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SEPTEMBER 2004

STUDENT GUIDE

FOR

UH-60 ROTOR SYSTEM

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SEPTEMBER 2004

UH-60 ROTOR SYSTEMS

TABLE OF CONTENTS

SECTION I. - INTRODUCTION

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify the characteristics of the UH-60 Rotor System

CONDITIONS: As a UH-60 maintenance test pilot

STANDARD: In Accordance with (IAW) TM 1-1520-237-23-3 and TM 1-1520-237-10

SAFETY REQUIREMENTS: Remove all watches, rings and other jewelry before operating, or maintaining electronic equipment.

RISK ASSESSMENT LEVEL: Low

ENVIRONMENTAL CONSIDERATIONS: There are no environmental concerns for this lesson.

EVALUATION: Evaluation will be accomplished with performance exam at the end of this module of instruction.

SECTION II. - PRESENTATION

A. ENABLING LEARNING OBJECTIVE No. 1

ACTION: Identify the function of the UH-60 Rotor System.

CONDITIONS: Using TM 1-1520-237-23 Series and TM 1-1520-237-10.

STANDARD: IAW TM 1-1520-237-23-Series and TM 1-1520-237-10.

a Function of the Rotor System

Frame #0025 (Main Rotor System)

(1) Function of the Main Rotor System

(a) The main rotor system is driven by the engines through the main transmission system, with pitch controlled by the flight control system.

(b) The main rotor head transmits the movements of the flight controls to the four main rotor blades with the main rotor head rotating in a counterclockwise direction.

(c) The main rotor consists of a four bladed, fully articulated, elastomeric rotor.

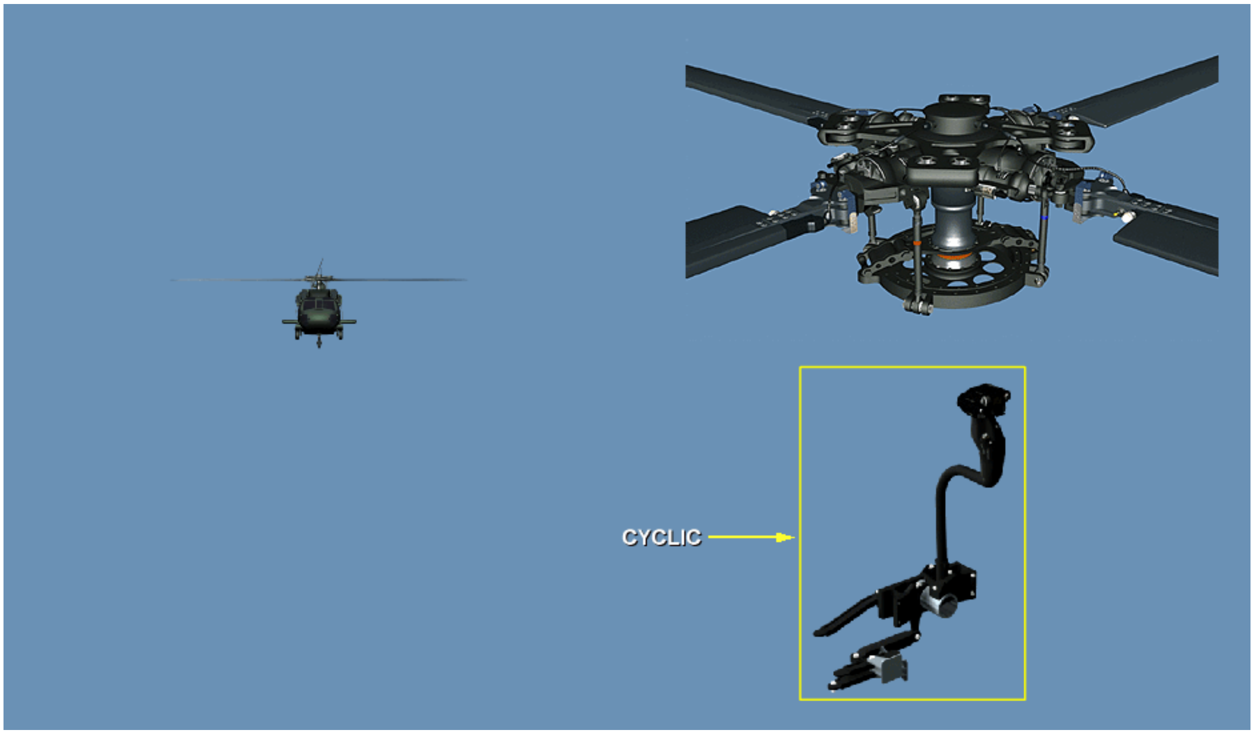
(d) Forward, aft, lateral, and vertical flight is done by the main rotor system

(2) Function of the Rotor System

Frame #0030 (Rotor System Function Collective FLASH)

(a) Collective input increases or decreases the angle of all four blades providing vertical movement.

Frame #0035 (Rotor System Function Cyclic FLASH)



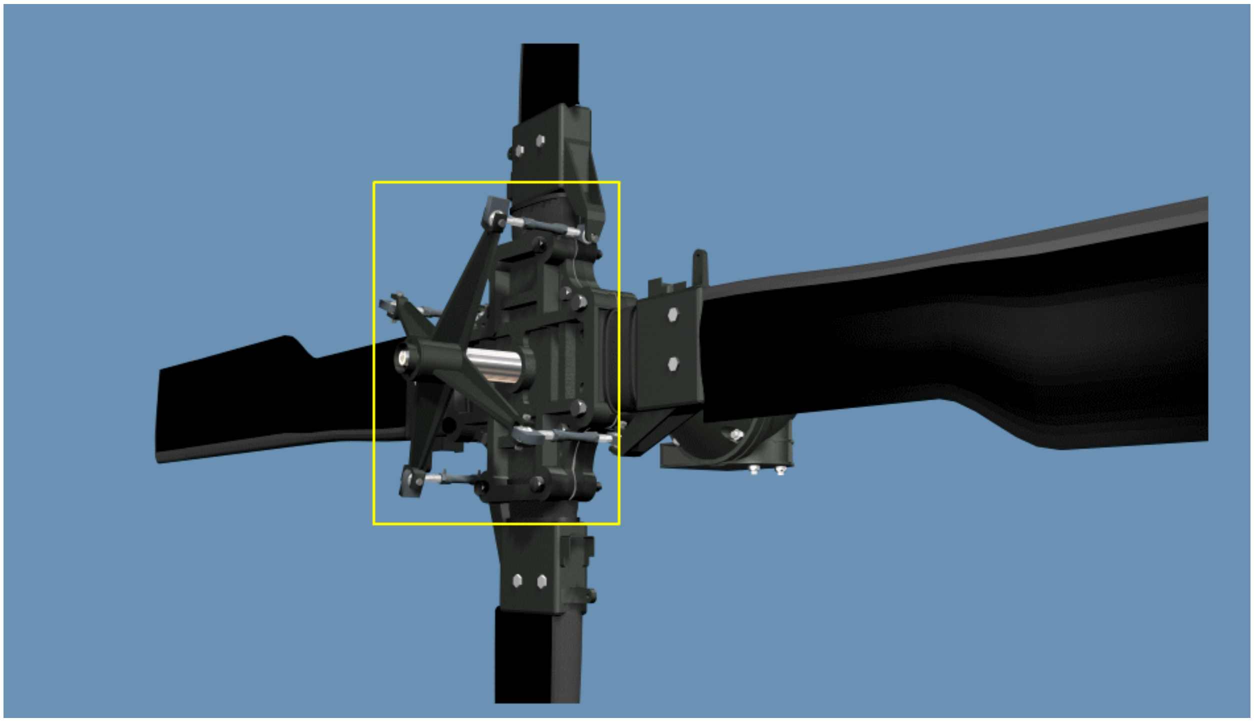
(b) Cyclic input increases or decreases the angle of selected blades, depending on the input and position of the blade as it rotates around the main rotor head providing forward, aft, and lateral movement.

Frame #0040 (Tail Rotor Function FLASH)

(c) The tail rotor system counteracts torque from the main rotor and provides directional control.

(d) As an input is made to the main rotor, a correlating input will occur to the tail rotor, providing anti-torque as an increase or decrease in power to the drive system is demanded.

Frame #0045 (Tail Rotor Pitch Angle)



(e) A decrease or increase in the angle (pitch) of the tail rotor blades, allow the aircraft to pivot (change direction) while remaining in one spot, or keep the fuselage of the aircraft in trim during the mode of flight.

Frame #0050 (Tail Rotor Configuration)

(f) The tail rotor head and blades are installed on the right side of the tail pylon, canted 20° upward.

(g) In addition to providing directional control and anti-torque reaction, the tail rotor provides 2.5% of the total lifting force, approximately 400 lbs, in a hover.

(h) A spring-loaded feature of the tail rotor control system will provide a setting of the tail rotor blades for balanced flight at cruise power setting in case of complete loss of tail rotor control.

CHECK ON LEARNING

1. When collective input is applied, it does which of the following?

2. When cyclic input is applied, it does which of the following?

3. What is the purpose of the tail rotor?

SECTION III. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the functions of the Rotor System topic.

The key points to remember are:

- The rotor system is driven by the engines through the transmission with pitch controlled by the flight control system.
- The rotor system provides vertical lift, and forward, aft and lateral movement.
- Collective inputs will increase or decrease the angle of all four main rotor blades, providing vertical movement.
- Cyclic inputs will increase or decrease the angle of selected blades depending on the input and position of the blade as it rotates around the main rotor head, providing forward, aft and lateral movement.
- Inputs made to the main rotor have a correlating response from the tail rotor providing directional control.
- The tail rotor system allows the aircraft to change direction while remaining in one location.
- The 20 degree upward cant of the tail rotor provides 400 lbs of additional lift.
- The tail rotor counter-acts torque from the main rotor.

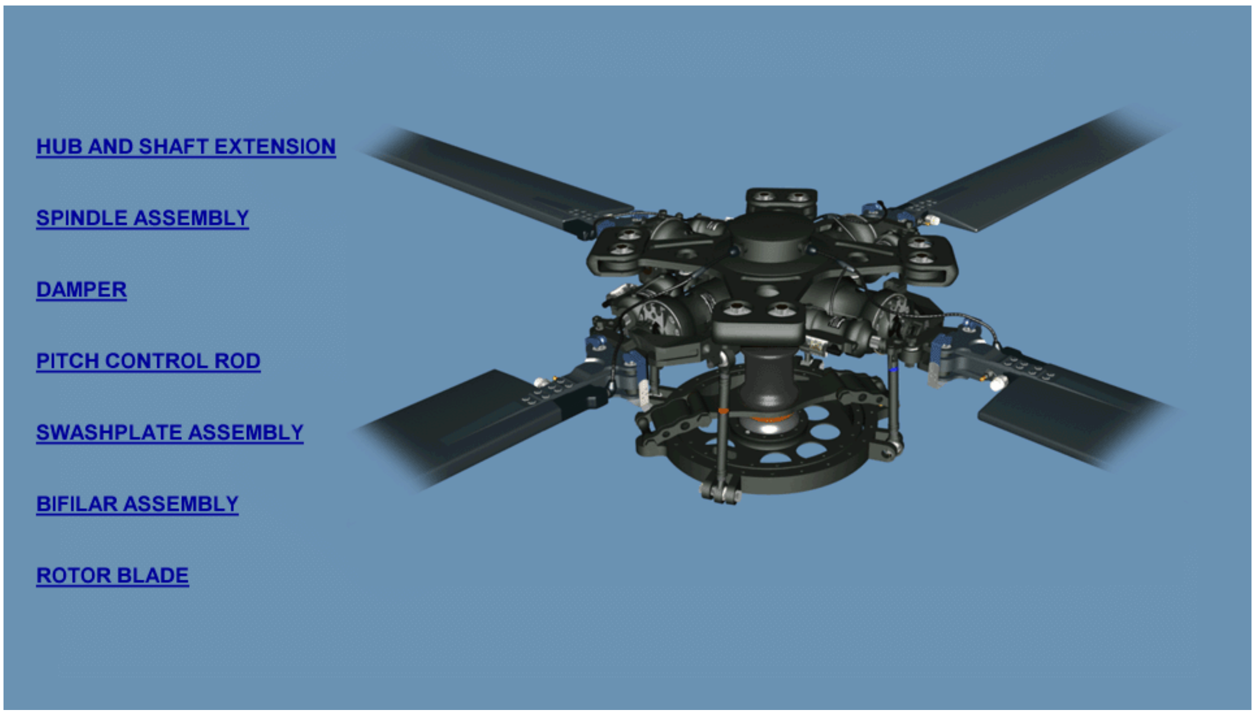
B. ENABLING LEARNING OBJECTIVE No. 2

ACTION: Identify the components of the UH-60 Main Rotor system.

CONDITION: Using TM 1-1520-237-23-3.

STANDARD: IAW TM 1-1520-237-23-3.

Frame #0105 (Main Rotor System Menu)



a The main rotor system is comprised of seven major subsystems:

(1) The main rotor hub and shaft extension

(2) Spindle

(3) Damper

(4) Bifilar assembly

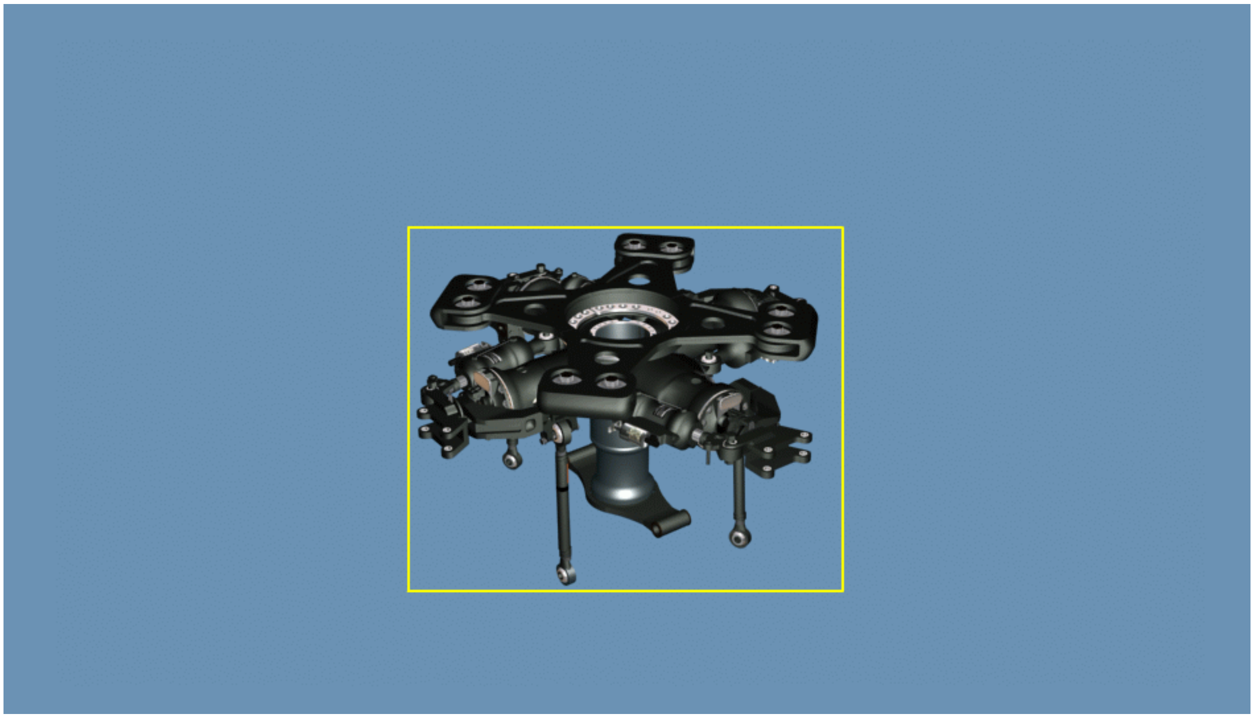
(5) Pitch control rod

(6) Swashplate assembly

(7) Main rotor blade

(a) Hub and Shaft Extension

Frame #0110 (Main Rotor Hub and Shaft Extension FLASH)



1) The main rotor head transmits the movements of the flight controls to the four main rotor blades.

2) The main rotor head turns in a counterclockwise direction.

3) The main rotor head is supported by the main rotor shaft extension.

4) The shaft extension is splined to the main rotor shaft, which drives the head.

5) The lower pressure plate and split cones, in conjunction with the main shaft nut, secure the shaft extension to the main shaft.

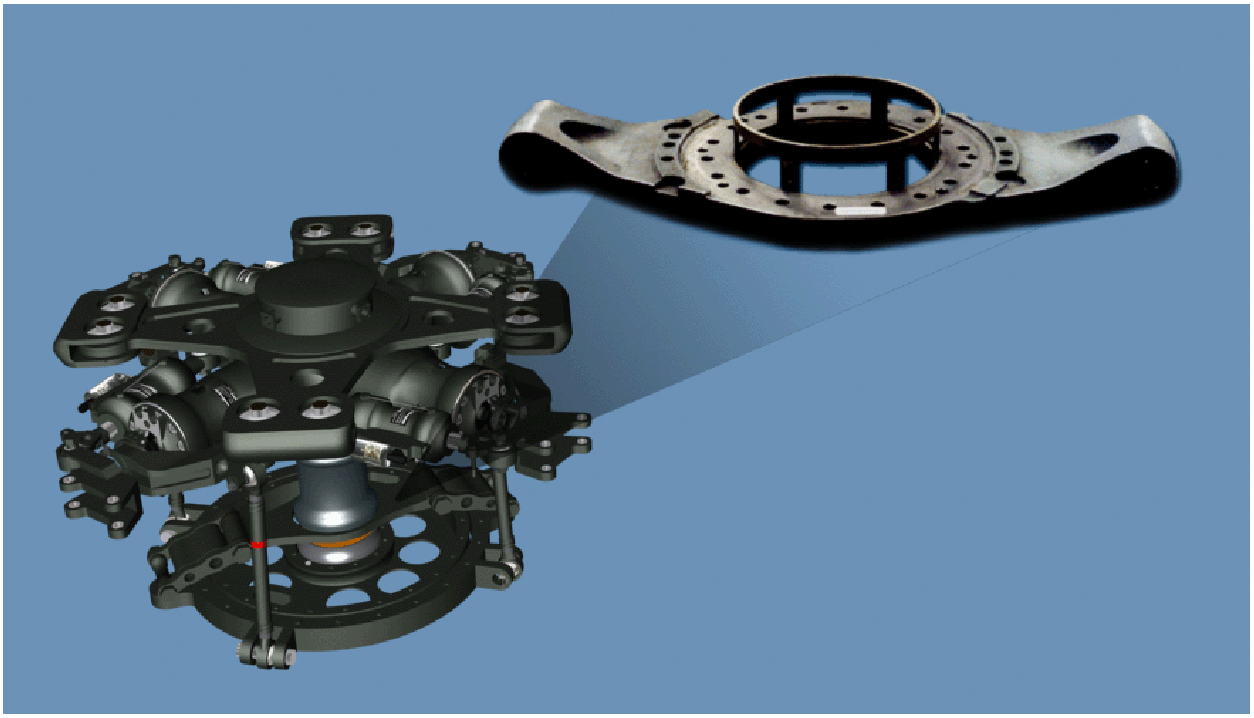
6) The lower pressure plate also provides attachment for the rotating scissors.

7) The main rotor hub is supported by the main rotor shaft extension.

8) The upper pressure plate and split cones secure the main rotor hub to the shaft extension.

a) Components Lower Pressure Plate

Frame #0115 (Lower Pressure Plate)

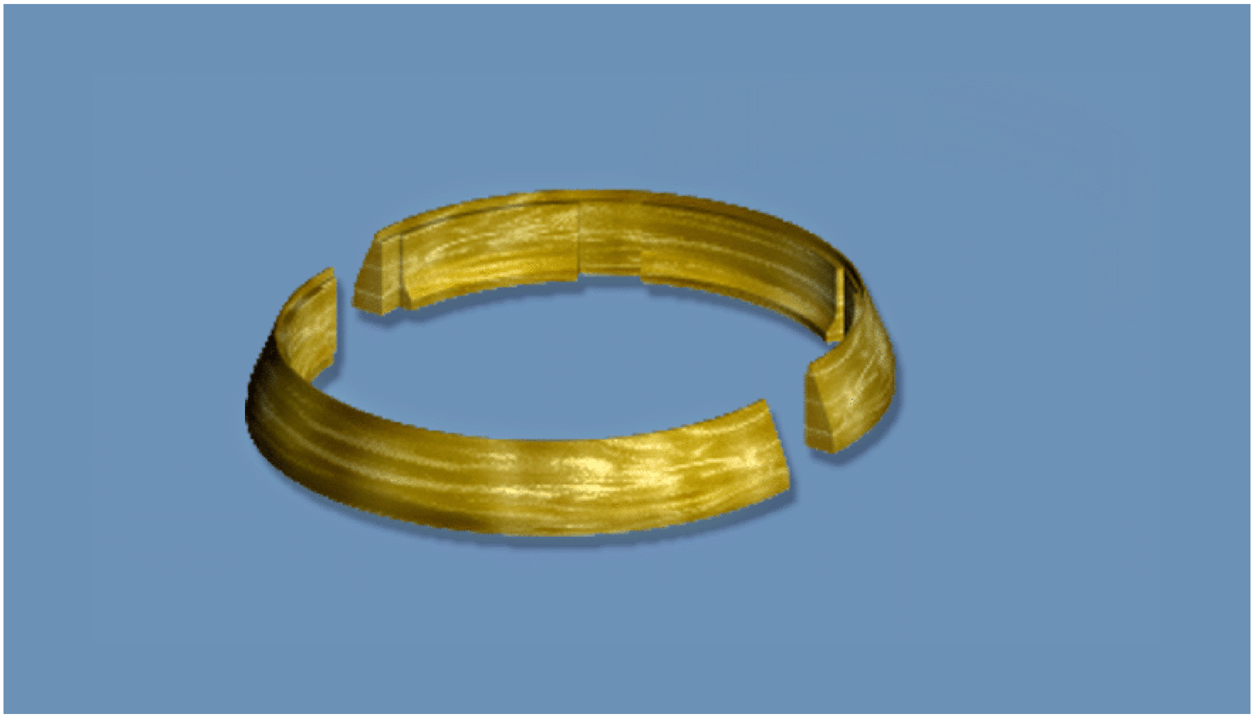


1 The lower pressure plate is attached to the shaft extension and the rotating swashplate.

2 The lower pressure plate centers the lower set of split cones.

b) Components Split Cones

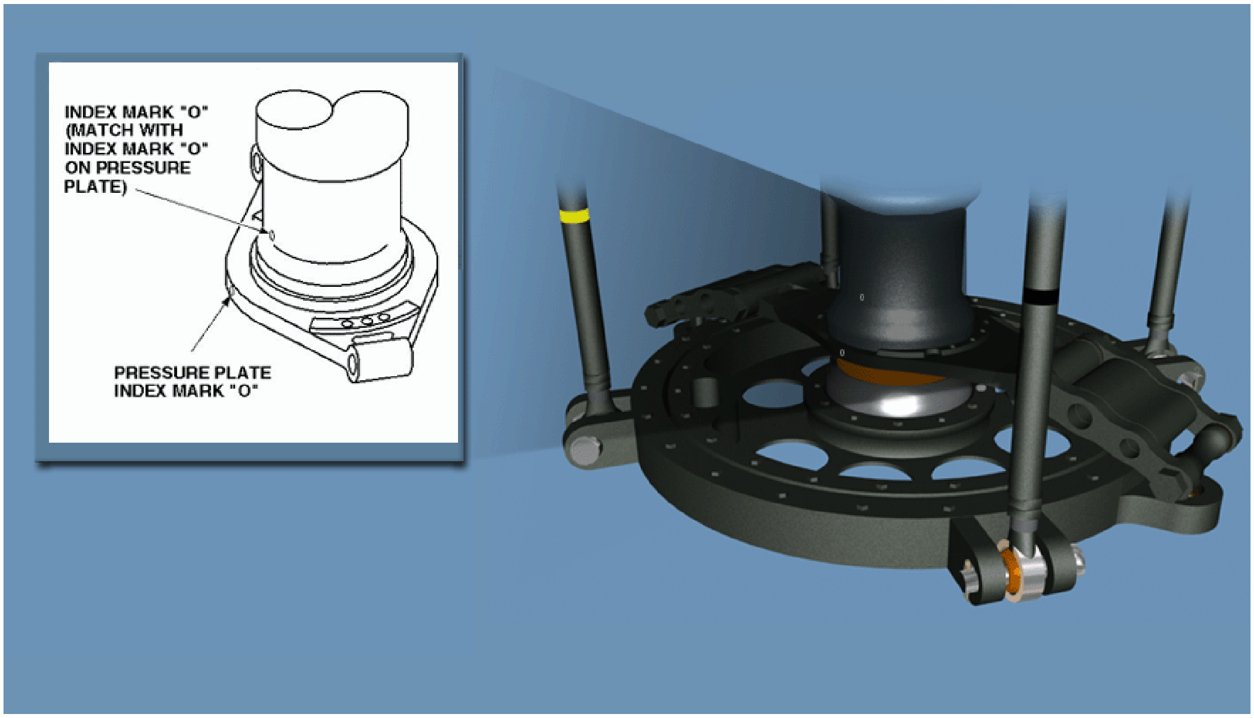
Frame #0120 (Split Cones)



1 The split cones are a matched set.

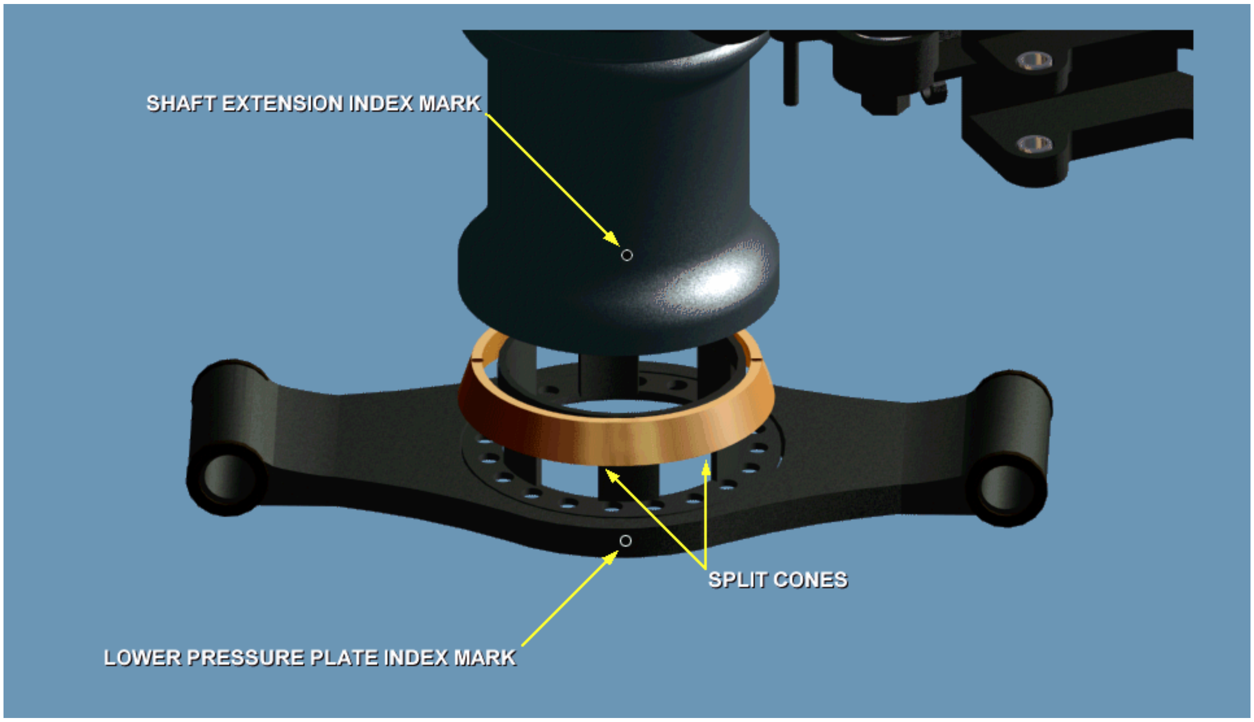
2 They center the hub and shaft extension and if not installed correctly, will affect the balance of the main rotor hub.

Frame #0120 (Split Cone Index Mark)



3 The lower pressure plate and shaft extension are marked with a "0" for proper alignment and installation of the shaft extension and split cones.

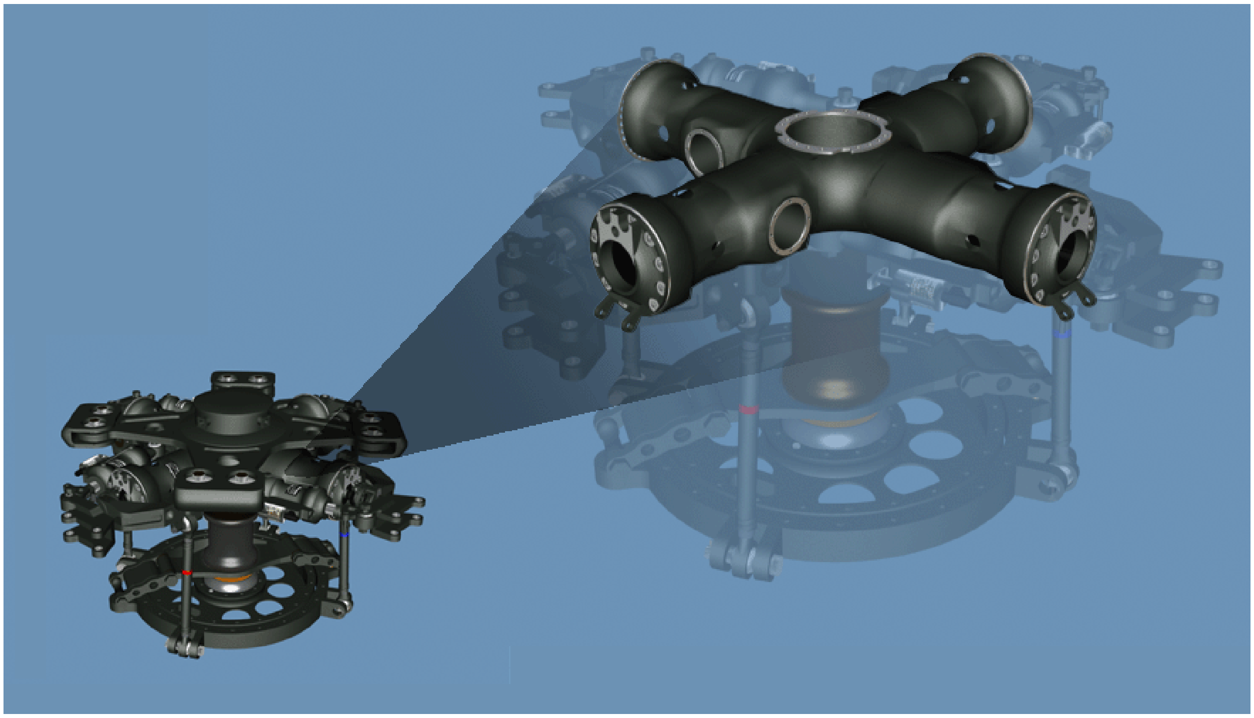
Frame #0120 (Index Mark)



4 The split cones are lined up 90 degrees out from the “O” index mark.

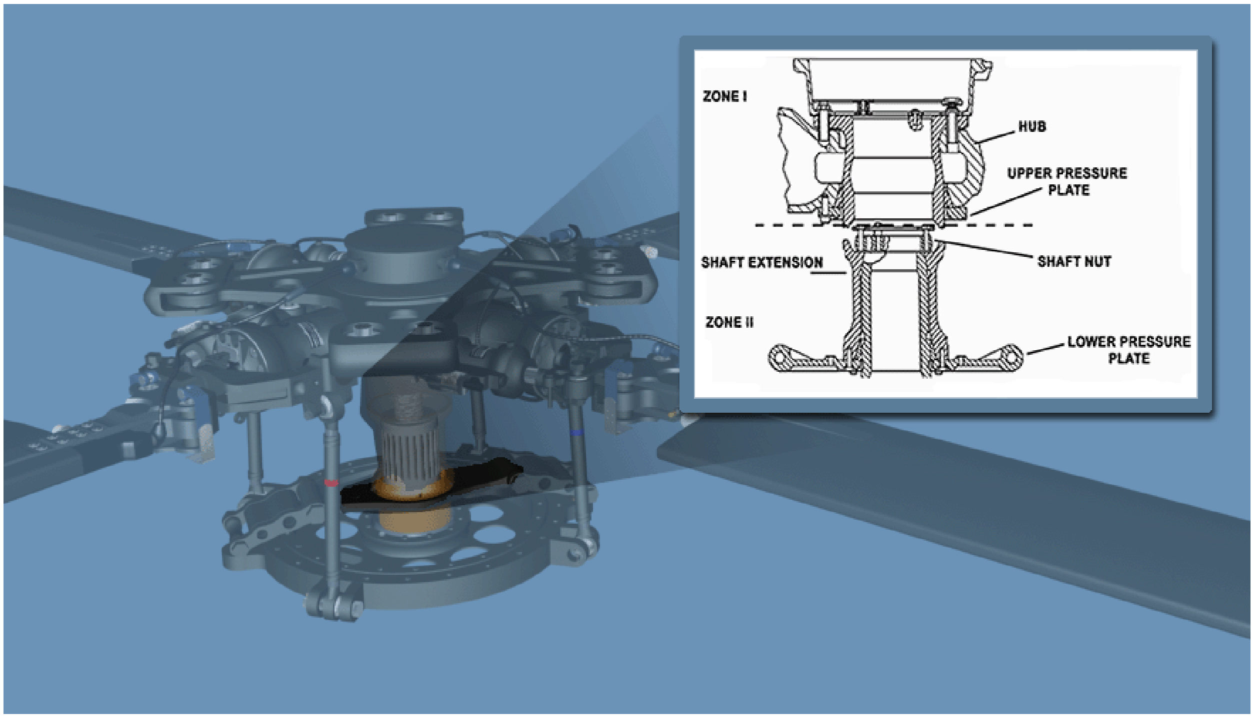
c) Components Main Rotor Hub

Frame #0125 (Main Rotor Hub)



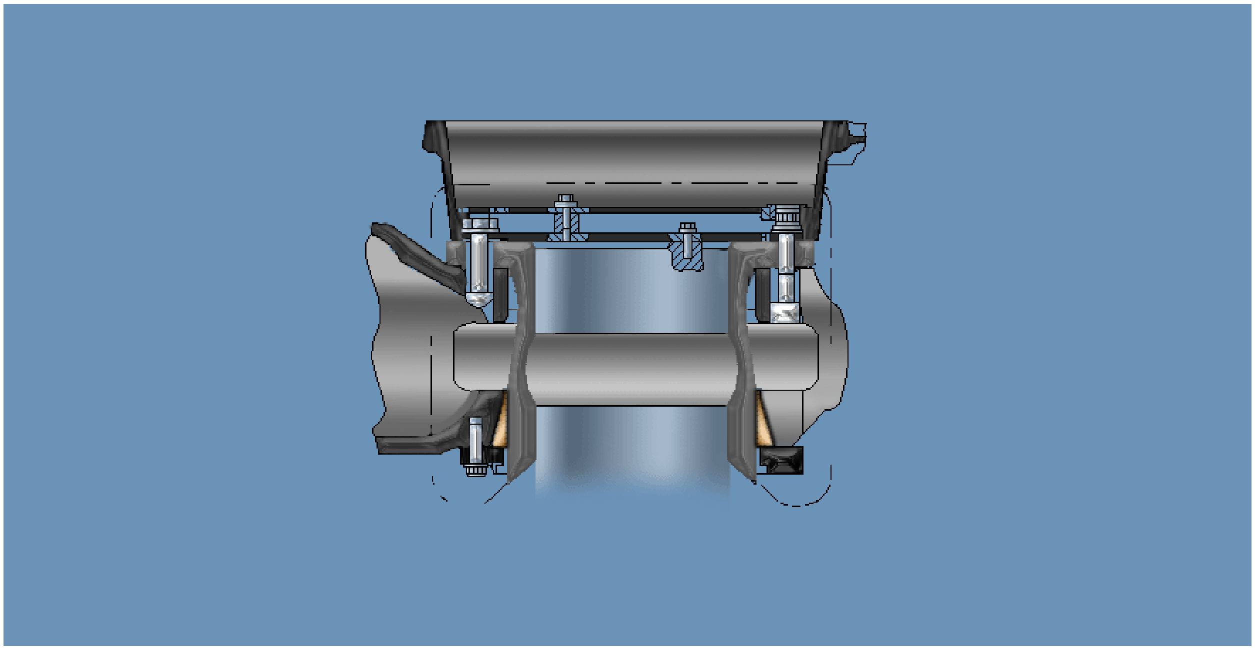
1 The main rotor hub is the mounting platform for the spindles, dampers, pitch control rods, antiflapping assemblies and bifilar assembly.

Frame #0130 (Main Rotor Hub Torque Zones)



2 The main rotor hub assembly is split into two torque zones; Zone I is the hub to shaft extension (upper pressure plate), and Zone II is the main rotor shaft nut (lower pressure plate).

Frame #0131 (Torque Zone I)



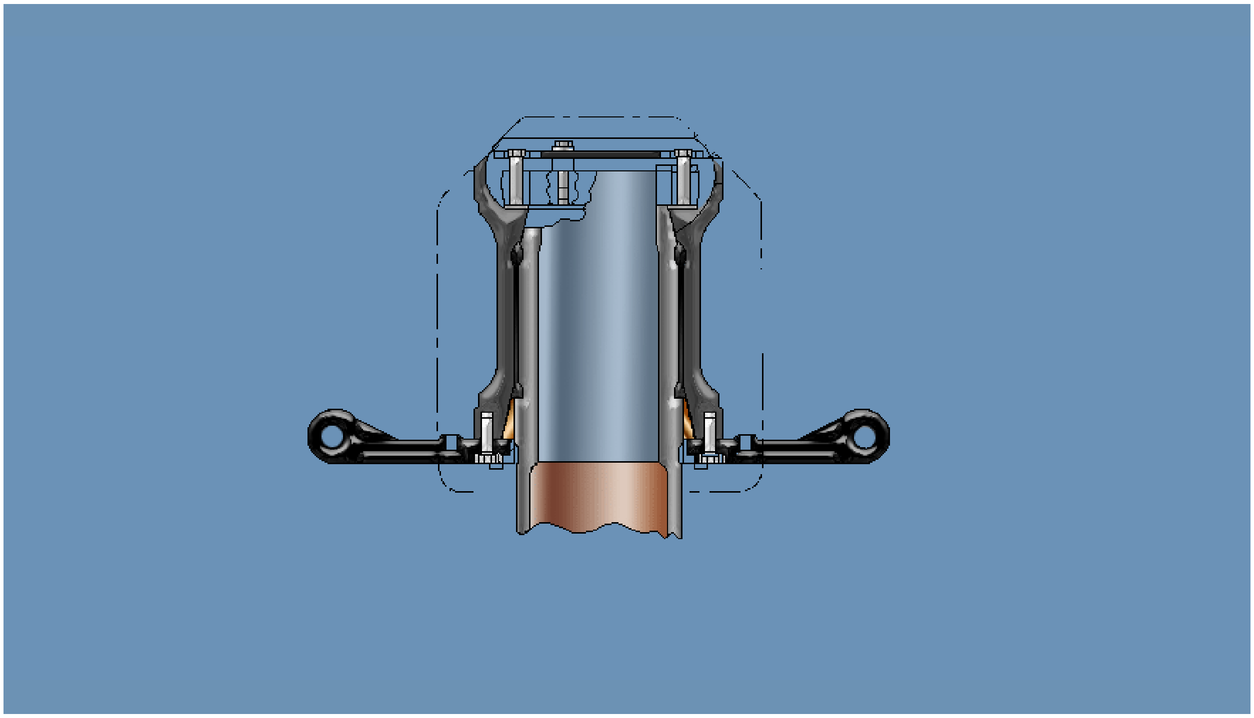
3 Zone I attaches the bifilar assembly to the hub, and the hub to the shaft extension.

4 The upper pressure plate seats the upper set of split cones centering the main rotor hub on the shaft extension.

5 During the Zone I torque check (9-11 hours), the torque stabilization requirements differ for each area.

6 Refer to the appropriate TM for stabilization requirements and if the torque has not stabilized by the fourth consecutive torque check, refer to the appropriate TM.

Frame #0132 (Torque Zone II)



7 Zone II attaches the shaft extension to the lower pressure plate, and the main rotor shaft.

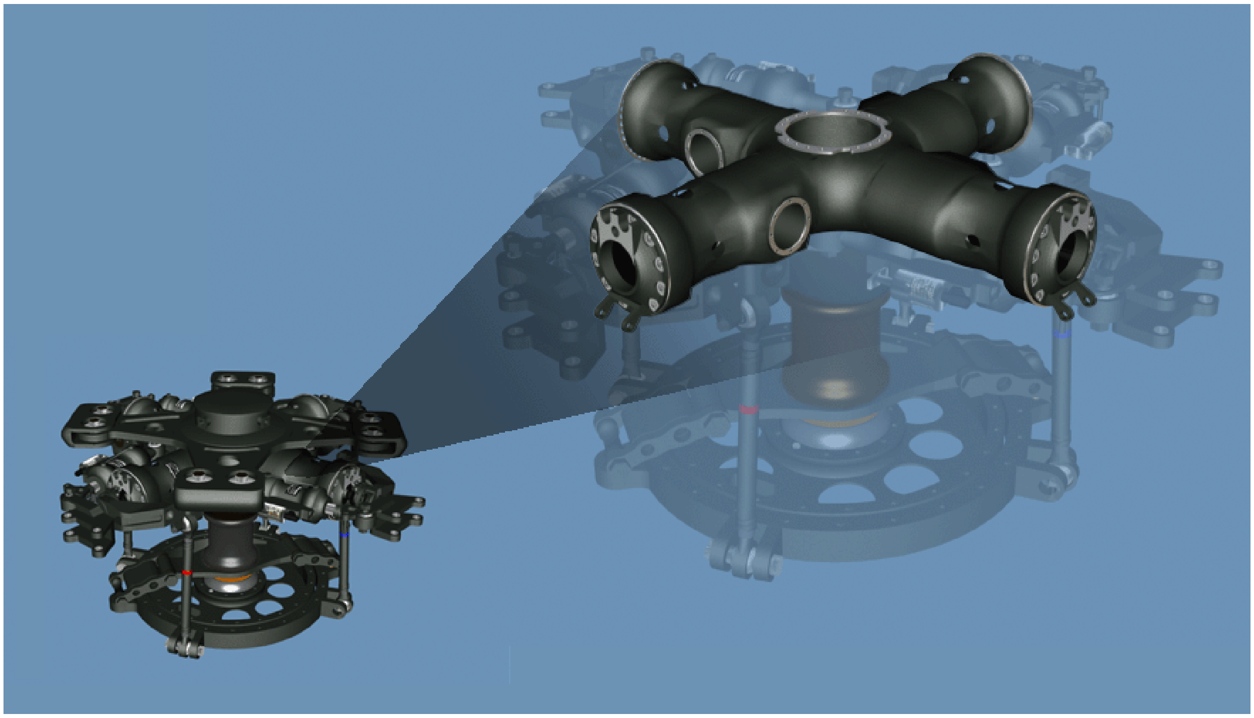
8 The lower set of split cones centers the shaft extension on the main rotor shaft.

9 During the Zone II torque check (9-11 hours), the torque stabilization requirements differ for each area.

10 Please refer to the appropriate TM for stabilization requirements.

11 If the torque has not stabilized by the fourth consecutive torque check, refer to the appropriate TM for the corrective action.

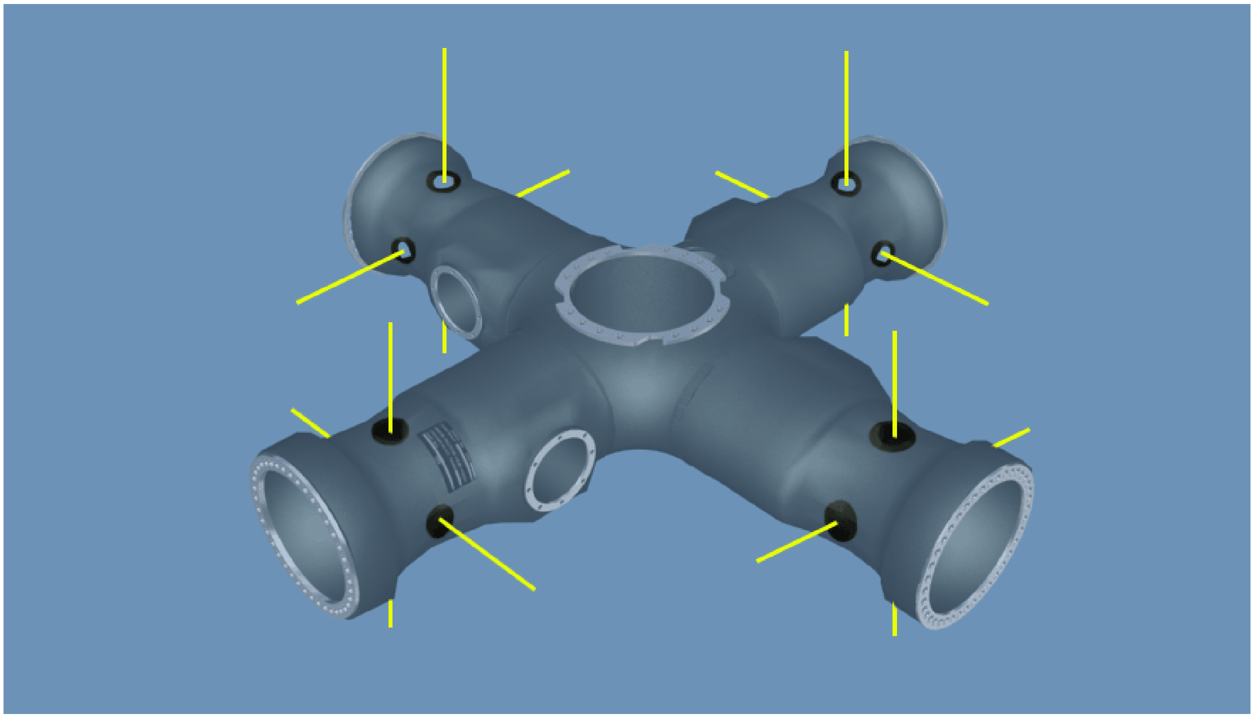
Frame #0135 (Main Rotor Hub Inspection)



12 Inspection of the main rotor hub is broken down into four zones.

13 Each zone has different criteria for inspection of cracks and damage.

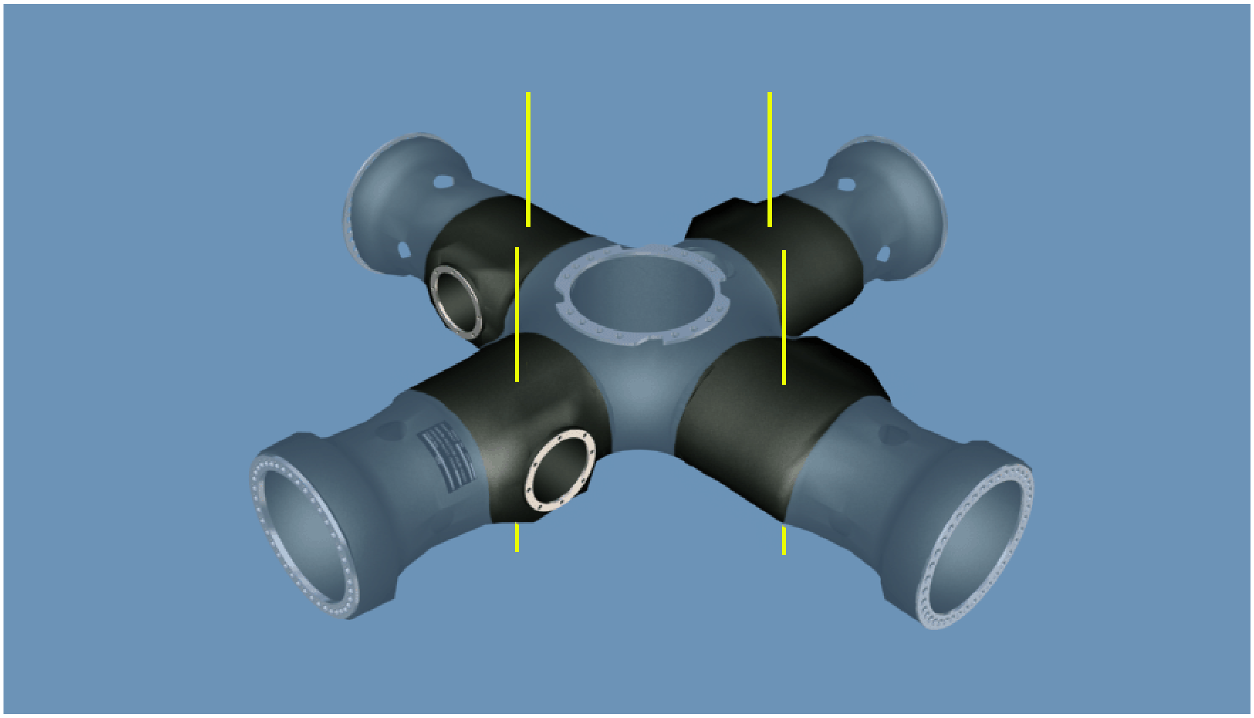
Frame #0140 (Main Rotor Hub Zone I Inspection)



14 Zone I Inspection: Check inspection holes for damage penetrating through the paint into the base metal and visually check for cracks.

