical Support](#).

CAUTION

Do not repair any dent that has a sharp cut or break in the skin; dent must have 0.060 inch minimum radius. If necessary, locally penetrant inspect, keeping penetrant materials away from bond joints.

1. Refer to Figure 28-14. Damage may not exceed the following limits:

a. Honeycomb:

- i. 0.020 inch maximum bulge on opposite side of blade, opposite dent.
- ii. 0.125 inch maximum depth dent between RS 162.90 and RS 198.0.
- iii. 0.090 inch maximum depth dent between RS 94.5 and RS 162.9.
- iv. 0.030 inch maximum depth dent between RS 18.7 and RS 94.5.

b. Leading edge of doublers: 0.010 inch maximum depth dent.

c. Supported bond joints:

C016-7 Blades: 0.006 inch maximum depth dent.

d. Local deformations:

C016-7 Blades: Within 0.75 inch forward of trailing edge:

- i. 0.060 inch deformation between RS 58.0 and RS 198.0.
- ii. 0.015 inch deformation between RS 18.7 and RS 58.0.

e. Spar: Refer to step 2. Blend damaged areas by hand with a minimum 1.0 inch blend radius. Blending is not allowed within 0.010 inch of spar groove leading edge.

C016-7 Blades:

- i. 0.020 inch maximum depth damage between RS 94.5 and RS 198.0.
- ii. 0.010 inch maximum depth damage between RS 58.0 and RS 94.5.

2. Refer to § 28-50 for repair procedures for damage within limits. Smooth, round bottom dents with 0.060 inch minimum radius may be filled and faired to an aerodynamic shape.

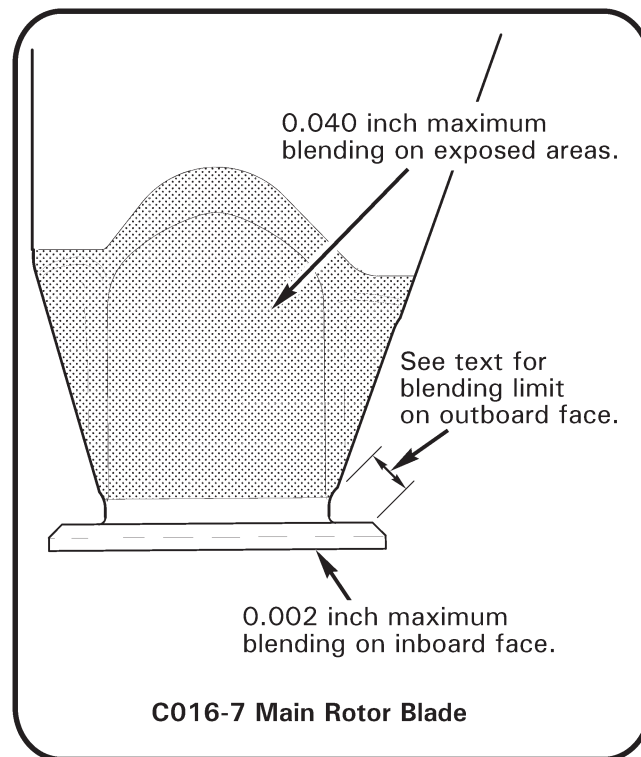


FIGURE 28-15 ROOT FITTING BLEND LIMITS

28-43 Root Fitting Damage

1. Refer to Figure 28-15. Damage may not exceed the following limits:

C016-7 Blades:

Refer to step 2. Blend damaged areas by hand with a minimum 0.030 inch blend radius.

- a. 0.002 inch maximum depth blending on flange inboard face.
- b. 0.005 inch maximum depth, 0.250 inch maximum diameter blending on flange outboard machined face (3 blends maximum). 0.10 inch minimum distance from hole edges.
- c. 0.040 inch maximum depth blending on exposed areas of root fitting.

