PFN NUMBER 011-9758

SEPTEMBER 2004

STUDENT GUIDE

FOR

UH-60 FLIGHT CONTROLS

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BLACK HAWK UH-60 FLIGHT CONTROL SYSTEM

TABLE OF CONTENTS

SECTION I. -INTRODUCTION

TERMINAL LEARNING OBJECTIVE: 011-9758

At the completion of this lesson you will:

ACTION: Identify the location, purpose, and rig characteristics of the UH-60 Flight Control system.

CONDITIONS: As a UH-60 Maintenance test pilot.

STANDARD: In Accordance with (IAW) UH-60 Technical Manuals.

SAFETY REQUIREMENTS: Will be addressed as NOTES, CAUTIONS, and WARNINGS throughout the lesson outline.

RISK ASSESSMENT LEVEL: Low

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

EVALUATION: None

SECTION II. -PRESENTATION

A. ENABLING LEARNING OBJECTIVE No.1

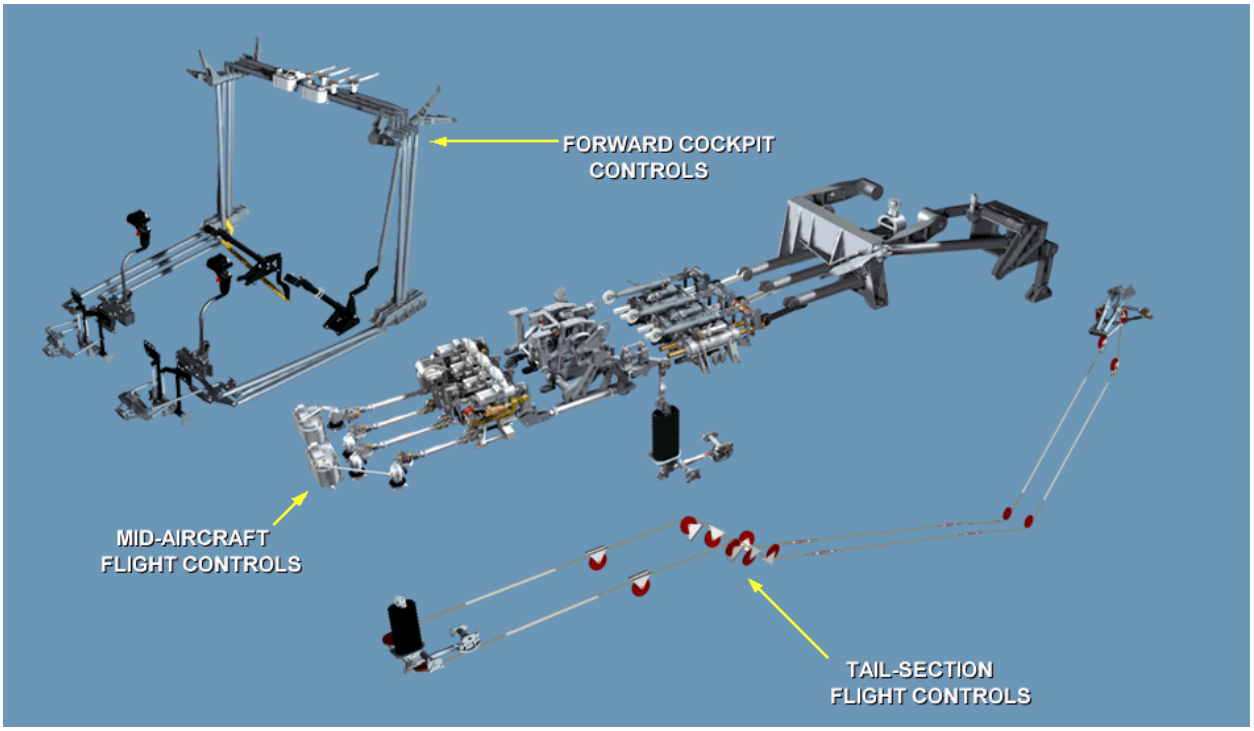
ACTION: Identify the routing of the Flight Controls System of the UH-60 helicopter.