15 If any cracks are suspected, perform a fluorescent penetrant inspection (Type I, Method C).

Frame #0145 (Main Rotor Hub Zone II Inspection)

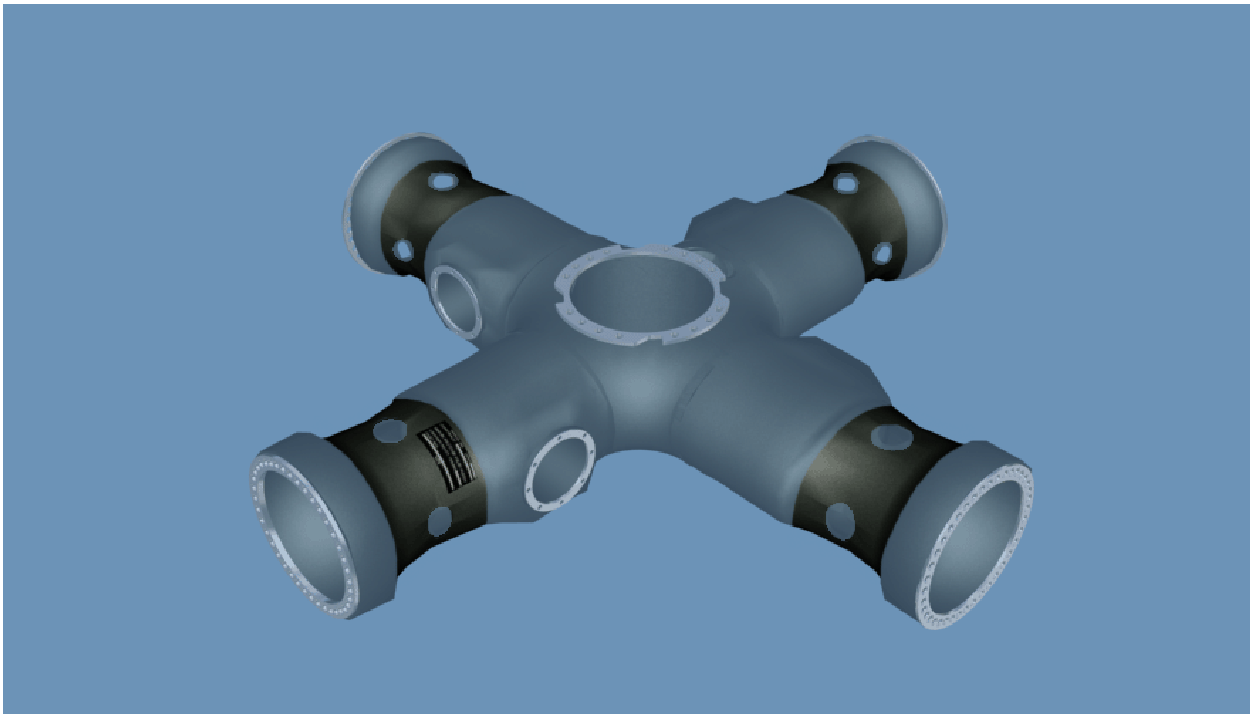


16 Zone II Inspection: Check top and bottom of hub Zone II for nicks and gouges.

17 Visually check for cracks.

18 If cracks are suspected, perform fluorescent penetrant inspection (Type I, Method C).

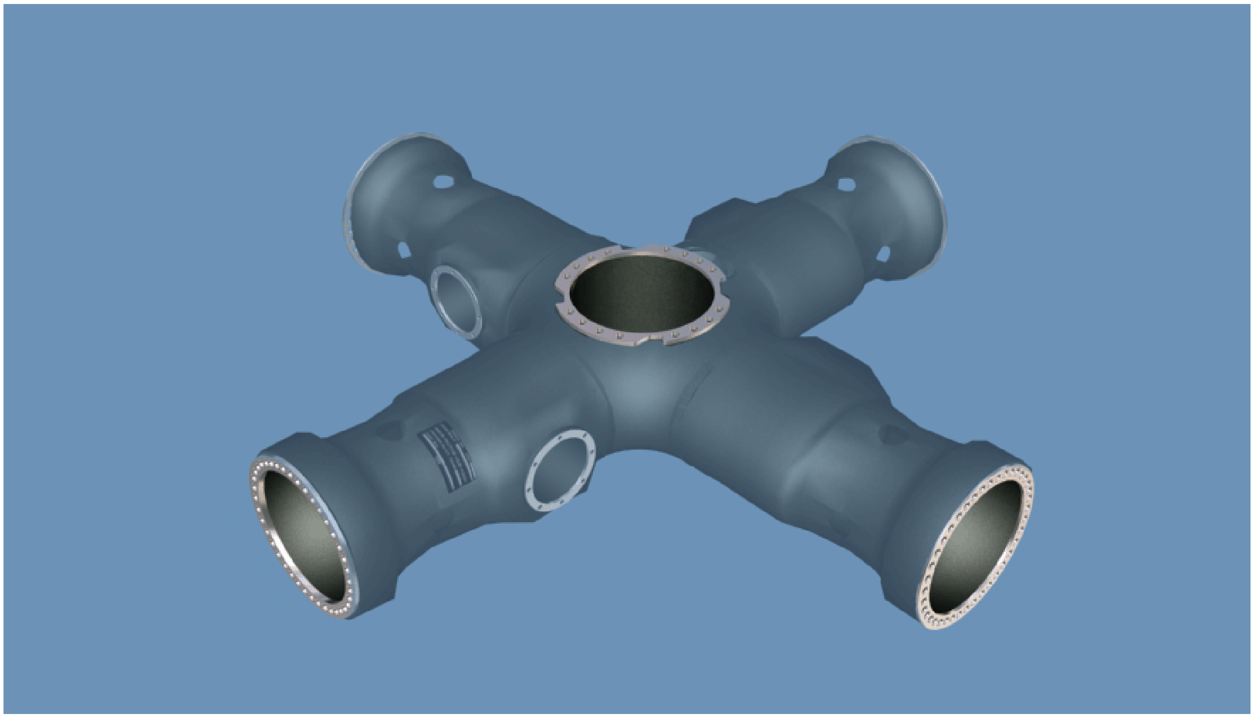
Frame #0150 (Main Rotor Hub Zone III Inspection)



19 Zone III Inspection: Check Zone III for nicks, gouges and visually check for cracks.

20 If cracks are suspected, perform fluorescent penetrant inspection (Type I, Method C).

Frame #0155 (Main Rotor Hub Zone IV Inspection)



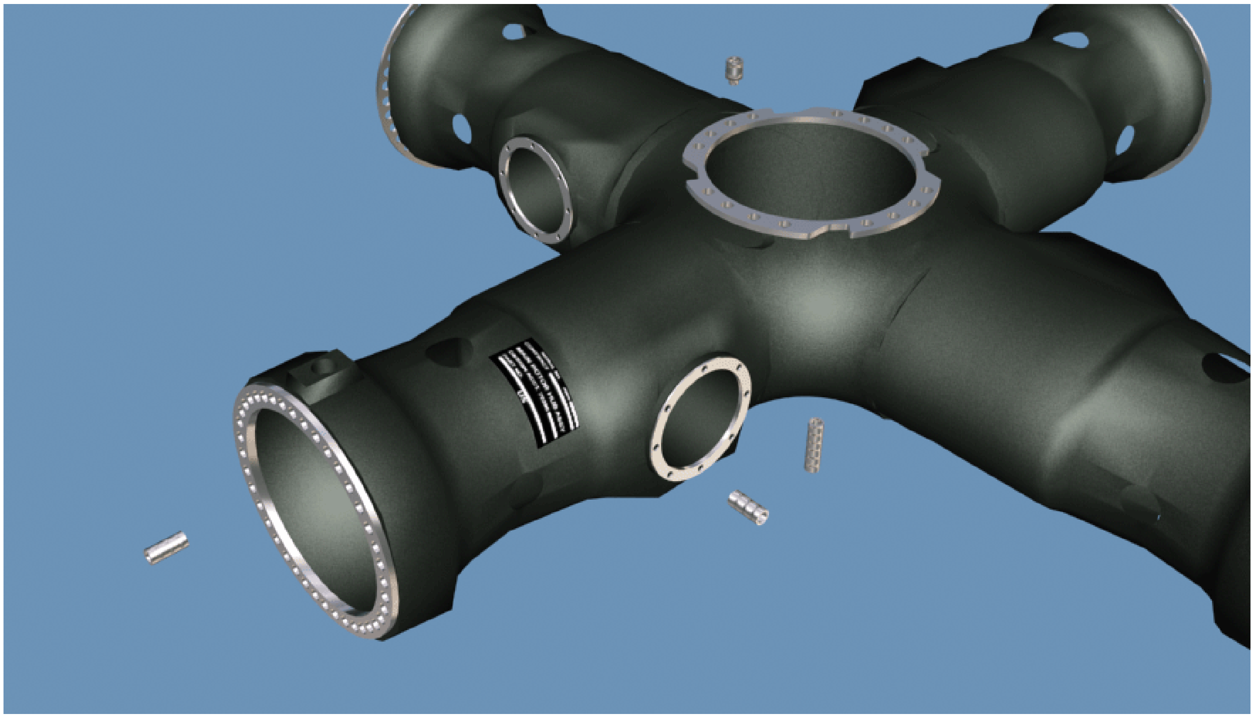
21 Zone IV Inspection: Check for nicks and gouges in the following areas; the upper pressure plate, lug, and mating surfaces. Inspect the cone seat surfaces on the shaft extension and hub Zone IV for fretting.

22 Inspect the bonded liners for edge voids.

23 Visually check for cracks.

24 If cracks are suspected, perform fluorescent penetrant inspection (Type I, Method C).

Frame #0160 (Main Rotor Hub Inserts)



25 The threaded inserts on the main rotor hub assembly are installed to protect the end item

26 When installing the threaded inserts, proper depth must be achieved.

27 If the insert depth is not enough, the insert could crack, causing damage to the end item and, or the attached components.

28 If the insert depth is too great, stress will be placed on the mounting hardware of the attached components.

29 The drag torque on the threaded insert is extremely important.

30 Drag torque is defined as the amount of measured resistance applied to the component (threaded insert) while installing or the amount of measured resistance applied before the component moves when verifying.

31 The inability to achieve proper drag torque may require one of two actions.

32 Replacement of the threaded insert, or the replacement of the end item (hub or shaft extension).

33 When proper drag torque has been achieved, the torque value should be annotated on the DA Form 2408-13-2.

Frame #0165 (Main Rotor Hub Installation)

WARNING: Exposed surfaces of main rotor shaft and shaft extension are critical surfaces which must not be damaged during and after removal of main rotor head. Use extreme caution when removing and provide protective covering over critical surfaces after removal of main rotor head. Exposed surfaces of main rotor shaft and shaft extension are critical surfaces which must not be damaged while breaking torque. Use protective covering as required.

CAUTION: Damage to main rotor head assembly will result if metallic scrapers are used to clean sealing compound from components. Do not use metallic items to remove sealant.

34 When removing or installing the main rotor hub and shaft extension, be sure the Crew Chief has an assistant and uses the proper slings.

35 The main rotor head weighs 875 lbs.

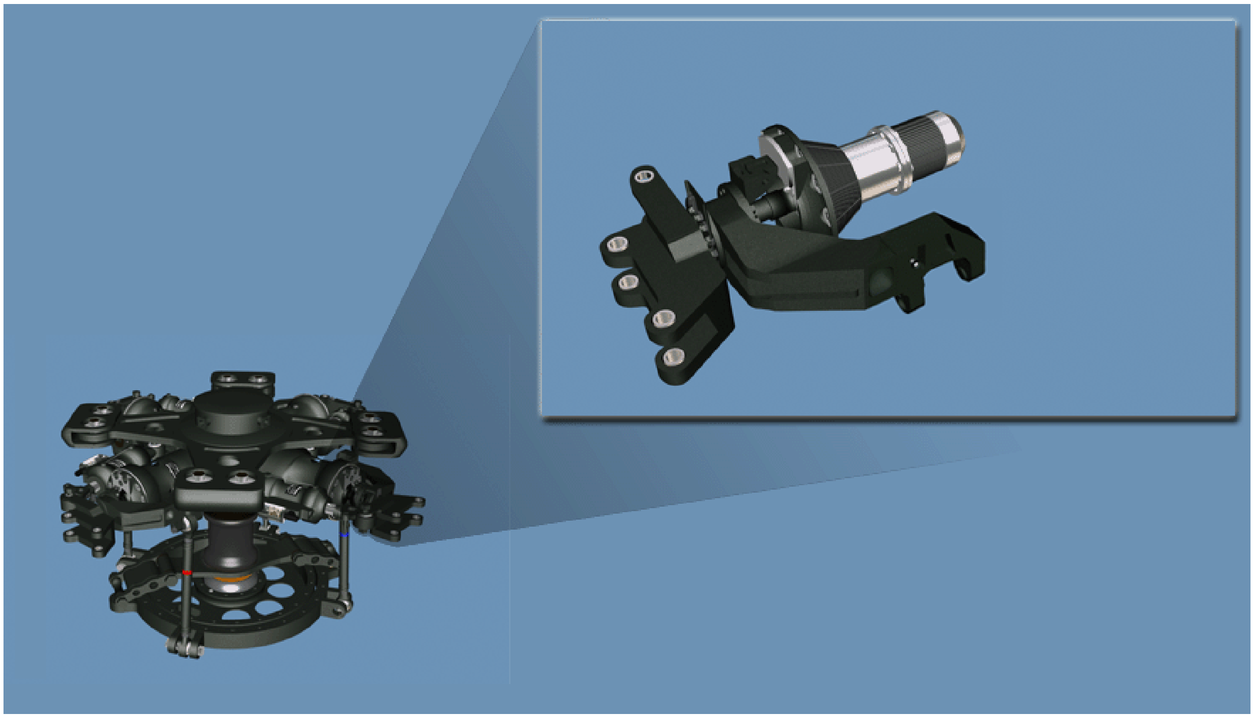
36 Ensure the sling legs are properly placed on the main rotor hub to prevent damage during removal or installation.

37 Some sticking may be experienced during the removal or installation of the main rotor hub and shaft extension.

38 This is normal, due to the angle of the main transmission and main rotor shaft.

(b) Spindle Assembly

Frame #0170 (Main Rotor Spindle)

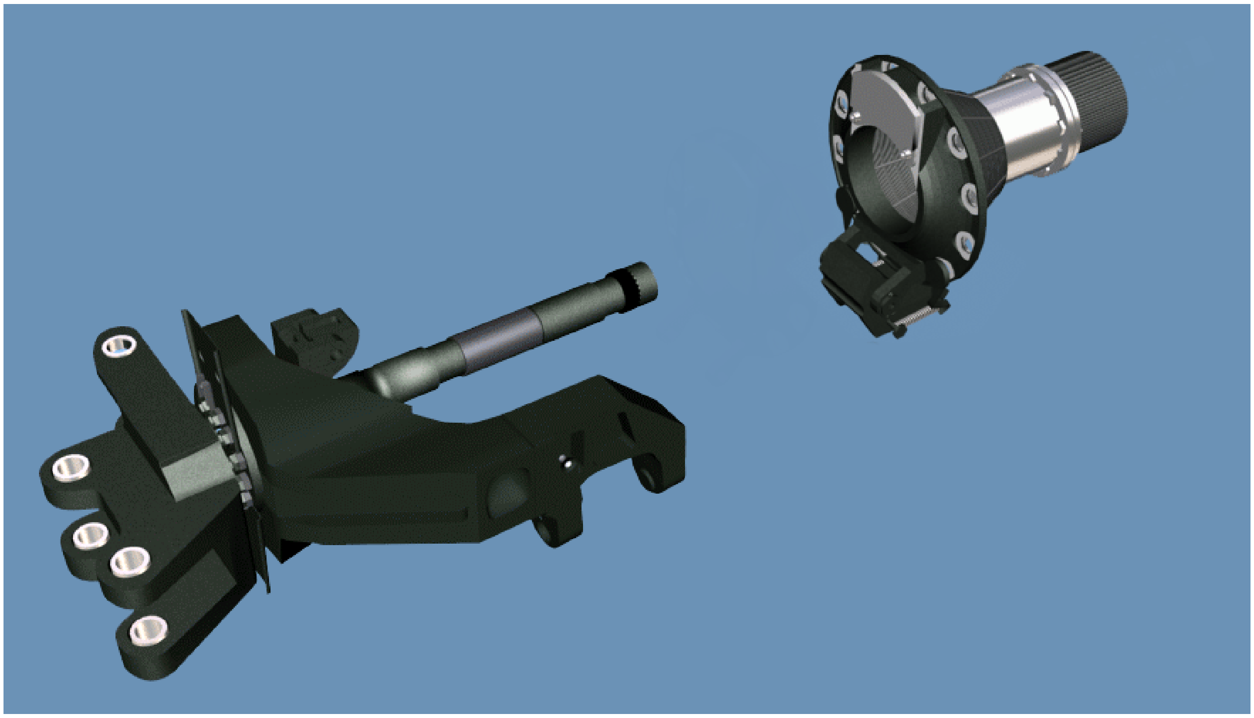


1) The main rotor spindle assembly is the mounting platform for the blade, and has an elastromeric bearing.

2) The bearing allows the blade to lead, lag, flap, and permits movement of the blade about its axis for pitch changes.

a) Main Rotor Spindle Components

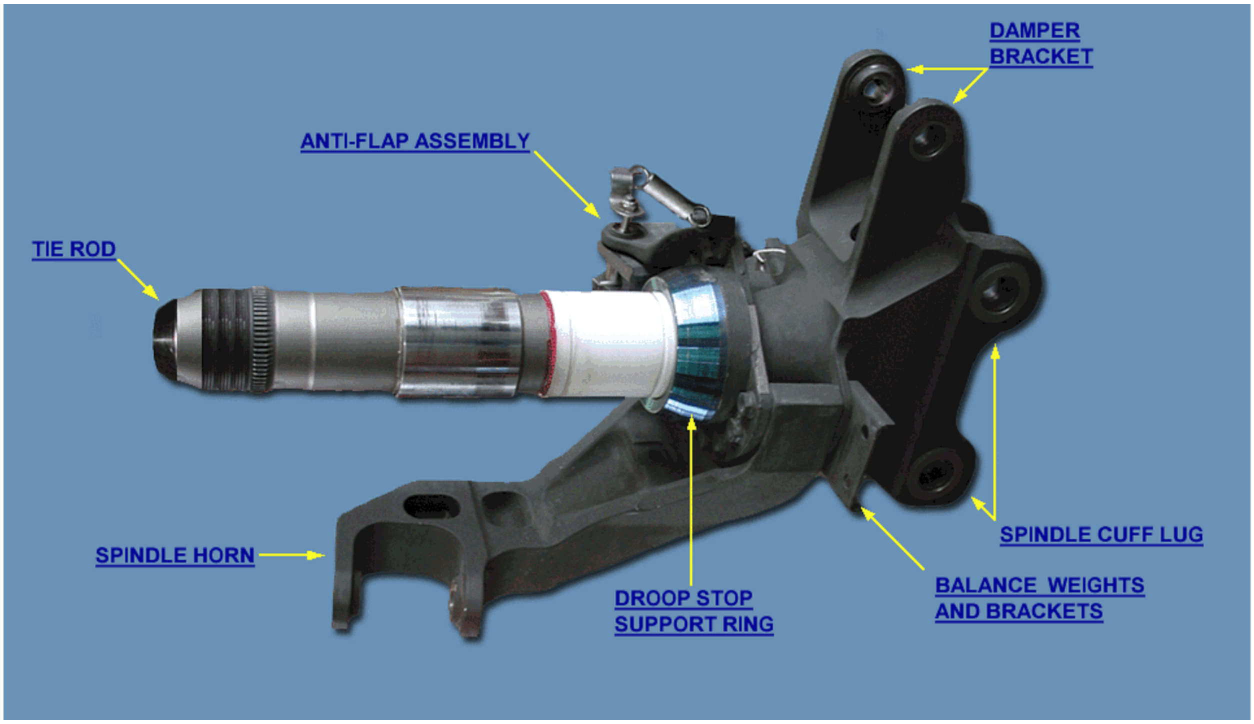
Frame #0175 (Spindle Tie Rod)



1 The main rotor spindle assembly can be broken down into two major subcomponents.

2 The spindle and liner assembly, and the elastomeric bearing.

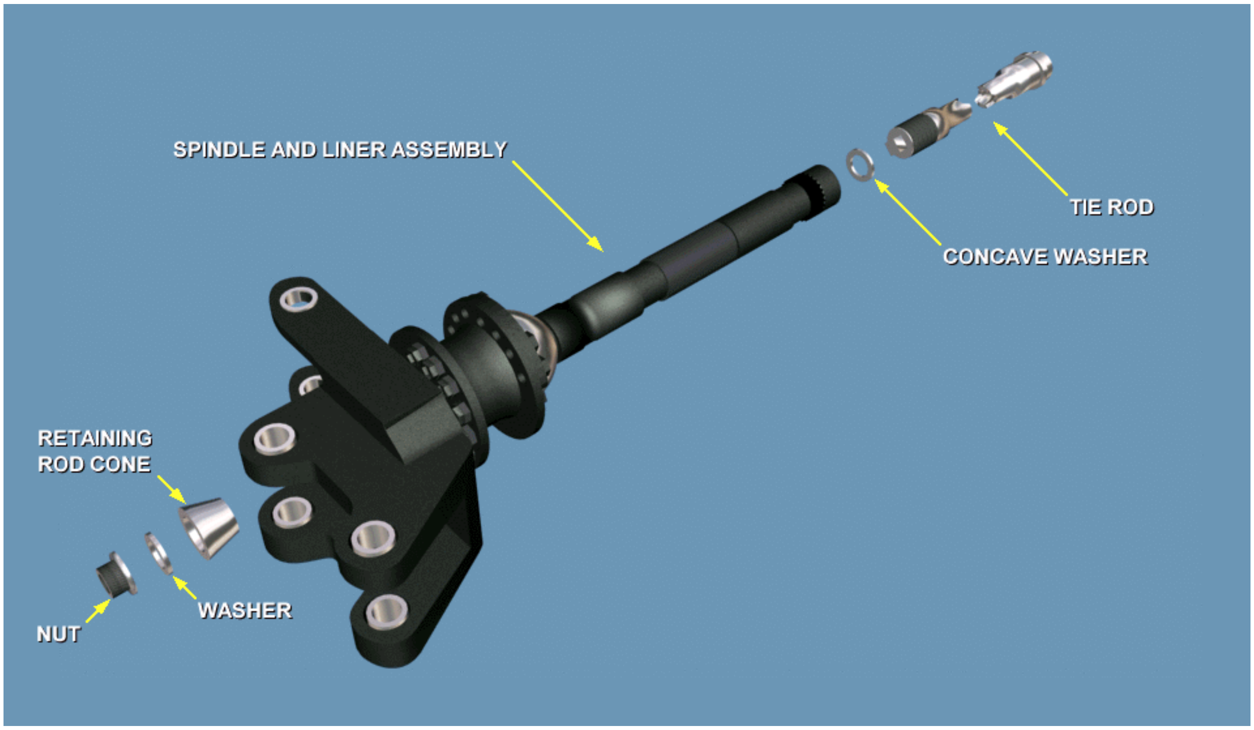
Frame #0180 (Spindle Components)



3 The spindle contains the anti-flap assembly, droop stop support ring, balance weights and bracket, damper bracket, spindle horn, tie rod, and the spindle cuff lug.

b) Tie Rod

Frame #0231 (Tie Rod)



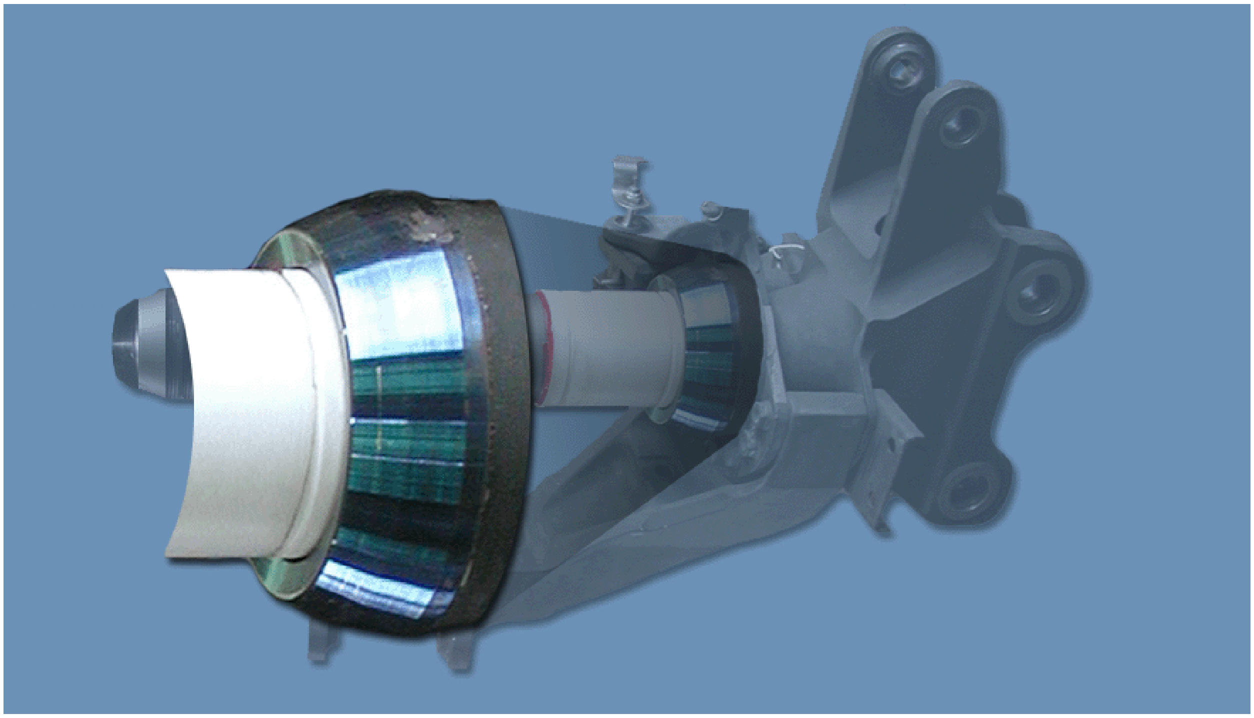
1 The tie rod is located inside the spindle and liner assembly.

2 Securing the tie rod at the outboard end of the spindle and liner assembly is a nut, washer and retaining rod cone.

3 A concave washer helps center the tie rod to the spindle and liner assembly.

c) Droop Stop Support Ring

Frame #0220 (Droop Stop Support Ring)



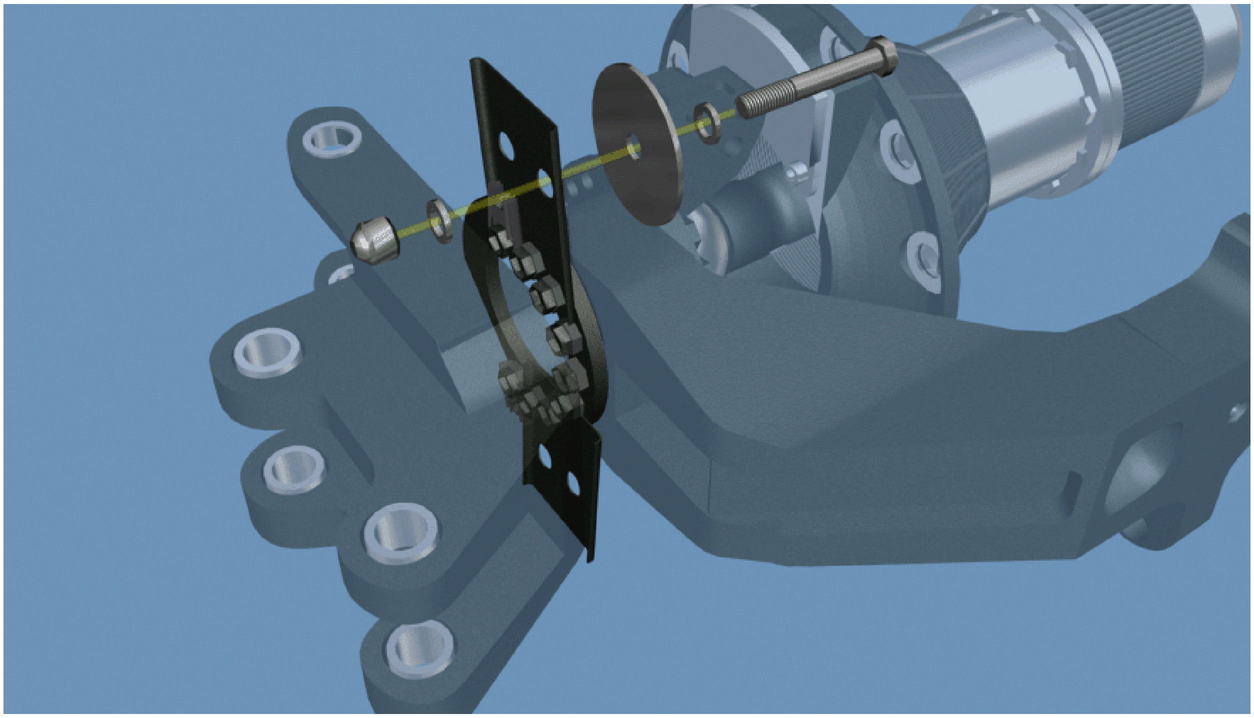
1 The droop stop support ring is mounted to the spindle and liner assembly.

2 The support ring is the only point of contact for the droop stop on the spindle and liner assembly.

3 The support ring rotates on the spindle and liner assembly, allowing forward and lateral movement of the blade while the droop stop is still engaged.

d) Balance Weights and Brackets

Frame #0215 (Balance Weights and Brackets)



1 The balance weights provide main rotor head balancing and smoothing.

2 The weights are mounted on brackets which are located at the top and bottom of the spindle and liner assembly providing a total of four mounting points.

3 Balance weights are installed with the bolt on the inboard side of the bracket.

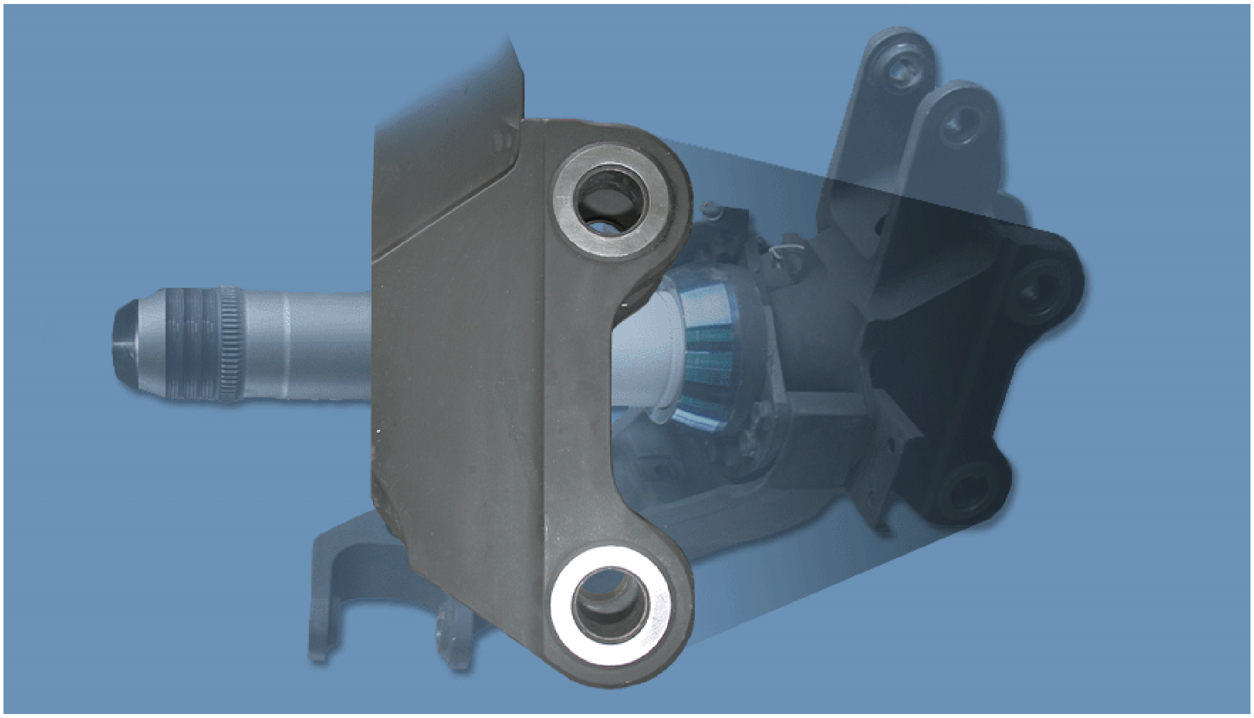
4 Maximum weight allowed on one spindle is 5 pounds.

5 When balance weights are to be used, disperse the weights equally between the upper and lower brackets.

6 If cracks are found during the inspection of the balance weight brackets, the brackets must be replaced.

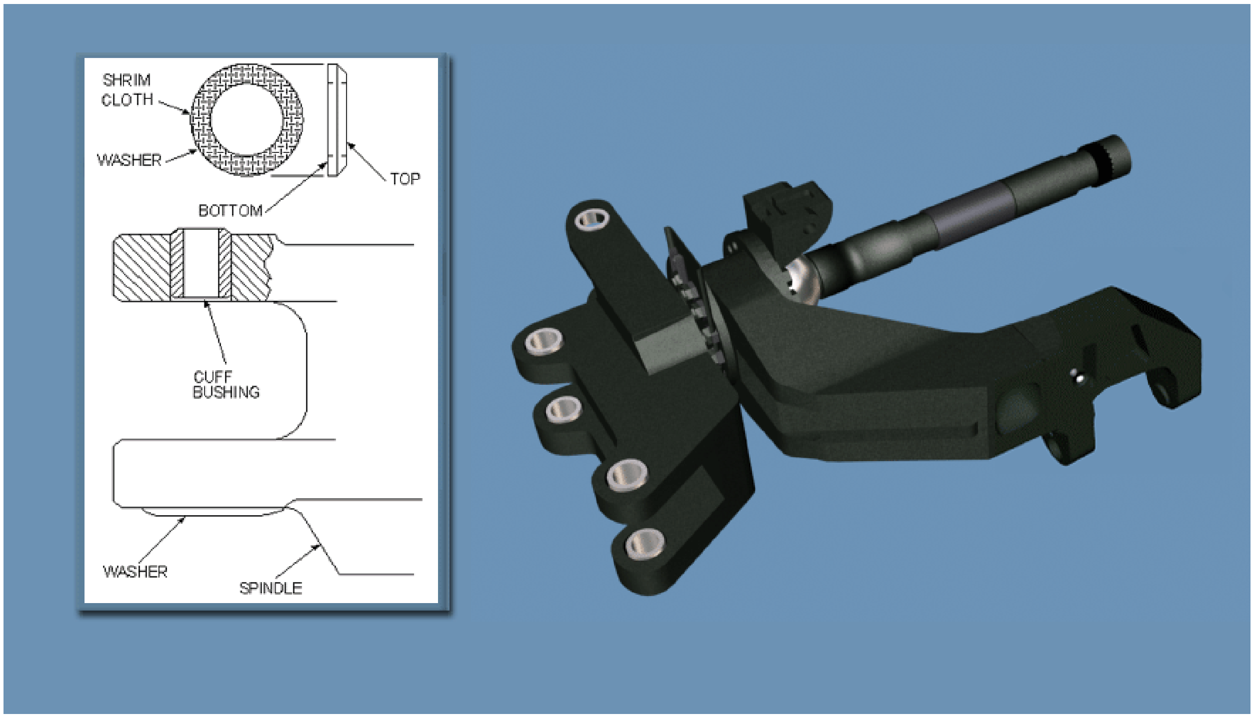
e) Spindle Cuff Lug

Frame #0205 (Spindle Cuff Lug)



1 The spindle cuff lug is the attaching point for the main rotor blade to the spindle assembly.

Frame #0210 (Spindle Cuff Lug Bonded Washers)



2 On the top and bottom of the spindle lug are four bonded washers with a shrim cloth between the washer and the spindle lug.

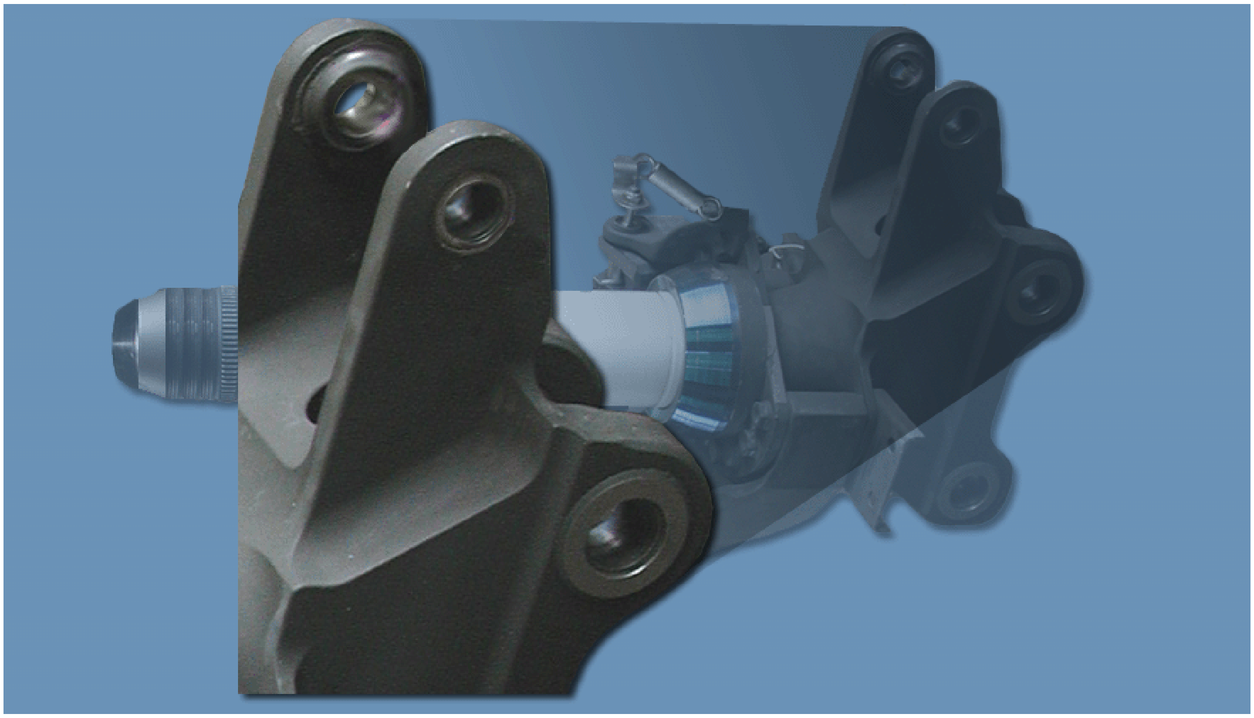
3 When repairing or replacing a bonded washer, the over all length at the lug must be between 4.187 - 4.189 inches.

4 Only one washer from each expandable pin hole can be missing or unserviceable.

5 If both washers are missing or unserviceable from one expandable pin hole, replace spindle.

f) Damper Bracket

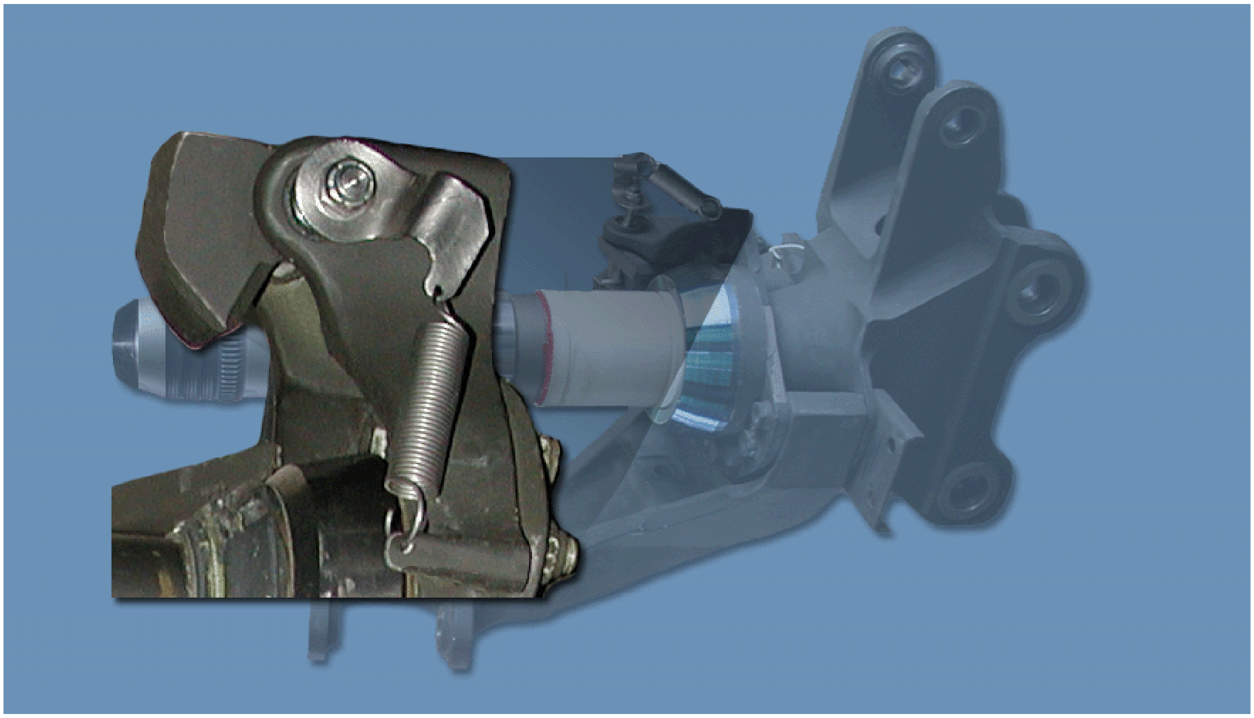
Frame #0200 (Damper Bracket)



1 The main rotor damper attaches to the spindle assembly at the spindle and liner assembly on the damper bracket.

g) Anti-Flap Assembly

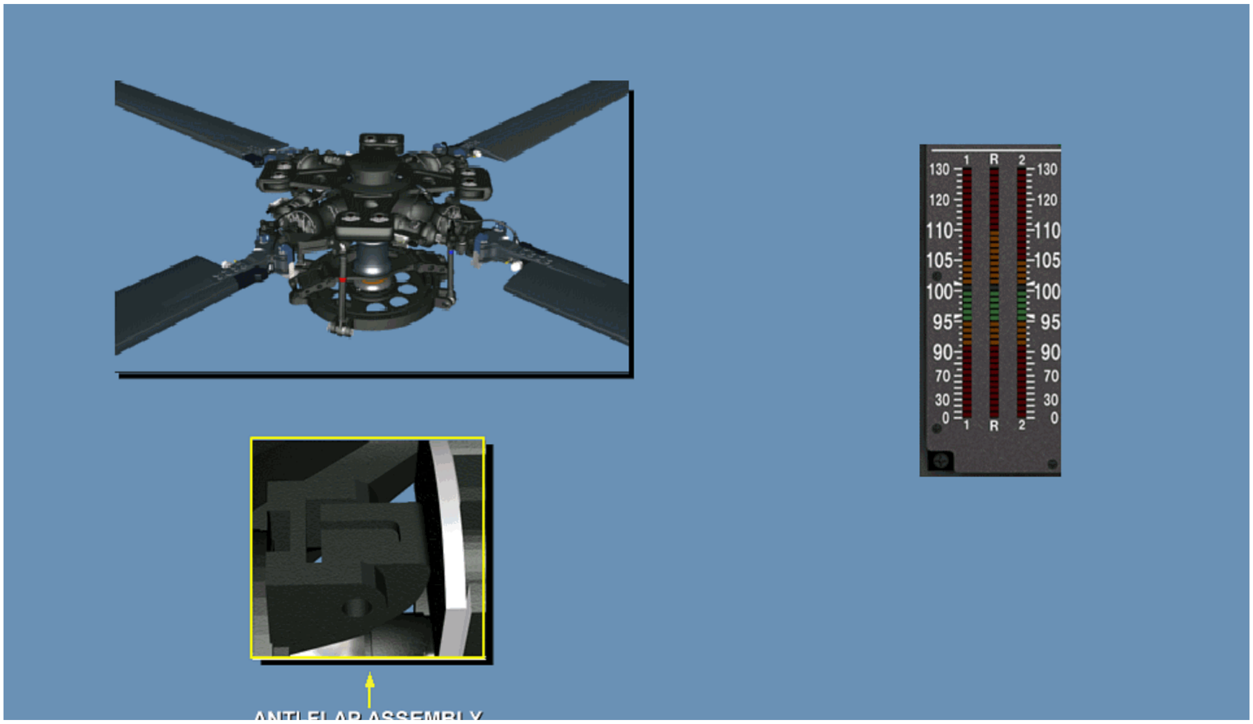
Frame #0185 (Anti-Flap Assembly)



1 The anti-flap assembly is mounted to the upper portion of the spindle and liner assembly.

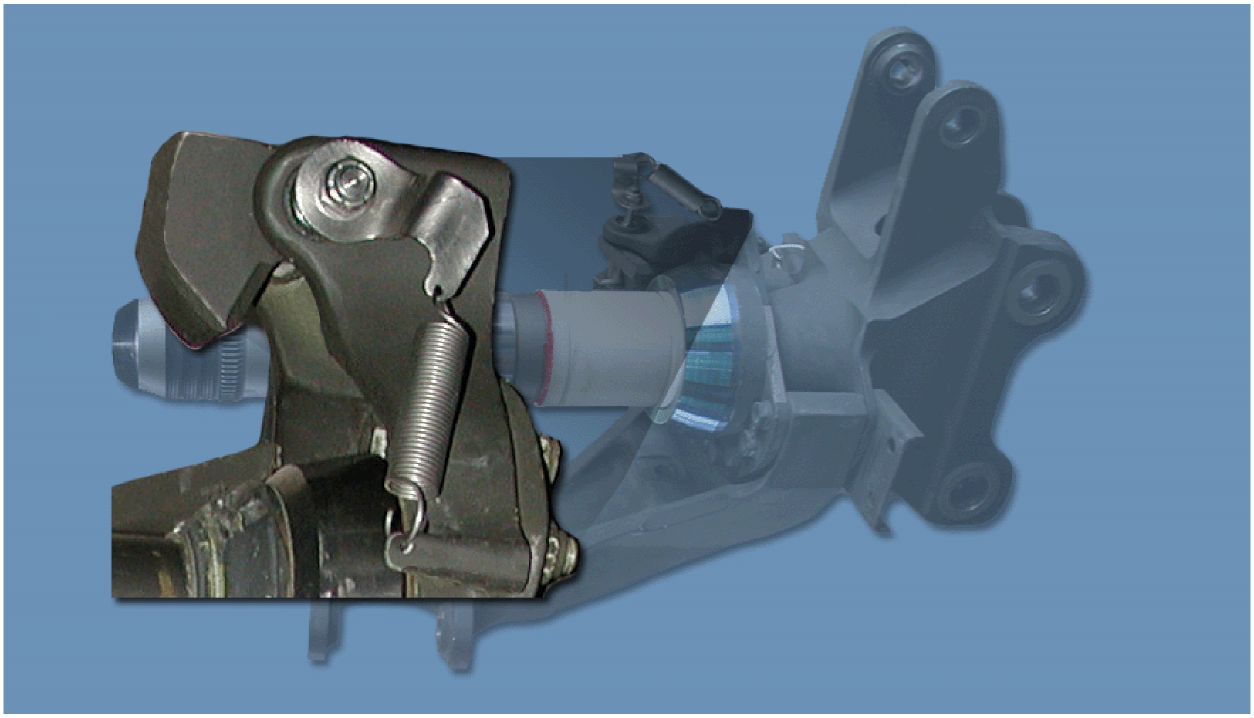
2 These are spring loaded locks that prevent the blade from flapping when the rotor speed is below 35% Nr or stopped.

Frame #0190 (Anti-Flap Assembly FLASH)



3 When the rotor is above 35% Nr, centrifugal force pulls the anti-flap assembly outward (down position) to permit flapping and coning of the blades.

Frame #0195 (Anti-Flap Inspection)



4 During inspection of the anti-flap, the cam is the only component allowed to have cracks or dents.

5 An 1/8 inch corner dent can be filed down.

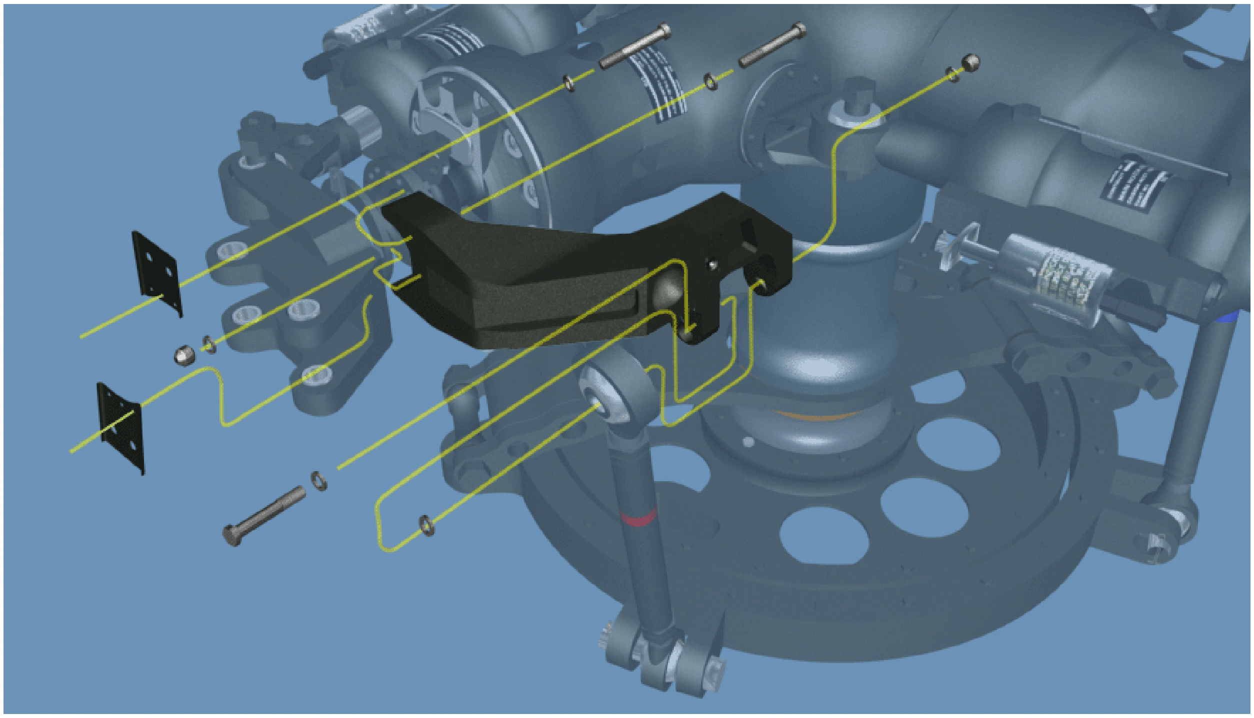
6 A crack on the assembly is likely to start at the thinnest part of the assembly.