2. Refer to § 28-50 for repair procedures for damage within limits.

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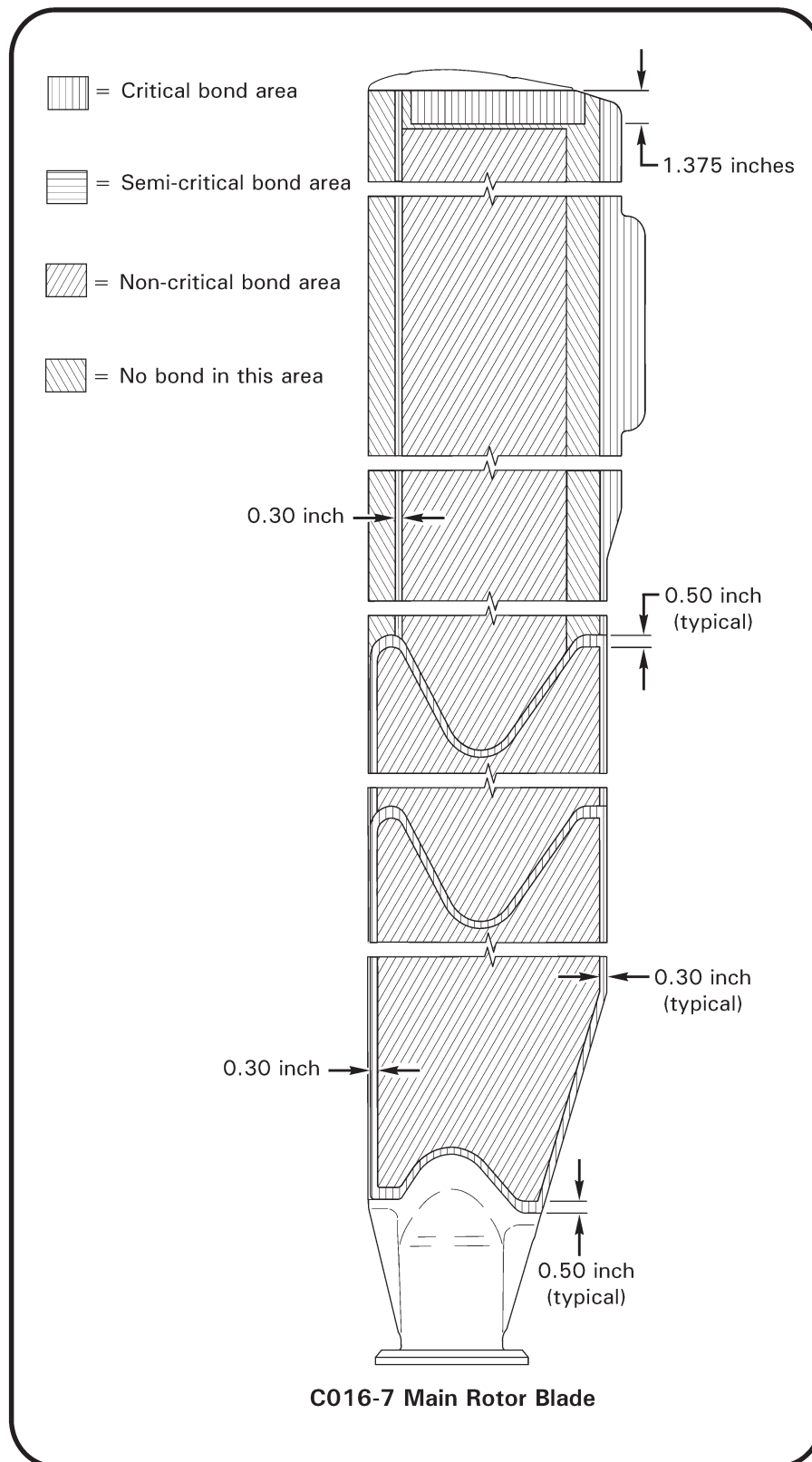


FIGURE 28-16 BOND AREAS

28-44 Voids**CAUTION**

Tap-test voids and debonds in blades using an AN970-4 washer or 1965 or later U.S. quarter dollar coin in good condition.

CAUTION

Voids or debonds in doublers are not field repairable. If voids or debonds are detected in doublers which exceed limits, contact [RHC Technical Support](#).

A. Critical Bond Areas

Refer to Figure 28-16. Critical bond areas are areas less than 0.50 inch spanwise and less than 0.30 inch chordwise from the edge of any structural bond joint.

Bond areas not defined as semi-critical or non-critical are considered critical.

Voids separated by less than 0.25 inch are considered continuous.

1. Damage may not exceed the following limits:

- a. 0.10 square inch maximum void.
- b. Area must be at least 90% bonded.