7 When performing maintenance on the anti-flap assembly, pay close attention to the spring.

8 The anti-flap and droop stop springs are very similar. Be sure you use the proper spring.

h) Spindle Horn

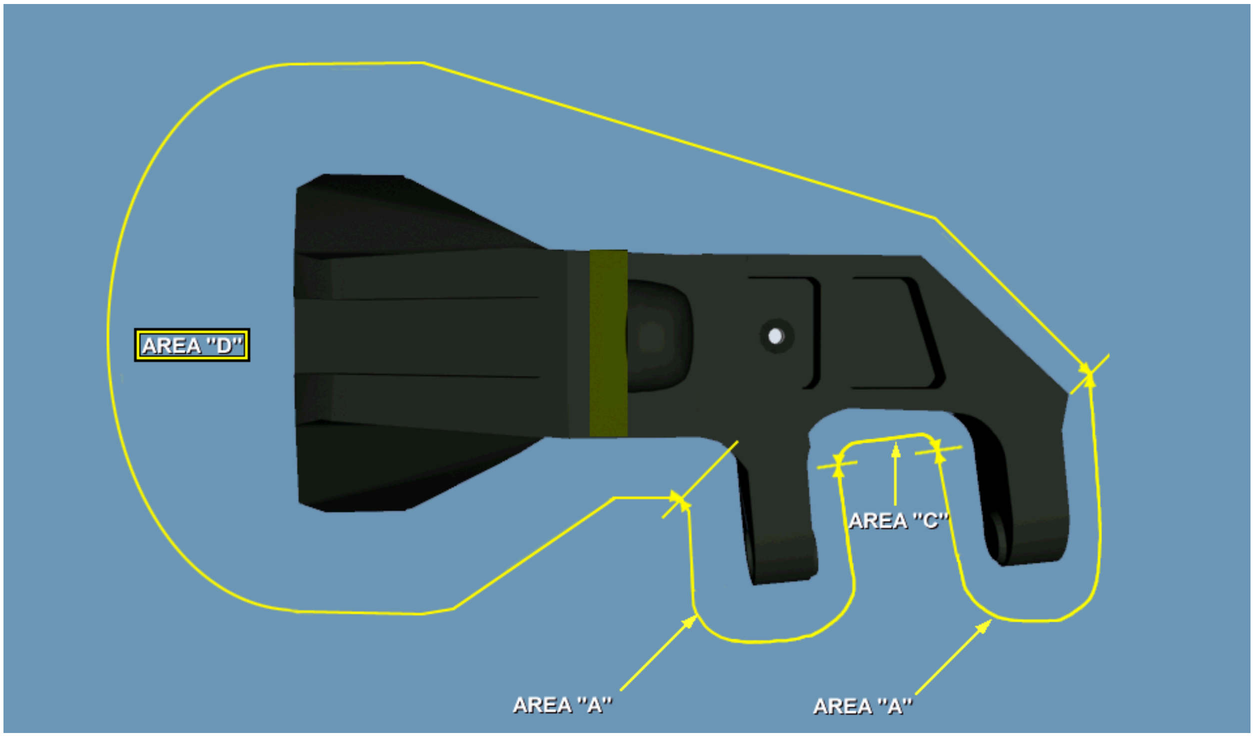
Frame #0225 (Spindle Horn)



1 The spindle horn is the attaching point for the pitch control rod to the spindle and liner assembly.

2 Inspections for the spindle horn are separated into four areas, A, B, C, and D.

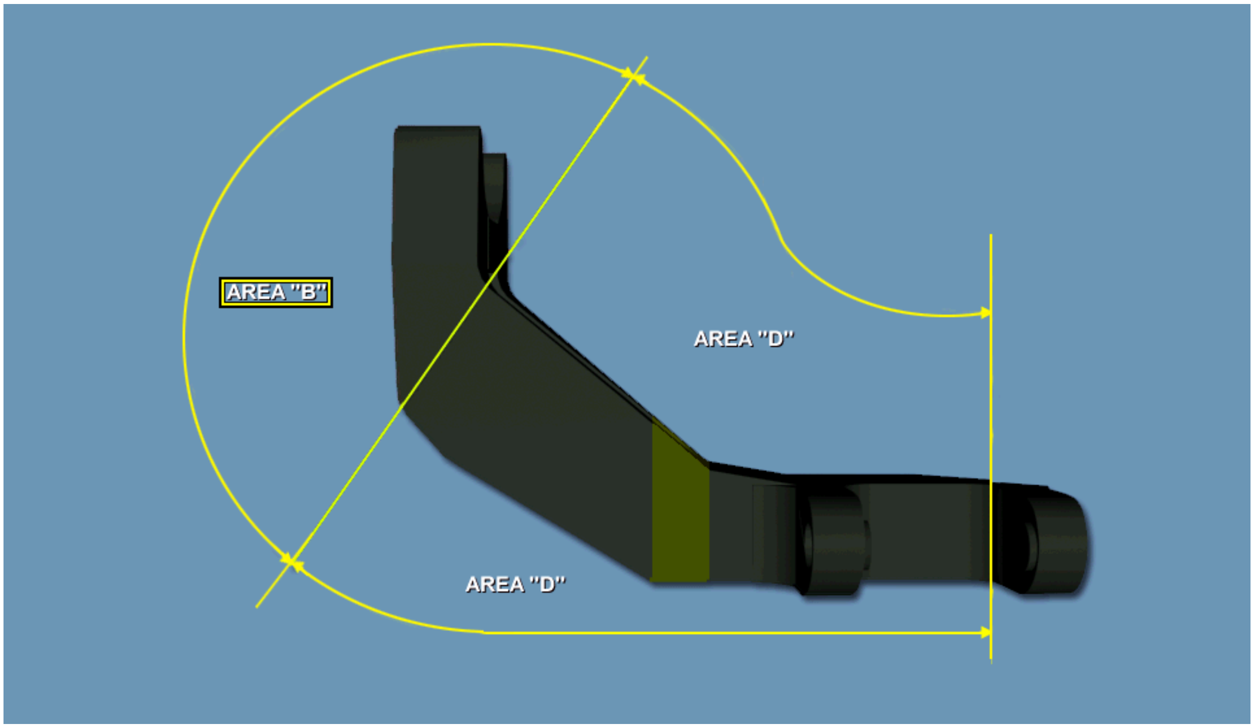
Frame #0230 (Spindle Horn Inspection)



<u>3</u> When inspecting the spindle horn, there can be no cracks in areas "A" and "C".

<u>4</u> However, for nicks, scratches, and gouges refer to the appropriate TM for damage limits.

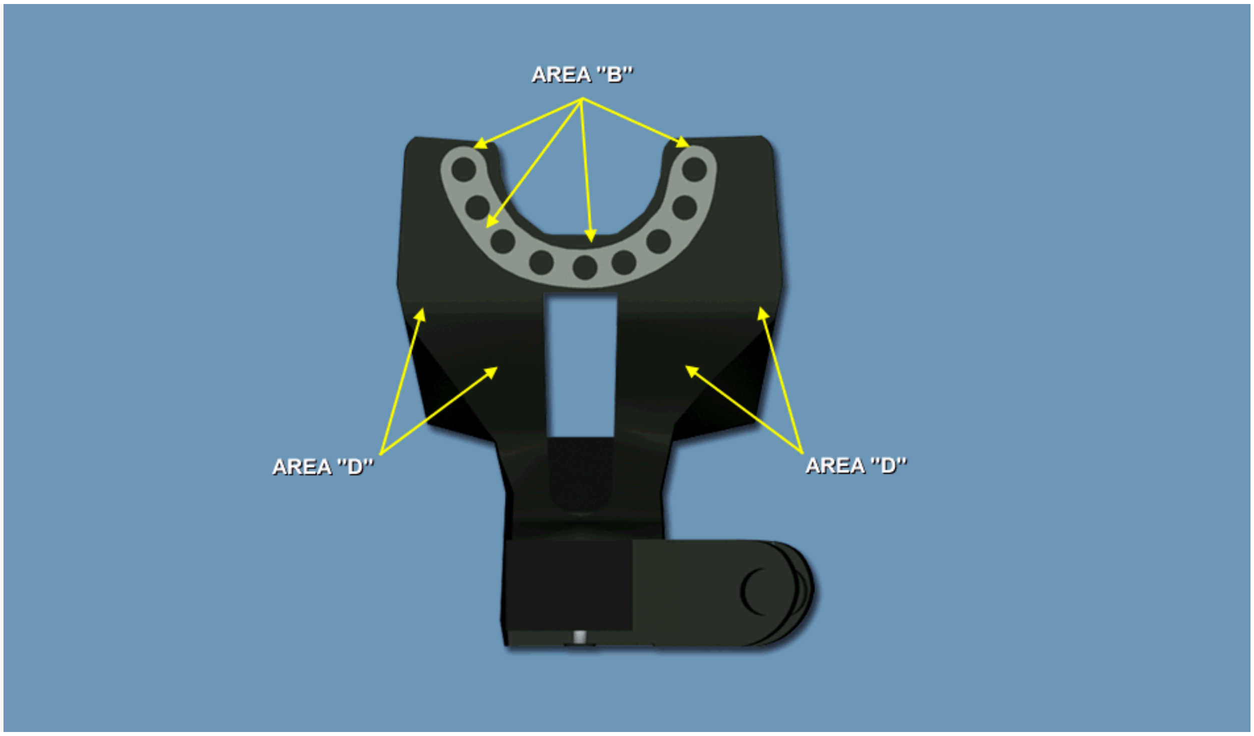
Frame #0230 (Spindle Horn Inspection 2)



5 When inspecting the spindle horn, there can be no cracks in area "D".

6 However, for nicks, scratches, and gouges refer to the appropriate TM for damage limits.

Frame #0230 (Spindle Horn Inspection 3)

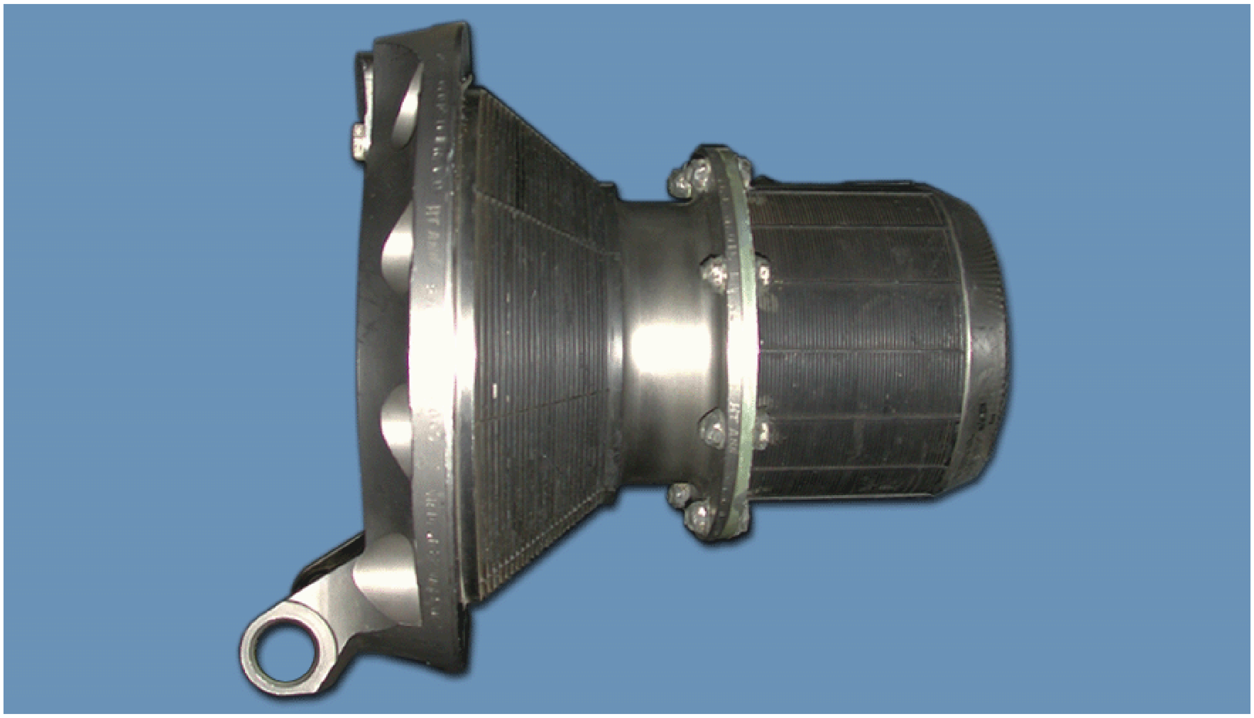


7 When inspecting the spindle horn, there can be no cracks in area "B".

8 However, for nicks, scratches, and gouges refer to the appropriate TM for damage limits.

i) Elastomeric Bearing

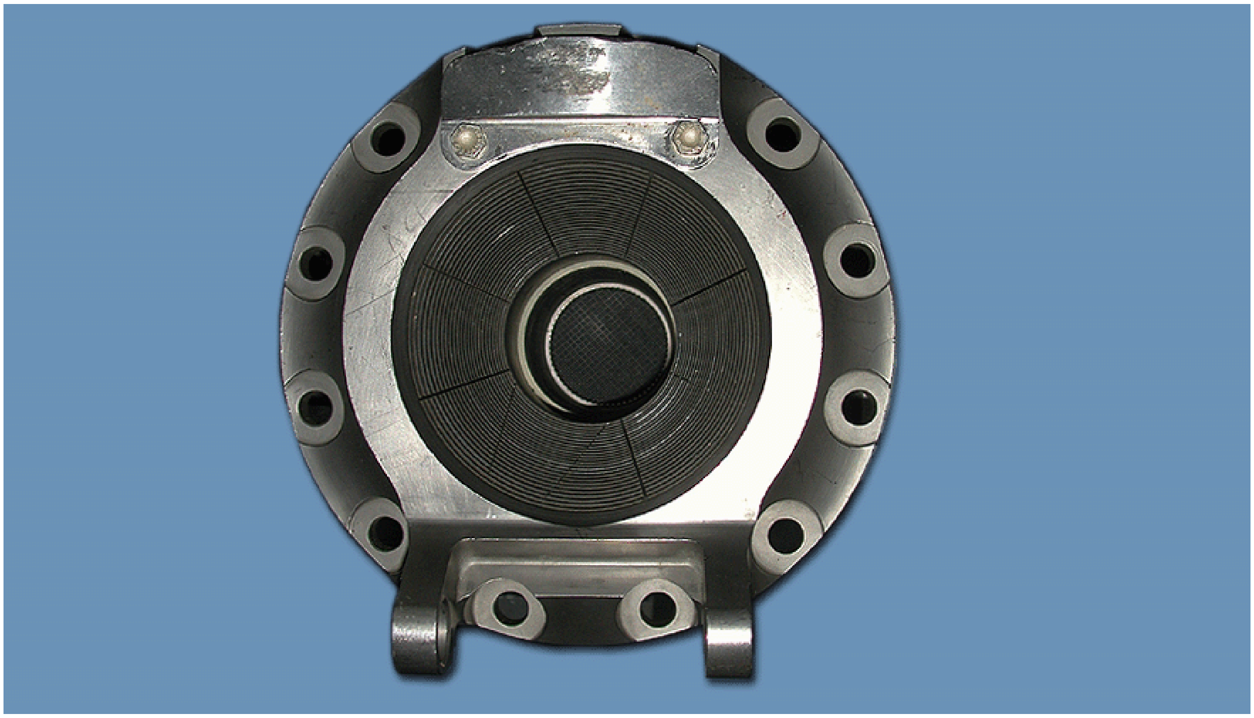
Frame #0235 (Elastomeric Bearing)



1 The elastomeric bearing contains rubber and steel laminates that allow blade movement.

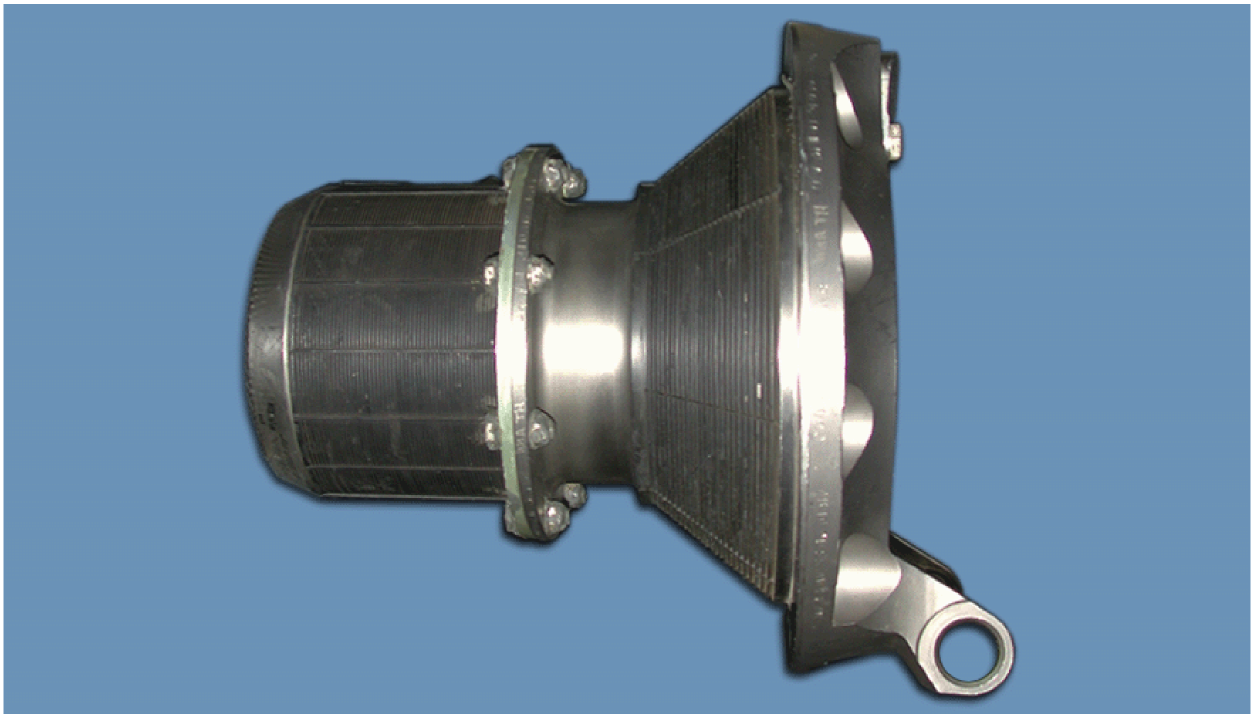
2 The blade is attached to the spindle at the spindle cuff lug.

Frame #0235 (Elastomeric Bearing Aft View)



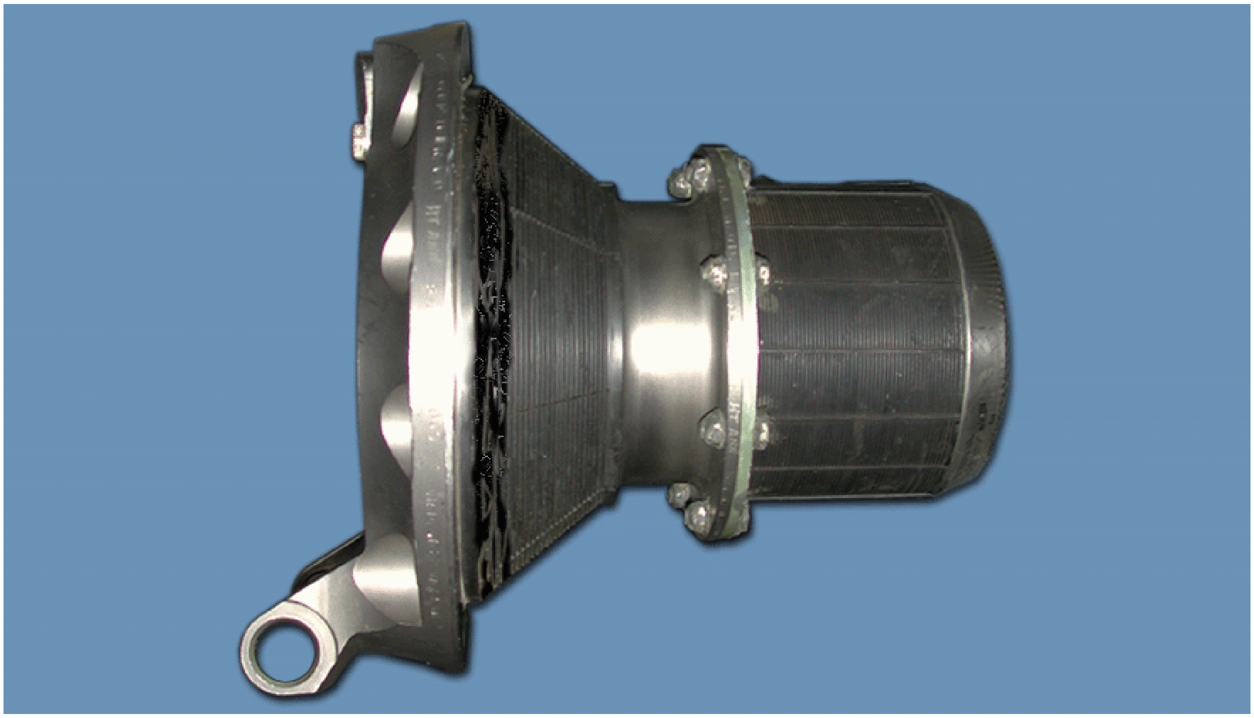
3 The tie rod is attached through the elastomeric bearing, allowing the blade to flap, lead, and lag, aiding in smoothness of flight.

Frame #0240 (Elastomeric Bearing Inspection)



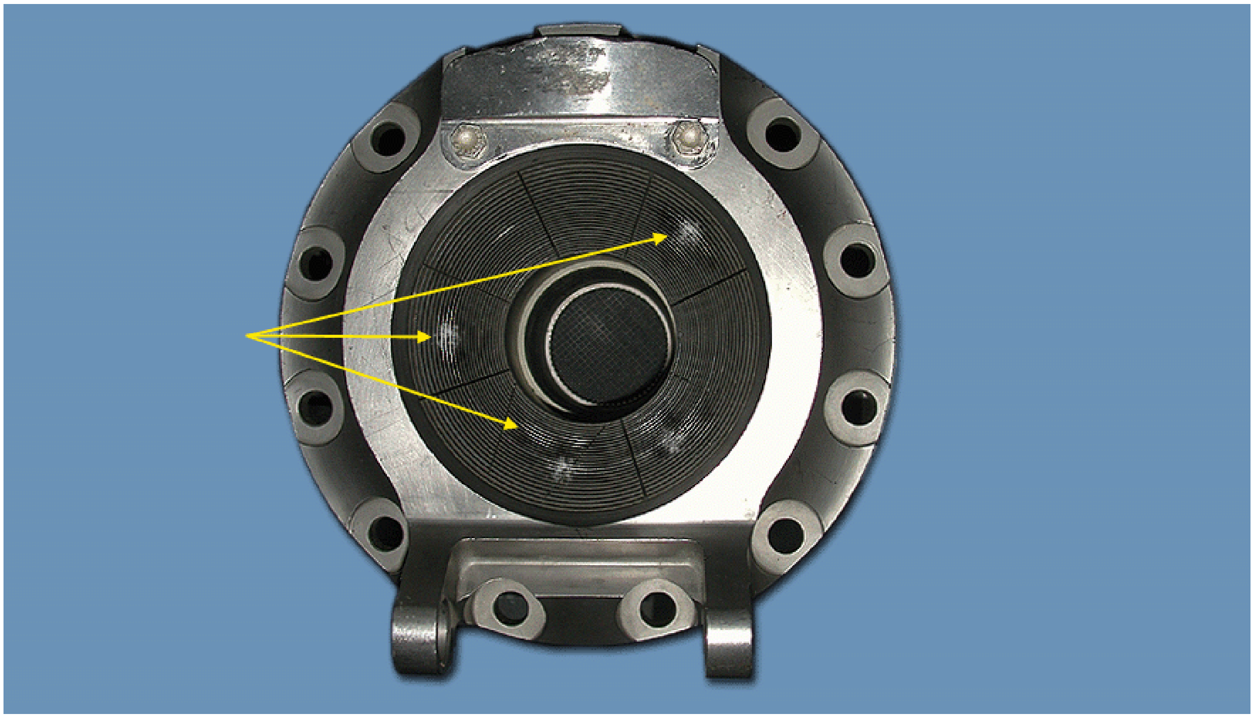
4 Elastomeric bearing inspections of the thrust and spherical bearings, are classified as three types, extrusion, disbonding and shim cracks.

Frame #0245 (Elastomeric Bearing Extrusion)



5 Elastomeric extrusion is rubber being pushed out from too much compression, no elastomeric extrusion is allowed.

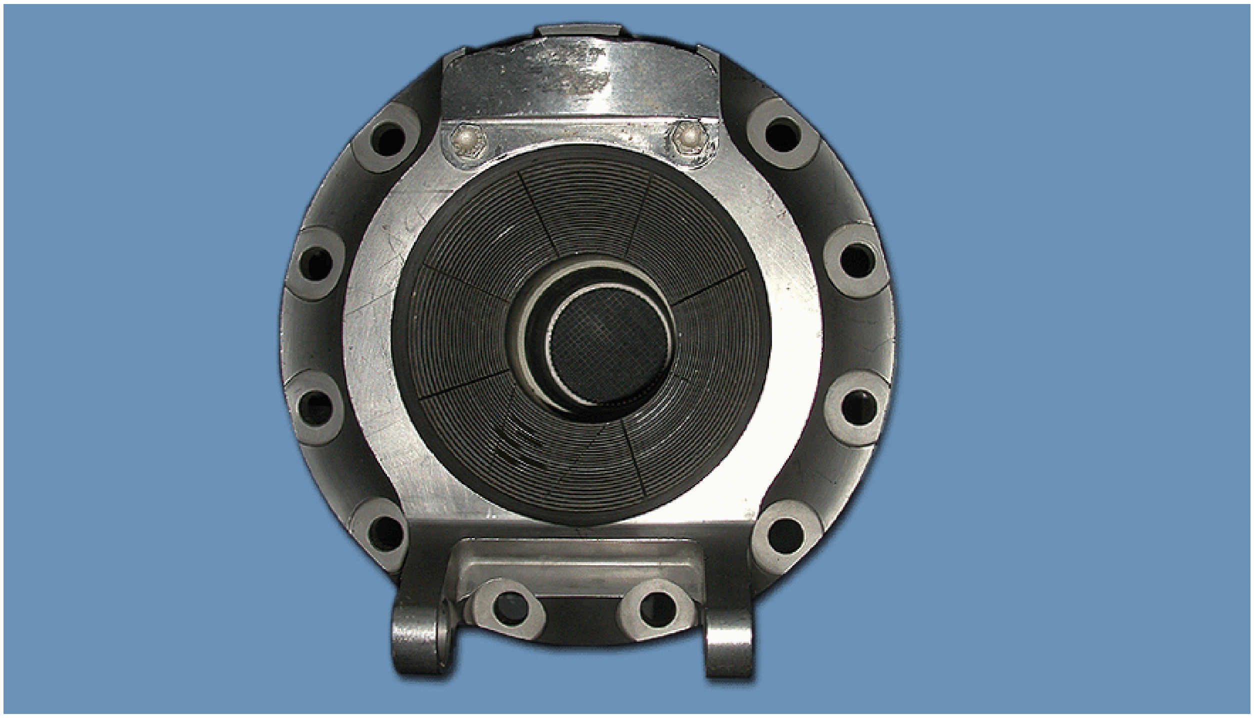
Frame #0250 (Elastomeric Bearing Disbonding)



6 Disbonding is metal and rubber separation.

7 For the inspection procedures and limits for disbonding refer to the appropriate section of the TM.

Frame #0255 (Elastomeric Bearing Shim Cracks)

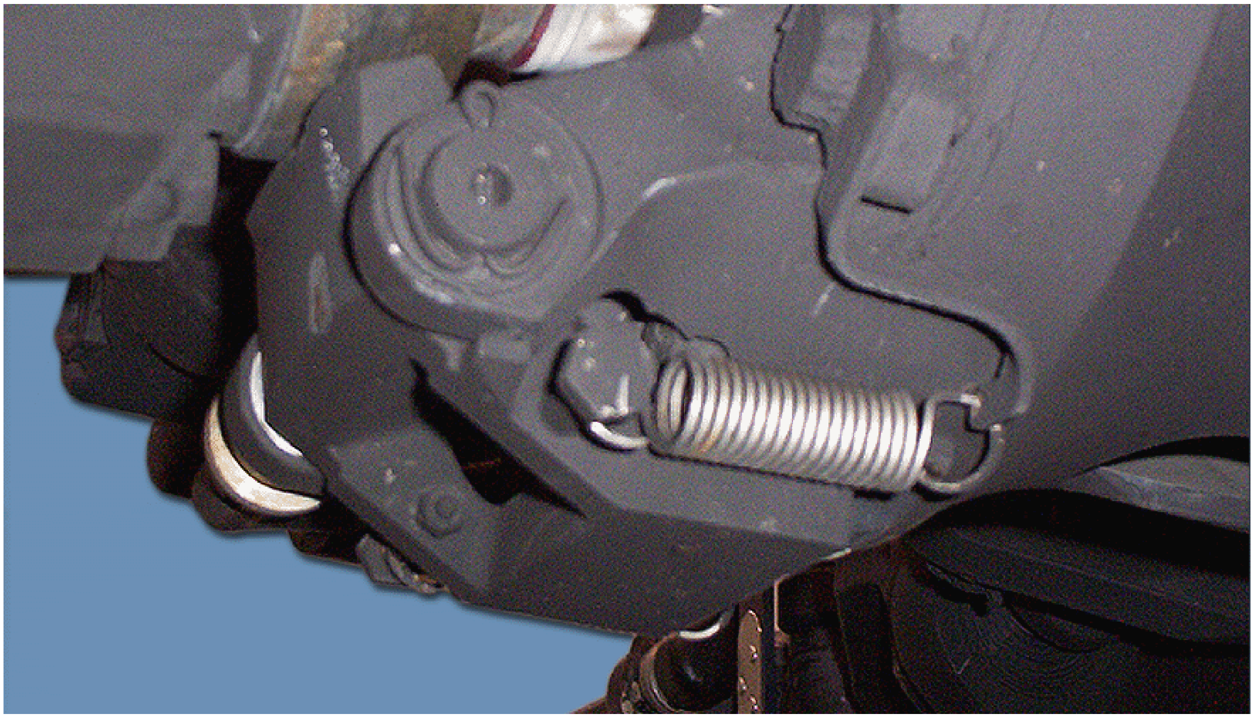


8 Shim cracks are broken or missing metal shims, no shim cracks are allowed..

Frame #0260 (Droop Stop)

9 The droop stop is mounted to the elastomeric bearing ears, with the droop stop support ring mounted to the spindle.

Frame #0265 (Droop Stop Components)



WARNING: The droop stop is made of beryllium copper metal, which can be a health hazard. Avoid breathing dust while reworking damaged areas. Use a dust respirator if necessary. Grinding is prohibited. Keep beryllium copper out of open wounds. Clean up visible dust piles and wash hands and arms after maintenance.

Verification of proper hardware, spring clip installation, and torque of bolts are critical characteristics.

<u>10</u> The droop stop is made of beryllium copper with a de-ice system installed to prevent it from freezing in one position.

<u>11</u> Rubber stops are installed on the hub to protect the hub from the movement of the droop stop assembly.

<u>12</u> The droop stop limits the droop of the blade when the main rotor head is slowing down or stopped.

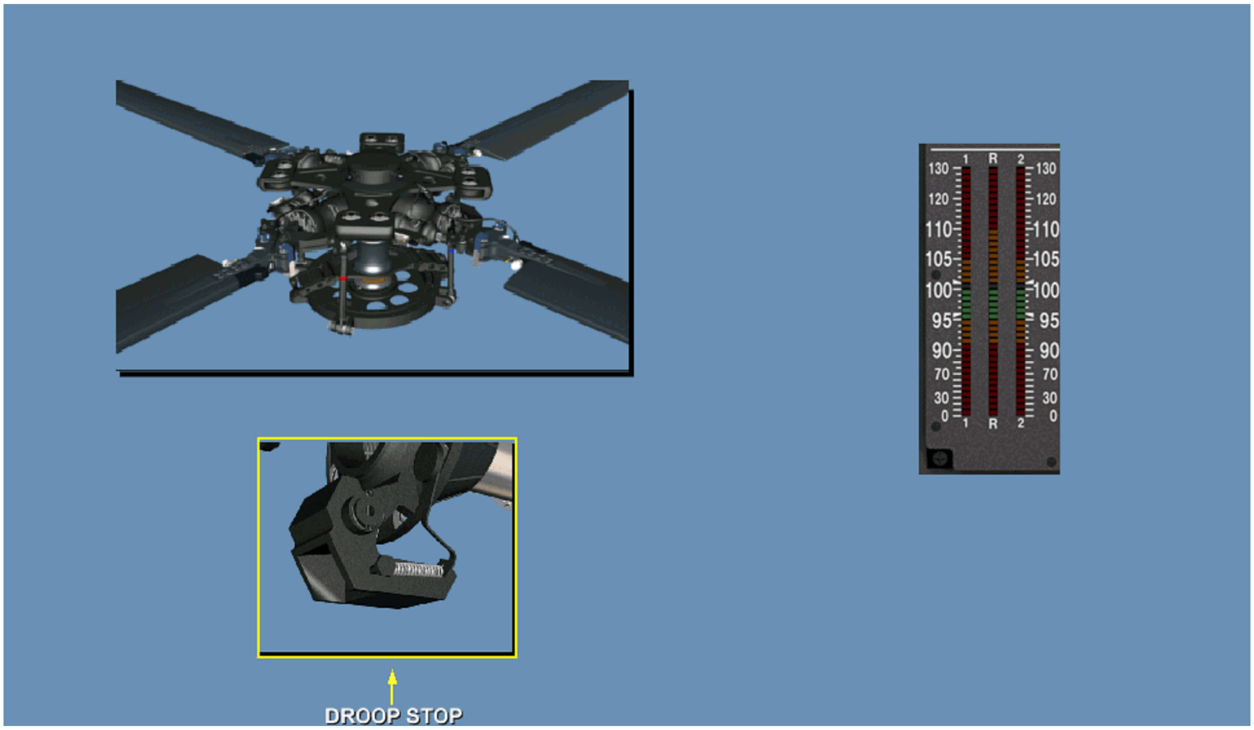
<u>13</u> During a visual inspection of the droop stop, a 1/8 inch crack on the corners can be shaved down when found.

<u>14</u> When performing maintenance on the droop stop, pay close attention to the spring.

15 The droop stop and anti-flap springs are very similar.

16 Be sure you use the proper spring.

Frame #0270 (Droop Stop FLASH)



17 When the main rotor head is rotating between 70%-75% Nr, centrifugal force throws the droop stop out and permits increased vertical movement of the blade.

j) Main Rotor Spindle Nut

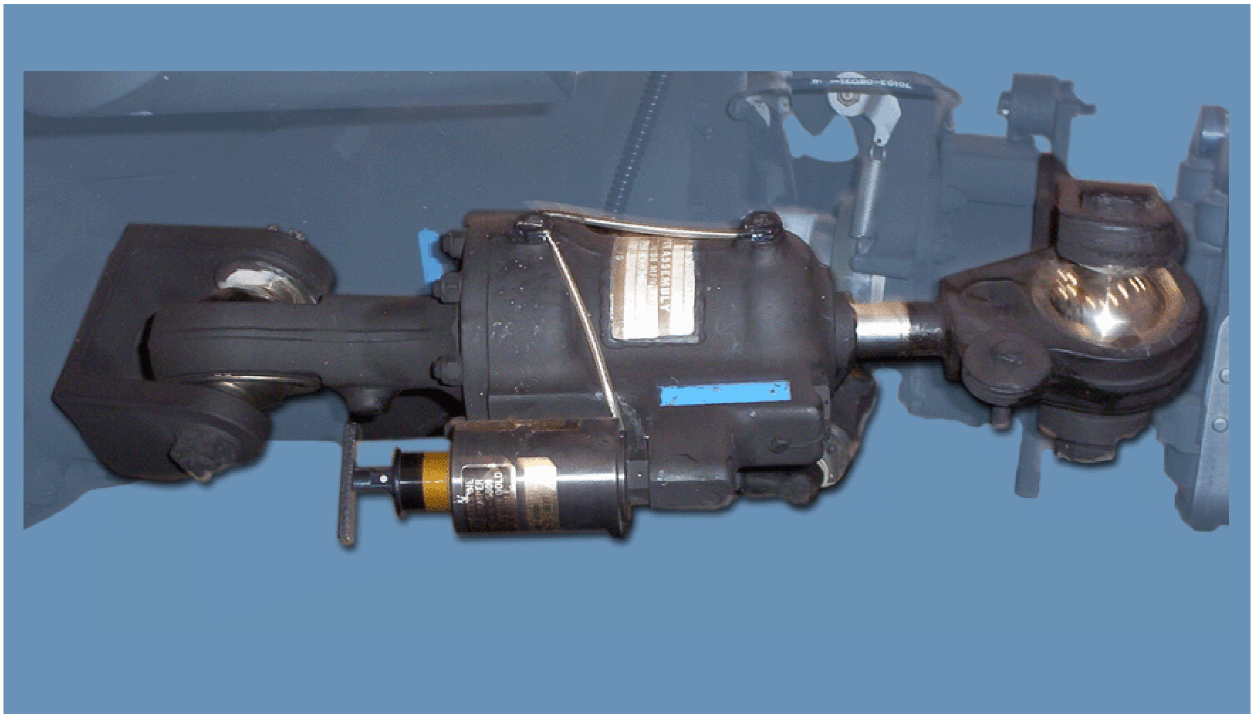
Frame #0275 (Main Rotor Spindle Nut)

1 The spindle has four bolt holes and the spindle nut has 12 holes which are used for the alignment of the lock bolts.

2 The bolts on the spindle nut are coated with Corrosion Preventative Compound (CPC).

(c) Damper

Frame #0280 (Main Rotor Damper)



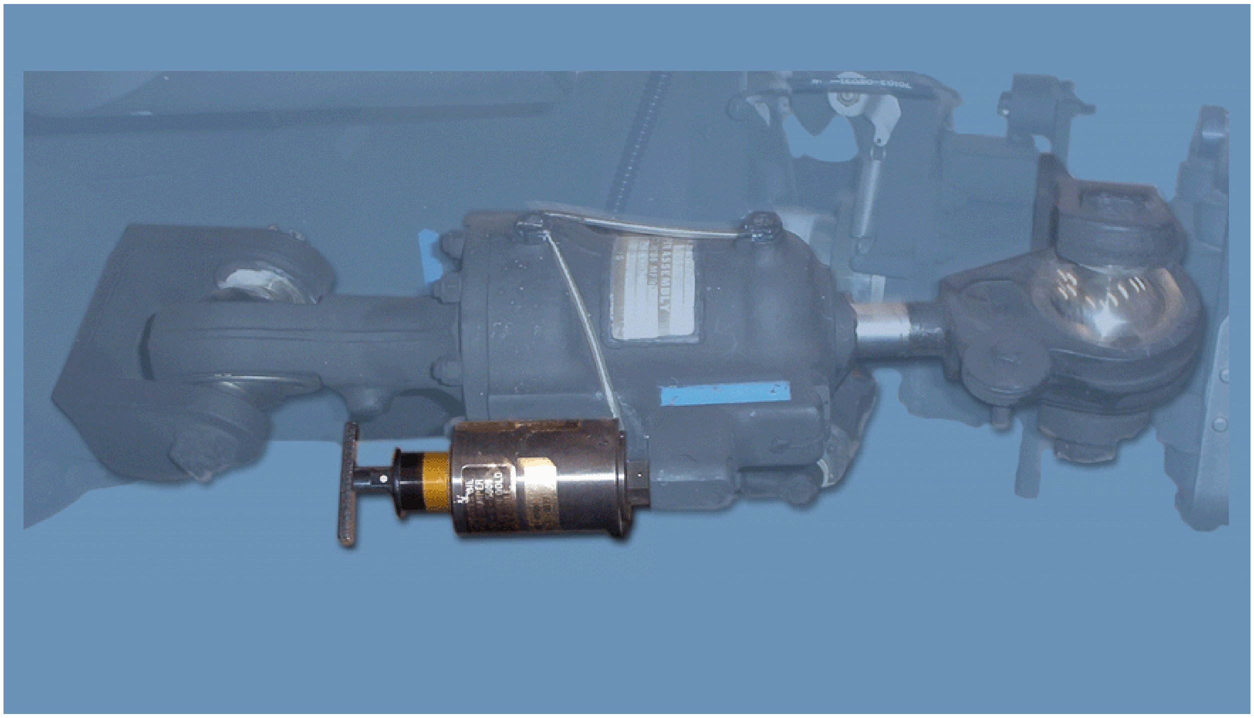
1) There are four dampers mounted to the main rotor hub; one between each of the spindles and hub assembly.

2) The dampers restrain hunting (lead and lag motions) of the blades during rotation and absorb rotor head engagement loads.

3) They will also absorb some of the shock to the main rotor system when collective inputs are made.

4) Some part number dampers must have a restraining cable installed.

Frame #0285 (Main Rotor Damper Indicator)



5) Each damper is equipped with an indicator to show the servicing level of the damper.

Frame #0285 (Damper Indicator Blowout)

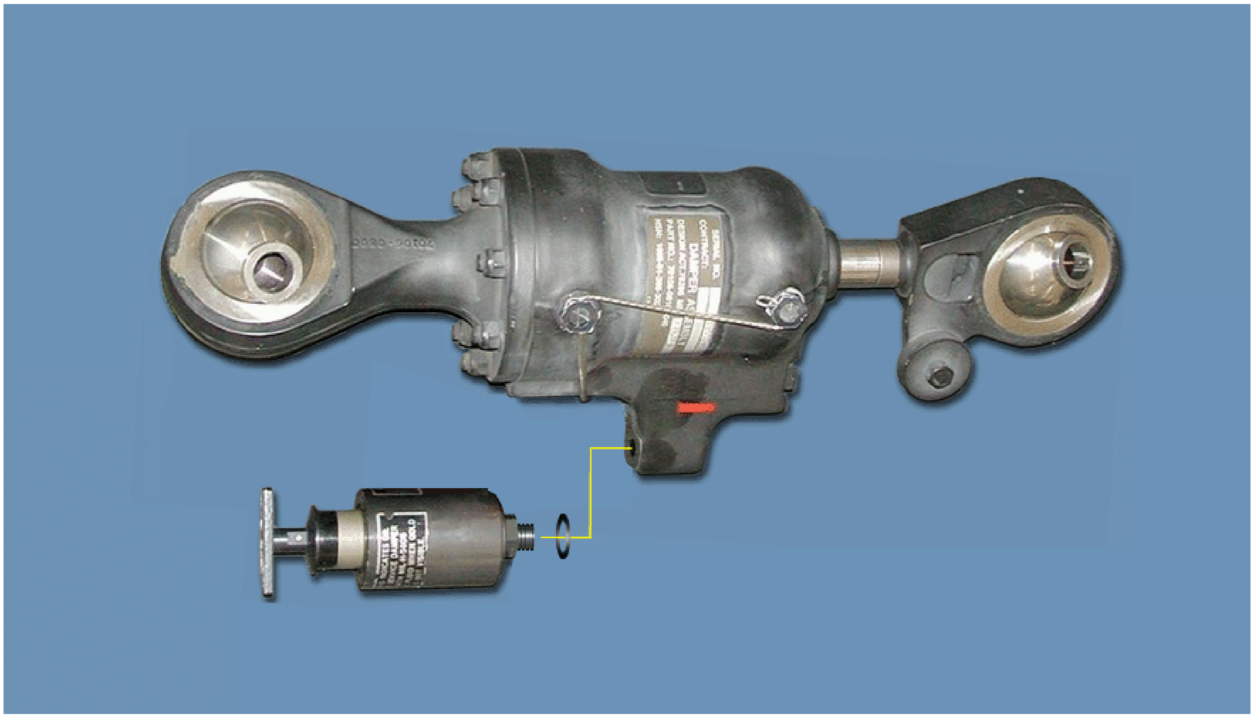
6) The damper indicator has its own inspection criteria and can be replaced separately.

7) Check for wear or scoring of the gold indicator band.

8) As long as the level of servicing can be seen, the indicator is usable.

9) Check for a sticky indicator piston.

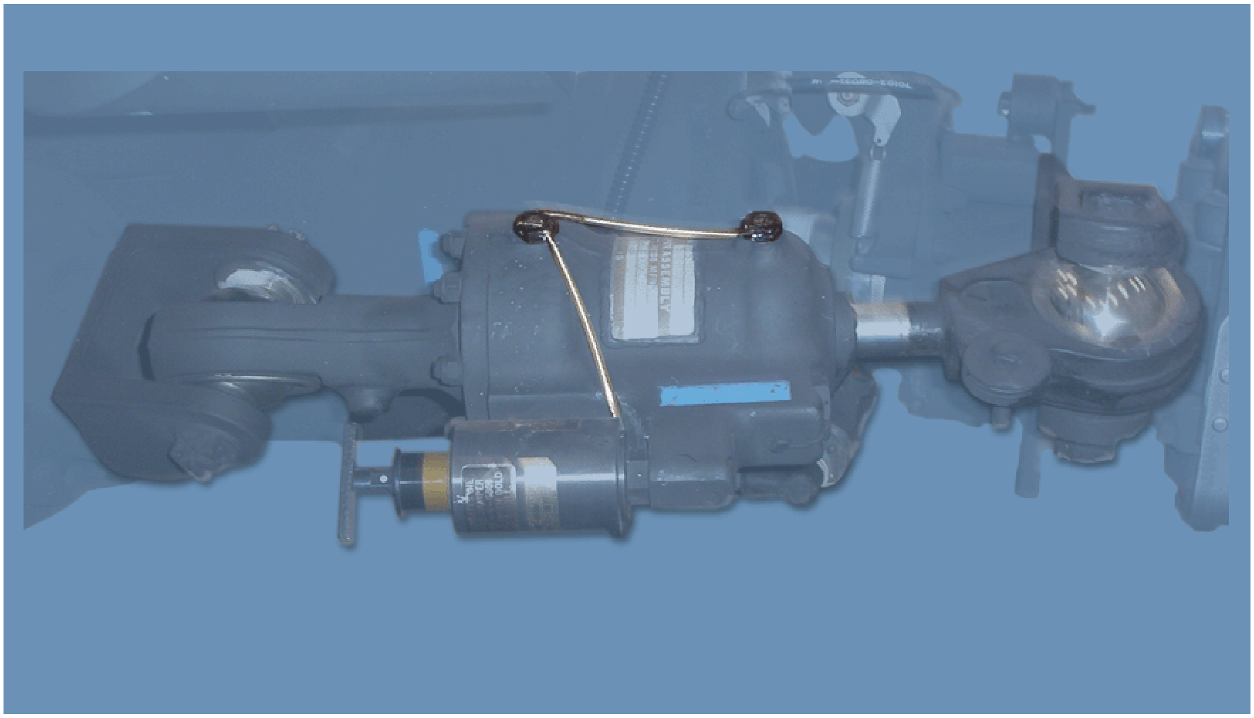
Frame #0290 (Damper Indicator Packing)



10) Should the damper indicator require replacement, ensure the packing located between the damper indicator and damper is replaced.

11) Failure to replace the packing could cause a hydraulic leak and interfere with the dampers ability to function properly.

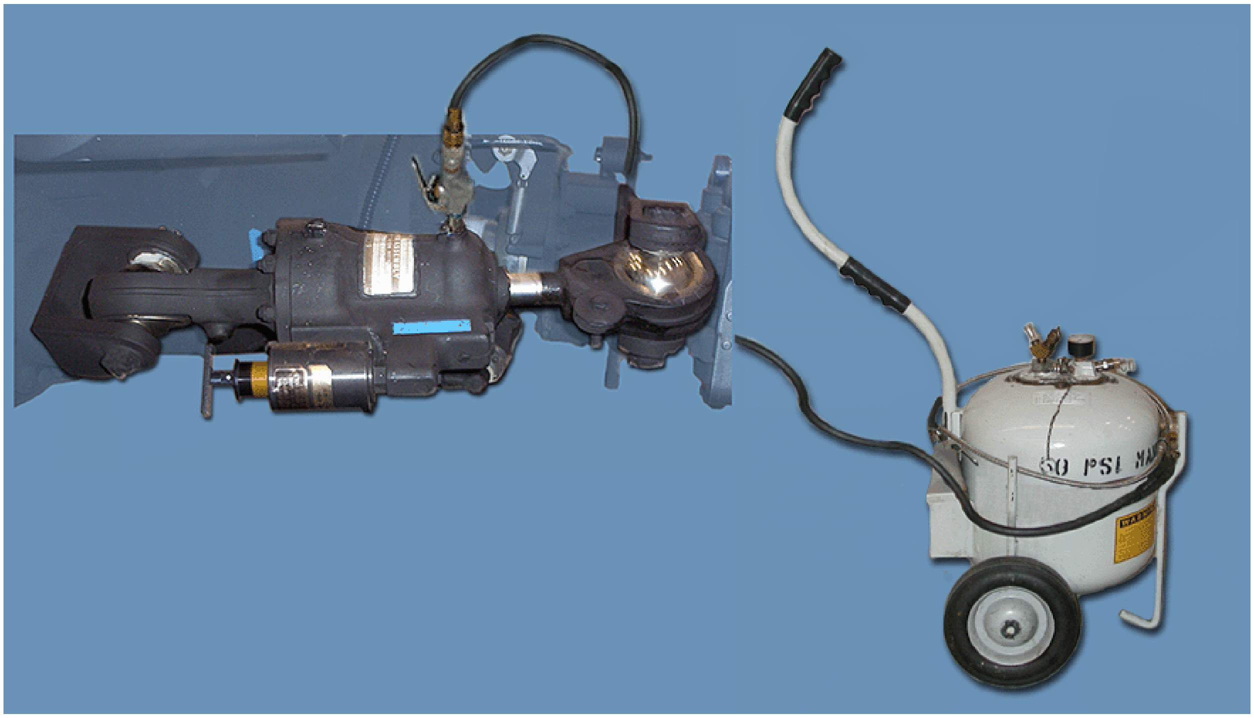
Frame #0295 (Damper Servicing Ports)



12) Two servicing ports on the damper allow for servicing of the damper cylinders with hydraulic fluid.

13) If it is not serviced properly, the damper can affect the main rotor track and balance.

Frame #0300 (Damper Servicing)



CAUTION: To prevent damage to helicopter. All dampers must be serviced with the same hydraulic fluid.

NOTE: At temperatures above -40 ºF (-40 ºC), hydraulic fluid, Item 155, Appendix D, or Item 154, Appendix D, can be used when filling dampers. Mixing hydraulic fluids is allowed. Flushing is not required when switching from hydraulic fluid Item 154, Appendix D, to hydraulic fluid Item 155, Appendix D. At temperatures below -40 ºF (-40 ºC), only hydraulic fluid, Item 154, Appendix D, shall be used.

14) The servicing unit is a pressurized hydraulic fluid dispenser containing either MIL-H-5606 or MIL-H-83282.

Frame #0305 (Damper Servicing 2)

15) After servicing the damper, a damper check must be done.

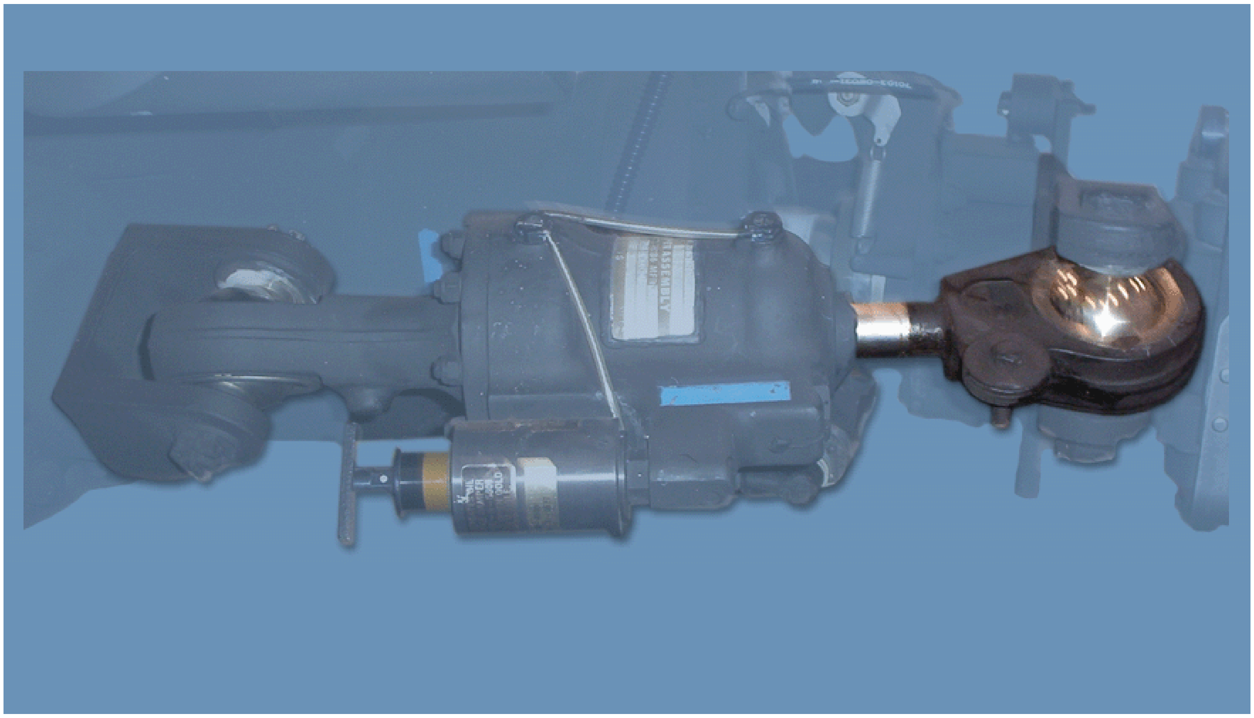
16) This is a two person task.

17) Position the blade of the damper being checked over the nose of the aircraft and engage the gust lock.

18) One person monitors the indicator for no more than 1/8 inch movement.

19) The other person will lead and lag the blade 3-9 inches.

Frame #0310 (Damper Counter Weights)



20) The counter weights on the damper prevent excessive wear on the damper rod end bearings and the shoulder bushings.

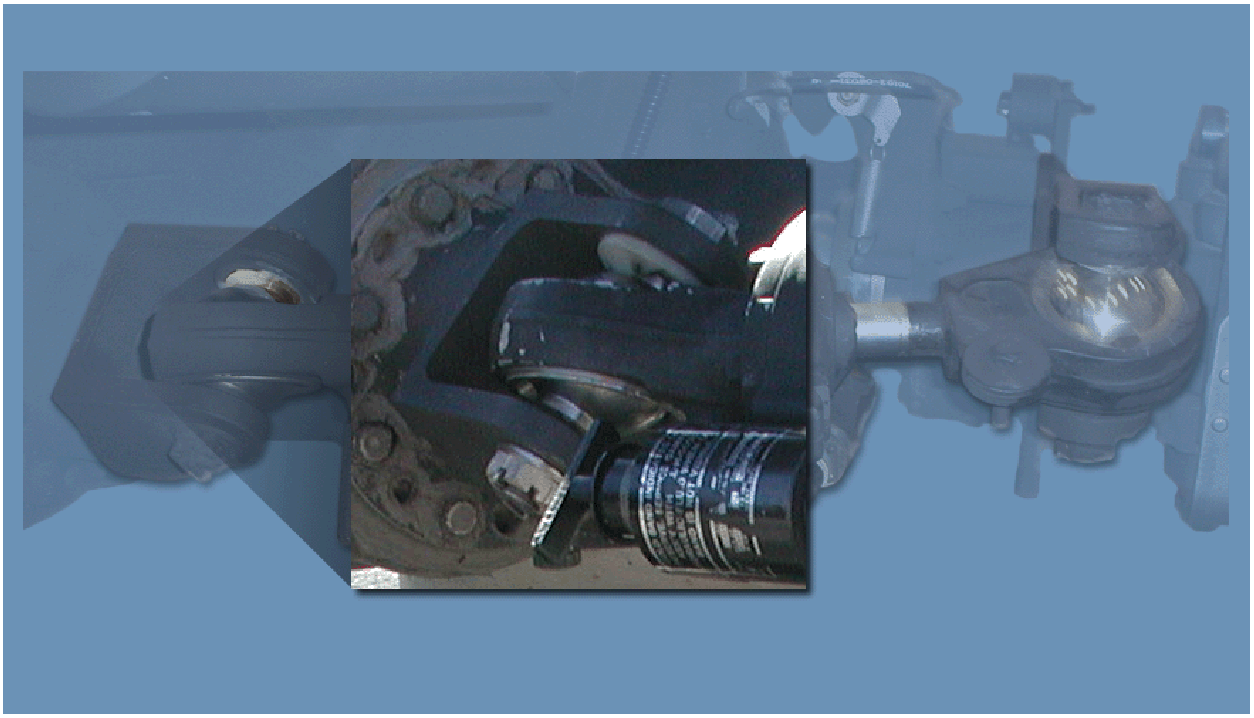
21) Check the shoulder bushings for visible signs of wear.

Frame #0315 (Damper Wear Patterns)

22) If wear is present on the lower outside, upper inside of the damper end, remove one damper weight.

23) If the wear is on the lower inside, upper outside of the damper end, add one weight.

Frame #0320 (Damper Nylon Washer)



24) Nylon washers are attached to the spindle and hub damper bracket.

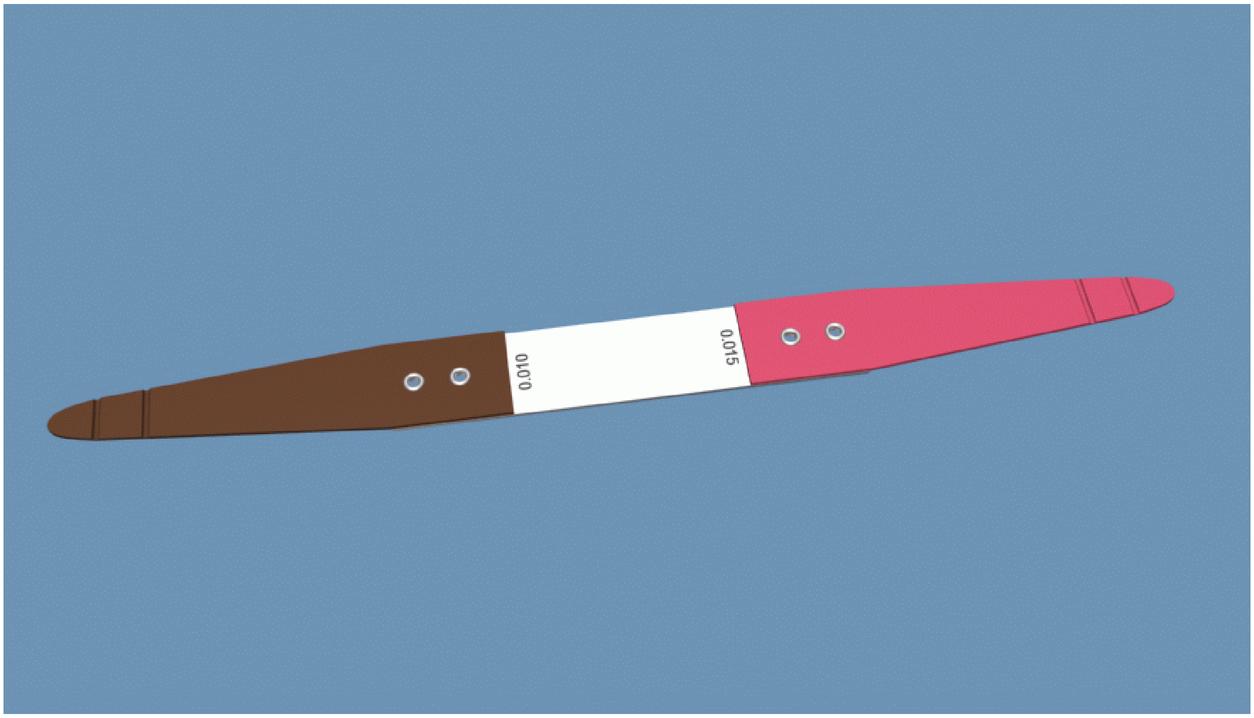
25) This prevents metal to metal contact between the damper, spindle, and bracket.

26) The opening to the washers should always face in the direction of the damper itself.

Frame #0325 (Damper Bearing Inspection)

27) The inspection of the damper bearings require a locally manufactured tool.

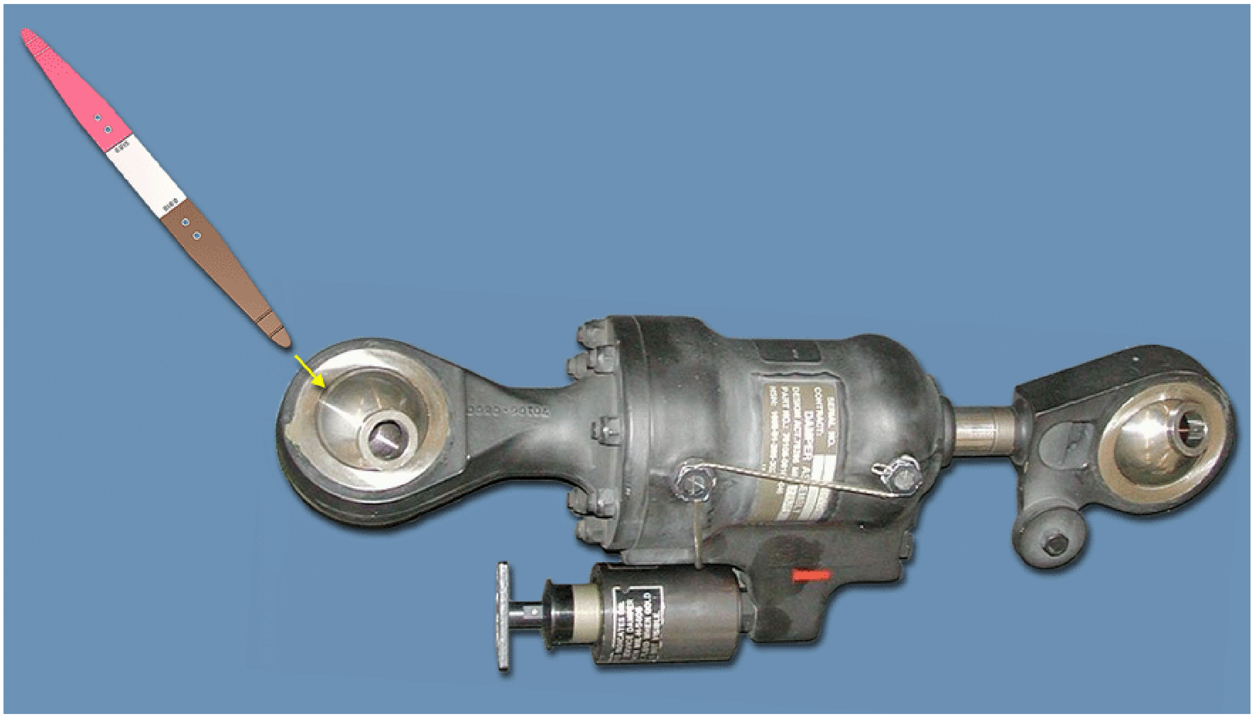
Frame #0325 (Spherical Bearing Inspection Tool)



28) The inspection tool has a brown 0.010 thickness gauge at one end, and a pink 0.015 thickness gauge at the other.

29) Instructions to manufacture the inspection tool can be found in ANNEX C of the Black Hawk TM series.

Frame #0385 (Damper Bearing Inspection)



NOTE: Check at least half of each spherical bearing closest to the damper body.

30) Push the damper in the direction of the bearing side being inspected; push up to check the top side of the bearing to race, and push down to check the bottom side of the bearing to race.

31) Using the 0.010 end of the inspection tool, probe both sides of the bearing around the entire circumference for clearance between the ball and outer race.

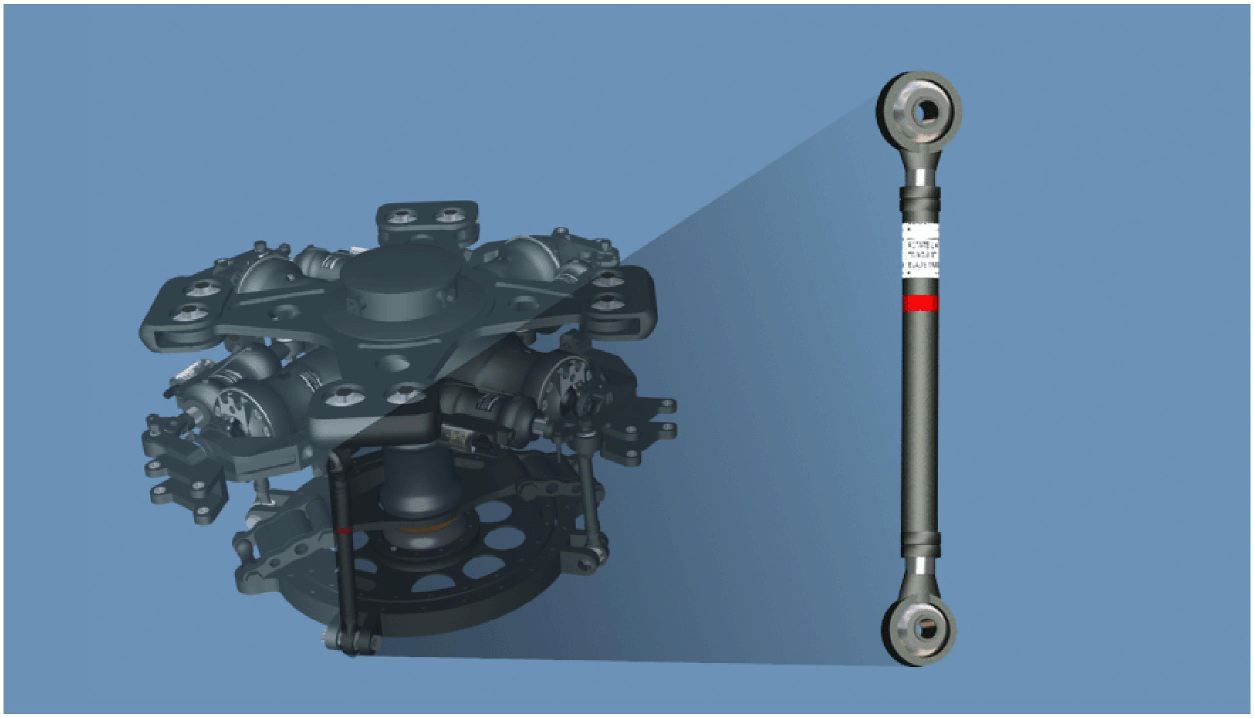
32) If the tool can not be inserted to the 0.250 mark, bearing is acceptable. If the tool can be inserted to or beyond the 0.250 mark, repeat the inspection using the 0.015 portion of the tool.

33) If you can not insert the .0015 portion to the 0.250 mark, the bearing is acceptable with a reinspection required IAW the appropriate TM.

34) Should the tool be inserted to or beyond the 0.250 mark, inspect the bearing for radial play using the dial indicator method IAW the appropriate TM.

(d) Pitch Control Rod

Frame #0330 (Main Rotor Pitch Control Rod)



1) Pitch control rods extend from the rotating swashplate to the blade pitch horn on the spindle.

2) All movements made in the cockpit area are transmitted through the flight controls, swashplate, pitch control rods, and to the blades.

3) This, in turn, allows the helicopter to move.

4) The pitch control rods are an adjustable flight control rod.

Frame #0335 (Pitch Control Rod Components)

5) The pitch control rod can be broken down into four major subcomponents:

a) The link

1 Adjustments to the overall length of the control rod are made by rotating the link.

b) Tang

1 The tang locks the control rod link to the desired length.

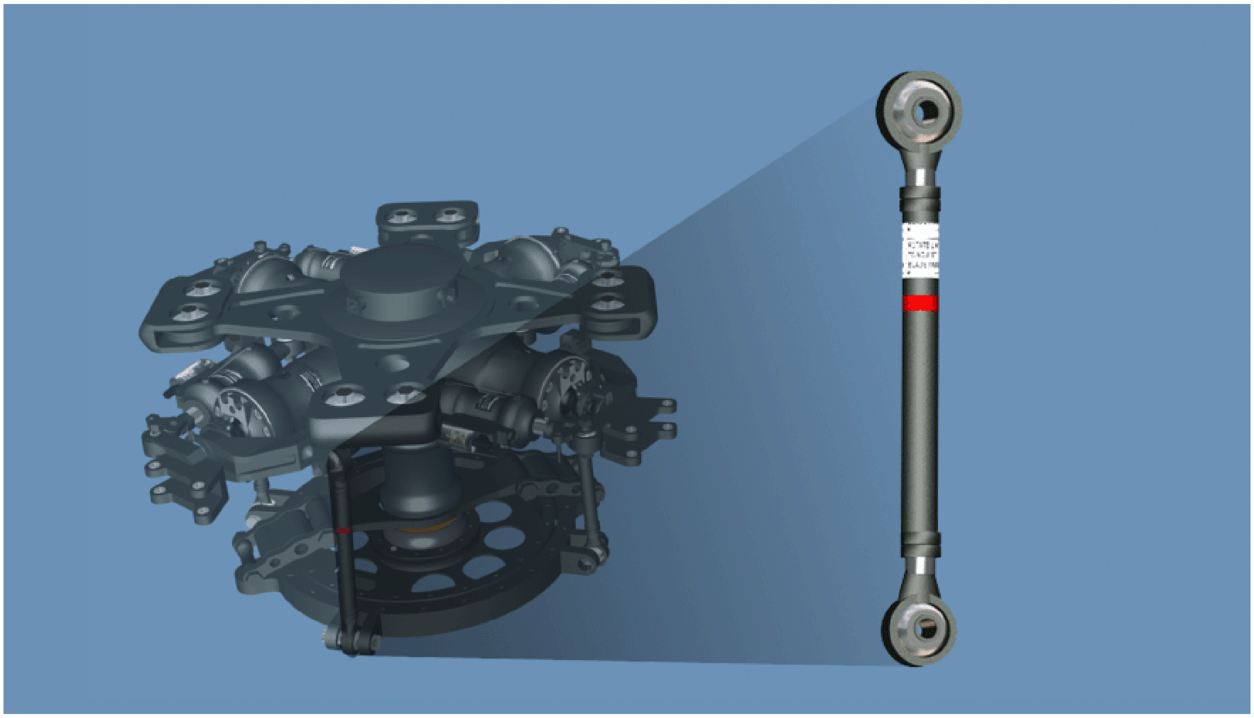
c) Jam nut

1 Jam nuts prevent the pitch control rod ends from rotating and creating metal to metal contact with the spindle horn and swashplate.

d) Rod end.

1 Pitch control rod ends are the attaching points for the control rod to the main rotor assembly and allows limited movement at the bearing located inside the rod end.

Frame #0340 (Pitch Control Rod Dimension X)

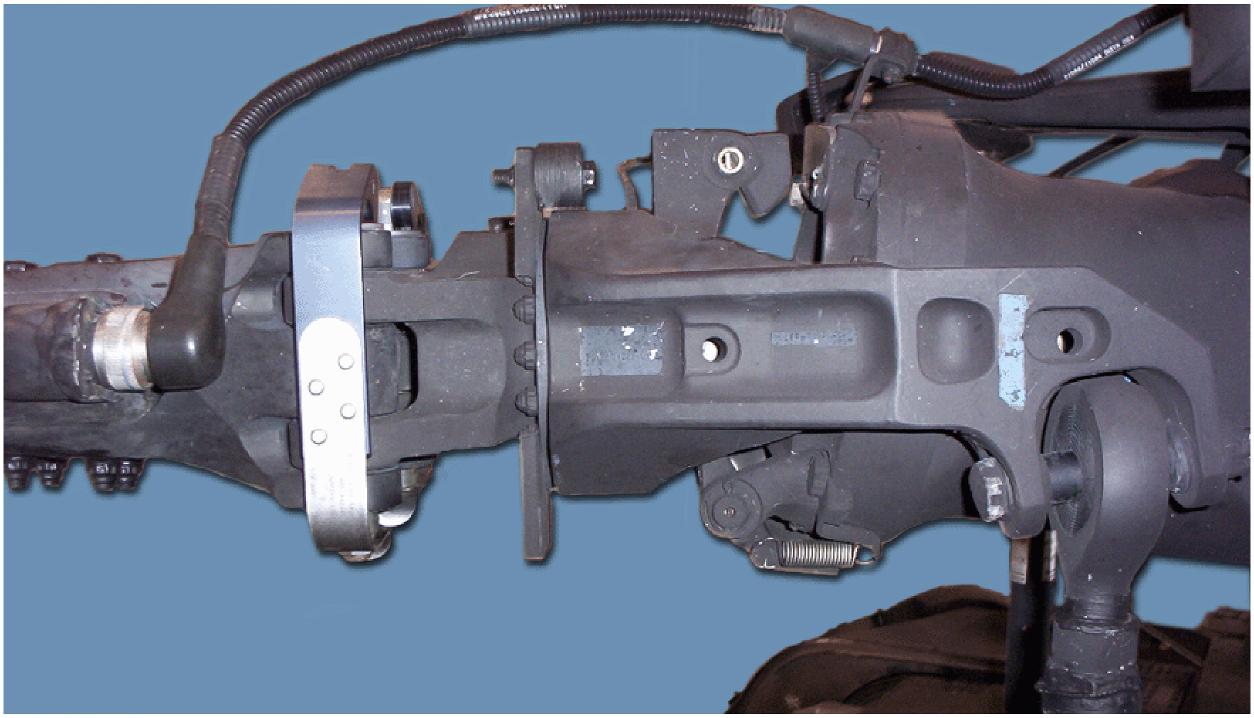


6) When installing a main rotor pitch control rod, it is important to know what pitch control rod is being installed.

7) If the same control rod is going to be installed on the aircraft with no adjustments or the ends have not been replaced, then it may be installed as is.

8) For a newly installed pitch control rod or a pitch control rod that has had adjustments, or the rod ends replaced, the dimension "X" will be set at 25.22 inches.

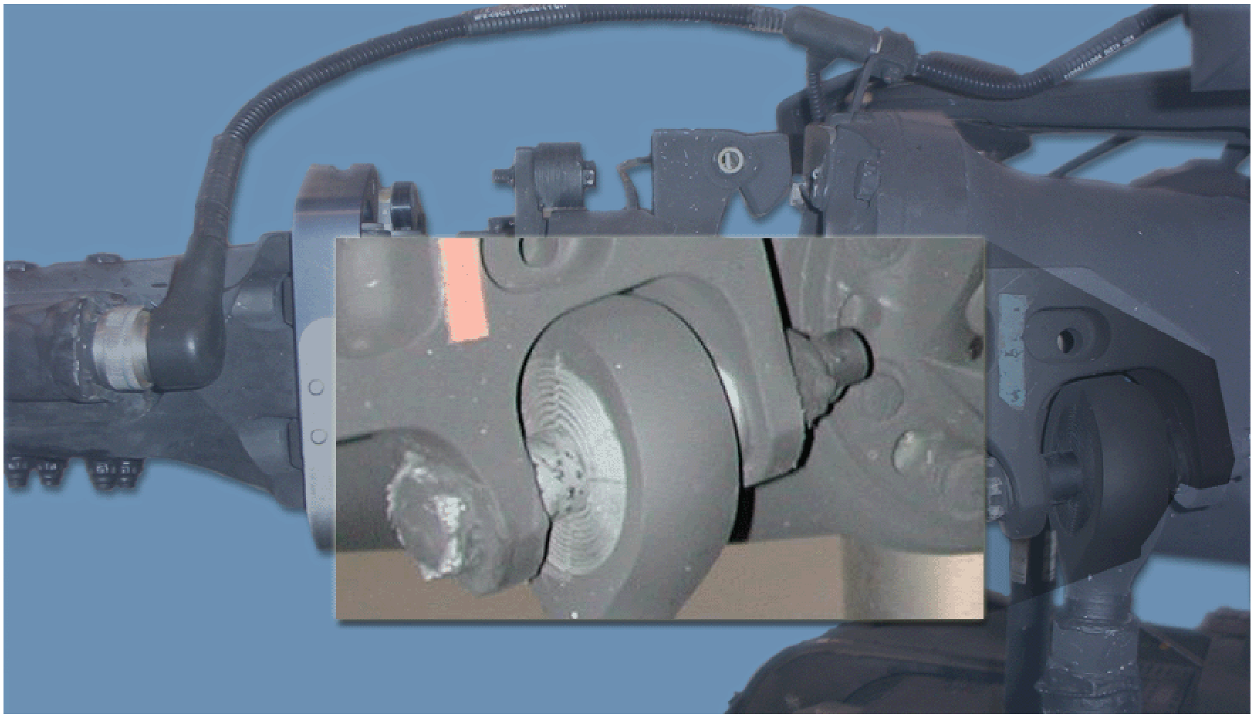
Frame #0345 (Pitch Control Rods/Elastomeric Bearing)



9) If the rod ends have elastomeric bearings installed, the blade pretrack can change by 0.04 inch.

10) Installation

Frame #0350 (Upper Pitch Control Rod End Installation)



a) When installing the pitch control rod, the upper rod end pawl bolts must be installed with the PAWL at the 6 o'clock position, and the head of the bolt facing outboard of the main rotor head.

b) The head of the cotter pin should be facing in the direction of rotation, or inboard toward the main rotor head.

Frame #0355 (Lower Pitch Control Rod End Installation)

c) When installing the pawl bolts on the lower rod end, the pawl bolts must be installed with the PAWL at the 6 o'clock position, and the head of the bolt facing in the direction of rotation.

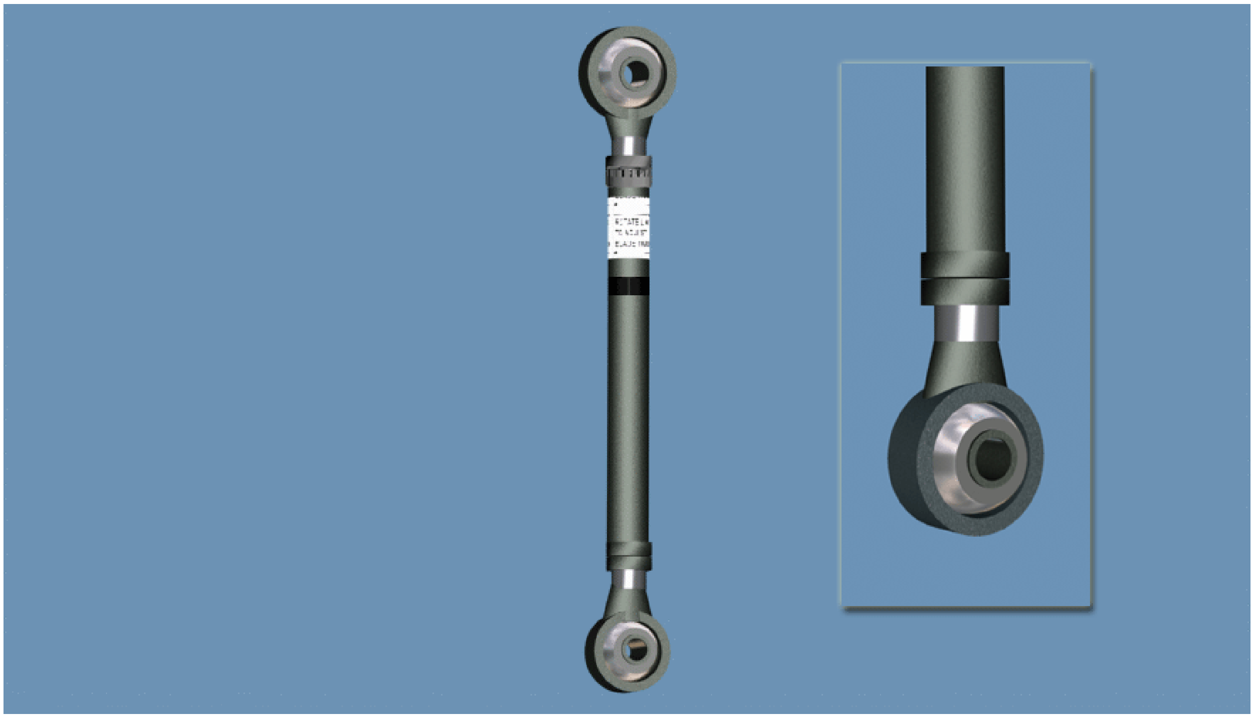
d) The cotter pin is installed with the head of the cotter pin facing in the direction of rotation or inboard, toward the main rotor head.

11) Adjustment

Frame #0360 (Pitch Control Rod Adjustment)

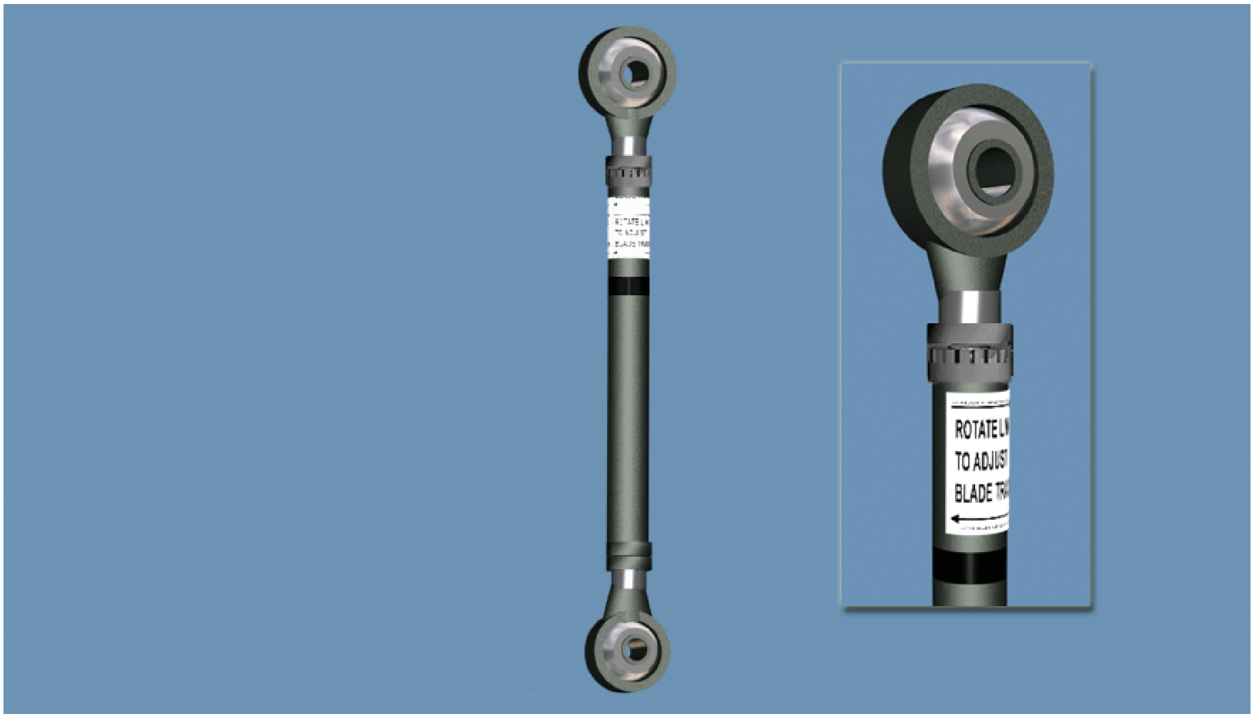
a) The upper rod end threads are left handed, and the lower rod end threads are right handed, to allow for adjustment of the Pitch Control (PC) rod without requiring disconnecting the PC rod from the main rotor.

Frame #0360 (Pitch Control Rod Lower Rod End Adjustment)



b) When adjusting the PC rods, a maximum 3/4" of thread may be exposed on the lower PC rod end.

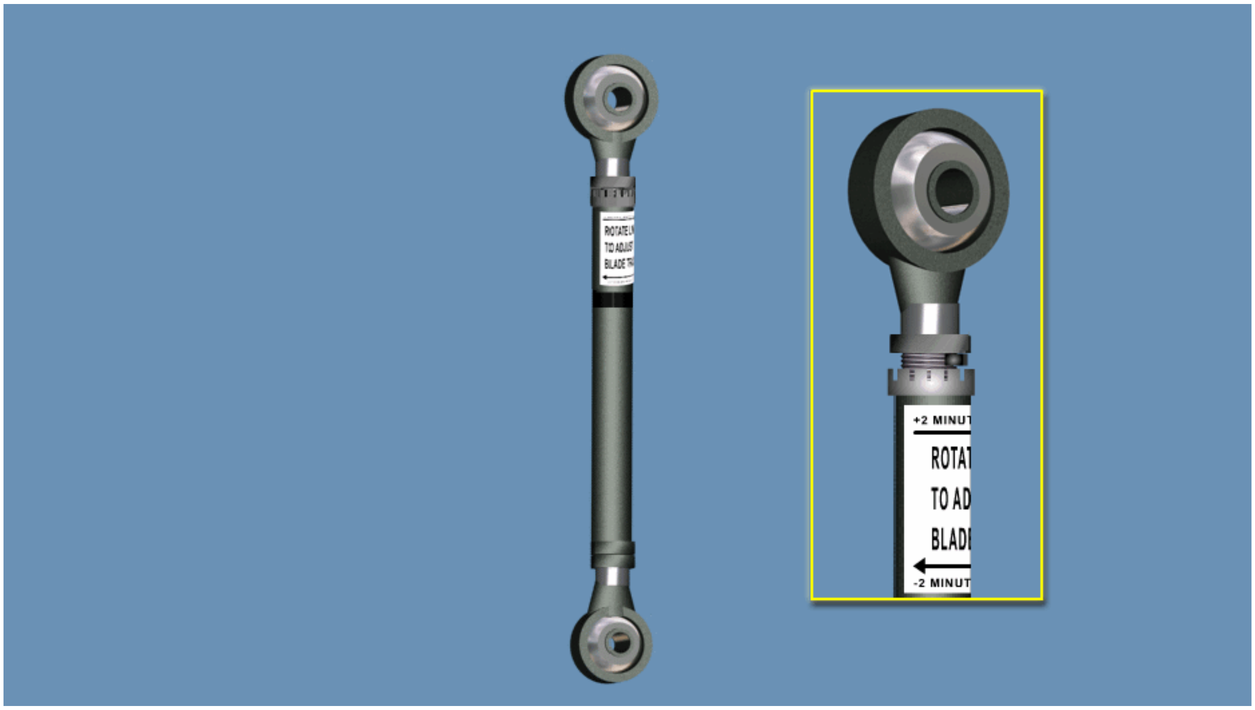
Frame #0360 (Pitch Control Rod End Upper Adjustment)



c) The PC rod jam nuts, located at each end of the PC rod link, are safety wired to the link.

d) These safeties are 3 point safeties (nut-link-nut, nut-lock key-nut).

Frame #0365 (Pitch Control Rod Adjustment FLASH)



e) When adjusting the PC rods, each notch equals two minutes (1/4 inch movement in blade track), this is used for adjusting the blade pre-track or track and balance.

f) When adjusting for auto-rotation, Revolutions Per Minute Rotor (RPMR), three notches equal 1% RPMR.

g) Be sure to adjust all four PC rods.

Frame #0370 (Pre-Track Adjustment)

h) Each main rotor blade has a pre-track marked on the blade and will differ from blade to blade.

i) The pre-track is factory set at the optimum track for each individual blade.

j) Compare the pre-track number of the removed (old) blade with the number on the blade now installed.

k) Adjustment is not necessary if the pre-track numbers are alike.

l) Subtract the pre-track number of the installed (new) blade from the pre-track number of the removed (old) blade.

m) If the difference between the removed (old) blade and the installed (new) blade is a plus (+) number, loosen the jam nuts on pitch control rod and turn in the -2 MINUTES/NOTCH direction.

n) If the difference between the old blade and the new blade is a minus (-) number, loosen the jam nuts on the rod and turn in the +2 MINUTES/NOTCH direction.

Frame #0375 (Pre-Track Adjustment Examples)

Example 1.	+ 8 Minutes	Removed (old) blade
Subtract	+ 4 Minutes	Installed (new) blade
Total	+ 4 Minutes	
Example 2.	+ 8 Minutes	Removed (old) blade
Subtract	- 4 Minutes	Installed (new) blade
Total	+12 Minutes	
Example 3.	- 2 Minutes	Removed (old) blade
Subtract	+10 Minutes	Installed (new) blade
Total	- 12 Minutes	

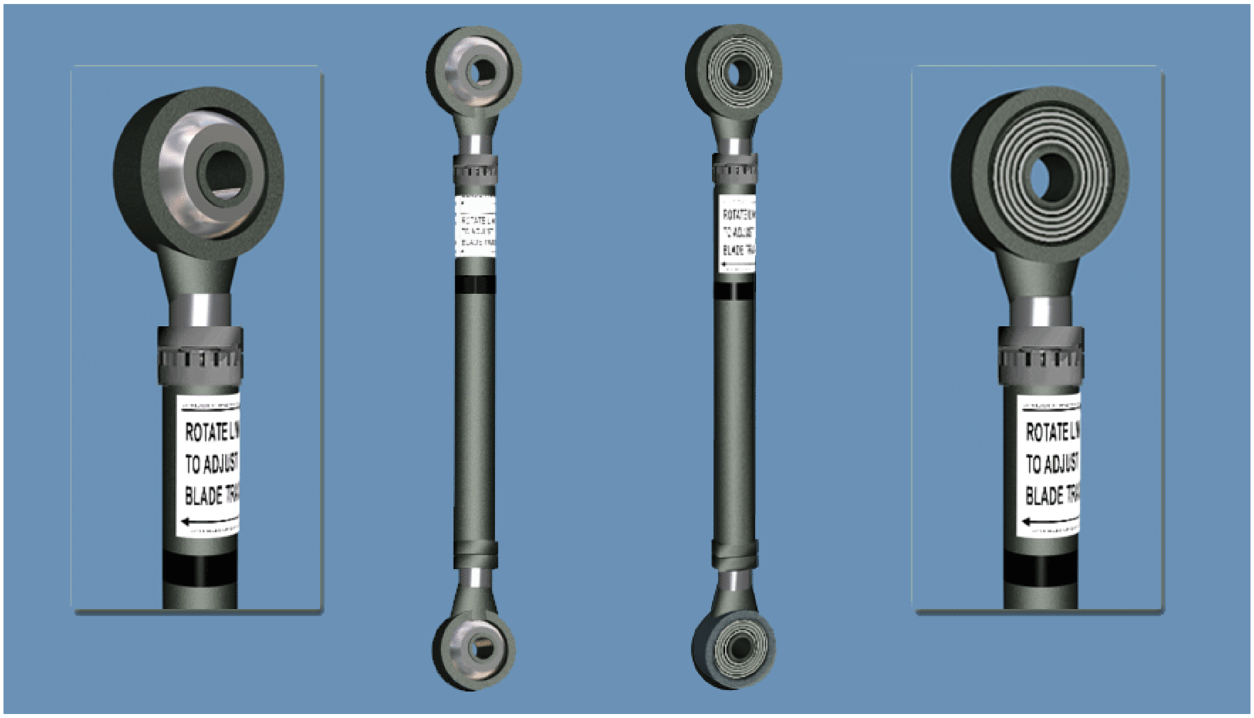
o) Example 1 shows the old blade at +8 and the new blade at +4; therefore adjust the pitch control rod 2 notches in -2 MINUTES/NOTCH direction.

p) Example 2 shows the old blade at +8 and the new blade at -4; therefore adjust the pitch control rod 6 notches in -2 MINUTES/NOTCH direction.

q) Example 3 shows the old blade at -2 and the new blade at +10; therefore adjust the pitch control rod 6 notches in +2 MINUTES/NOTCH direction.

12) Pitch Control Rod Bearing Inspection

Frame #0380 (Pitch Control Rod Bearing Inspection)



a) There are two types of main rotor PC rod bearings, spherical and elastomeric.

b) They can not be mixed and each type has its own inspection criteria.

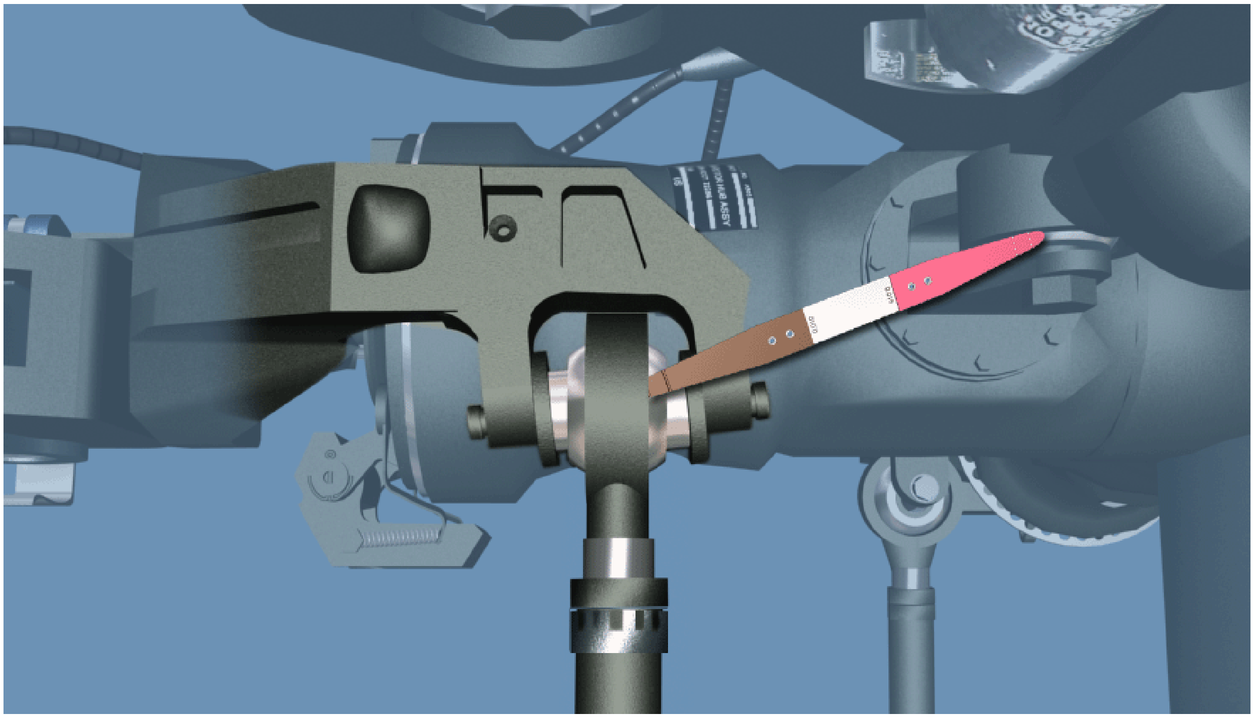
13) Spherical Bearing Inspection

Frame #0390 (Spherical Bearing Inspection)

a) For the spherical bearing, position the blade of the bearing being inspected over the nose of the aircraft and engage the gust lock.

b) With the spherical bearing, use the same spherical bearing inspection tool as the main rotor damper bearing.

Frame #0395 (Spherical Bearing Inspection 2)



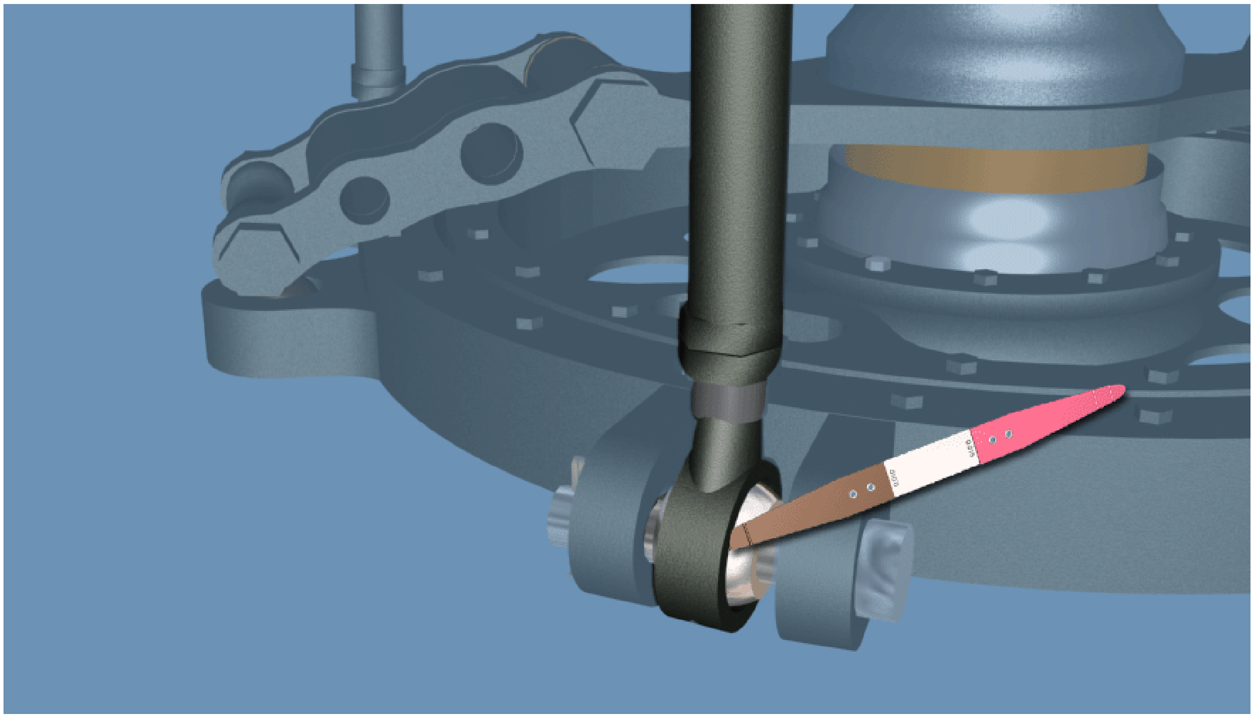
c) Apply hand force on the opposite side of the bearing being inspected.

d) The inspection limits are the same as the main rotor damper bearing.

e) Using the 0.010 end of the inspection tool, probe both sides of the bearing around the entire circumference for clearance between the ball and outer race.

f) If the tool can not be inserted to the 0.250 mark, the bearing is acceptable.

Frame #0395 (Spherical Bearing Inspection 3)



g) If the tool can be inserted to or beyond the 0.250 mark, repeat the inspection using the 0.015 portion of the tool.

h) If you can not insert the .0015 portion to the 0.250 mark, the bearing is acceptable with a reinspection required IAW the appropriate TM.

i) Should the tool be inserted to or beyond the 0.250 mark, inspect the bearing for radial play using the dial indicator method IAW the appropriate TM.