B. Semi-Critical Bond Areas**C016-7 Blades:**

C016-7 Blades do not have semi-critical bond areas.

C. Non-Critical Bond Areas

Refer to Figure 28-16. Non-critical bond areas are areas more than 0.50 inch spanwise or more than 0.30 inch chordwise from doubler edges and bonded areas between skin and honeycomb.

28-44 Voids (continued)**C. Non-Critical Bond Areas (continued)****C016-7 Blades:**

1. Voids in doubler bond joints separated by less than 0.25 inch are considered continuous. Damage in doubler bond joints may not exceed the following limits:
 - a. Area must be at least 80% bonded.
 - b. 6.0 square inches, 2.0 inches chordwise, & 7.0 inches spanwise maximum void.
 - c. 0.10 square inch maximum of a void extending into a critical bond area.
 - d. Voids are permissible within 0.30 inch of doubler leading edge where it wraps around spar and root fitting.
2. Voids in honeycomb bond joints separated by less than 0.50 inch spanwise or 1.0 inch chordwise are considered continuous. Damage in honeycomb bond joints may not exceed the following limits:
 - a. Area must be at least 80% bonded.
 - b. 15.0 square inches, 1.5 inches chordwise, & 20.0 inches spanwise maximum void inboard of RS 121.0.
 - c. 15.0 square inches, 2.5 inches chordwise, & 20.0 inches spanwise maximum void outboard of RS 121.0.

28-50 Repair of Main Rotor Blades**WARNING**

Unauthorized repairs to rotor blades have caused fatal crashes.

CAUTION

Do NOT use power tools, chemical paint strippers, or chemical corrosion removers to repair main rotor blades.

NOTE

Refer to § 23-70 for approved materials.

1. Measure damage per § 28-40.
2. Remove damage at trailing edges, trim tab edges, tip cap, and/or tip corner by trimming per § 28-51 as required.
3. Polish out damage using 220 grit or finer wet-or-dry aluminum-oxide or silicon-carbide abrasive paper, and finish with 320 grit or finer wet-or-dry abrasive paper. A fine-toothed file may be used along the spar and trailing edge, provided the area is finished with 320 grit or finer wet-or-dry abrasive paper. Sand or file in spanwise direction. Remove only the material necessary to remove the damage and blend to the radius or dimension specified. Visually inspect and verify damage is removed.
4. Measure material removed per § 28-40. Verify repair does not exceed limit specified.
5. Seal or fill as required per the following:
 - a. Clean area to be sealed or filled using approved solvent (refer to § 23-70).
 - b. Apply approved primer (chromate primer preferred; refer to § 23-75) to bond joints with pin holes or other openings. Mix primer per manufacturer's instructions. Allow a minimum of 24 hours cure time.
 - c. Using 220-grit or finer wet-or-dry aluminum-oxide or silicon-carbide abrasive paper, hand-sand cured adhesive in spanwise direction to a smooth, aerodynamic finish, congruent with the blade airfoil. Do not remove metal.
 - d. Hand-sand surrounding painted surface until 25% primer remains. Keep bare metal to a minimum.
6. Paint per § 28-52 as required.
7. Track and balance main rotor per § 10.230 as required.