14) Elastomeric Bearing

Frame #0400 (Elastomeric Bearing Inspection)

a) The visual inspection of the main rotor pitch control rod elastomeric bearing is similar to the elastomeric bearing on the main rotor spindle.

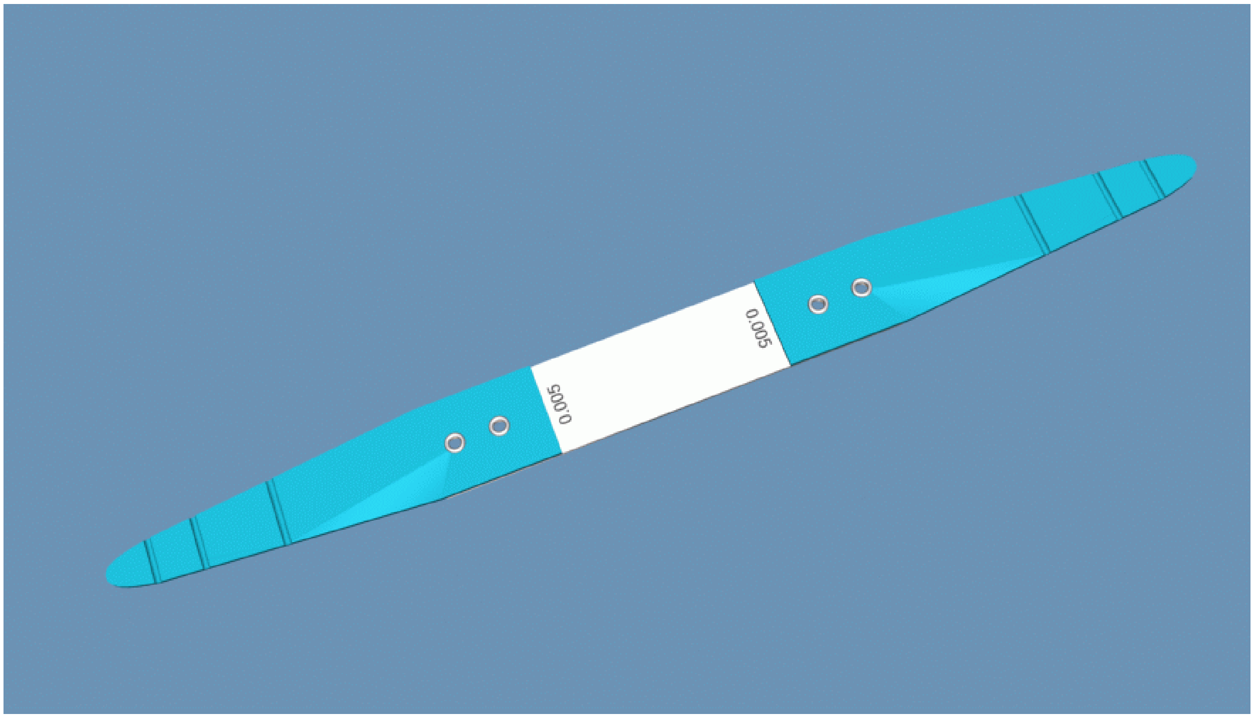
b) There are 3 types of wear; extrusion, disbonding, and shim cracks.

c) Elastomeric extrusion, is when the rubber is being pushed out (too much compression).

d) Shim cracks, these are broken or missing metal shims.

e) The third is disbonding, metal and rubber separation.

Frame #0405 (Elastomeric Bearing Inspection Tool)



f) When inspecting for disbonding, use the locally manufactured elastomeric bearing inspection tool, similar to the one used for the inspection of the spherical bearings.

g) Carefully try to insert the plastic inspection tool where the separation is suspected.

h) If the tool can be inserted, separation has occurred.

Frame #0410 (Elastomeric Bearing Inspection 3)

i) Small hairline surface cracking, minor disbonding and crazing of the elastomer up to 0.060 inch is acceptable in all areas of the rod end bearing.

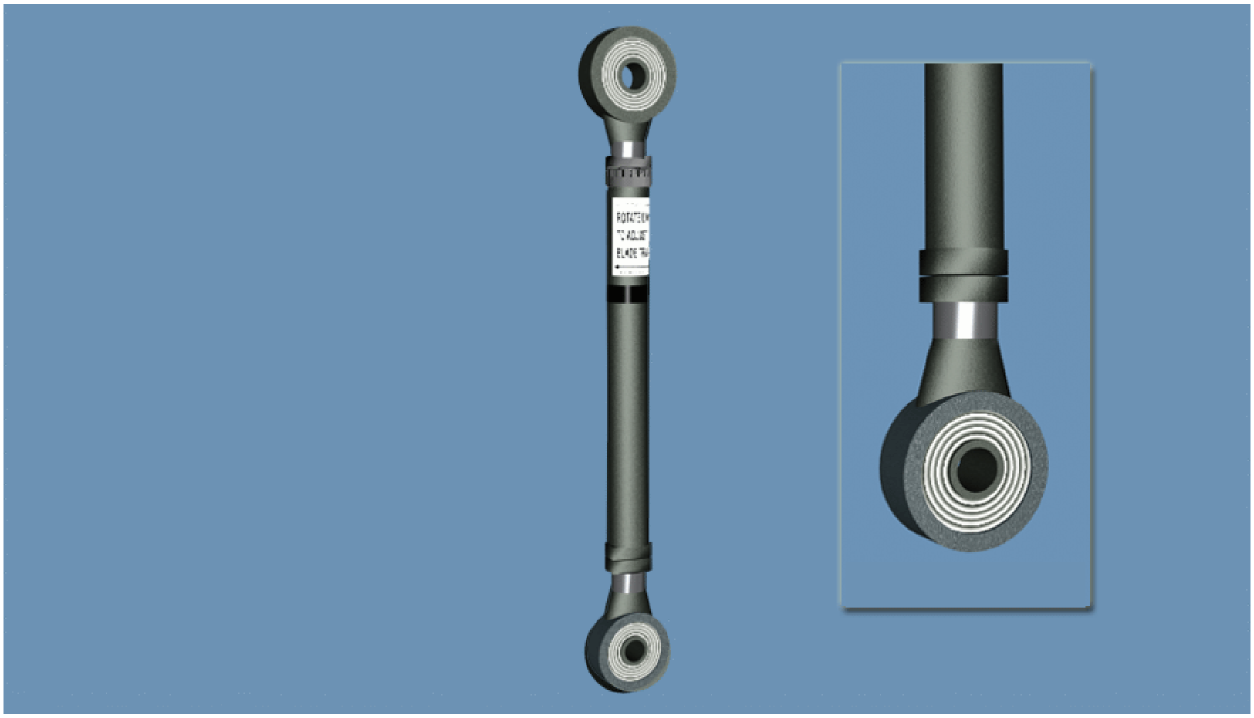
j) On the upper rod end bearing, carefully inspect Zone I.

k) If the inspection tool can be inserted into areas of suspected disbonding, separation has occurred.

l) Separations up to 0.40 inch in Zone I is acceptable.

m) If the separation exceeds limits, replace the rod end within the next 10 flight hours.

Frame #0410 (Elastomeric Bearing Inspection 4)

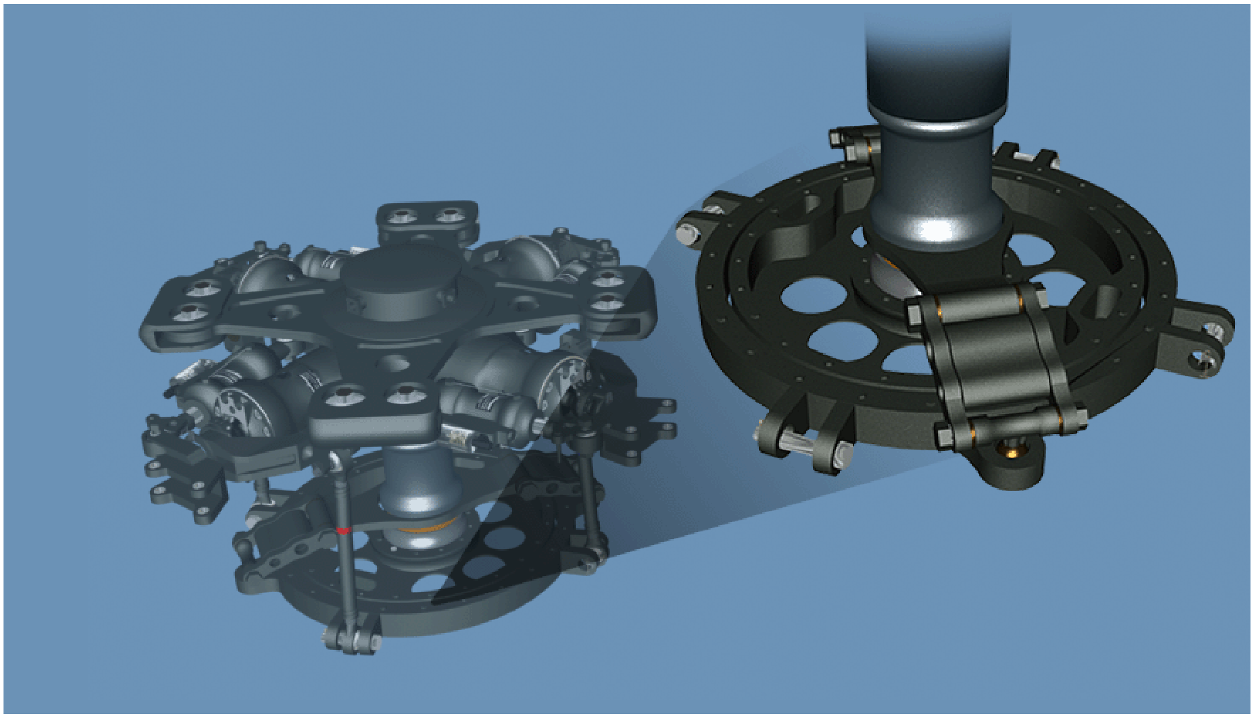


n) On the lower rod end bearing, separation up to 0.20 inch in Zone I is acceptable.

o) If the separation is beyond limits, replace the rod end within the next 10 flight hours.

(e) Main Rotor Swashplate

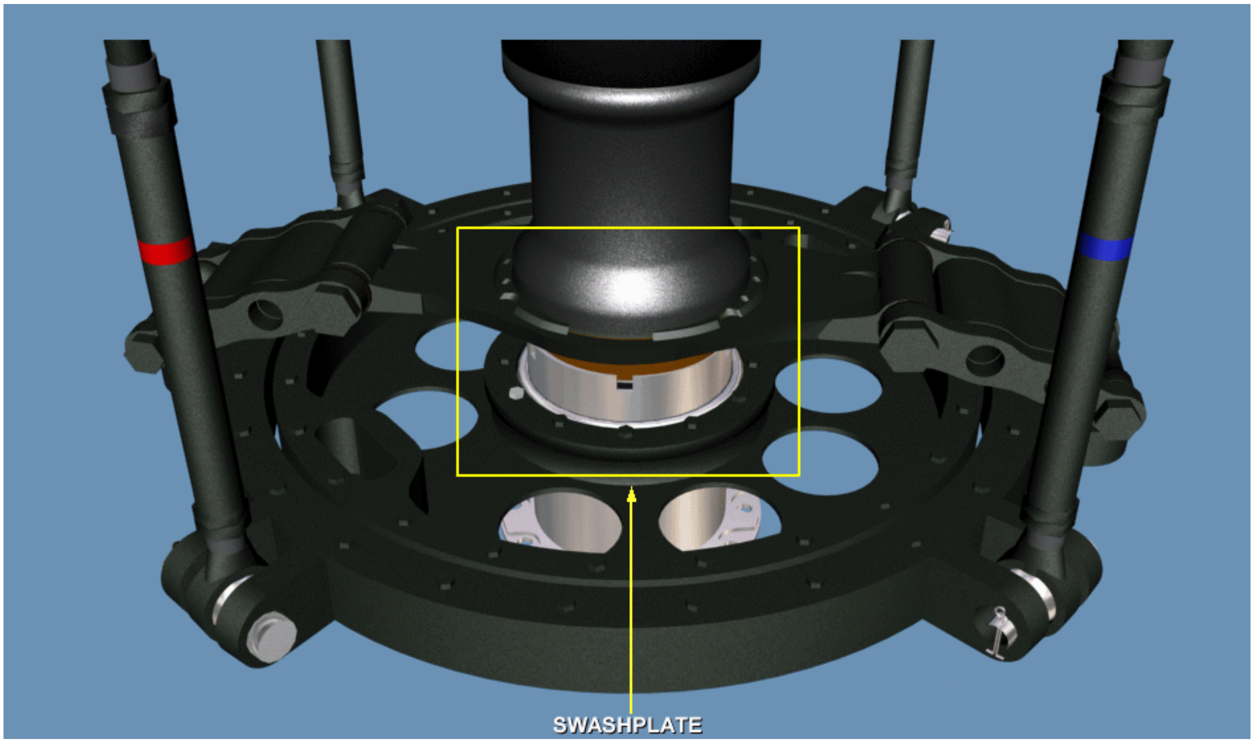
Frame #0150 (Main Rotor Swashplate)



1) The swashplate assembly has stationary and rotating disk.

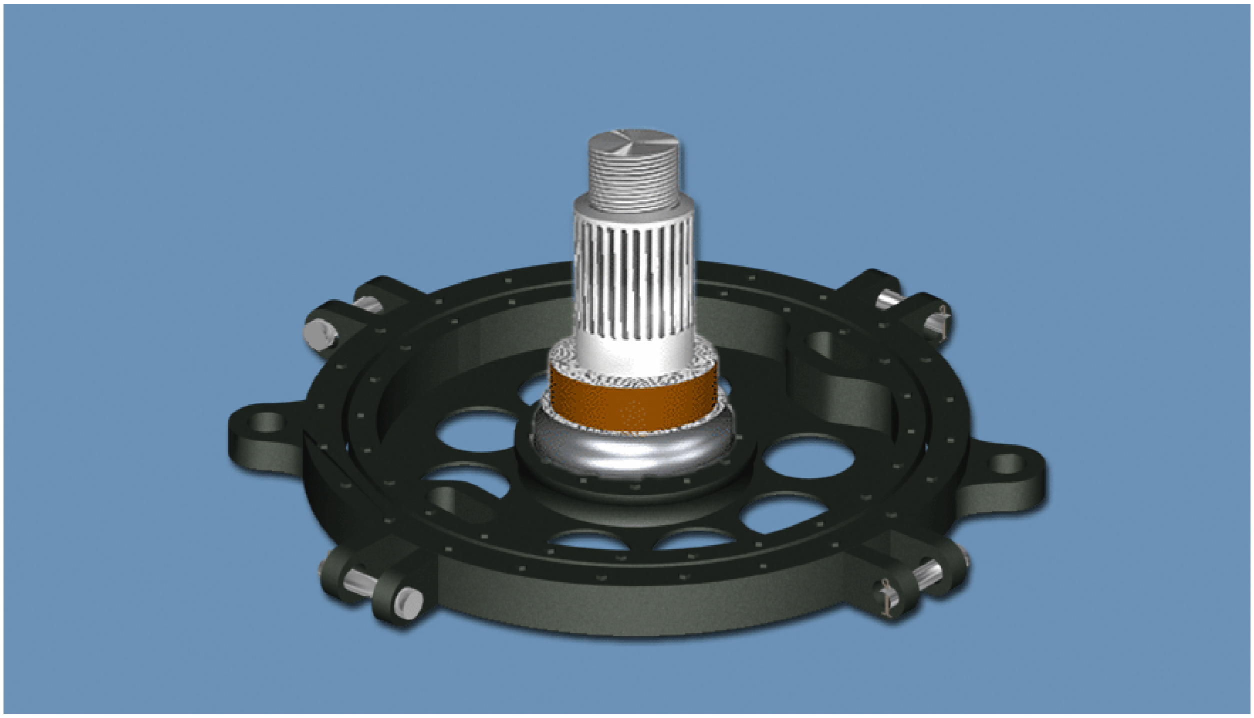
2) The swashplate transmits flight control movements to the main rotor head through the four pitch control rods.

Frame #0420 (Main Rotor Swashplate Flash)



3) The swashplate is permitted to slide vertically on the main rotor shaft and tilt in any direction following the motion of the flight controls.

Frame #0425 (Main Rotor Swashplate Components)

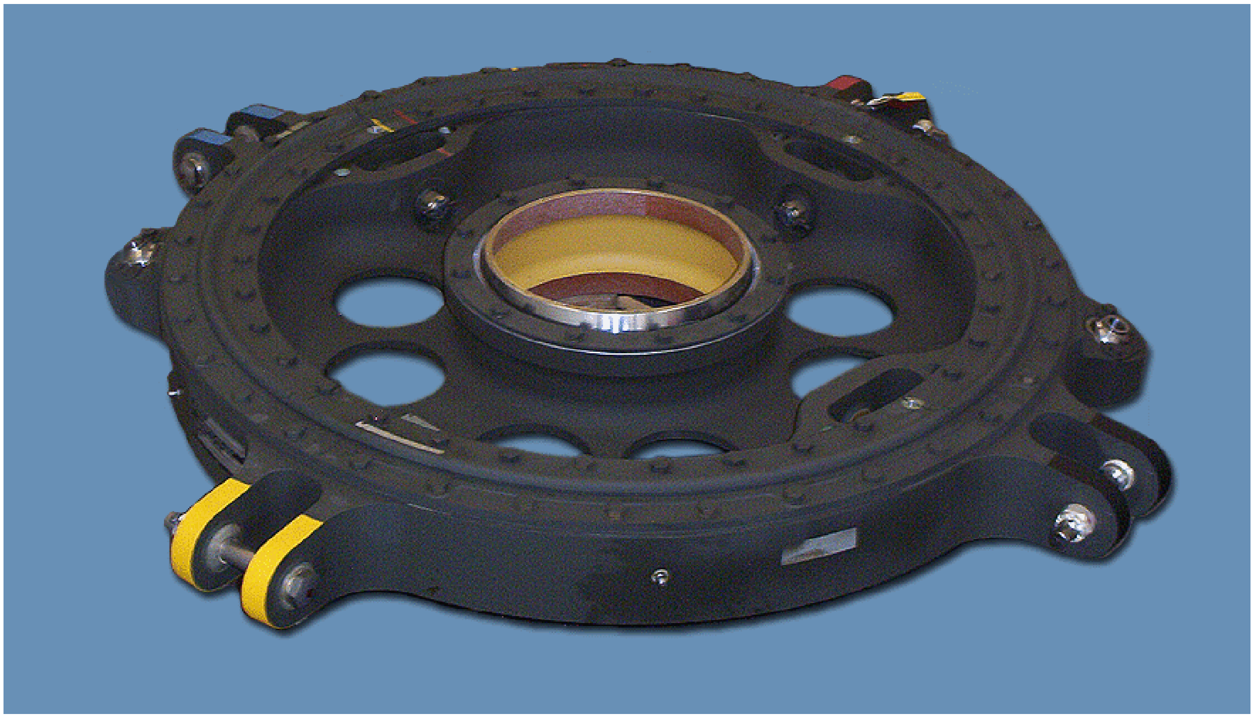


4) The stationary swashplate contains a spherical bearing (uni-ball), which allows motion between the swashplate guide and the swashplate.

Frame #0425 (Swashplate Guide)

5) The swashplate guide directs the movement of the swashplate as collective inputs are made to the main rotor system.

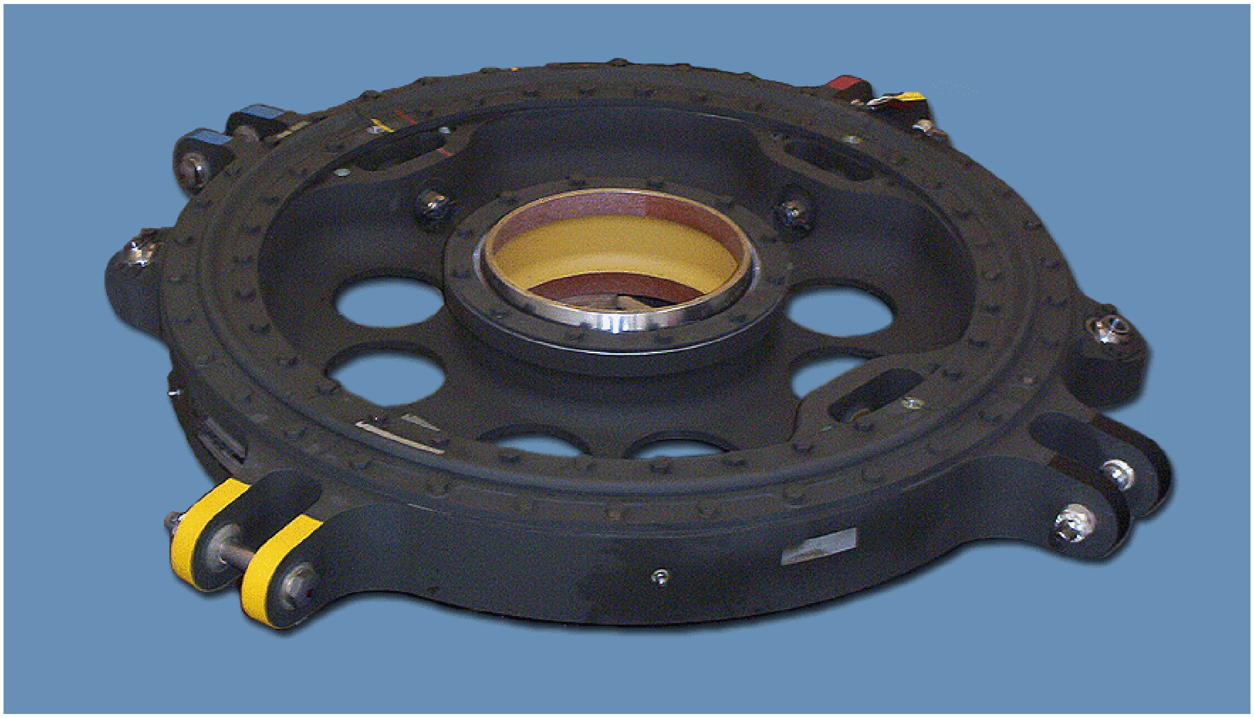
Frame #0425 (Swashplate Teflon Liner)



6) To maintain smoothness of motion, there is a Teflon liner between the swashplate guide to uni-ball, and the uni-ball to swashplate.

a) Servo Links

Frame #0430 (Servo Links)

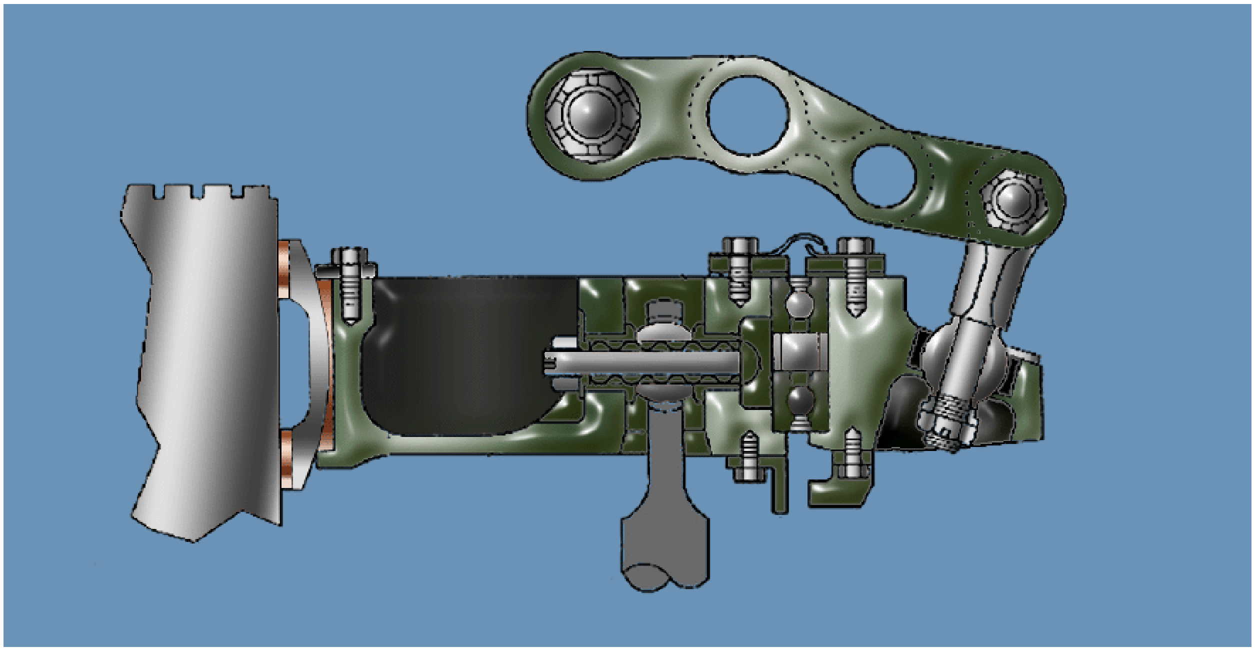


1 There are three servo links (forward, aft and lateral) which attach to the inner stationary ring of the swashplate.

2 These links transmit the inputs from the cockpit to the swashplate.

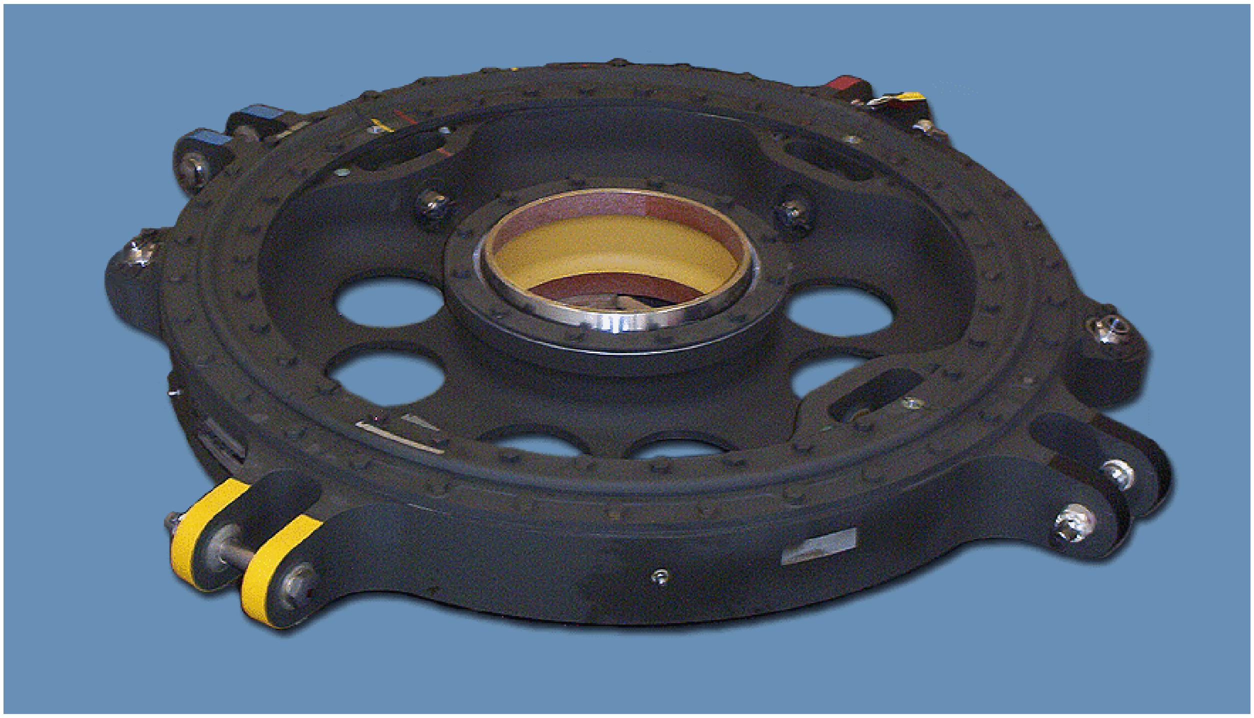
b) Duplex Bearings

Frame #0435 (Duplex Bearings)



1 Contained between the stationary and rotating discs of the swashplate are duplex bearings packed in grease.

Frame #0435 (Duplex Bearings Location)

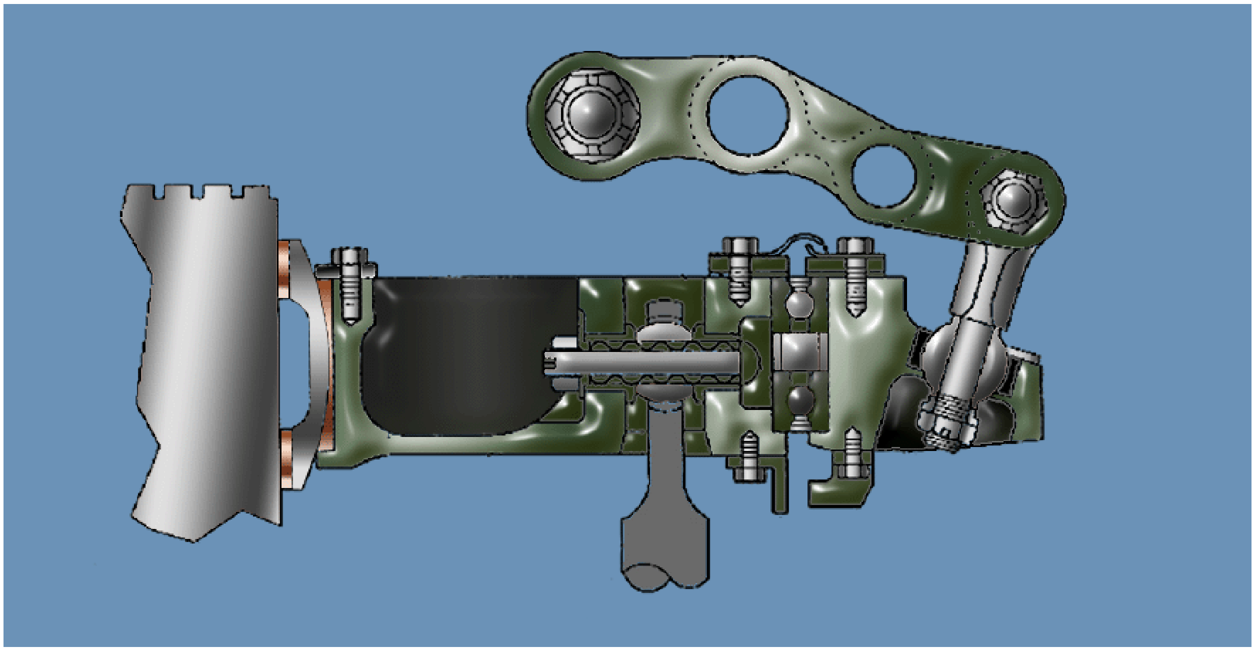


2 When inspecting the swashplate for signs of wear of the duplex bearings, visually inspect the rotating and stationary disks at the stationary bearing retaining plate for metal particles in extruded grease.

3 Extruded grease is not a cause for replacement of the swashplate however, if metal particles are found in the grease, replace the swashplate and have it tagged with the reason for removal.

c) Uni-Ball Bearing

Frame #0440 (Uni-Ball Bearing)



1 A collective chatter (ratcheting) in the flight controls is an indication of binding between the uni-ball and the swashplate guide.

Frame #0445 (Swashplate Guide)

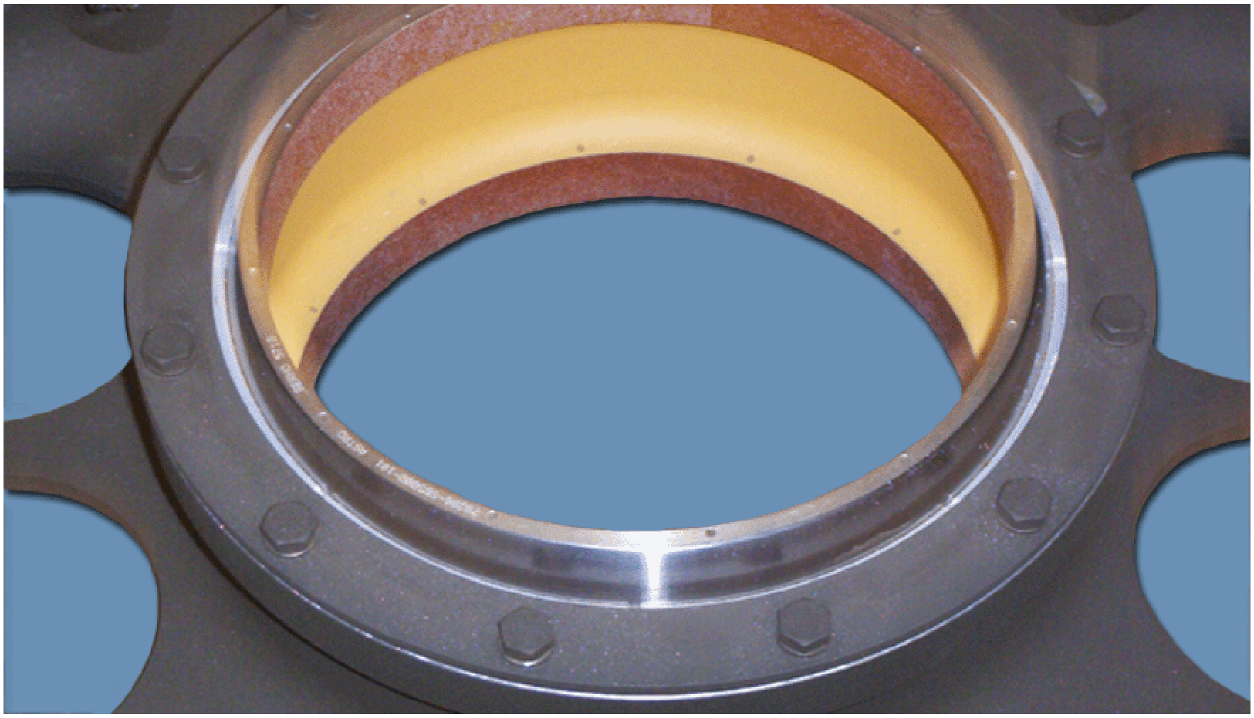
7) Position the swashplate to allow the maximum exposure of the swashplate guide.

8) Check the plated surfaces of the bearing.

9) If they show signs of metal-to-metal contact, or peeling of the plating greater than 1/4 inch in diameter in more than two places, replace the swashplate guide.

a) Uni-Ball Bearing Teflon Liner

Frame #0450 (Uni-Ball Bearing Teflon Liner)

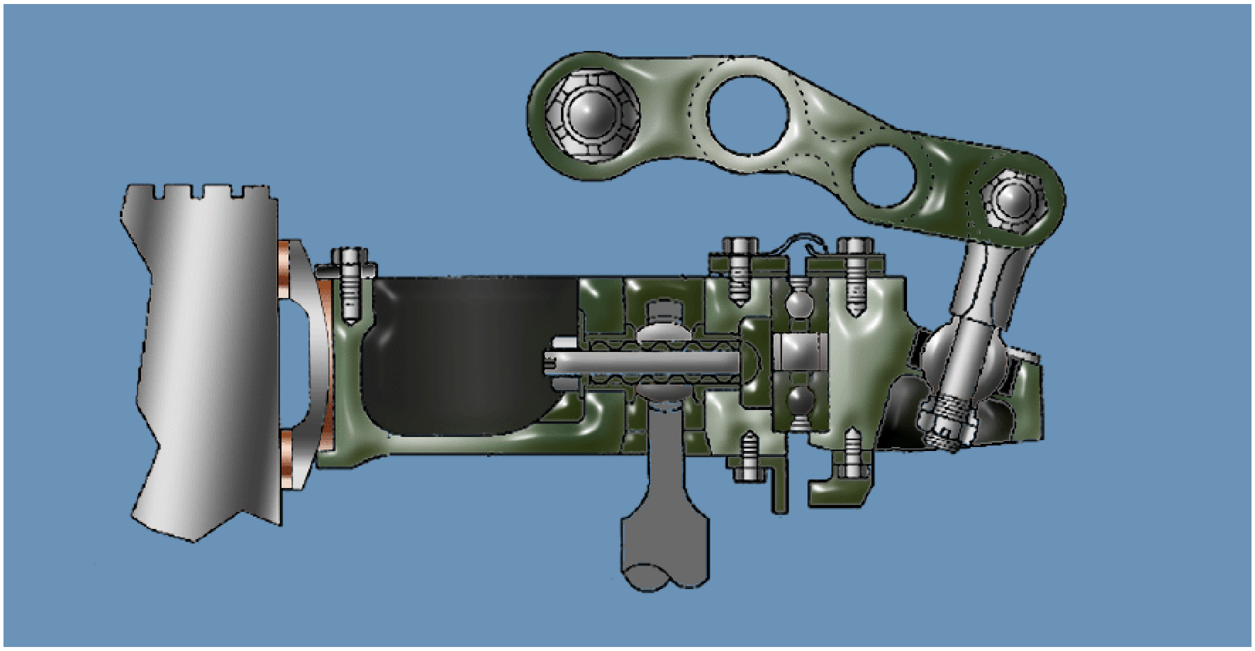


1 Inspect the Teflon surfaces of the uni-ball bearing for debonding or separation of Teflon from the uni-ball, or outer race; or pieces of the Teflon coming out of the bearing.

2 If there is debonding or separation of the Teflon, replace the uni-ball bearing.

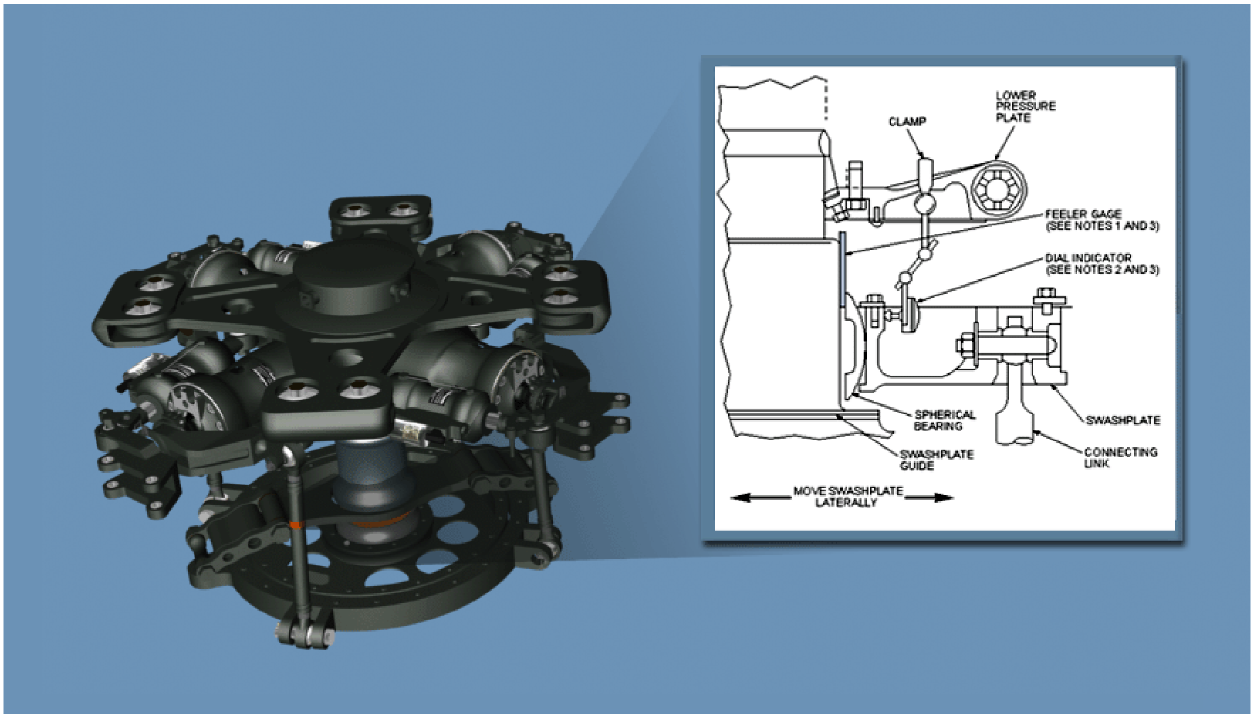
b) Uni-Ball Bearing Inspection

Frame #0455 (Uni-Ball Bearing Inspection)



1 A cyclic chatter (ratcheting) in the flight controls is an indication of binding between the uni-ball and stationary swashplate.

Frame #0460 (Uni-Ball Bearing Inspection 2)



2 Clamp a dial indicator on the lower pressure plate.

3 Place the indicator probe on the swashplate guide as near as possible to the inner ring of bolts.

4 The probe must be at a 90º angle to the main rotor shaft.

5 Disconnect the input connecting links from the swashplate and carefully insert the feeler gauge between the bearing and swashplate guide, locking out any play from the inner race.

6 The feeler gauge must be located directly in line and above the indicator on the assembly.

7 Move the swashplate assembly laterally by pushing and pulling on the assembly.

8 Read the indicator when the swashplate is pushed; then read the indicator when the swashplate is pulled.

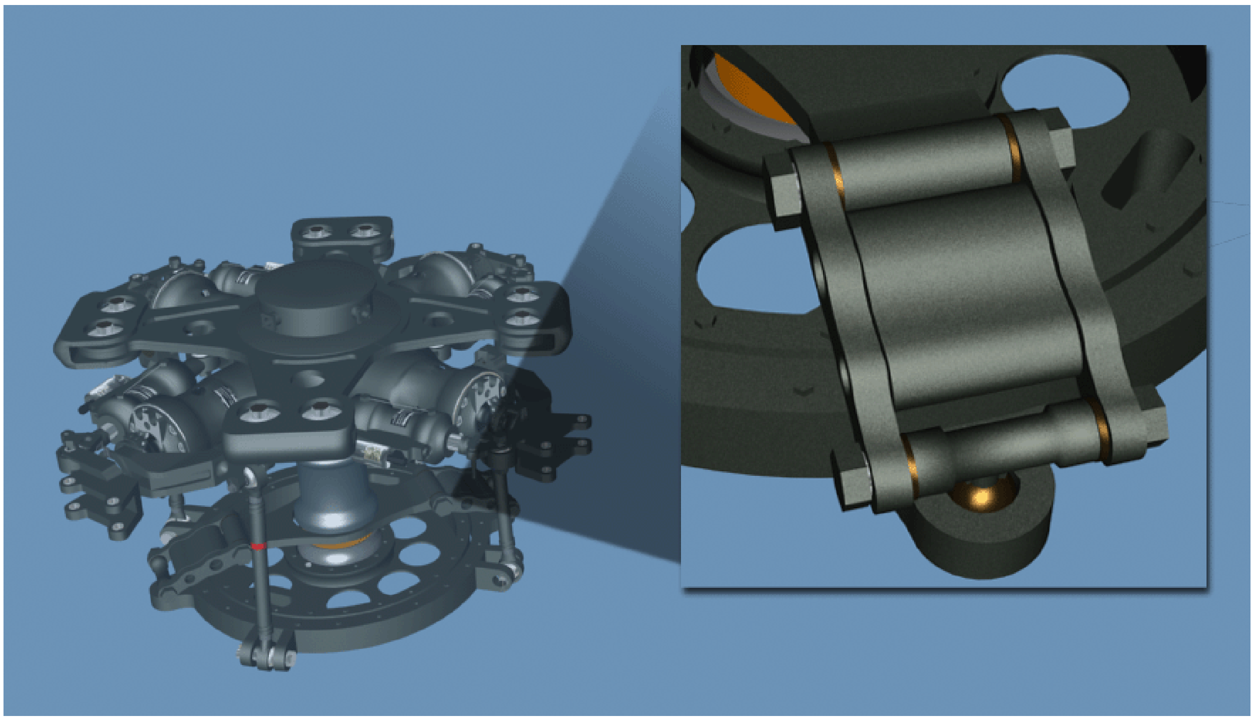
9 The gap will be the difference between the two readings.

10 The maximum gap allowed is 0.012 inch and no metal-to-metal contact is permitted.

11 If either limit is exceeded, replace the uni-ball bearing.

c) Rotating Scissors

Frame #0465 (Rotating Scissor)

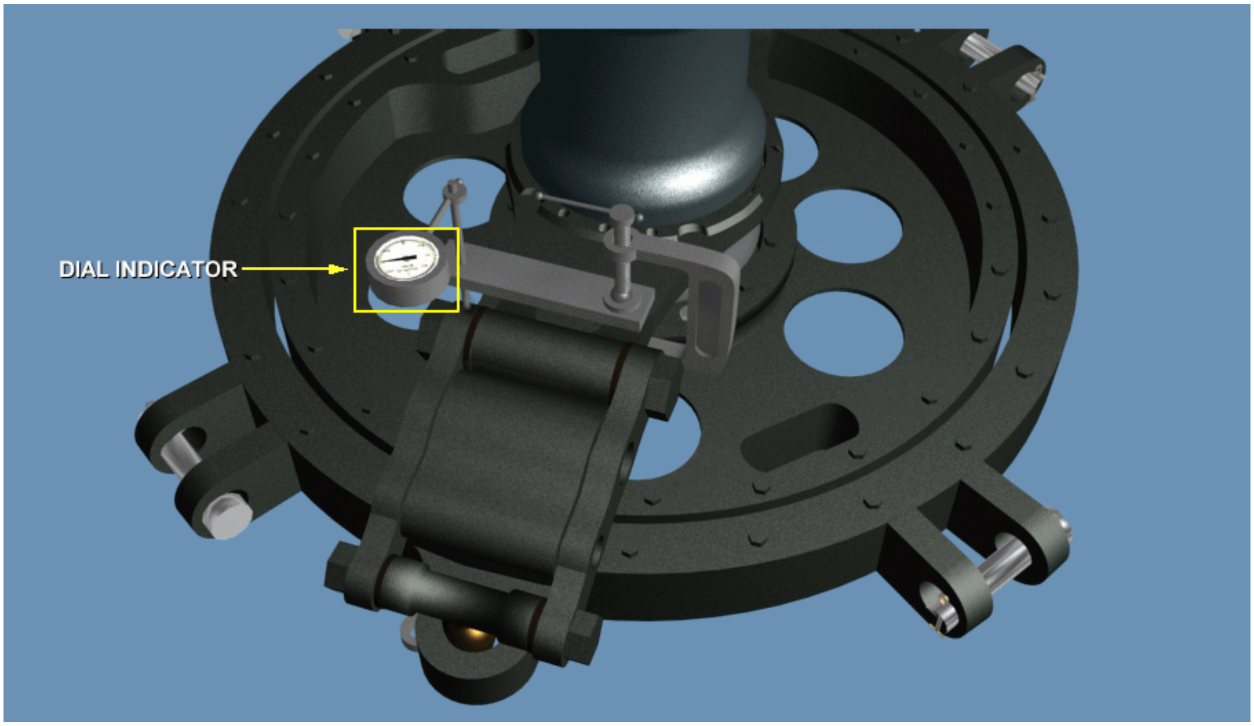


1 The main rotor scissors are connected to the swashplate and the lower pressure plate.

2 The rotating scissors change non-rotational input into rotational output to the main rotor head.

d) Rotating Scissors Upper Link Inspection

Frame #0475 (Rotating Scissors Upper Link Inspection Flash)



1 Before inspecting the rotating scissors bearing, rotate the swashplate and scissors in the direction of rotation to make sure there is no load on the rotating scissors upper link.

2 Clamp the dial indicator to the pressure plate lug.

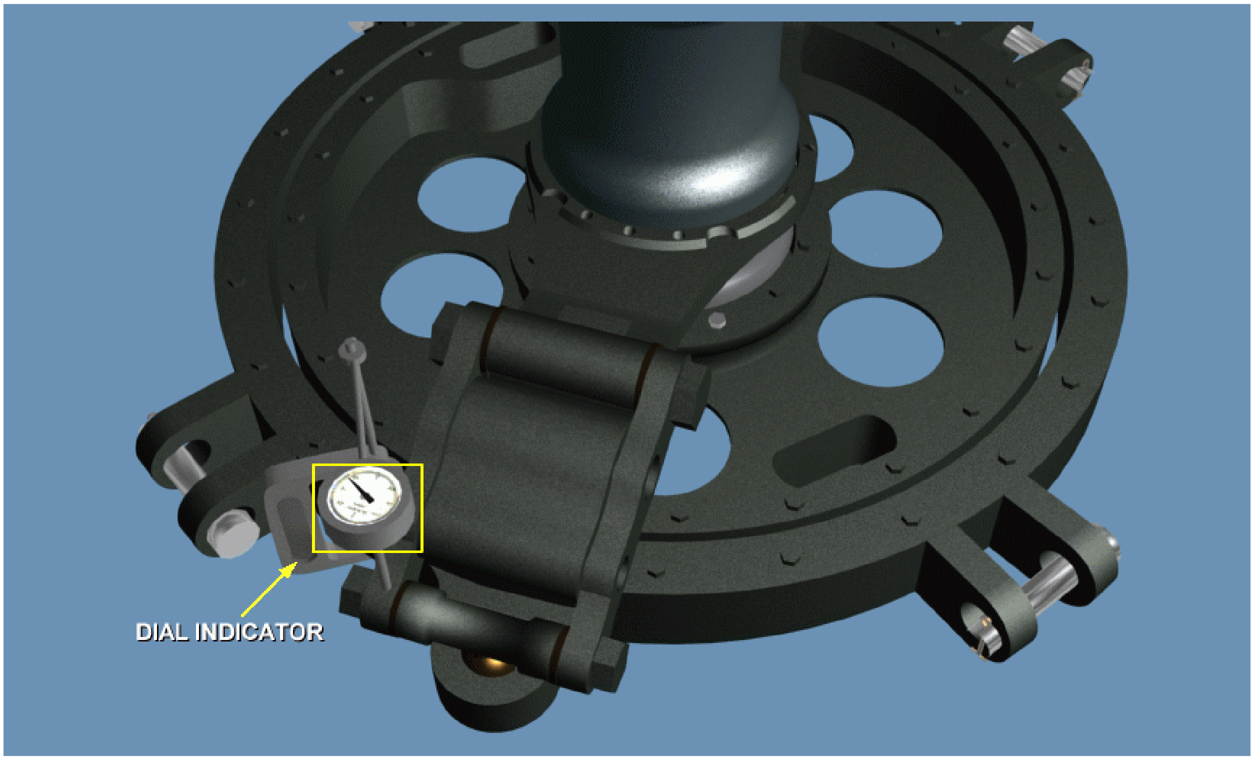
3 Move the rotating scissors upper link up and down at the indicator.

4 Radial play as shown on the indicator must not be more than 0.012 inch.

5 If play is more, the bearings require replacement.

e) Rotating Scissors Lower Link Inspection

Frame #0475 (Rotating Scissors Lower Link Inspection)



1 Clamp the dial indicator to the lower link.

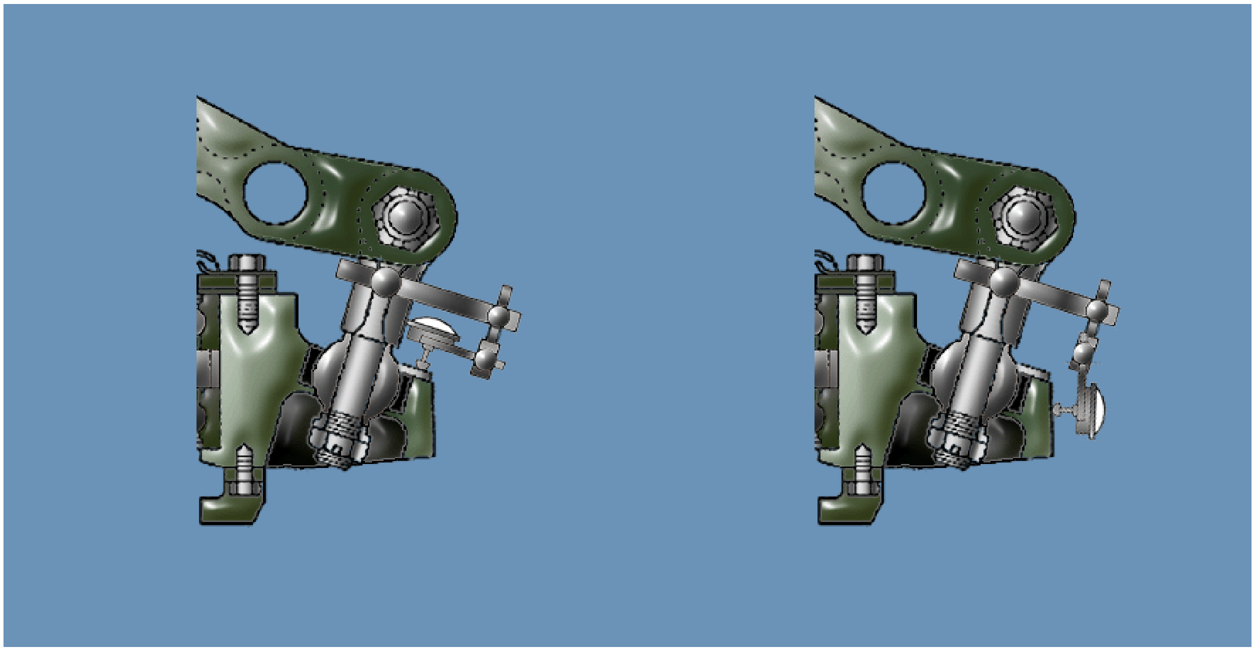
2 Move the lower link up and down at the indicator.

3 Radial play must not be more than 0.012 inch.

4 If play is more, the bearings require replacement.

f) Rotating Scissors Spherical Bearing Inspection

Frame #0480 (Rotating Scissors Spherical Bearing Inspection)



1 When inspecting the scissors attachment spherical bearing, there are two steps to the inspection.

2 Step 1 is checking for axial play and step 2 is checking for radial play.

3 When checking for axial play, place the collective is in the full down position.

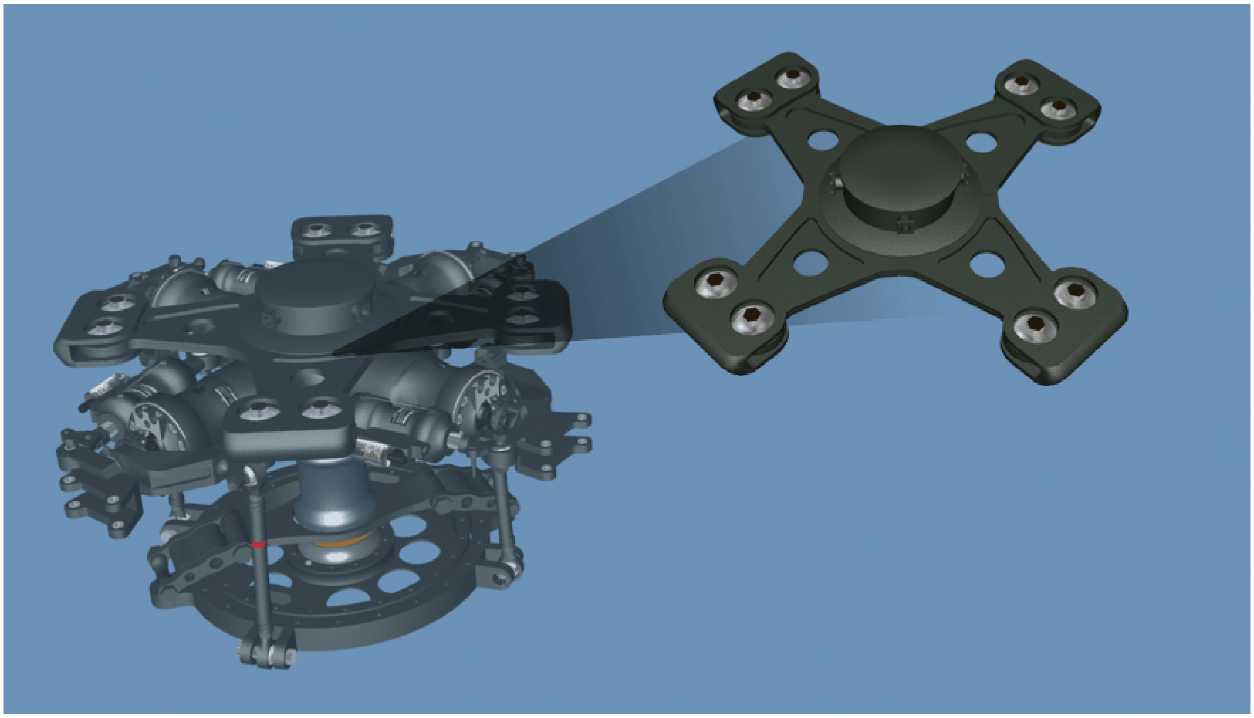
4 Clamp a dial indicator to the scissors lower link and move the link up and down as shown in the graphic above, measuring the amount of play.

5 For step 2, adjust the dial indicator position and move the link as shown in the graphic above.

6 Should the measured play of either step exceed acceptable limits, replace the bearing.

(f) Bifilar Assembly

Frame #0485 (Main Rotor Bifilar)



1) The bifilar assembly is a vibration absorber located on top of the main rotor hub.

2) The bifilar assembly contributes to the life of all components and provides a smoother ride for the crew and passengers.

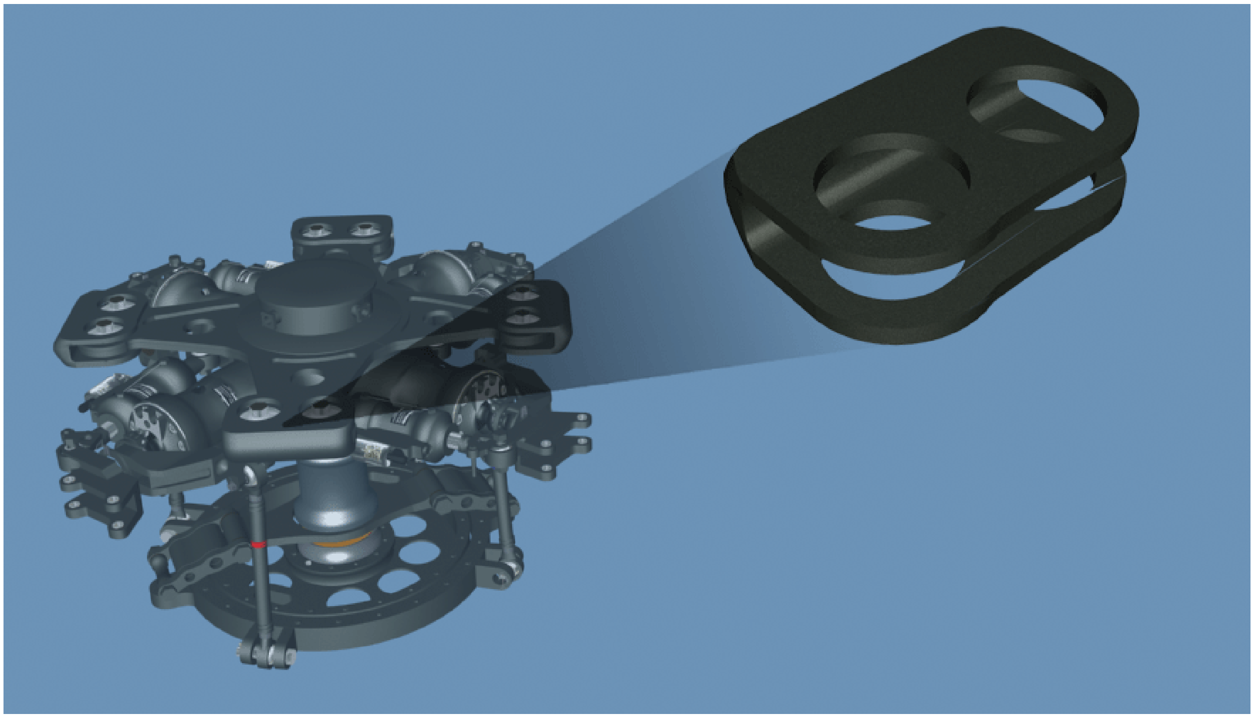
3) The bifilar is a cross shaped aluminum forging.

4) A steel weight pivots on two points at the end of each arm.

5) The bifilar also uses a "0" index mark to ensure proper installation.

a) Bifilar Weight

Frame #0490 (Bifilar Weight)



1 The bifilar weights have a bumper installed to prevent damage to the weight and bifilar assembly.

b) Bifilar Inspection

Frame #0495 (Bifilar Inspection)

1. Inspect the bifilar support arm for cracks.

2. For suspected cracks, use the fluorescent penetrant inspection kit.

3. If any cracks are found, replace the bifilar support assembly.

4. Inspect the bushing for wear.

5. Up to 0.030 inch wear of the original thickness is allowed.

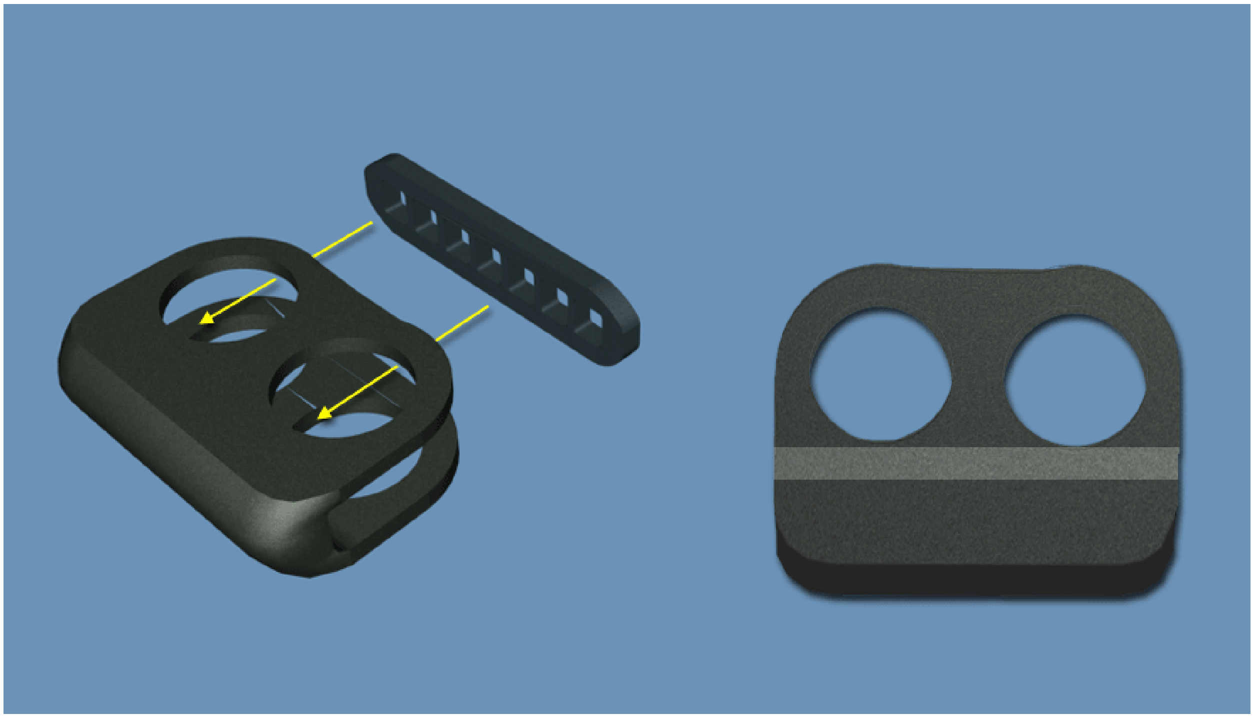
6. Use the part number of the bushing to identify the original thickness.

7. If the part number is not readable, use 0.050 inch as the original thickness.

8. Replace the bushing if wear is beyond limits.

c) Bifilar Weight Inspection

Frame #0500 (Bifilar Weight Inspection)



1 The inspection of the bifilar weight is broken into areas A, B, C, D, and the Bumper Pad.

2 Inspect AREA "A" of the bifilar weight for nicks, gouges or cracks. Nicks and gouges, no more than 0.150 inch deep are acceptable. If cracks are found, the bifilar weight requires replacement.

3 Inspect AREA "B" for nicks, gouges or cracks. Corner nicks and gouges, no more than 0.10 inch deep and surface nicks and gouges shall not exceed 0.030 inch deep are acceptable. If cracks are found, the bifilar weight requires replacement.

4 Inspect AREA "C" for nicks, gouges and cracks. If cracks are found, the bifilar weight requires replacement.

5 When inspecting the bumper pad, if any damage is found, the bumper pad must be replaced.

d) Bifilar Tapered Washer Inspection

Frame #0505 (Bifilar Tapered Washer Inspection)

1 Check the tapered washer for damage.

2 In non-contact areas, damage 0.020 inch deep and corner damage up to 0.040 inch deep is acceptable.

3 Check the tapered washers for wear.

4 If more than 20% of the tapered washers contact surfaces are pitted, worn, or have metal pickup, replace the tapered washer.

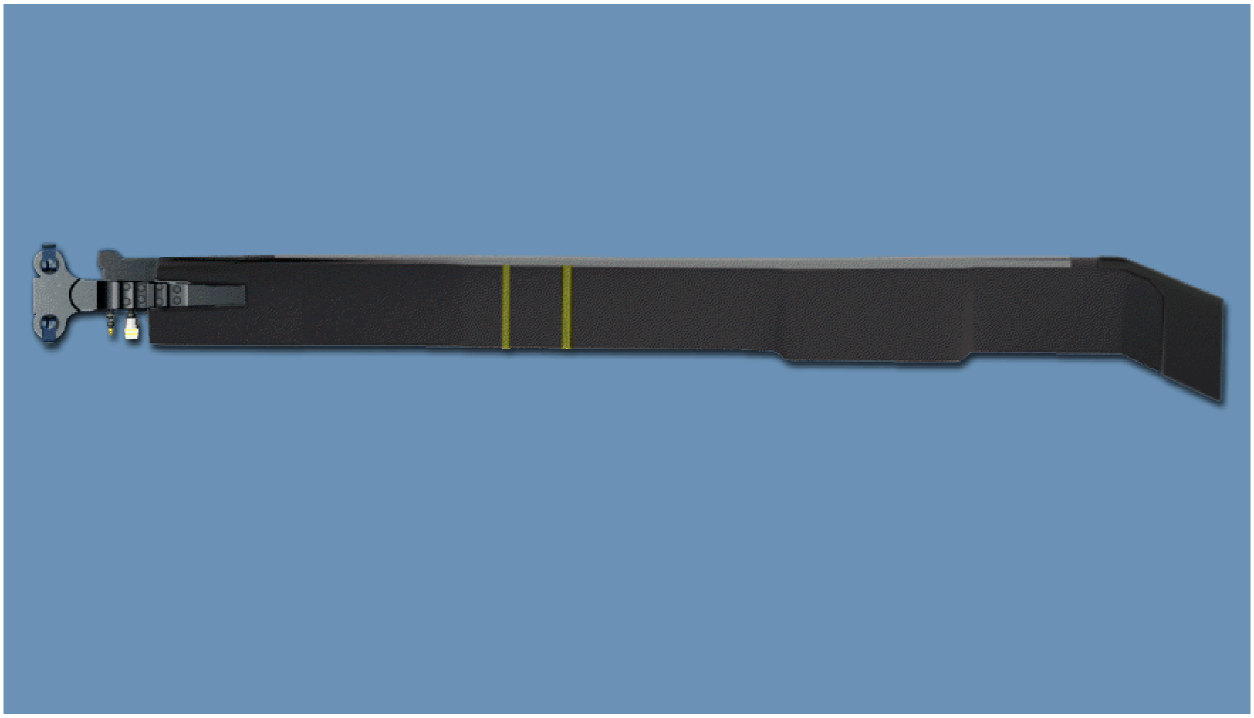
5 Even circular wear up to 0.020 inch deep is acceptable in contact areas between the bushings and tapered washers.

6 Visually check the washers for cracks, if a crack is suspected, conduct a fluorescent penetrant inspection.

7 If cracks are found, or any of the limits exceeded, replace the tapered washer.

(g) Rotor Blade

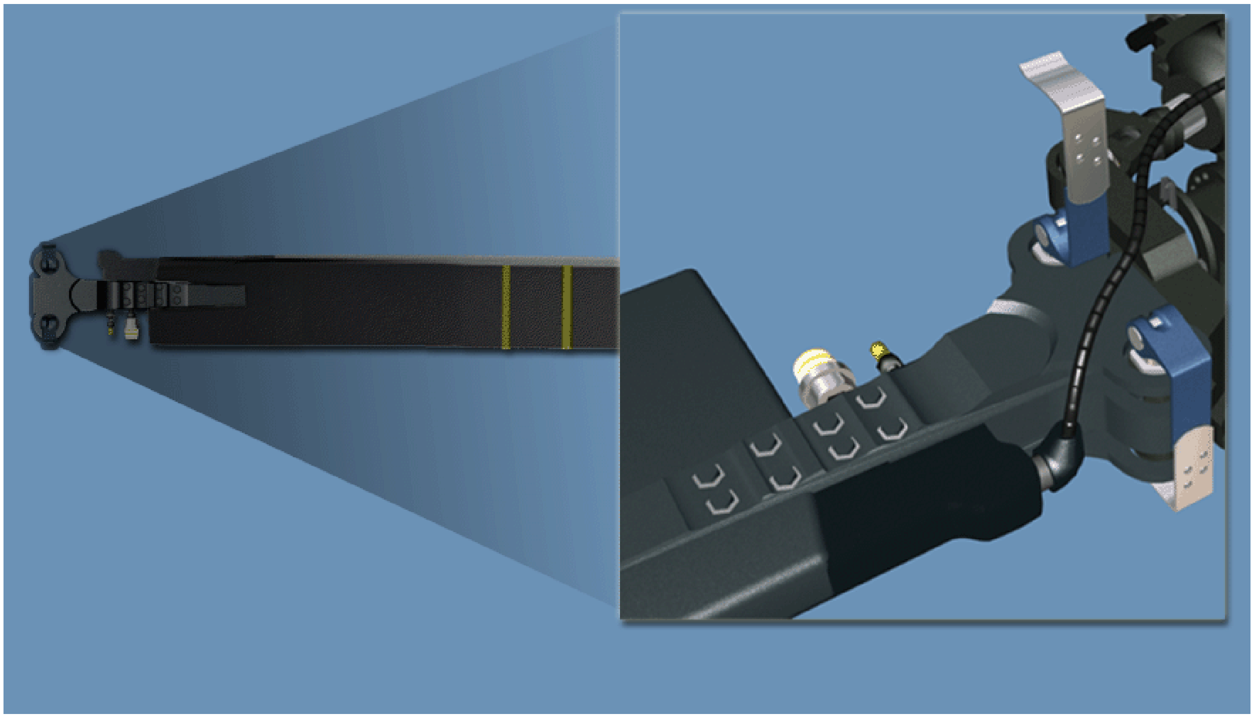
Frame #0600 (Main Rotor Blade)



1) The main rotor blade is 24 feet 4 inches in length, weighs 214 lbs and the rotor disk is 53 feet 8 inches.

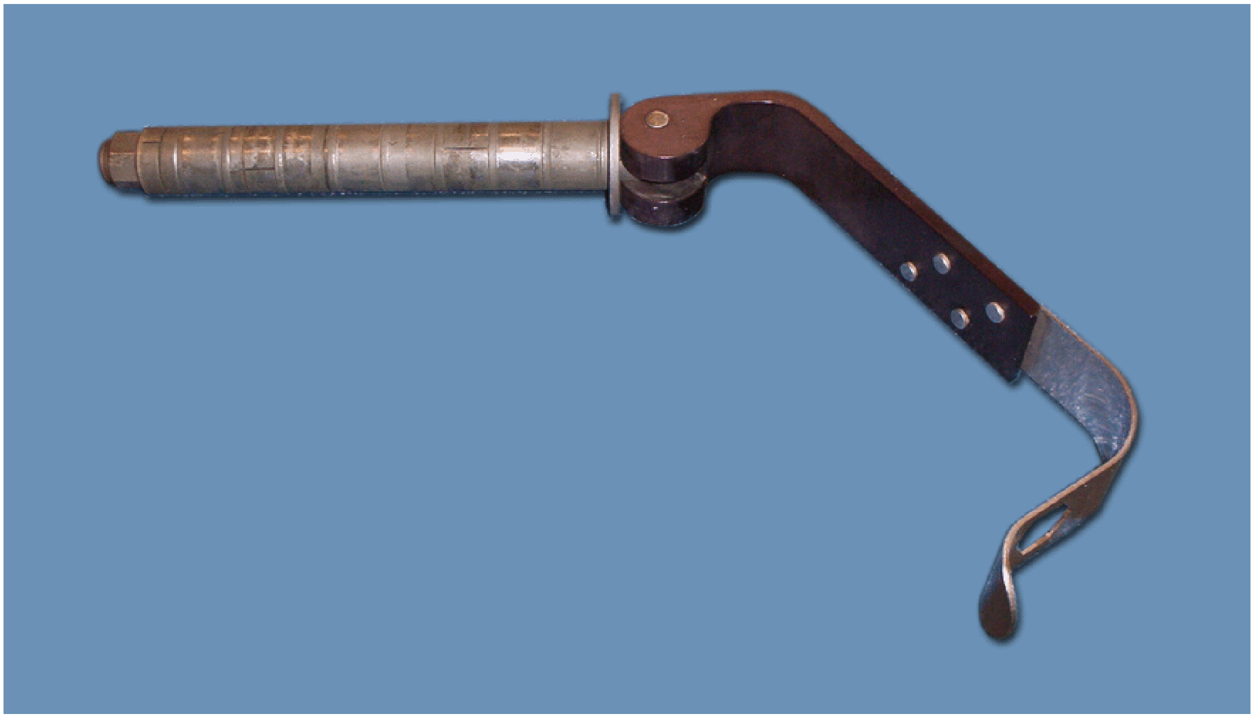
a) Main Rotor Blade Expandable Pins

Frame #0605 (Main Rotor Blade Expandable Pins)



1 The main rotor blade is attached to the spindle by two expandable pins.

Frame #0610 (Main Rotor Blade Expandable Pin)

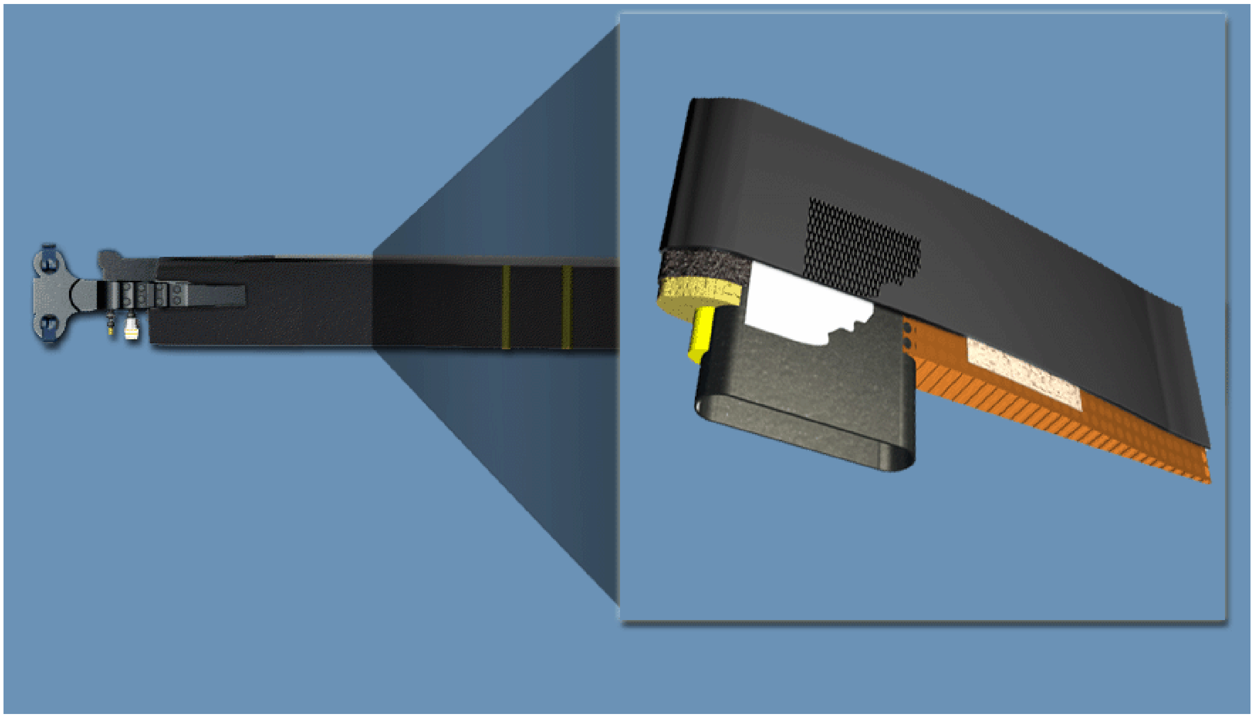


2 As the arm of the pin is opened or closed, the sleeves around the pin expand or contract to ensure a secure attaching point between the blade and the spindle.

3 Adjustments to the expandable pin are accomplished by the adjustment nut, located at the bottom of the pin.

b) Main Rotor Blade Construction

Frame #0615 (Main Rotor Blade Construction)



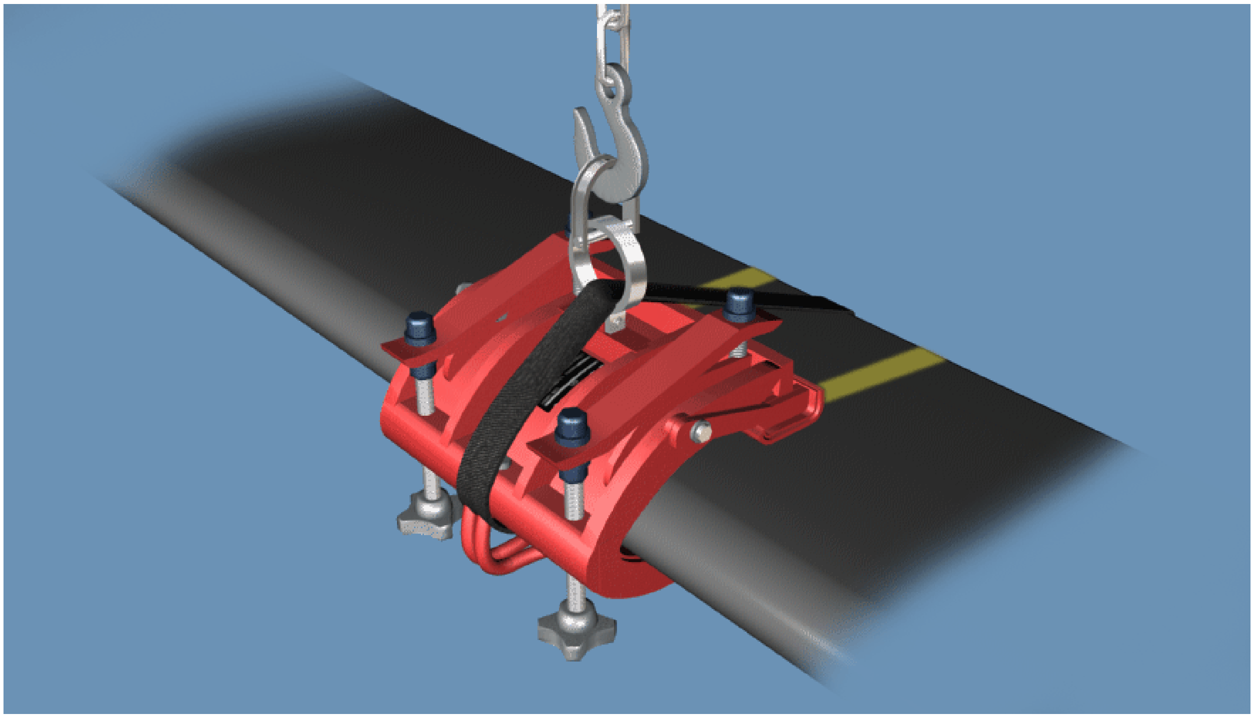
1 The main rotor blade is constructed with a one piece titanium alloy spar, nickel abrasive strip, wire mesh for lightening protection, heater mat for blade de-ice, and a honeycomb core.

c) Main Rotor Blade Removal

Frame #0620 (Main Rotor Blade Removal)

1 When removing a main rotor blade, position the blade being removed at the 9 o'clock position and engage the gust lock.

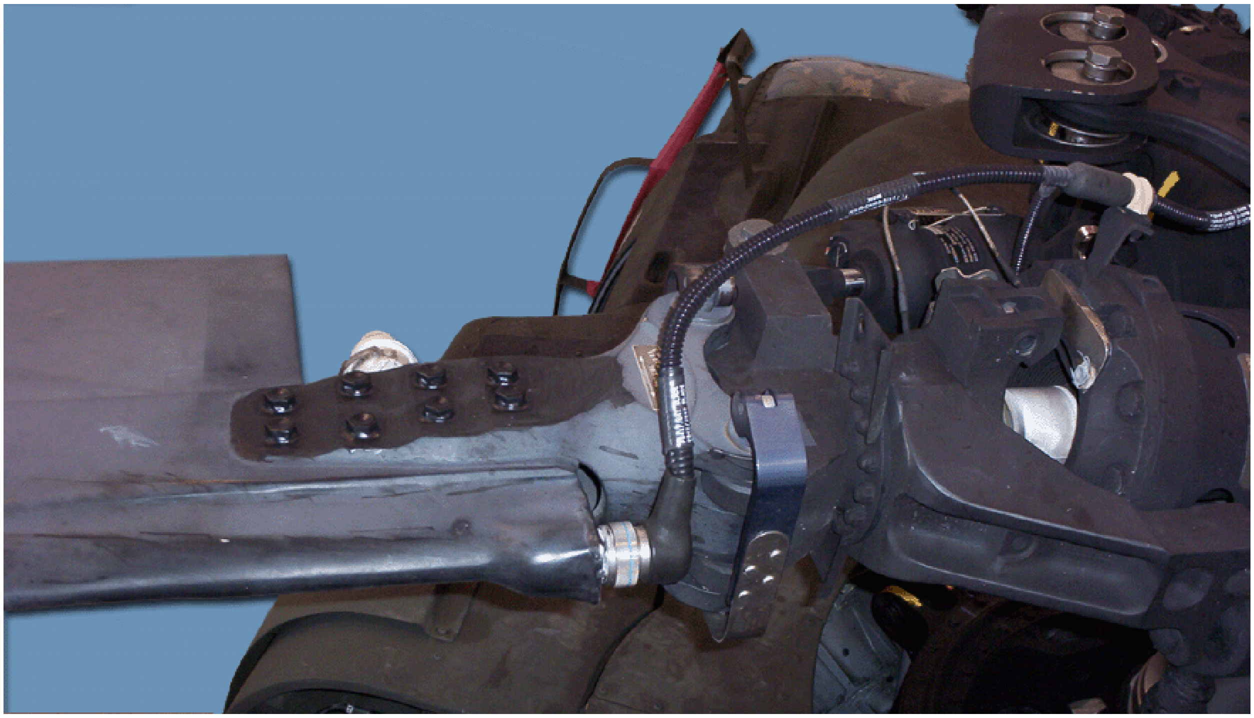
Frame #0625 (Main Rotor Blade Clamp)



2 Use the blade stripes on the main rotor blade to install the blade clamp.

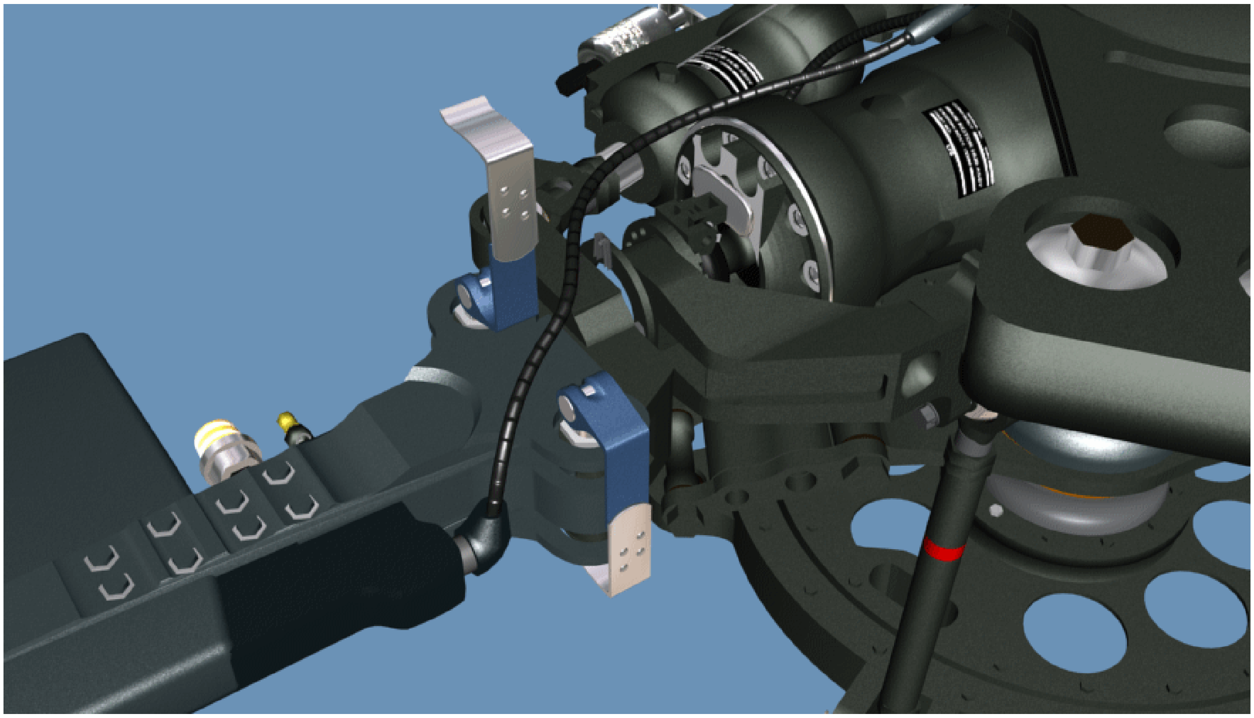
3 After the blade clamp has been installed, use a safety strap (cargo strap) to ensure the blade will not slip out of the clamp.

Frame #0630 (Main Rotor Blade Removal)



4 Disconnect the main rotor blade de-ice electrical connector and move the anti-flap cam to the flight position, securing it with a tie down strap.

Frame #0635 (Main Rotor Blade Removal 2)



5 Attach guide lines to blade cuff and blade tip.

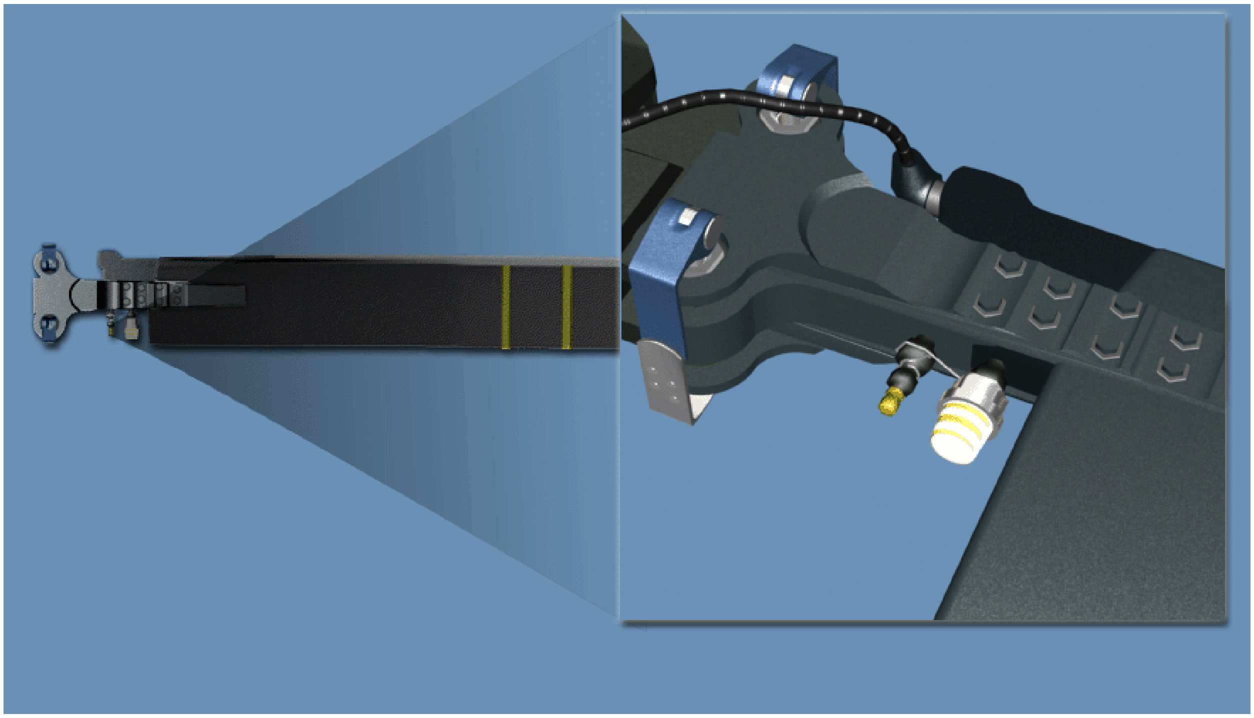
6 Position assistants at the blade tip and cuff to help guide the blade. Release (open) the expandable pins.

7 Relieve the load on the expandable pins by lifting the blade slightly until the expandable pins can be removed.

8 After the expandable pins have been removed, the blade may be removed from the main rotor head and carefully placed on a blade stand or on padding.

d) Main Rotor Blade Spar Indicator

Frame #0640 (Main Rotor Blade Spar Indicator)



1 A spar indicator is located on each blade at the root end of the trailing edge.

2 This indicator provides a visual indication when the spar structural integrity is degraded.

3 If a spar cracks or a seal leaks, the nitrogen will escape from the spar.

4 When pressure drops below the minimum, the indicator will show red bands.

5 The spar indicator, Blade Indication Method (BIM), compares a reference pressure built into the indicator to the pressure within the spar.

6 This compensates for temperature changes.

e) BIM Indicators

Frame #0645 (BIM Indicators)

CAUTION: Do not hold indicator, as heat of hand may change internal reference pressure and result in erroneous indicator reading.

1 When using the self test on the BIM indicator, press and hold the manual lever.

2 If the indicator is operating properly, a full red (unsafe) indication will show within 10 to 30 seconds.

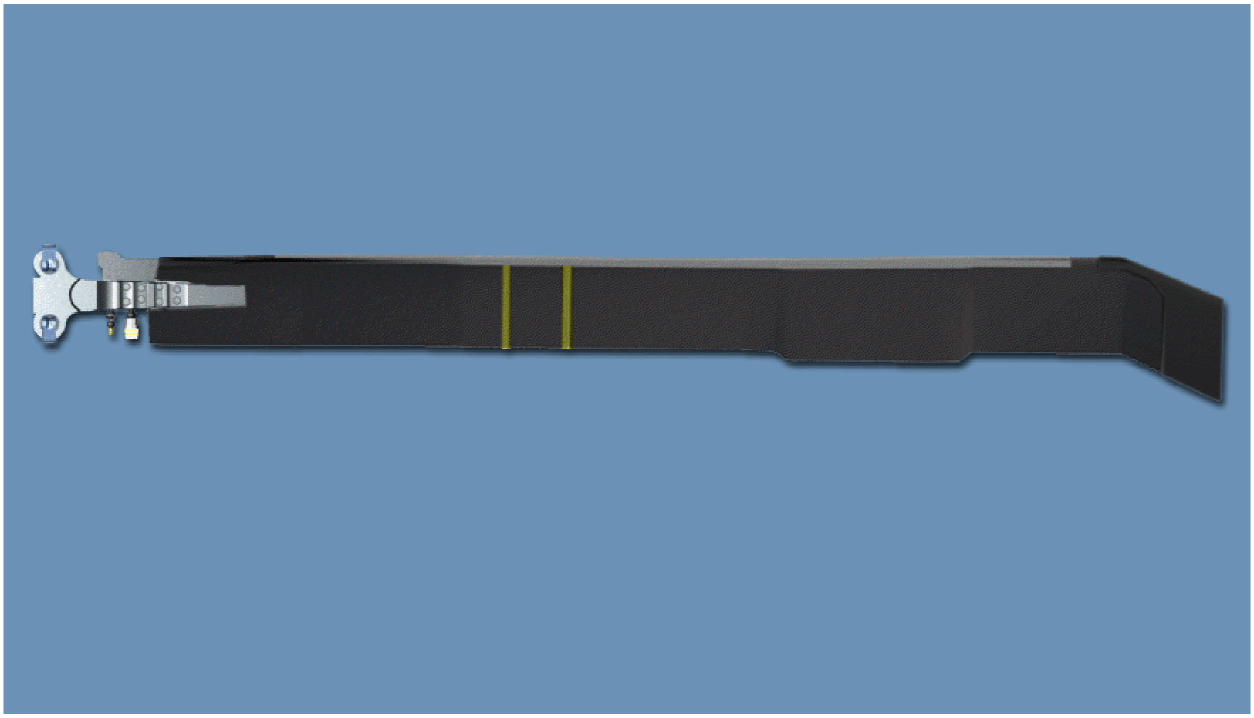
3 When the lever is released, the red indication will return to the yellow (safe) indication immediately.

4 When conducting a pre-flight, do not depress the manual lever.

5 Depressing the manual lever allows nitrogen to escape the spar.

f) Main Rotor Blade Servicing

Frame #0650 (Main Rotor Blade Servicing)



NOTE: If blade, equipment, or nitrogen tank is moved to an area of different temperature before servicing, for accurate servicing in accordance with measured blade spar temperature, allow enough time for temperature of these items to stabilize. For example, if temperature change is from -17.8º to 21.1 ºC (0º to 70 ºF), allow 5 hours for temperature of nitrogen in blade, equipment, or tank to stabilize.

Do not attempt to measure spar pressure with blade exposed to sunlight. Solar heating of blade can raise spar pressure by over 2 psi above free-air-temperature pressure, resulting in an inaccurate spar pressure measurement. Allow a minimum of 90 minutes after removing blade from sunlight, for blade spar temperature to stabilize, before measuring pressure in spar.

When helicopter is to be operated in extreme cold temperatures, generally below 0 ºF (-17.8 ºC), the blade may be serviced to 1 psi over the maximum allowable pressure for the ambient temperature at the time of servicing. Servicing must be performed in controlled climate environment, otherwise the additional 1 psi should not be added. Allow time for temperature to stabilize when the blade has been exposed to outside air temperature.

1 Before servicing a main rotor blade, it is important to know the temperature and location of the blade, and or servicing equipment prior to servicing.

Frame #0655 (Main Rotor Blade Servicing Table)

Blade Pressures Chart

Blade Spar Temperature (Note 1 and Note 5)		Permissible Blade Pressure (PSI) (Note 2, Note 3, and Note 4)			
Degrees C	Degrees F	Minimum When Checking Installed Blade	Minimum When Installing Blade	Minimum When Servicing Blade	Maximum
70 to 72	158 to 162	12.50	14.00	14.25	14.50
67 to 69	153 to 157	12.25	13.75	14.00	14.25
64 to 66	148 to 152	12.00	13.50	13.75	14.00
61 to 63	143 to 147	11.75	13.25	13.50	13.75
59 to 60	138 to 142	11.50	13.00	13.25	13.50
56 to 58	133 to 137	11.25	12.75	13.00	13.25
53 to 55	128 to 132	11.00	12.50	12.75	13.00
50 to 52	123 to 127	10.75	12.25	12.50	12.75
48 to 49	118 to 122	10.50	12.00	12.25	12.50
42 to 47	108 to 117	10.25	11.75	12.00	12.25
39 to 41	103 to 107	10.00	11.50	11.75	12.00
36 to 38	98 to 102	9.75	11.25	11.50	11.75
34 to 35	93 to 97	9.50	11.00	11.25	11.50
31 to 33	88 to 92	9.25	10.75	11.00	11.25
28 to 30	83 to 87	9.00	10.50	10.75	11.00
25 to 27	78 to 82	8.75	10.25	10.50	10.75
23 to 24	73 to 77	8.50	10.00	10.25	10.50
20 to 22	68 to 72	8.50	9.75	10.00	10.25
17 to 19	63 to 67	8.25	9.50	9.75	10.00
14 to 16	58 to 62	8.00	9.25	9.50	9.75
12 to 13	53 to 57	7.75	9.00	9.25	9.50
9 to 11	48 to 52	7.50	8.75	9.00	9.25
6 to 8	43 to 47	7.25	8.50	8.75	9.00
3 to 5	38 to 42	7.00	8.25	8.50	8.75
1 to 2	33 to 37	6.75	8.00	8.25	8.50
-5 to 0	23 to 32	6.50	7.75	8.00	8.25
-7 to -6	18 to 22	6.25	7.50	7.75	8.00
-10 to -8	13 to 17	6.00	7.00	7.25	7.50
-15 to -14	3 to 7	5.50	6.75	7.00	7.25
-18 to -16	-2 to 2	5.25	6.50	6.75	7.00
-21 to -19	-7 to -3	5.00	6.25	6.50	6.75
-24 to -22	-12 to -8	4.75	6.00	6.25	6.50
-27 to -25	-17 to -13	4.50	5.75	6.00	6.25

Blade Spar Temperature (Note 1 and Note 5)		Permissible Blade Pressure (PSI) (Note 2, Note 3, and Note 4)			
Degrees C	Degrees F	Minimum When Checking Installed Blade	Minimum When Installing Blade	Minimum When Servicing Blade	Maximum
-30 to -28	-22 to -18	4.50	5.50	5.75	6.00
-32 to -31	-27 to -23	4.25	5.25	5.50	5.75
-35 to -33	-32 to -28	4.00	5.00	5.25	5.50
-38 to -36	-37 to -33	3.75	4.75	5.00	5.25
-41 to -39	-42 to -38	3.50	4.50	4.75	5.00
-46 to -42	-52 to -43	3.25	4.25	4.50	4.75
-49 to -47	-57 to -53	3.00	4.00	4.25	4.50
-52 to -50	-62 to -58	2.75	3.75	4.00	4.25
-55 to -53	-67 to -63	2.50	3.50	3.75	4.00

NOTES

1. This table is for measured blade spar temperature with nitrogen in blade spar at a stabilized temperature. If blade is moved to an area of different temperature before servicing or checking spar pressure, allow enough time for temperature of nitrogen in spar to stabilize. For example, if temperature change is from 0°F(-18°C) to 70°F(21°C) , allow five hours for temperature of nitrogen in blade to stabilize. When servicing blade, also allow an equivalent period of time for temperature of equipment and nitrogen tank to stabilize.

2. Servicing pressures listed provide an allowance for normal nonsignificant leakage that can occur between servicing intervals, before blade pressure indicator will start to show red.

3. Pressure gage used in checking unit or checking and filling unit is an absolute pressure type. This means that gage, when not connected to blade, measures and indicates barometric pressure of the day in inches of mercury, but, when connected to blade, indicates in psi any pressure applied to it above that barometric pressure, up to a maximum of 20 psig. Pointer position may vary from day to day because of changes in barometric pressure. Pointer variance is a normal occurrence and should have no influence on use of checking unit or checking and filling unit. No attempt should be made to zero pointer.

4. It is not mandatory that spar pressure of each blade to be installed be checked against "MINIMUM WHEN INSTALLING BLADE" column if spar pressure has been checked within last 6 months. However, this practice is recommended to obtain maximum service from blade.