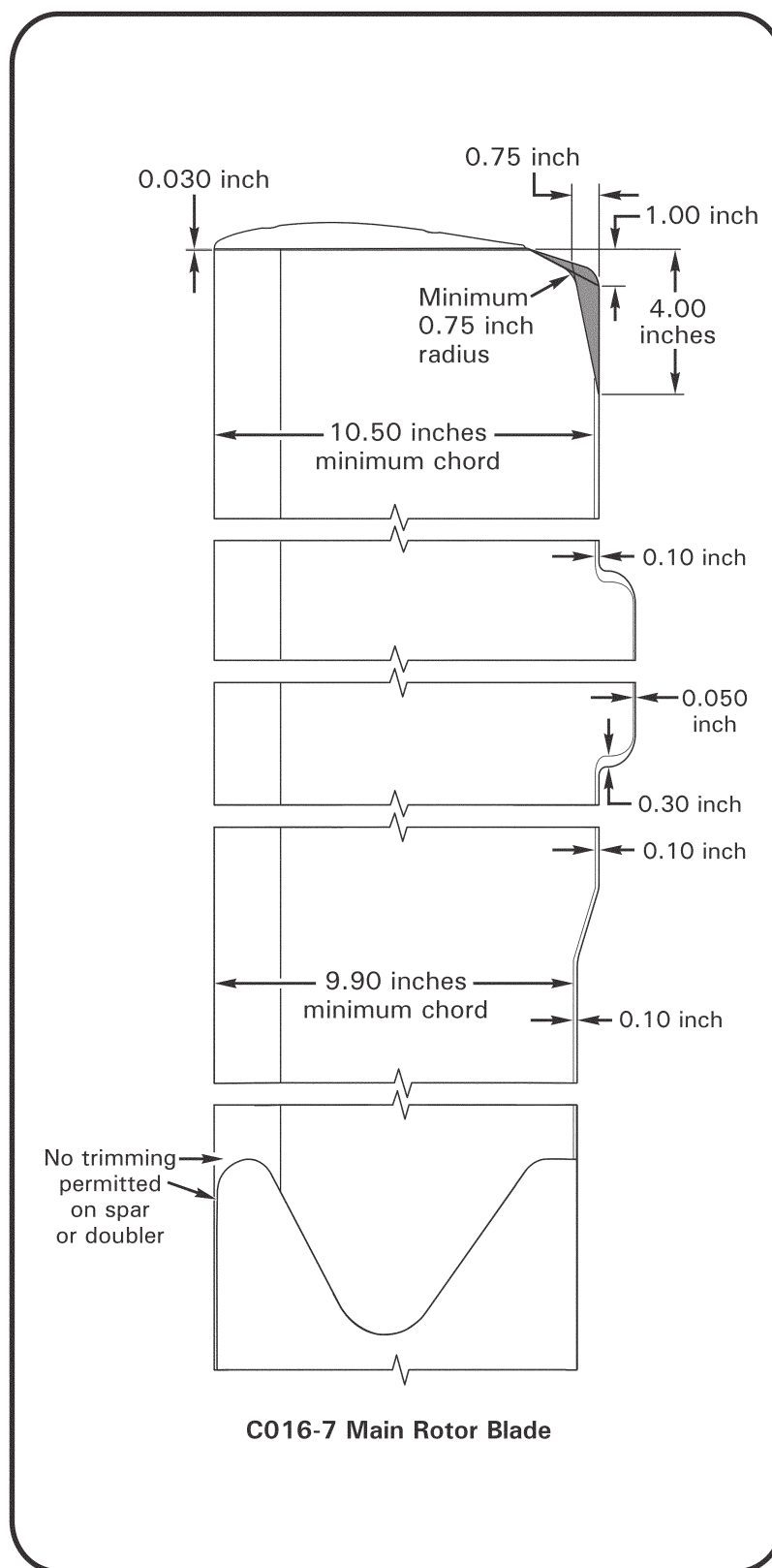


FIGURE 28-17 TRIM LIMITS

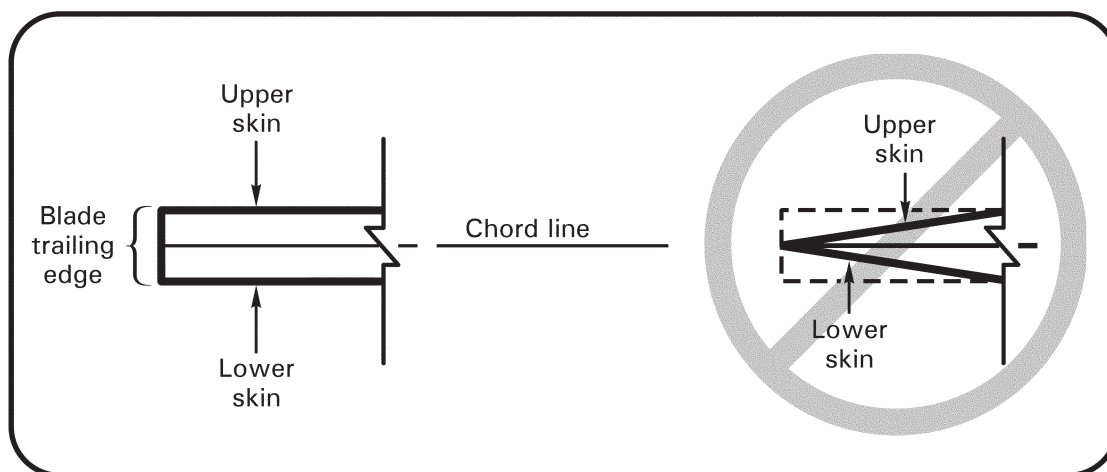


FIGURE 28-18 FILING EDGES SQUARE WITH SKINS

28-51 Trimming

Refer to Figures 28-17 & 28-18. Trimming may be performed on the trailing edge of main rotor blade skins and trim tab edges within limits shown. (Alternately, a trailing edge nick or notch may be blended out 1.0 inch minimum spanwise, each side of nick or notch within limits shown.) Trimming is not permitted on spar or doublers.

Tip cap and tip corner may be trimmed within limits shown.

Finish repair per § 28-50 steps 2 thru 7. File trailing edge or trim tab edges square with skins (do not file into a point). Verify minimum chord dimension.

28-52 Painting

Refer to § 23-70 for approved materials. Refer to paint manufacturer's recommendations.

CAUTION

If force-drying paint, do not exceed 175° F surface temperature on blade; monitor blade temperature.

1. Remove main rotor blade tip cover(s) as required. Clean the blade(s).
2. Feather edge of paint bordering bare metal by hand-sanding spanwise with 220-grit or finer wet-or-dry aluminum-oxide abrasive paper. Do not remove metal.
3. Clean bare metal to be painted with a lint-free cloth dampened with an approved solvent (ref. § 23-70).
4. Refer to Figure 28-19. Mask blade(s) as required, and protect helicopter to prevent overspray contamination.
5. Prime bare metal, including bare metal under tip cover(s) as required, with at least two coats approved primer (chromate primer preferred; refer to § 23-75). Scuff first coat of primer with 320-grit abrasive paper (or very fine Scotch-Brite), and wipe down with a lint-free cloth dampened with an approved solvent (ref. § 23-70) prior to applying second coat.

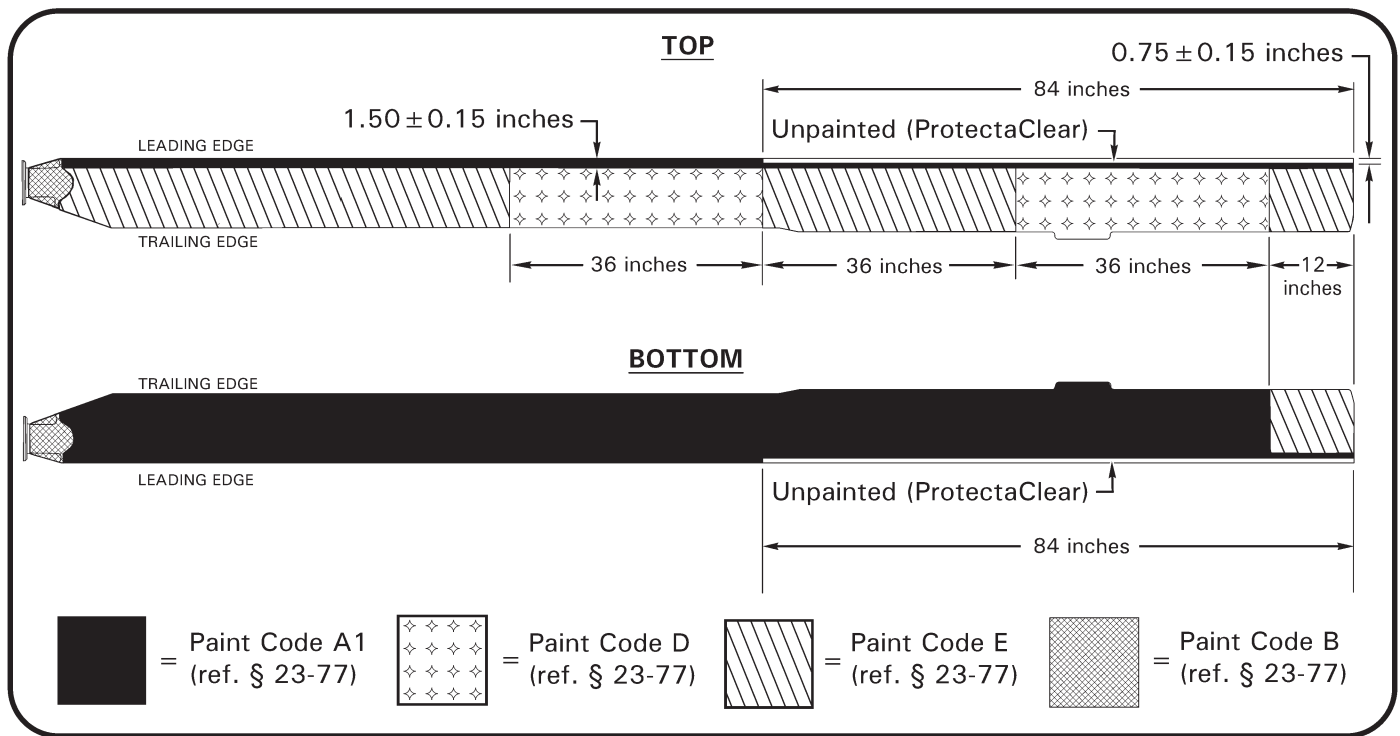


FIGURE 28-19 C016-7 MAIN ROTOR BLADE PAINT SCHEME

28-52 Painting (continued)

6. Refer to Figure 28-19. Apply dark gray, flat black, white, and/or yellow polyurethane enamel, as required, to primed area in accordance with paint manufacturer's recommendations.

NOTE

Allow Imron paint to cure at least 72 hours before flying in erosive conditions (such as drizzle, rain, or dust).

7. Remove masking materials.
8. Using 320-grit or finer aluminum-oxide abrasive paper, carefully break leading edges (upper & lower) of paint spanwise.
9. Install screws, wet with A257-9 anti-seize, securing tip covers. Special torque screws per § 23-33; ensure cover edges are flush with blade profile.

28-53 Leading Edge Care**NOTE**

Blades with painted outboard leading edge may be paint-stripped per Part C to match new-blade paint scheme, if desired.

A. Unpainted Outboard Leading Edge

1. Remove any oxidation from unpainted leading edges using maroon-colored Scotch-Brite™ pad (3M General Purpose Hand Pad 7447).
2. Clean surface to be coated using mild soap and water (acetone may be used as necessary; do not use MEK or alcohol). Water-rinse immediately and allow to dry.
3. Wearing a nitrile glove, apply a coat of ProtectaClear using lint-free cloth and allow to dry (approximately one hour).
4. A second coat may be applied for additional protection.

B. Painted Leading Edge

Refer to Figure 28-19. Repaint leading edge per § 28-52 as required. Outboard leading edge may be refinished per Part C.

C. Leading Edge Refinishing**CAUTION**

Do NOT use power tools or chemical paint strippers to remove blade paint.

NOTE

Earlier blades with painted outboard leading edge may be refinished per Part C for improved appearance and protection against erosion.

1. Remove main rotor blade tip cover(s). Clean the blade(s).
2. Using a felt-tip marker, draw a straight line on blade's top and bottom surfaces: 0.80-inch aft of leading edge, from blade-tip to 84 inches inboard of blade-tip.
3. Support blade while sanding to avoid pushing blade down. Remove paint, without removing metal, forward & outboard of marked lines using 220-grit or finer wet-or-dry aluminum-oxide abrasive paper by hand-sanding blade spanwise and feather paint edges.
4. Clean feathered-paint edges and surfaces of blade requiring touch-up with a lint-free cloth dampened with an approved solvent (ref. § 23-70).

28-53 Leading Edge Care (continued)**C. Leading Edge Refinishing (continued)**

5. Refer to Figure 28-19. Using 3M vinyl tape (or equivalent), apply masking to blade(s) along 0.75-inch dimension and aft of feathered paint. Protect blade(s) and helicopter from overspray contamination.
6. Wipe area to be painted using PreKote wipes (or equivalent adhesion promoter) and allow to air dry.
7. Apply light coat of approved primer (chromate primer preferred; refer to § 23-75) to feathered paint.
8. Apply black paint (ref. § 23-77), as required.
9. Remove masking materials.
10. Using 320-grit or finer aluminum-oxide abrasive paper, feather leading edge of black paint spanwise without exposing primer.
11. Wipe bare metal leading edge using PreKote wipes (or equivalent adhesion promoter) and allow to air dry.
12. Wearing a nitrile glove, apply a coat of ProtectaClear using lint-free cloth and allow to dry (approximately one hour).
13. A second coat of ProtectaClear may be applied per step 12 for additional protection.
14. Install screws, wet with A257-9 anti-seize, securing tip covers. Special torque screws per § 23-33; ensure cover edges are flush with blade profile.