5. Round off measured blade temperature reading to nearest degree.

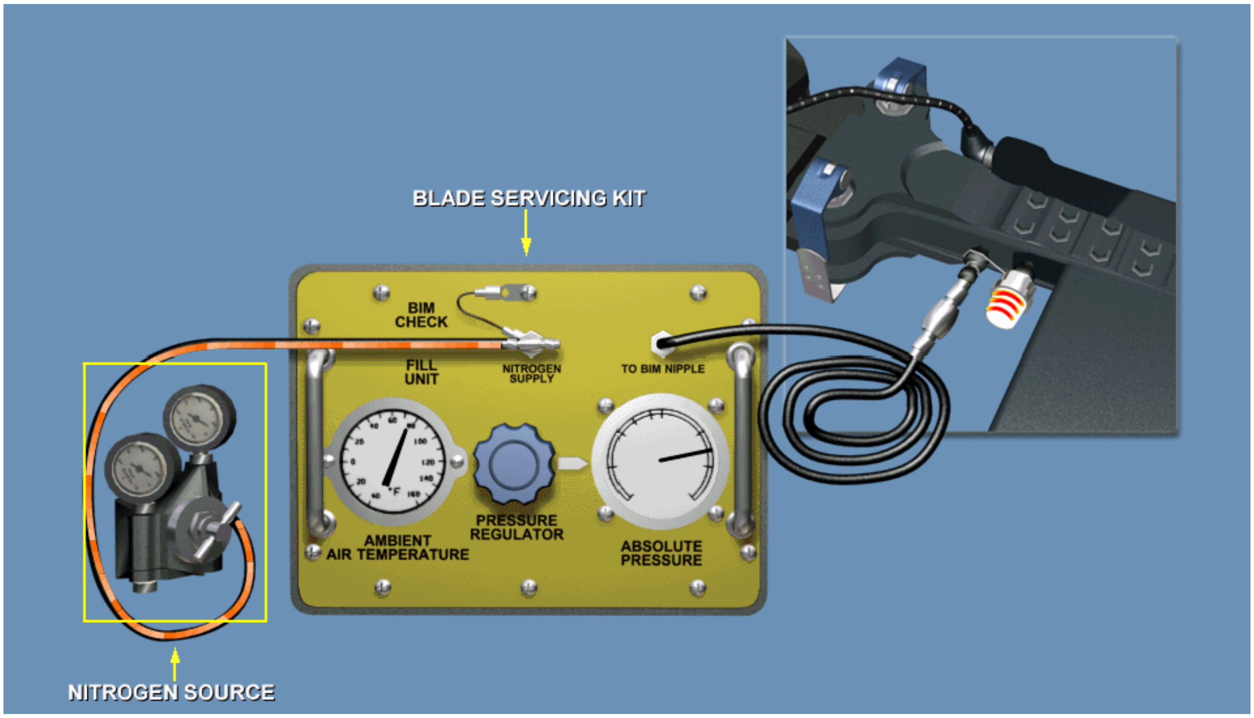
NOTE: The 10 to 30 second time limit applies when temperature is -6.7 ºC (20 ºF) or above. At any lower temperature, extend upper limit to the corresponding time listed.

2 Above is a blade servicing chart.

3 To properly service a main rotor blade, locate the correct temperature range and move from left to right on the chart to the Minimum and Maximum columns of When Servicing Blade.

4 Be sure the notes are observed when servicing a main rotor blade.

Frame #0660 (Main Rotor Blade Servicing 2 Flash)



5 The blade servicing kit is used to bring the nitrogen in the blade spar to the proper pressure.

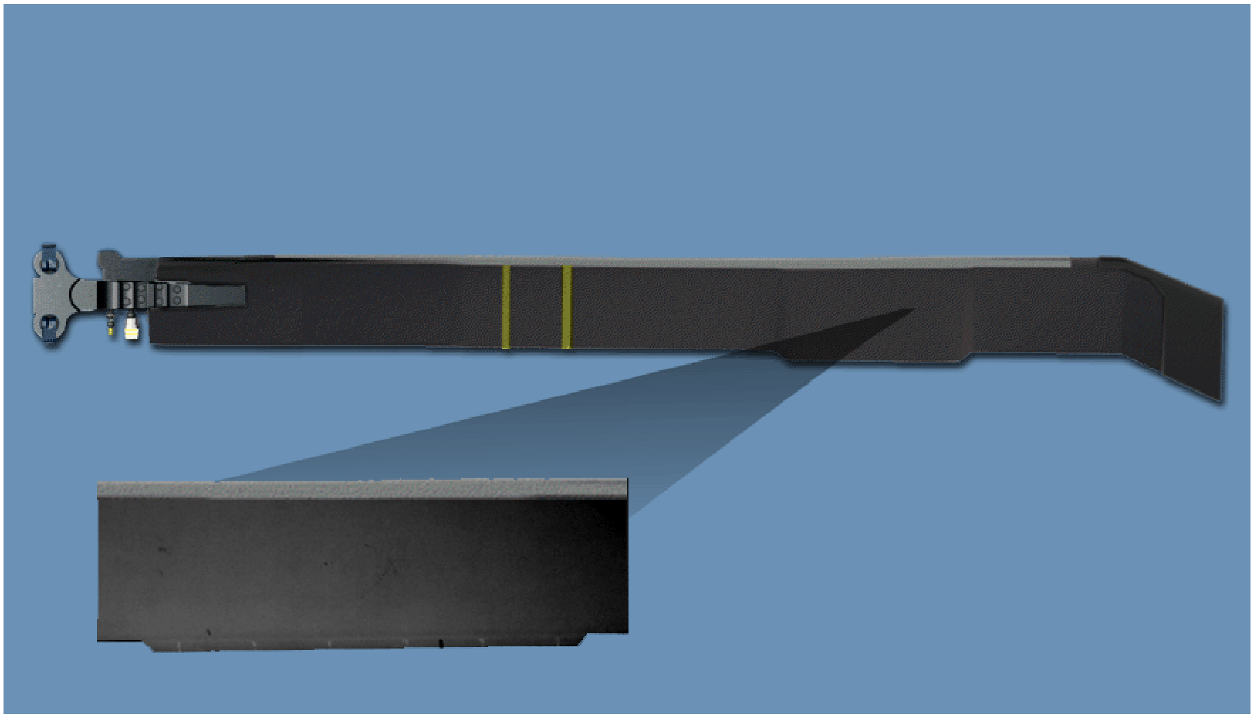
6 The nitrogen flows from the nitrogen tank, through the regulator into the blade servicing kit.

7 At the blade servicing kit, the pressure is adjusted to the proper absolute pressure and fed into the main rotor blade spar through the schrader valve.

8 As the nitrogen flows into the spar, the BIM indicates the spar is fully serviced.

g) Main Rotor Blade Trim Tab

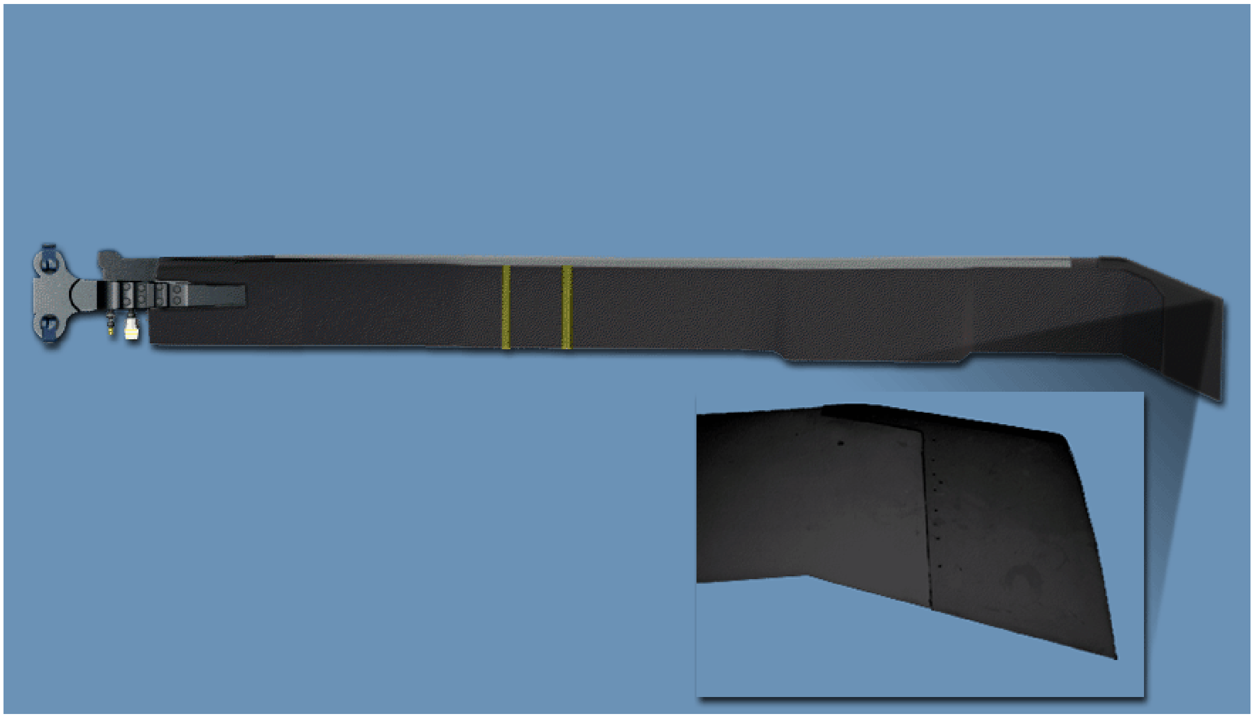
Frame #0665 (Main Rotor Blade Trim Tab)



1 A trim tab is located on the trailing edge of each blade to allow for rotor smoothing, and minimizing vibrations to the aircraft.

h) Main Rotor Blade Tip Cap

Frame #0670 (Main Rotor Blade Tip Cap)



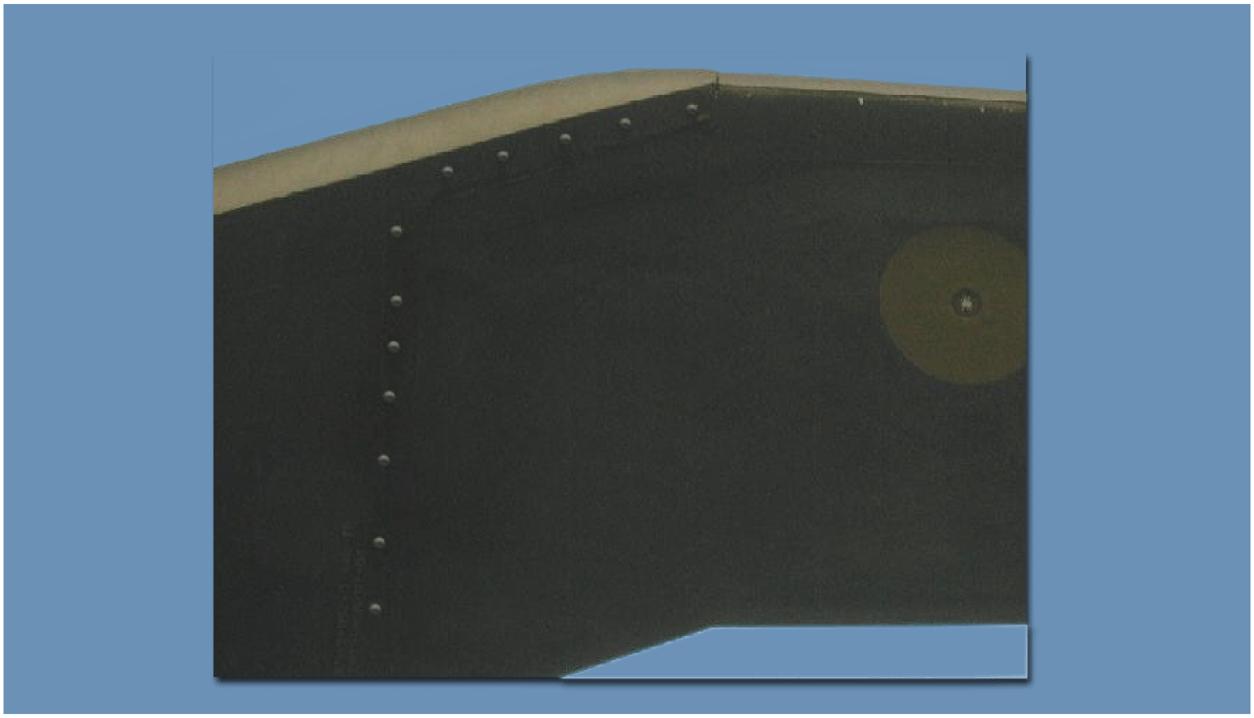
1 The tip cap is swept aft 20 degrees.

2 This reduces the vortices at the tip and permits forward air speed to be increased approximately 6 knots.

3 It also reduces the noise signature of the aircraft.

4 When inspecting the main rotor blade tip cap, only certain screws of the 24 mounting screws can be missing.

Frame #0675 (Main Rotor Blade Tip Cap Inspection)



5 No screws from positions 4-6 can be missing on either side.

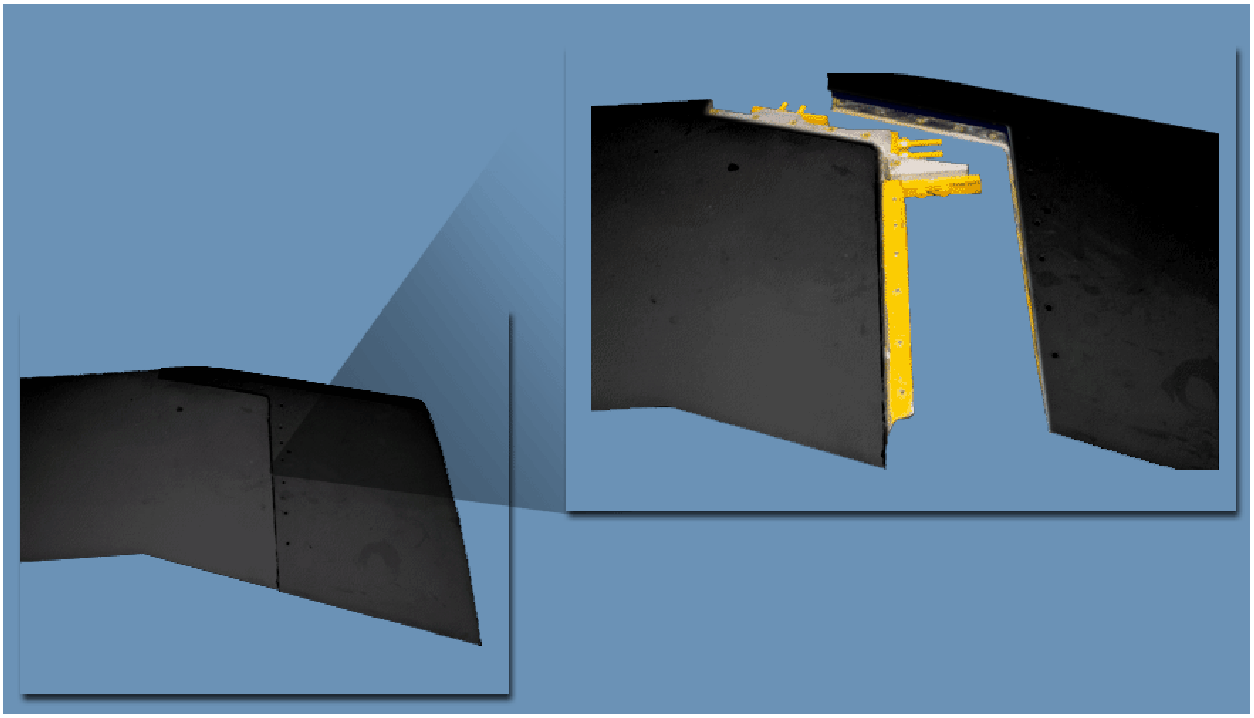
6 One screw from positions 1-3 may be missing from either side, but no more than one screw total.

7 One screw per set, from positions 7-12 may be missing from either side, for a total of no more than two screws.

8 The tip cap screws, when replaced or reinstalled, require a torque check after 9-11 flight hours IAW the appropriate TM.

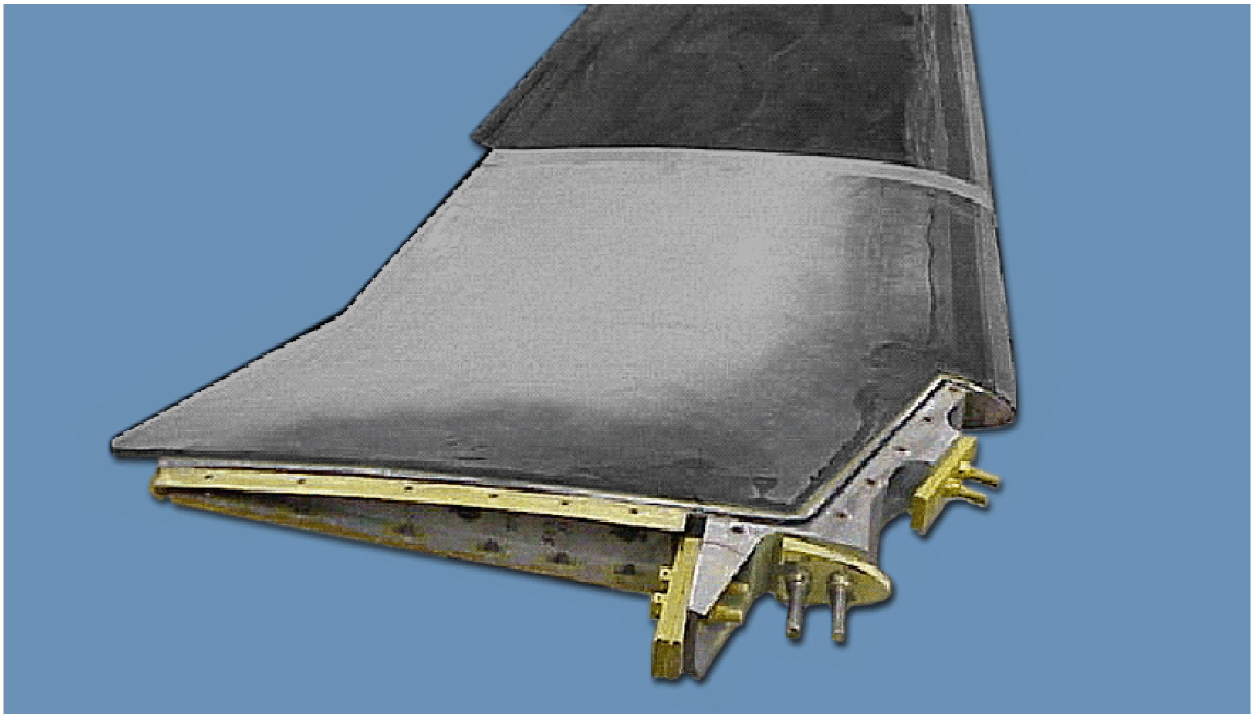
i) Main Rotor Blade Weights

Frame #0680 (Main Rotor Blade Weights)



1 Inside the tip cap is a chord and span weight for blade balance.

Frame #0680 (Main Rotor Blade Weight Location)



2 These weights are factory set and are not to be adjusted.

CHECK ON LEARNING

3.

1. Which of the following is one of the major subsystems of the main rotor system?

2. Flight control movement is transmitted through which component to the pitch control rods?

3. Which of the following is true about the wire mesh of the main rotor blade?

4. The purpose of the damper is to provide which of the following?

5. The main rotor hub and shaft extension are mounted, and centered to the lower pressure plate using which of the following?

6. When inspecting the elastomeric bearing of the main rotor spindle, which of the following is NOT a type of wear?

7. Which of the following is a true statement about servicing the damper?

8. Which of the following statements is true when installing a pitch control rod?

9. Which of the following statements is true concerning collective chatter in the flight controls?

10. When checking the BIM of the main rotor blade at 20 ºC (70 ºF), the safe/unsafe indication will show within how many seconds?

<u>SECTION IV. -SUMMARY</u>

1. REVIEW/SUMMARIZE:

You have completed the Main Rotor System component Identification lesson.
The key points to remember are:

- The main rotor system consists of seven major subsystems; the hub and shaft extension, spindle assembly, damper, bifilar assembly, pitch control rod, swashplate assembly, and rotor blade.
- The hub and shaft extension is the platform for all of the subsystems except the swash plate assembly.
- The spindle assembly allows blade movement about its axis for pitch change.
- The dampers restrain hunting (lead and lag motions) of the blades during rotation and absorb rotor head engagement loads.
- The bifilar assembly is a vibration absorber that contributes to the life of all components and provides a smoother ride for crew and passengers.
- Pitch control rods receive input initiated from the cockpit, creating changes in blade angles that allow the helicopter to move in the desired direction.
- Flight control movement is transmitted through the swashplate assembly to the four pitch control rods.
- The main rotor blade is constructed with a titanium spar, nickel abrasive strip, wire mesh for lightening protection, heater mat for blade de-ice and a honeycomb core.
- The main rotor hub is mounted to the shaft extension by an upper and lower pressure plate using two pairs of split cones.
- The index marks on the lower pressure plate, main rotor shaft extension, and the bifilar assembly are for alignment and balancing.
- For proper balancing, the split cones are a matched set and must be seated properly.
- When installing the lower pressure plate, the gap must be checked and within limits during each step of the installation.
- The main rotor head is divided into two torque zones; Zone I and Zone II.
- Elastomeric extrusion, debonding, and shim cracks are the three types of wear experienced by the elastomeric bearing.
- Improper servicing of the damper affects blade track and balance.
- Inspection procedures for the damper and pitch control rod bearings require the use of an inspection tool.
- When installing a new pitch control rod, the pitch control rod must be set to the nominal dimension "X".
- Adjusting the length of the pitch control rod is done by turning the link in a clockwise or counter clockwise direction.
- When flight control chattering is experienced, inspect the uni-ball bearing, and swashplate guide for play.
- Shimming of a new rotating scissor link requires measuring the gap between the lower pressure plate, and the rotating scissor link.
- When servicing a main rotor blade, the main rotor blade and servicing equipment must be stabilized at temperature together, prior to servicing.
- During the inspection of the main rotor blade tip cap, the 12 screws on each side are broken down into three groups, 1 - 3, 4 - 6, and 7 - 12.

C. ENABLING LEARNING OBJECTIVE No. 3

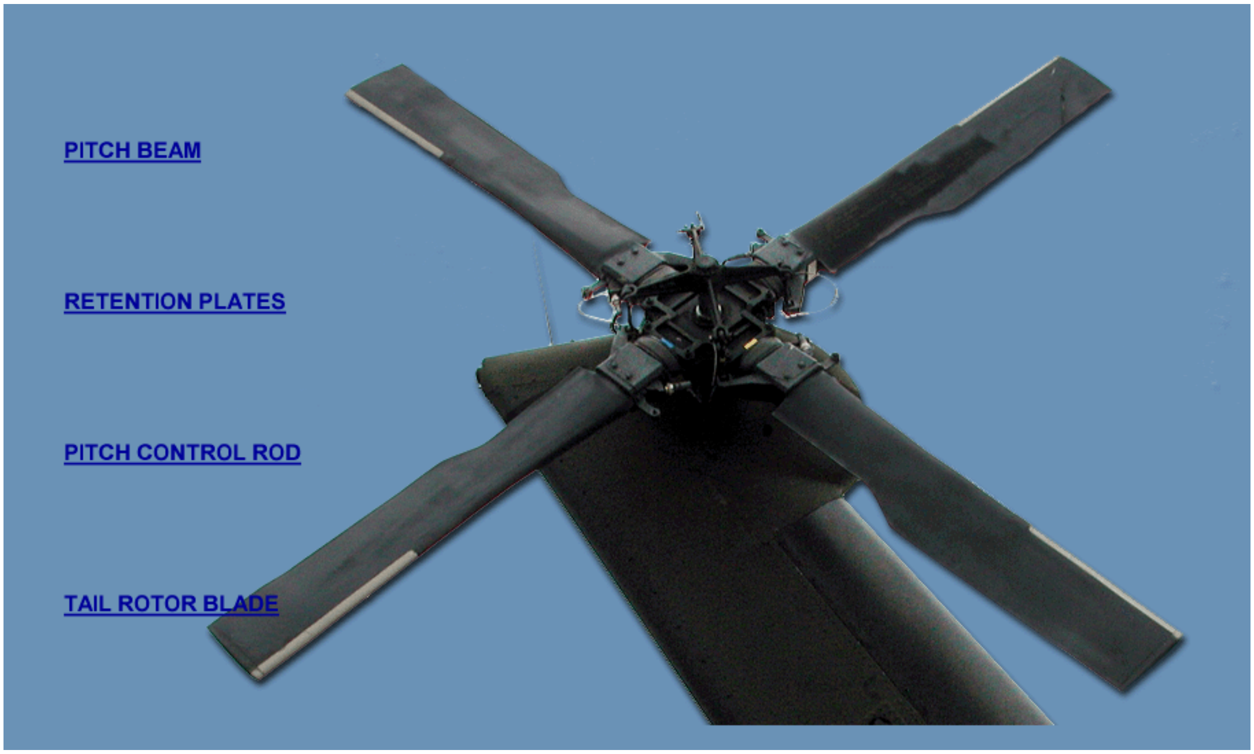
ACTION: identify the components of the UH-60 tail rotor system.

CONDITION: Using TM 1-1520-237-23-3

STANDARD: IAW TM 1-1520-237-23-3

a Tail Rotor Assembly

Frame #1005 (Tail Rotor Assembly MENU)



(1) The tail rotor assembly incorporates two cross beam tail rotor blades with flexible spars that accommodate flapping and pitch change.

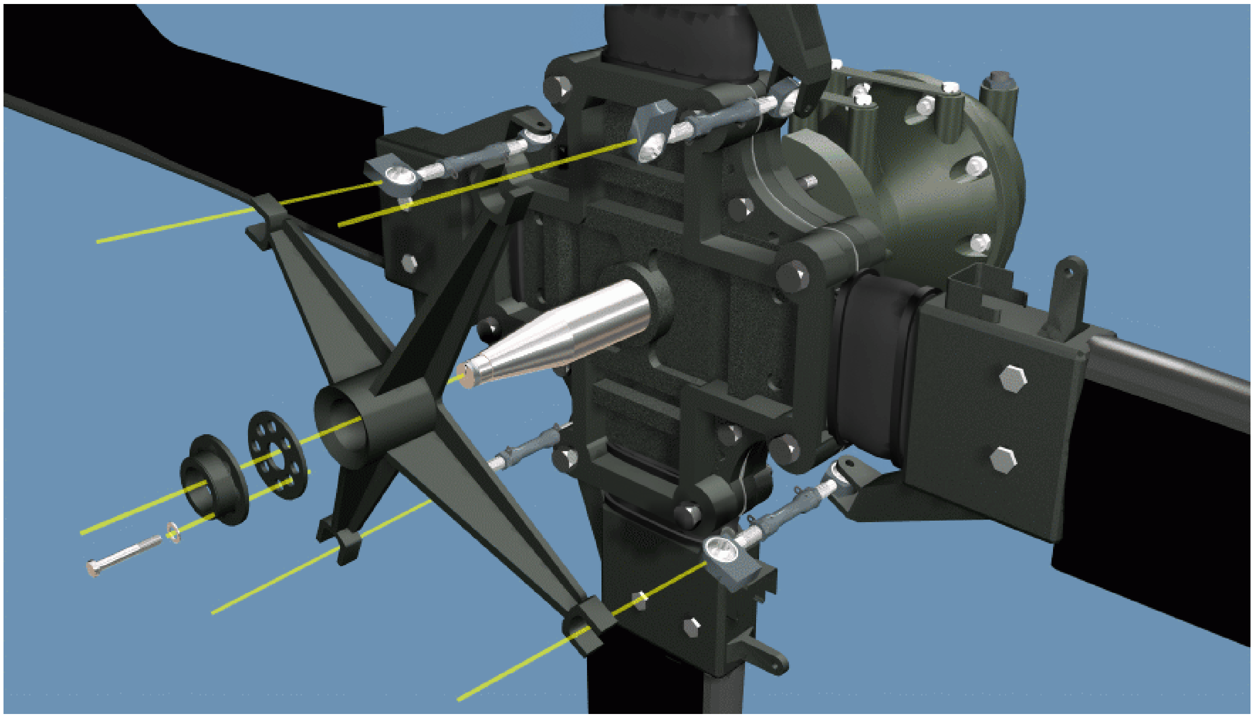
(2) A pitch change beam, on the pitch control shaft, changes the angle of the tail rotor blades through the pitch change links.

(a) Pitch Beam

Frame #1010 (Pitch Beam)

1) The pitch beam is a four-armed cross-beam that transmits an increase or decrease to the tail rotor blades through the four pitch change rods.

Frame #1015 (Pitch Beam Inspection)



2) The pitch beam is attached to the end of the pitch change shaft using a retaining nut and washer.

3) Any time the retaining nut has been removed, a torque check is required after 9 - 11 flight hours from the time of installation.

4) Inspect the retaining nut for cracks, and the threads for chafing.

5) If cracks are found, or there is any damage to the threads, the retaining nut must be replaced.

6) Check the washer for cracks, and the contact surfaces for nicks, gouges, corrosion, or fretting.

7) If any cracks are found, the washer requires replacement.

8) For all other damage to the washer, refer to the appropriate TM for the corrective action.

9) Visually check the pitch beam for cracks, nicks, gouges, and fretting.

10) If cracks are found, the pitch beam requires replacement.

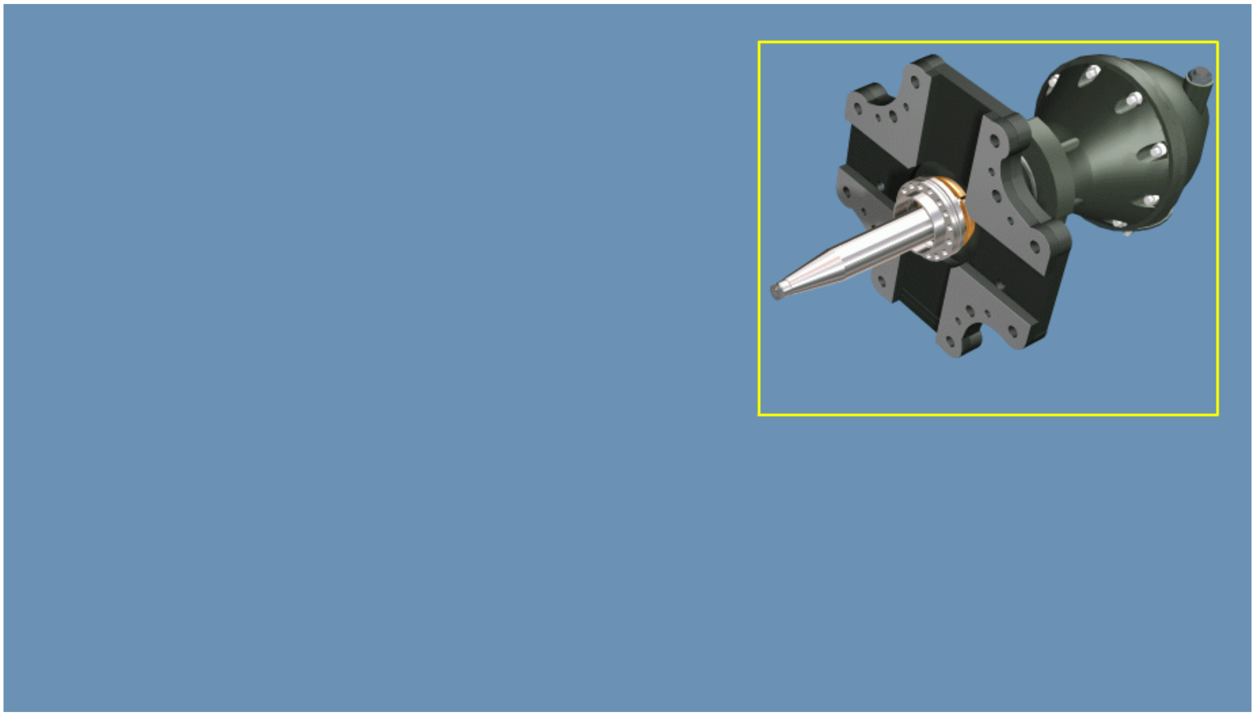
11) For all other damage to the pitch beam, refer to the appropriate TM for the corrective action.

(b) Rétention Plates

Frame #1020 (Rétention Plates)

1) Attaching the tail rotor blades to the tail rotor assembly are two retention plates.

Frame #1025 (Inboard Retention Plate FLASH)

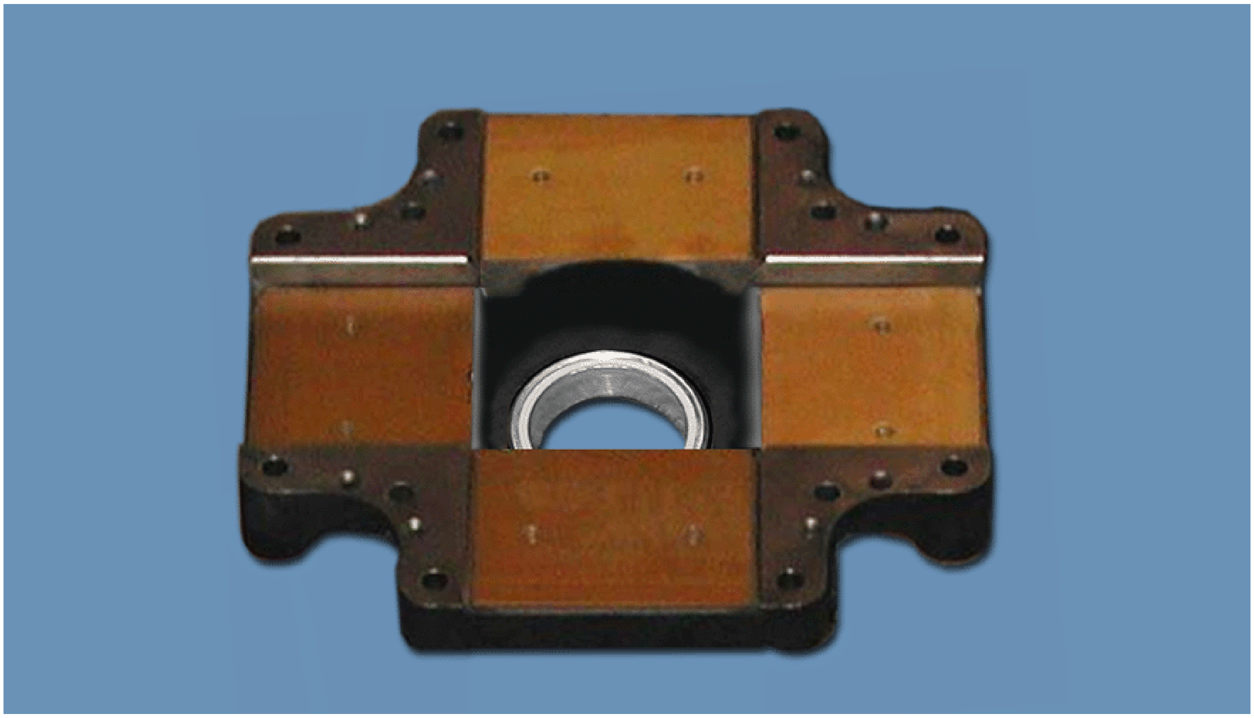


2) The inboard retention plate is centered on the tail rotor pitch change shaft by the two sets of split cones and secured by a retaining nut.

3) The two sets of split cones are similar to the split cones used on the main rotor, they are a matched set and if not seated properly will create an unbalanced condition at the tail rotor.

4) Whenever maintenance is performed on the split cone retaining nut, a torque check is required 9- 11 flight hours form the time of installation.

Frame #1030 (Inboard Retention Plate Inspections)



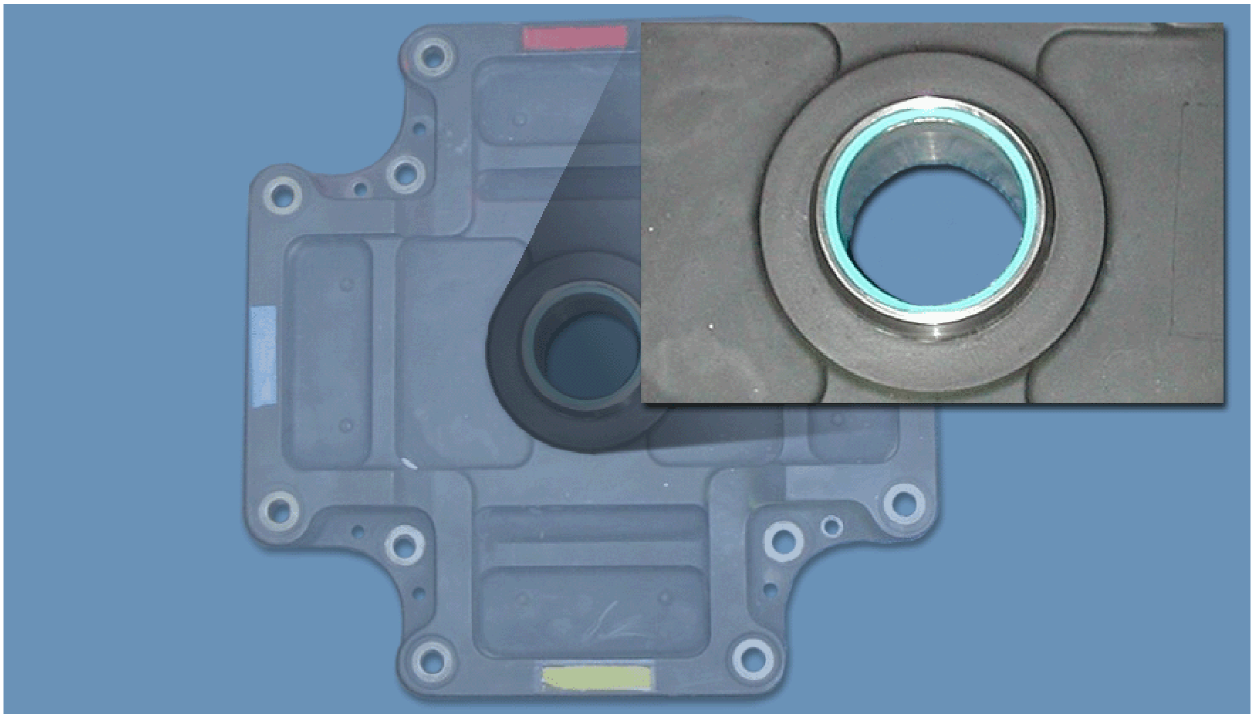
5) When inspecting the inboard retention plate, check the nylon shims one inch in from the edge of each corner using a micrometer for proper thickness.

6) Replace the nylon shims if they are not within acceptable limits or if the surface is not flat.

7) Inspect the retention plate for cracks, nicks, gouges, fretting, and scoring.

8) If cracks are found, replace the retention plate.

Frame #1035 (Outboard Retention Plate)

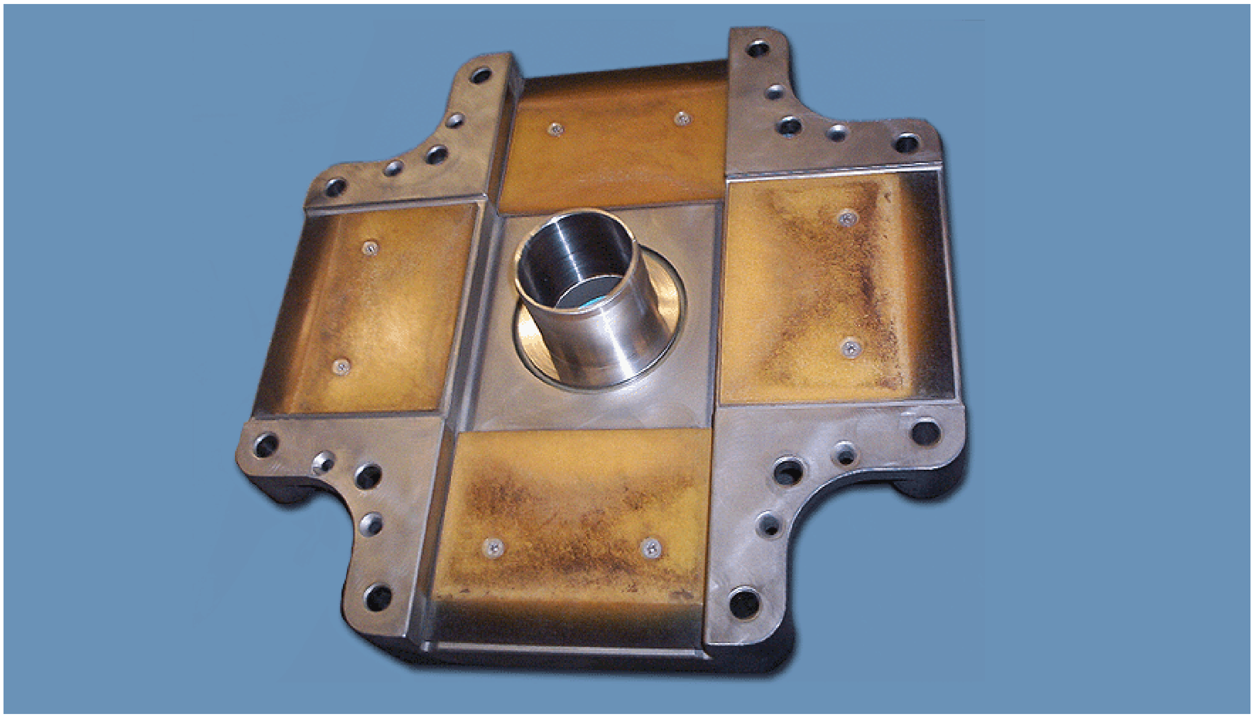


9) The outboard retention plate compresses the two tail rotor blade spars together.

10) A collet bushing is located in the center of the outboard retention plate.

11) The collet bushing on the outboard retention plate allows the pitch change shaft to move smoothly through the retention plate.

Frame #1040 (Outboard Retention Plate Inspections)



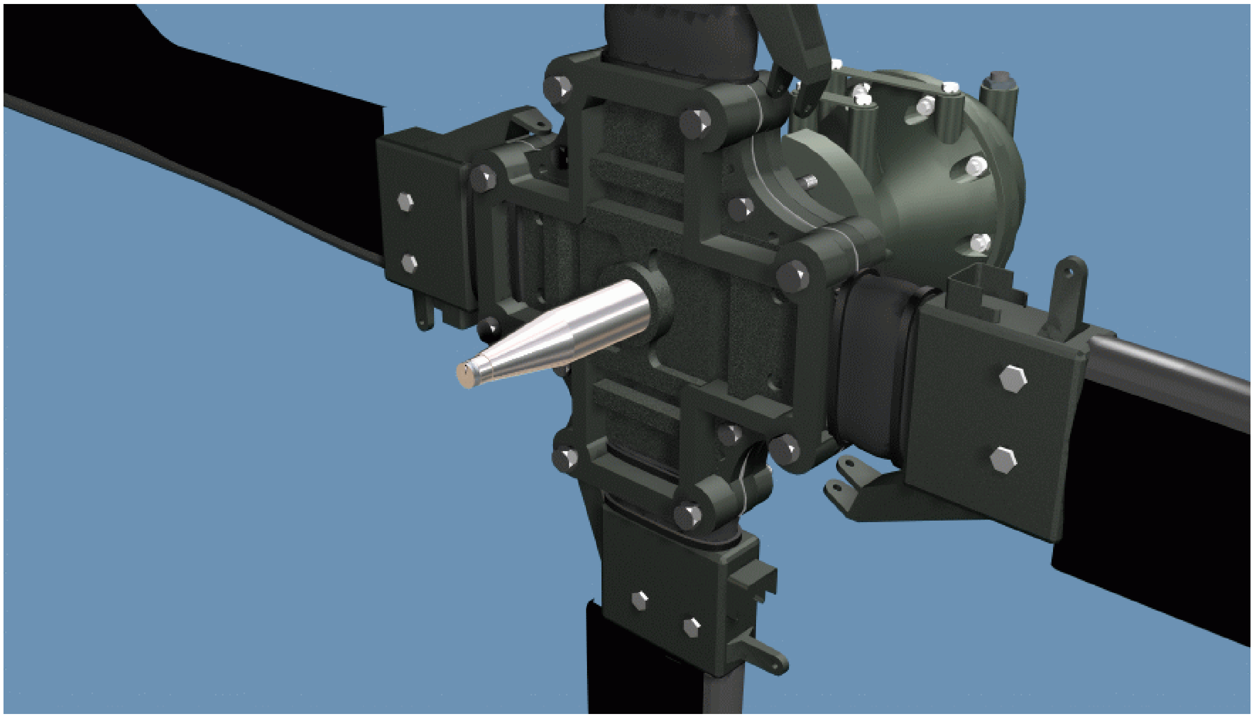
12) When inspecting the retention plate check for cracks, nicks, gouges, fretting, and scoring.

13) If cracks are found, replace the retention plate.

14) Check the nylon shims one inch in form the edge of each corner using a micrometer.

15) Replace the shims if they are not within allowable limits or the surface is not flat.

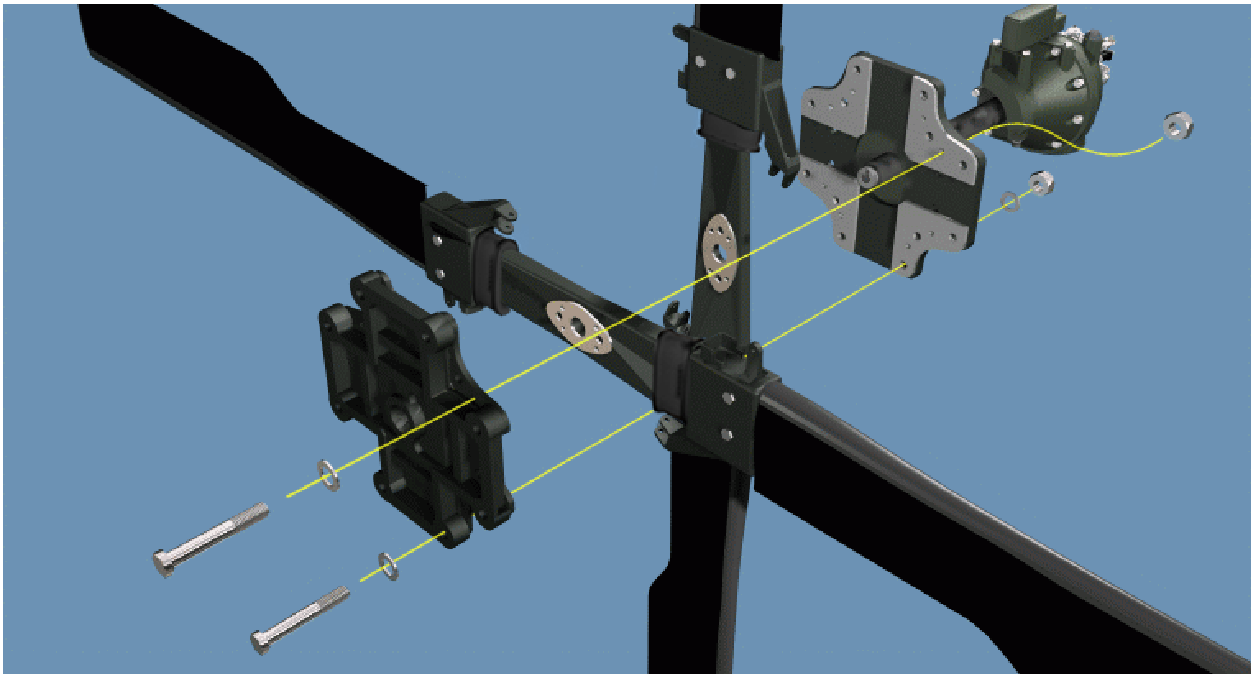
Frame #1045 (Outboard Retention Plate Hardware)



16) Any time the outboard retention plate is to be removed, mark the location of all attaching hardware prior to removal.

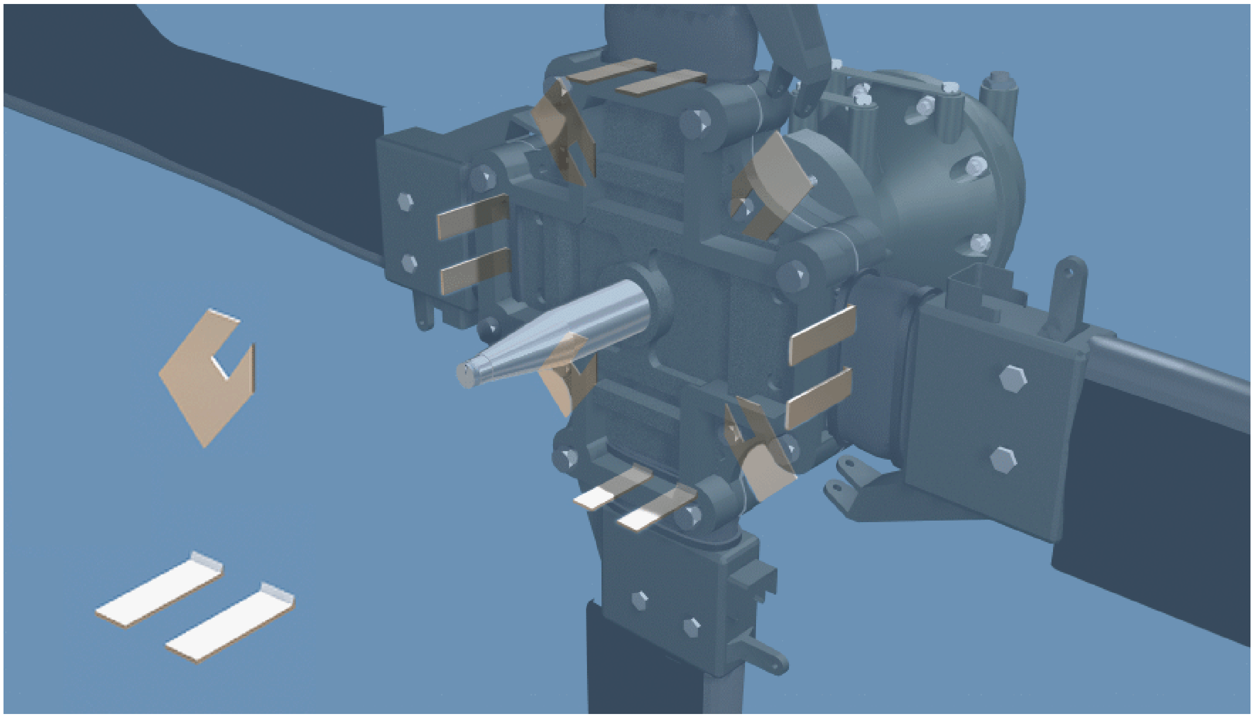
17) This will aid in the balancing of the tail rotor after the maintenance is complete.