28-60 Main Rotor Blade Tip Maintenance

After removing rounded tip covers, use 10X magnification when visually inspecting blade tip to verify no loose or blistered paint, white-powder corrosion products, or pitting of skins aft of skin-to-spar bond lines (upper & lower). If bare metal (other than spar leading edge) or corrosion is detected, proceed as follows:

WARNING

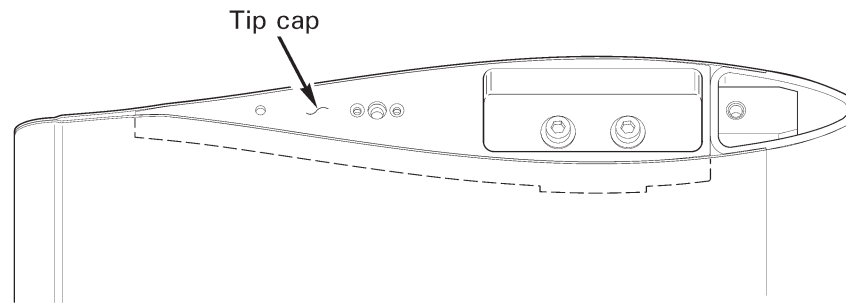
Review appropriate Safety Data Sheet (SDS) when working in proximity to hazardous materials. Specific recommendations for use of personal protective equipment are located in the SDS.

CAUTION

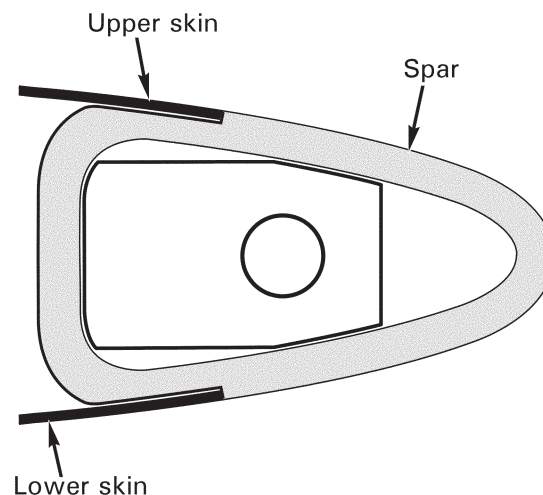
Do NOT use power tools or chemical paint strippers to remove blade paint.

28-60 Main Rotor Blade Tip Maintenance (continued)

1. Remove any corrosion and loose paint on tip cap and outboard edges of blade skins by hand-sanding vertical surface in a chordwise direction; use a hard, flat block with 220-grit aluminum-oxide abrasive paper, then finish sand with 320-grit aluminum-oxide abrasive paper. Remove only material necessary to eliminate corrosion.



2. Remove any corrosion and loose paint from skins on upper or lower surface of blade, aft of skin-to-spar bond joint, by hand-sanding in a spanwise direction using 220-grit aluminum-oxide abrasive paper and minimum 0.1 inch blend radius; finish sand with 320-grit aluminum-oxide abrasive paper. Remove only material necessary to eliminate corrosion.



3. Clean bare metal area with lint-free cloth dampened with an approved solvent (ref. § 23-70) and allow to dry.
4. Seal exposed bond joints, including bond joints on vertical surfaces, with smooth layer of B270-1 sealant (poly-sulfide, refer to § 23-79) and allow to cure.
5. Prime remaining exposed metal with two coats of epoxy primer (chromated epoxy preferred).
6. Apply yellow paint topcoat within 2–48 hours of primer application. For best performance, allow paint to cure 48 hours before flight.
7. Install screws, wet with A257-9 anti-seize, securing tip covers. Special torque screws per § 23-33; ensure cover edges are flush with blade profile.

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