Frame #1050 (Clamp-Up Check)



18) Any time the outboard retention plate, and tail rotor blades have been removed, a clamp-up check must be done during the reinstallation process.

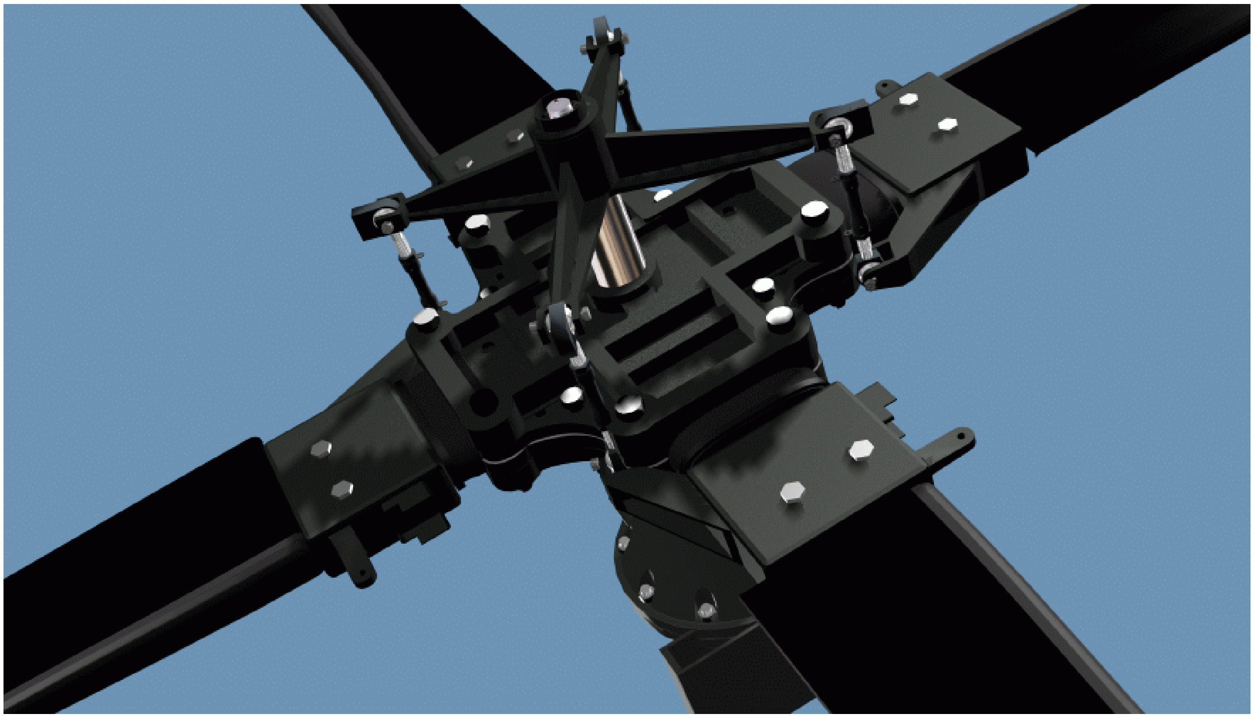
Frame #1050 (Clamp-Up Check 2)



19) If the clamp-up check fails the "A" shim portion, inspect the tail rotor blade for minimum thickness at the nylon wrap, the nylon shim thickness of the outboard retention plate and the spar channels of the retention plate with the nylon shims removed.

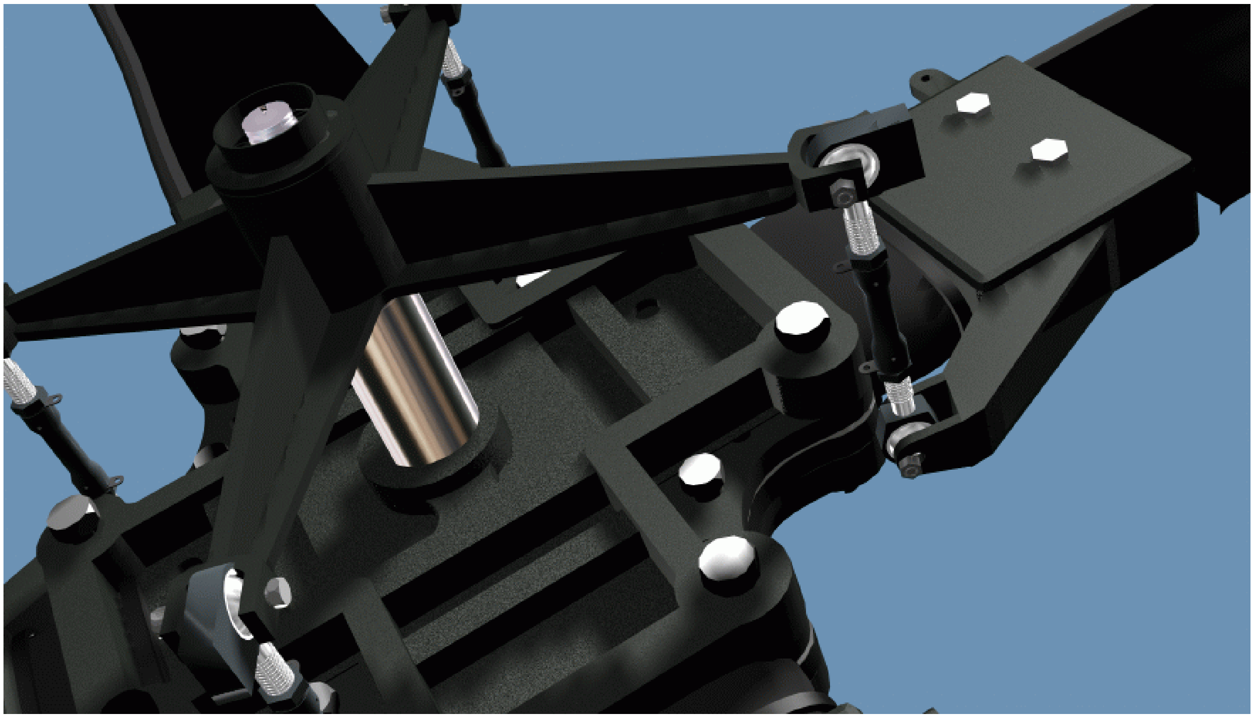
(c) Pitch Control Rod

Frame #1055 (Pitch Control Rod)



1) Four pitch control rods are installed on the tail rotor head assembly.

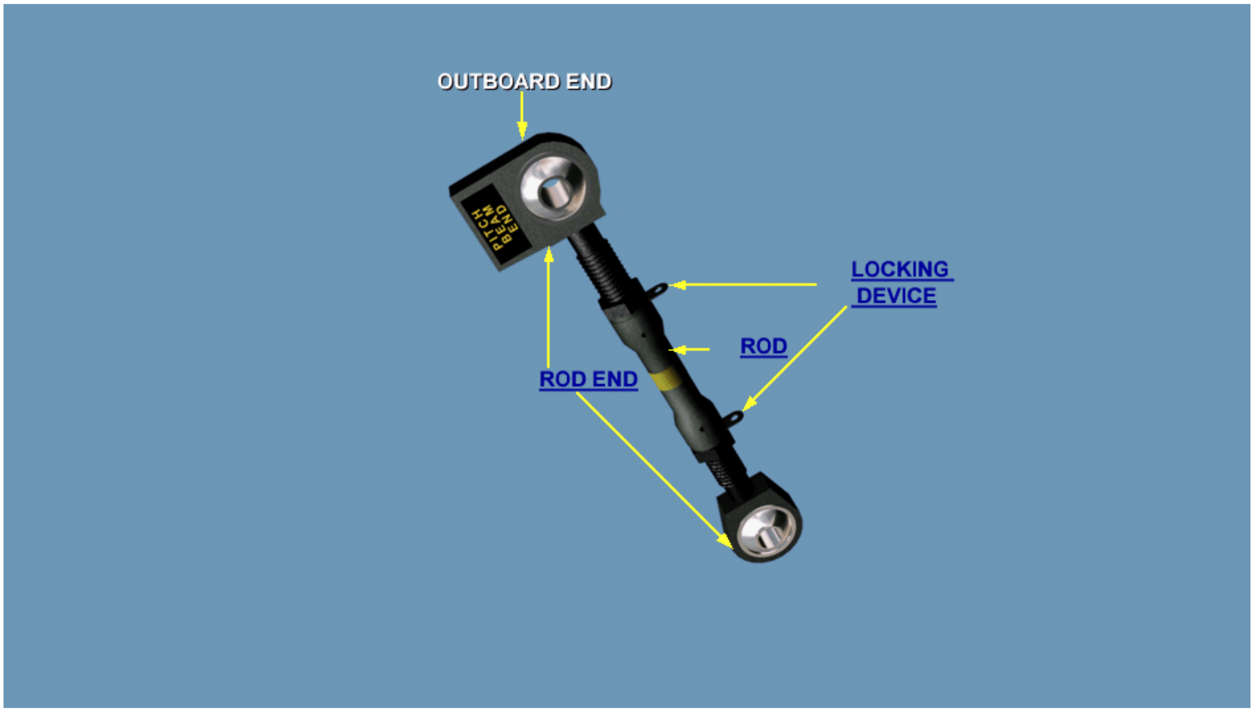
Frame #1055 (Pitch Control Rod 2)



2) Each pitch control rod connects to an arm of the pitch beam and to the pitch control horn of the blade.

3) The control rod transmits movement necessary for blade pitch changes from the pitch beam.

Frame #1060 (Pitch Control Rod Components)



4) Each pitch control rod consists of:

a) Rod End

1 Pitch control rod ends are the attaching points for the control rod to the tail rotor pitch beam and tail rotor blade pitch horn.

2 The outboard is clearly marked as the "PITCH BEAM END".

b) Rod

1 Adjustments to the overall length of the control rod are made by rotating the rod.

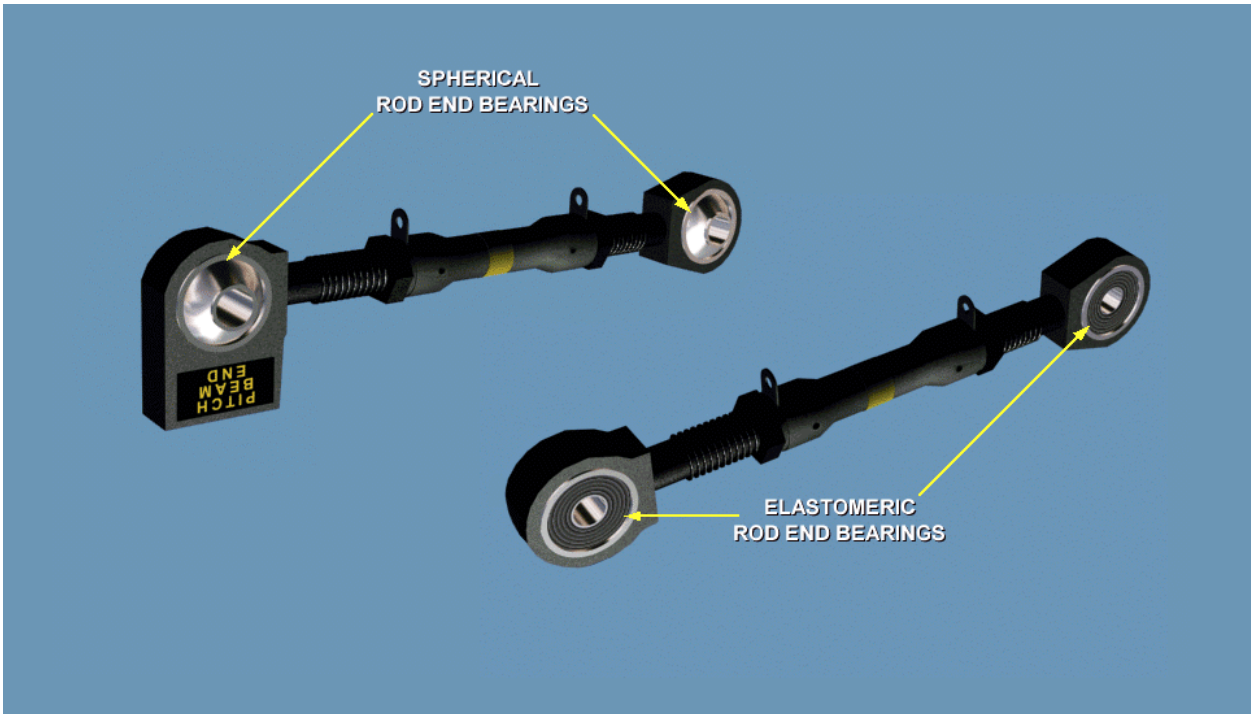
c) Locking Device

1 The locking device locks the control rod to the desired length.

Frame #1065 (Pitch Control Rod Bonding Jumper)

5) A bonding jumper is mounted with the pitch control rod at the pitch beam and blade spindle horn for grounding purposes and static electricity discharge.

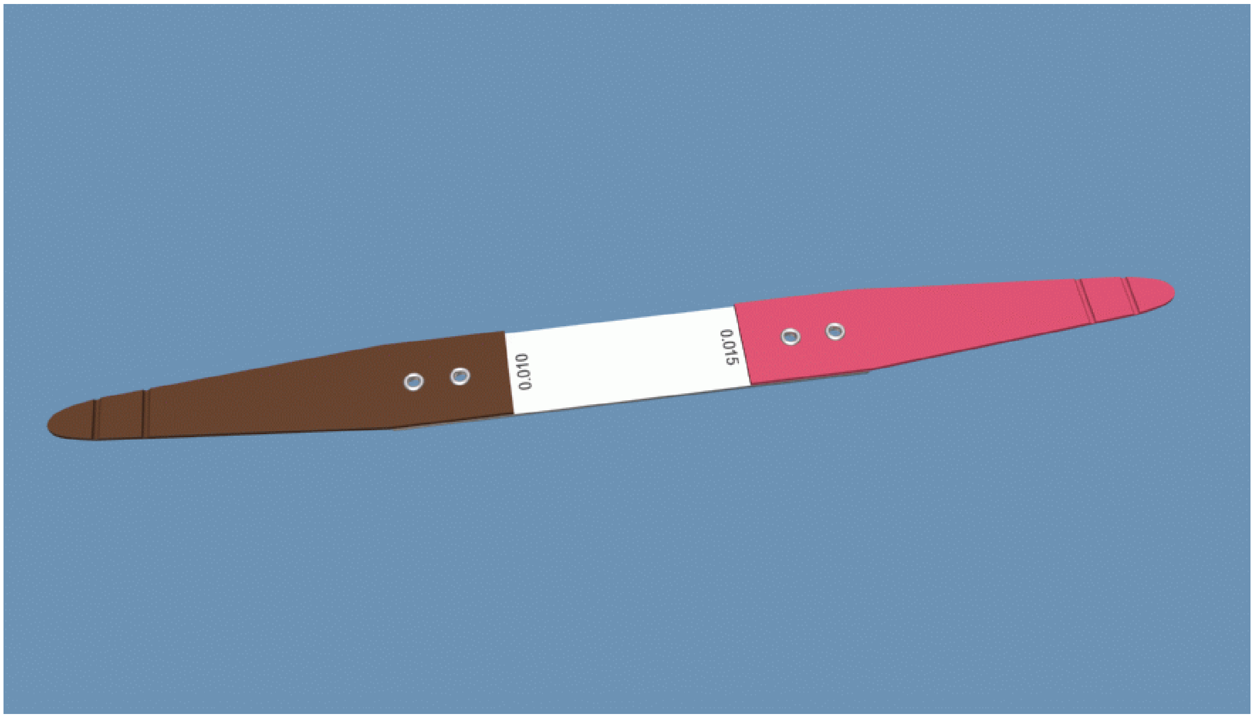
Frame #1070 (Pitch Control Rod Inspections)



6) The pitch control rod is a self-centering, adjustable flight control with a bearing at each end.

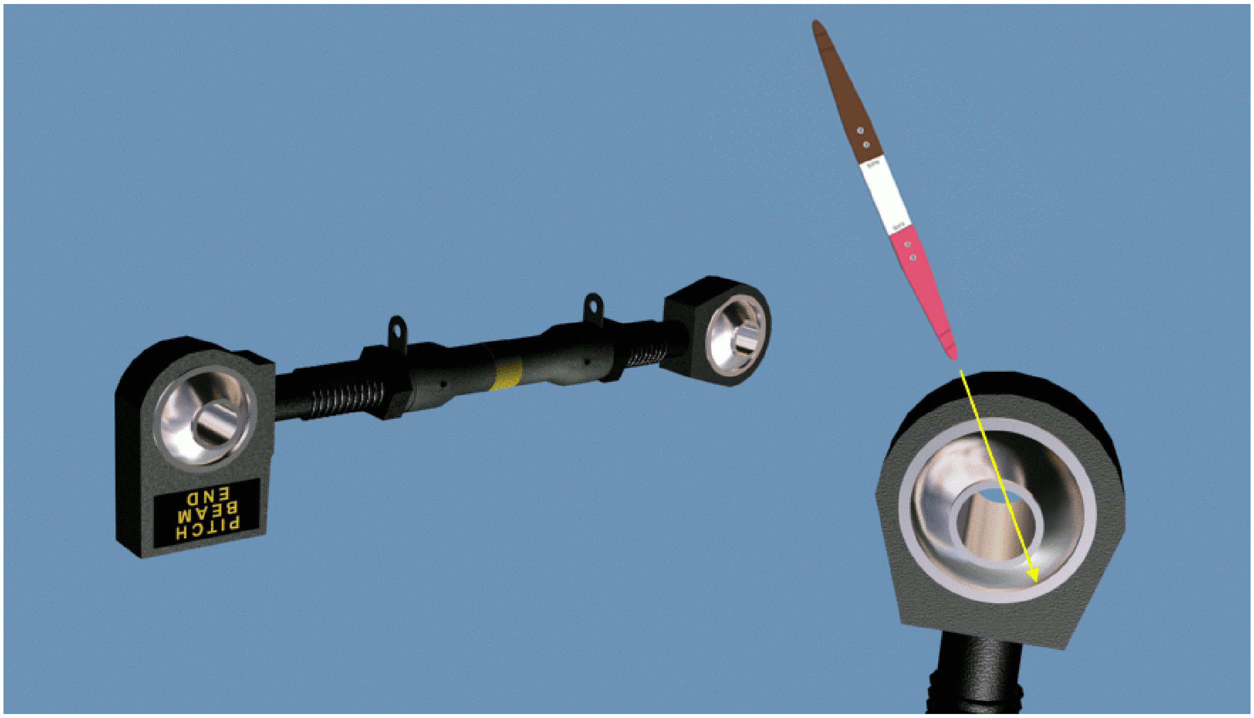
7) The pitch control rod end can have two different styles of bearings (spherical and elastomeric).

Frame #1075 (Spherical Bearing Inspection Tool)



8) With the spherical bearing, use the same spherical bearing inspection tool as the main rotor damper, and pitch control rod bearings.

Frame #1080 (Spherical Bearing Inspection)



9) Apply hand pressure to the tail rotor blades, and twist each blade in the direction of reduced pitch.

10) The inspection limits are the same as the main rotor damper and pitch control rod bearings.

11) Using the 0.010 end of the inspection tool, probe both sides of the bearing around the entire circumference for clearance between the ball and outer race.

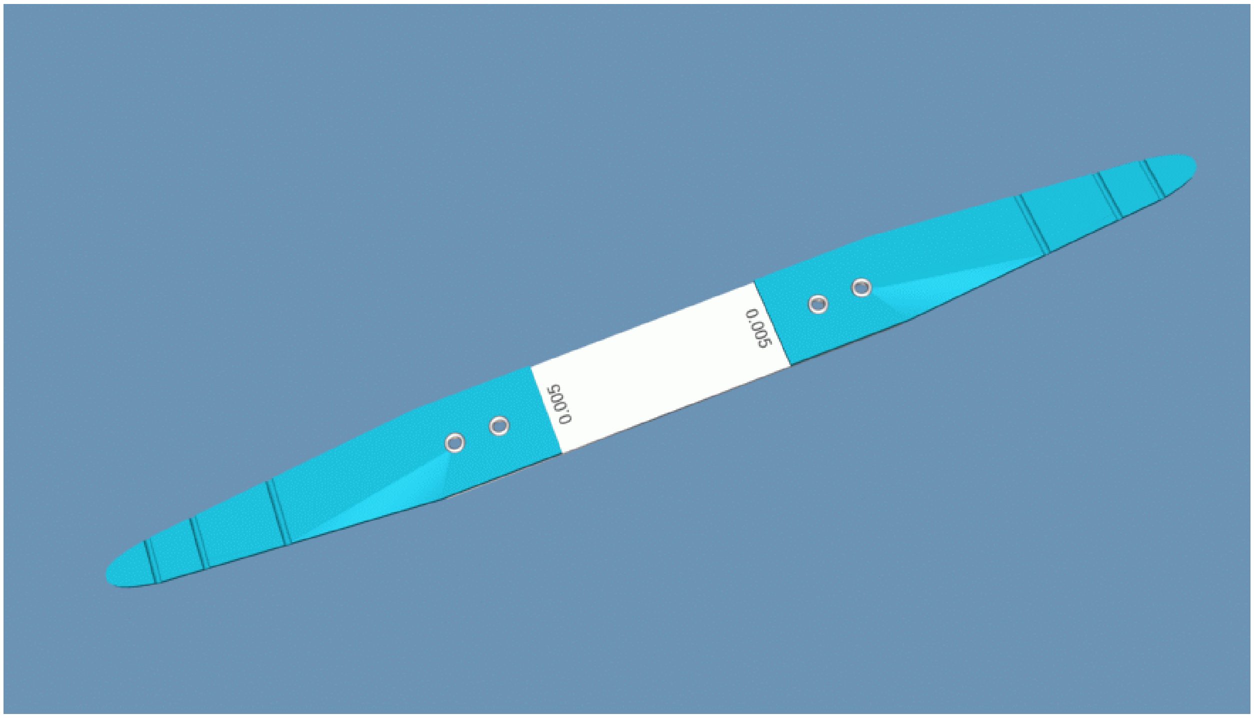
12) If the tool can not be inserted to the 0.250 mark, the bearing is acceptable.

13) If the tool can be inserted to or beyond the 0.250 mark, repeat the inspection using the 0.015 portion of the tool.

14) If you can not insert the 0.015 portion to the 0.250 mark, the bearing is acceptable with a reinspection required IAW the appropriate TM.

15) Should the tool be inserted to or beyond the 0.250 mark, inspect the bearing for radial play using the dial indicator method IAW the appropriate TM.

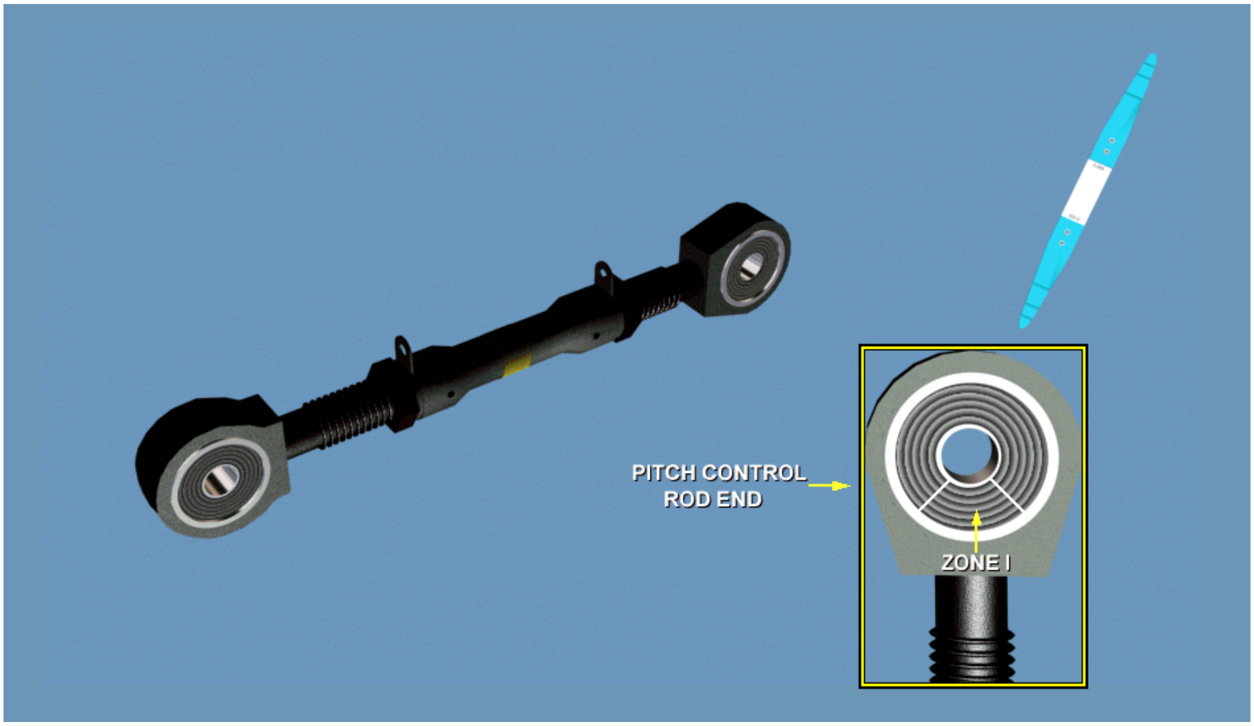
Frame #1085 (Elastomeric Bearing Inspection Tool)



16) With the elastomeric bearing, use the same elastomeric bearing inspection tool as the main rotor spindle elastomeric bearings.

17) Use the inspection tool to identify the extent of damage to the elastomeric bearing.

Frame #1090 (Elastomeric Bearing Inspection)



18) Inspect Zone I, any separation depth that is 0.20 inch or less is acceptable.

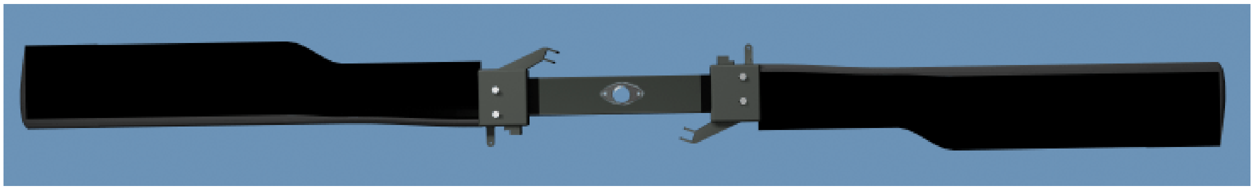
19) In all other areas, separation depth up to 0.060 inch is acceptable. If limits are exceeded, replace the elastomeric rod end.

20) Visually check for elastomeric extrusion (rubber pushing out between shims), cracking or disbonding from the shim liner, and inner member separation.

21) No inner member looseness, exposed metal of inner ball surface, or missing elastomer is allowed.

(d) Tail Rotor Blade

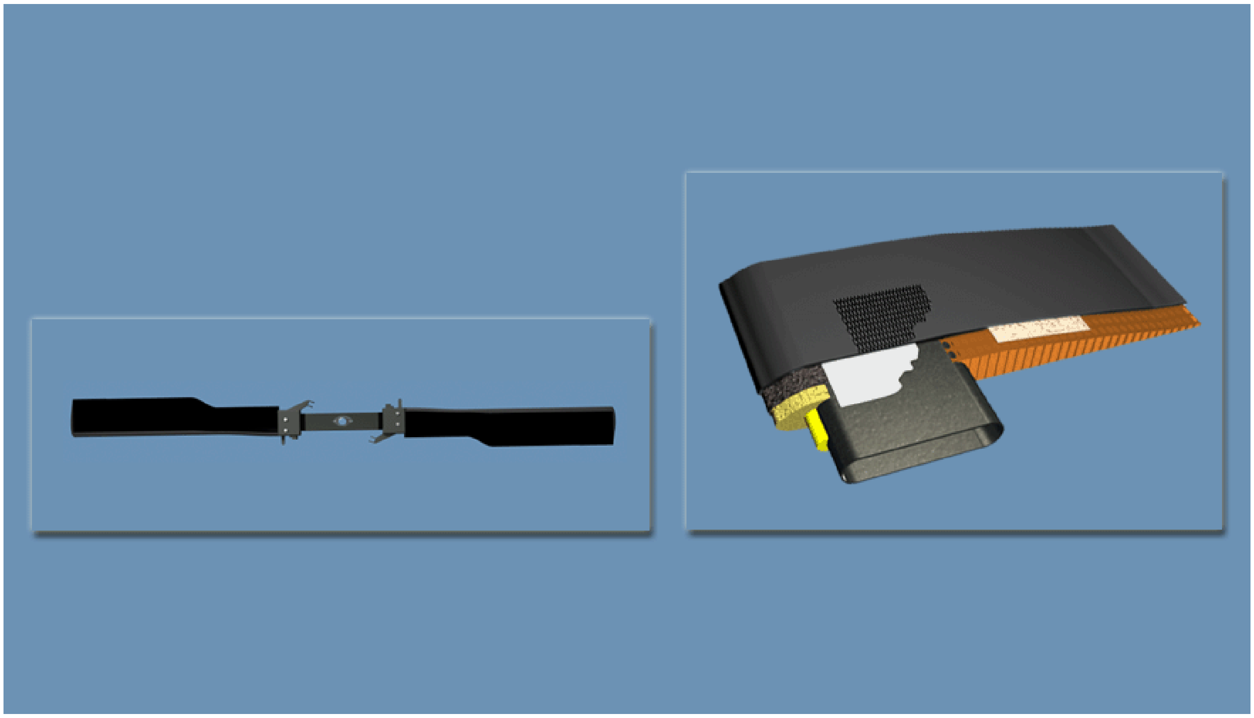
Frame #1095 (Tail Rotor Blade)



1) The tail rotor blade is built around two graphite composite spars running from tip-to-tip and crossing each other at the center to form the four blades.

2) The two spars are interchangeable and can be replaced individually.

Frame #1100 (Tail Rotor Blade Construction)



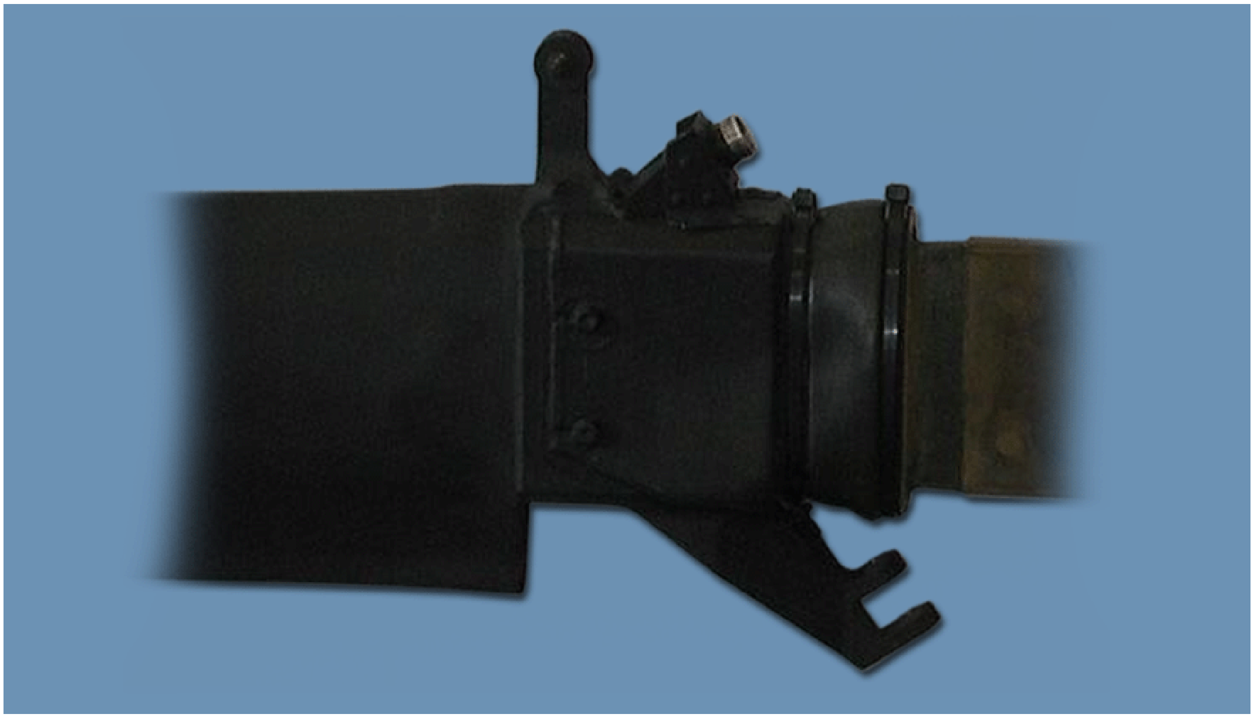
3) The blade spars are covered with crossply fiberglass to form the airfoil shape.

4) Polyurethane and nickel abrasion strips are bonded to the leading edge of the blades.

5) Blade pitch changes are made by twisting the spar.

6) The tail rotor blade also has a heater mat for blade de-ice, Kevlar tip cap, and wire mesh for lightning protection.

Frame #1105 (Tail Rotor Blade Counter Weight)

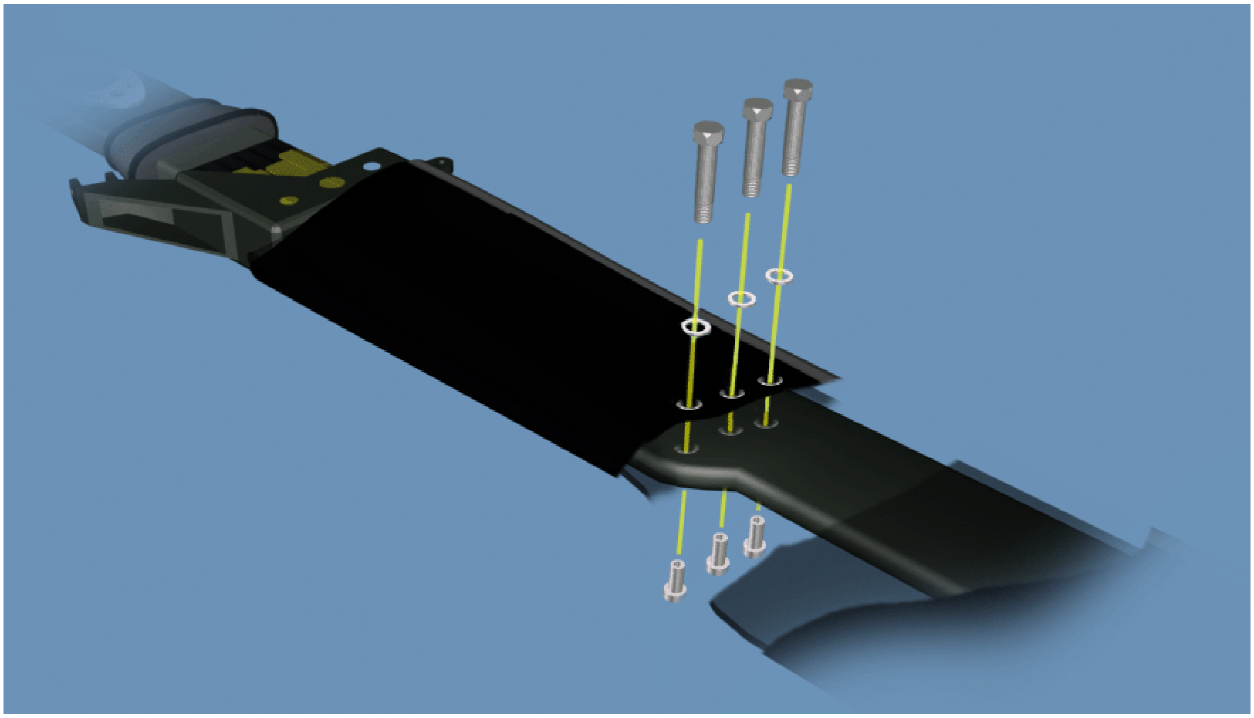


7) There is a counter weight on the tail rotor blade to keep the blade centered if the pitch control rod should fail.

8) It functions by countering the weight of the pitch horn.

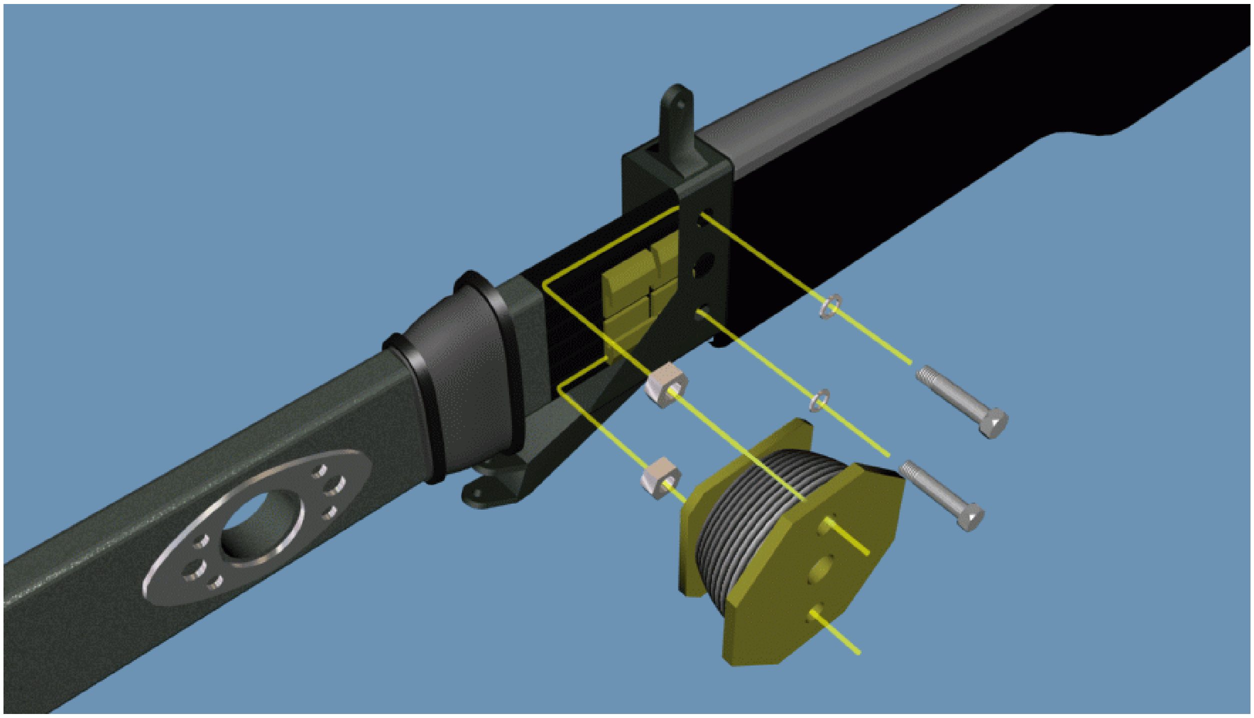
9) The tail rotor boot keeps out dirt and debris.

Frame #1110 (Tail Rotor Blade Torque Rib)



10) The tail rotor blade pivots at the torque rib on the blade.

Frame #1115 (Tail Rotor Blade Pivot Bearing)



11) The pivot bearing keeps the blade centered during pitch changes.

12) The pivot bearing is bolted to the blade and held to the spar by means of a bonded retention plate.

Frame #1120 (Tail Rotor Blade Spar Inspection)

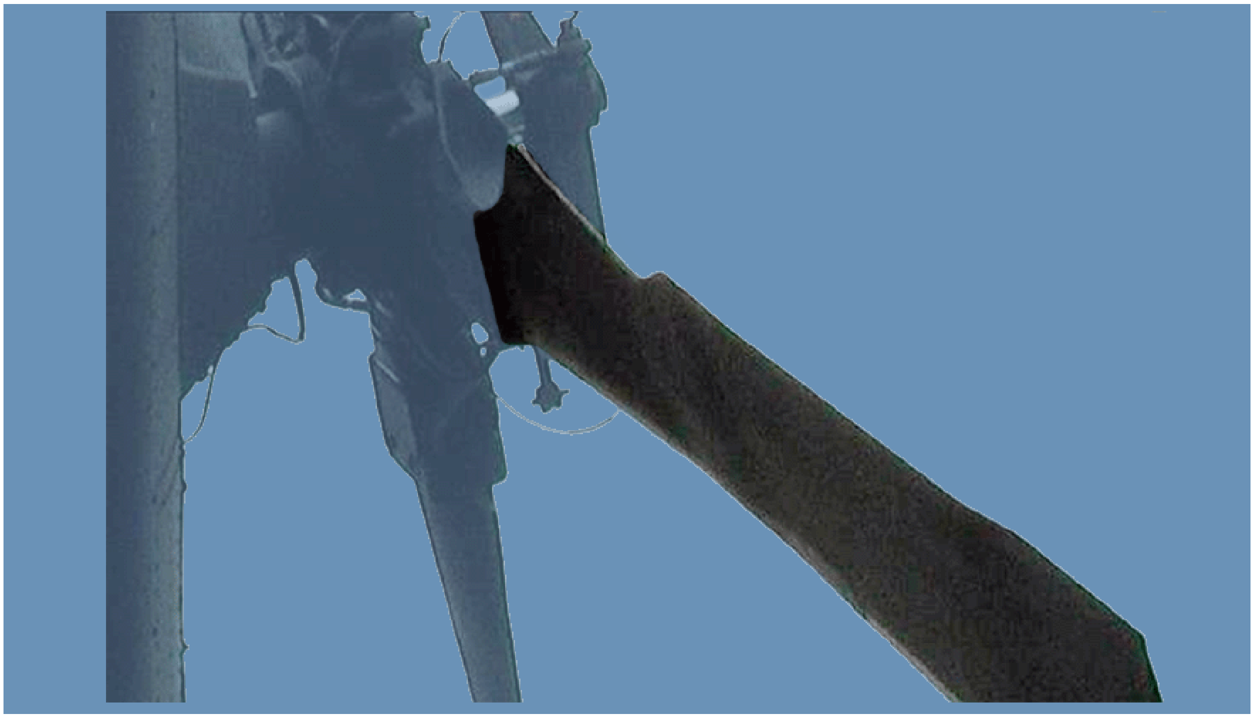
13) Inspect tail rotor blade spar.

14) Grasp a tail rotor blade tip at mid-width and apply light hand force in a flat wise direction for approximately 3 to 4 inches (either towards or away from the tail rotor pylon).

15) Check the opposite blade tip for deflection.

16) If there is movement of equal deflection observed in the opposite blade, remove the tail rotor blades and inspect the spars.

Frame #1125 (Pivot Bearing Inspection)



17) Inspect the trailing edge of the tail rotor blade for disbonding.

18) If the trailing edge is disbonding between stations 15.06 to 36.75, inspect the pivot bearing.

CHECK ON LEARNING

1. The function of the pitch beam is to provide which of the following?

2. What component(s) center(s) the inboard retention plate on the pitch change shaft?

3. Which of the following statements is true about the tail rotor pitch control rod?

4. The tail rotor blade is constructed of a nickel abrasion strip, crossply fiberglass, Kevlar tip cap, de-ice heater mat, and which of the following?

5. Which of the following types of damage requires replacement of the pitch beam, with no further inspections needed?

6. Which statement is true when inspecting the tail rotor pitch control rod spherical bearing?

7. While installed, the inspection of the tail rotor blade spar is done by which of the following?

SECTION V. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Tail Rotor Component Identification.
The Key Points to remember are:

- The tail rotor system consists of four major components; pitch beam, retention plates, pitch control rod, and the tail rotor blade.
- The pitch beam transmits an increase or decrease to the tail rotor blades through the four pitch change rods.
- The outboard retention plate compresses the two tail rotor blade spars together.
- The pitch control rods transmit movement from the pitch beam to the tail rotor blades.
- The pitch control rod consists of two rod ends, two locking devices, and a rod.
- The pitch control rod is a weighted, self-centering adjustable flight control.
- Contained inside the tail rotor blade is an interchangeable spar.
- The tail rotor blade consists of a nickel abrasion strip, crossply fiberglass, Kevlar tip cap, de-ice heater mat, and wire mesh for lightning protection.
- A torque rib allows the tail rotor blade to pivot.
- The pivot bearing keeps the tail rotor blade centered during pitch changes.
- When inspecting the pitch beam and attaching hardware, look for nicks, cracks gouges, fretting and damaged threads.
- The inboard retention plate is mounted and centered to the tail rotor assembly with two sets of matched split cones, and a retaining nut.
- Measure the thickness of the nylon shims when inspecting the inboard and outboard retention plates prior to doing a clamp up check.
- Marking the retention plate hardware aides in the balancing of the tail rotor.
- A specific inspection tool is used when inspecting the tail rotor pitch control rod spherical bearings for wear.
- A specific inspection tool is used when inspecting the tail rotor pitch control rod elastomeric bearings for wear.
- Inspecting the tail rotor blade spar while installed on the aircraft is done by applying hand force in the direction away from, or toward the tail rotor pylon.
- Inspect the trailing edge of the tail rotor blade between stations 15.06, and 36.75 for visible signs of pivot bearing separation.

APPENDIX A

ILLUSTRATION LISTING

0275	Main Rotor Spindle Nut
0280	Main rotor Damper
0285	Main Rotor Damper Indicator
0285	Damper Indicator Blowout
0290	Damper Indicator Packing
0295	Damper Servicing Ports
0300	Damper Servicing
0305	Damper Servicing 2
0310	Damper Counter Weights
0315	Damper Wear patterns
0320	Damper Nylon Washer
0325	Damper Bearing Inspection
0325	Spherical Bearing Inspection Tool
0330	Main Rotor Pitch Control Rod
0335	Pitch Control Rod Components
0340	Pitch Control Rod Dimension X
0345	Pitch Control rods/Elastomeric Bearing
0350	Upper Pitch Control Rod End Installation
0355	Lower Pitch Control rod End Installation
0360	Pitch Control Rod Adjustment
0360	Pitch Control Rod Lower Rod End Adjustment
0360	Pitch Control Rod End Upper Adjustment
0365	Pitch Control Rod Adjustment FLASH
0370	Pre-Track Adjustment
0375	Pre-Track Adjustment Examples
0380	Pitch Control Rod Bearing Inspection
0385	Damper Bearing Inspection
0390	Spherical Bearing Inspection
0395	Spherical Bearing Inspection 2
0395	Spherical Bearing Inspection 3
0400	Elastomeric Bearing Inspection
0405	Elastomeric Bearing Inspection Tool
0410	Elastomeric Bearing Inspection 3
0410	Elastomeric Bearing Inspection 4
0420	Main Rotor Swashplate
0425	Main Rotor Swashplate Components
0425	Swashplate Guide
0425	Swashplate Teflon Liner
0430	Servo Links
0435	Duplex Bearings
0435	Duplex Bearings Location
0440	Uni-Ball Bearing
0445	Swashplate Guide
0450	Uni-Ball Bearing Teflon Liner
0455	Uni-Ball Bearing Inspection
0460	Uni-Ball Bearing Inspection 2
0465	Rotating Scissor
0475	Rotating Scissors Upper Link Inspection
0475	Rotating Scissors Lower Link Inspection
0480	Rotating Scissors Spherical Bearing Inspection
0485	Main Rotor Bifilar
0490	Bifilar weight
0495	Bifilar Inspection
0500	Bifilar Weight Inspection
0505	Bifilar Tapered Washer Inspection
0600	Main Rotor Blade

0605	Main Rotor Blade Expandable Pins
0615	Main Rotor Blade Construction
0620	Main Rotor Blade Removal
0625	Main Rotor Blade Clamp
0630	Main Rotor Blade Removal
0635	Main Rotor Blade Removal 2
0640	Main Rotor Blade Spar Indicator
0645	BIM Indicators
0650	Main Rotor Blade Servicing
0655	Main Rotor Blade Servicing Table
0660	Main Rotor Blade Servicing 2
0665	Main Rotor Blade Trim Tab
0670	Main Rotor Blade Tip Cap
0675	Main Rotor Blade Tip Cap Inspection
0680	Main Rotor Blade weights
0680	Main Rotor Blade Weight Location
1005	Tail Rotor Assembly MENU
1010	Pitch Beam
1015	Pitch Beam Inspection
1020	Retention Plates
1025	Inboard Retention Plate FLASH
1030	Inboard Retention Plate Inspection
1035	Outboard Retention Plate
1040	Outboard Retention Plate Inspections
1045	Outboard Retention Plate Hardware
1050	Clamp-Up Check
1050	Clamp-Up Check 2
1055	Pitch Control Rod
1055	Pitch Control Rod 2
1060	Pitch Control Rod Components
1065	Pitch Control Rod Bonding Jumper
1070	Pitch control Rod Inspection
1075	Spherical Bearing Inspection Tool
1080	Spherical Bearing Inspection
1085	Elastomeric Bearing Inspection Tool
1090	Elastomeric Bearing Inspection
1095	Tail Rotor Blade
1100	Tail rotor blade Construction
1105	Tail Rotor blade Counter Weight
1110	Tail Rotor Blade torque Rib
1115	Tail Rotor Blade Pivot Bearing
1120	Tail Rotor Blade Spar Inspection
1125	Pivot Bearing Inspection

APPENDIX B

TEST AND TEST SOLUTIONS

1. This appendix is only used when the test and solutions are internal to the POI file.

2. When the test and solutions are internal to the POI file, then the POI file becomes a FOR OFFICIAL USE ONLY document.