CONDITION: As a UH-60 Maintenance test pilot.

STANDARD: IAW UH-60 technical manuals.

a. Flight Control System Components

Frame # 0040 (Flight Control System Components)



(1) The forward flight controls consist of the collective, cyclic control systems.

(2) These systems use a series of push-pull rods, bellcranks, cables, pulleys, and servos that transmit control movements from the cockpit to the mid-aircraft flight controls and tail-section flight controls.

(3) The pilot and copilot have dual controls.

(4) Cyclic control sticks control forward, rearward, and lateral helicopter movements.

(5) Collective control sticks control vertical helicopter movements, and the tail rotor control pedals control helicopter headings.

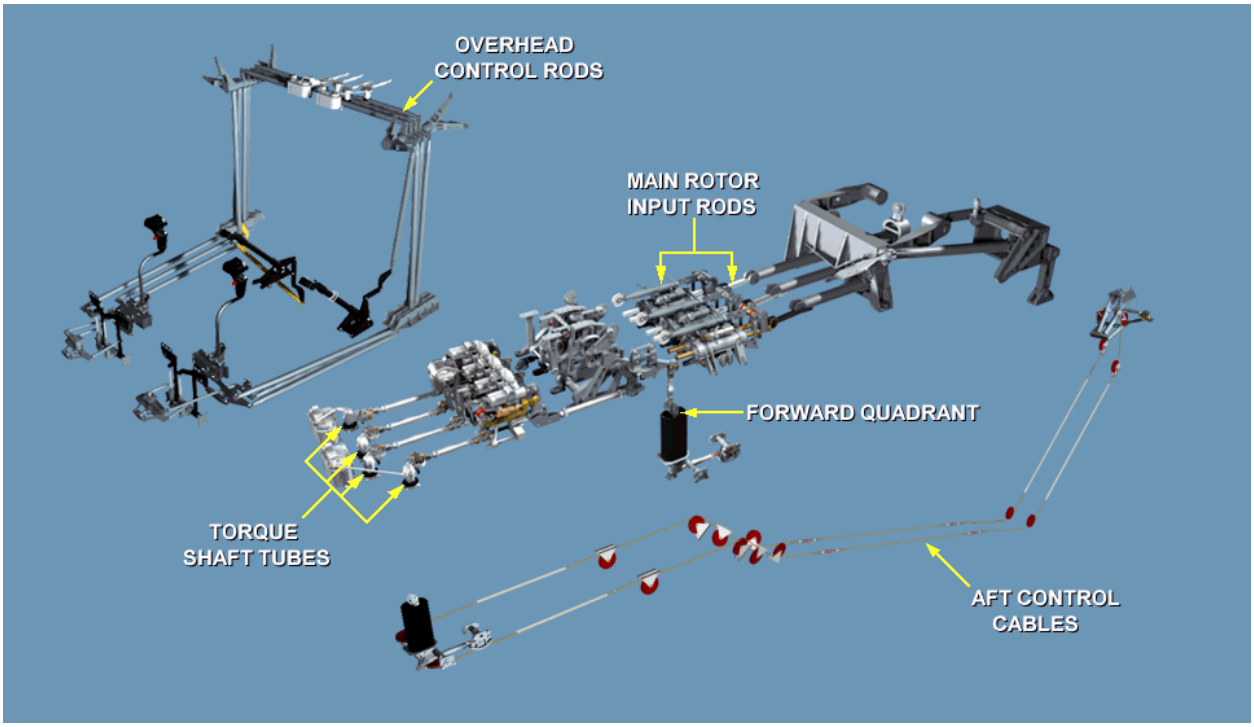
(6) Hydraulic power is supplied by the first stage, second stage, and backup hydraulic systems.

(7) Electrical power is supplied by the AC and DC electrical systems.

(8) Assistance for the pilot or copilot in pitch, roll, and yaw control is provided by the Stability Augmentation System (SAS), Flight Path Stabilization (FPS), and electromechanical trim.

b. Flight Control Routing

Frame # 0055 (Flight Control Routing)

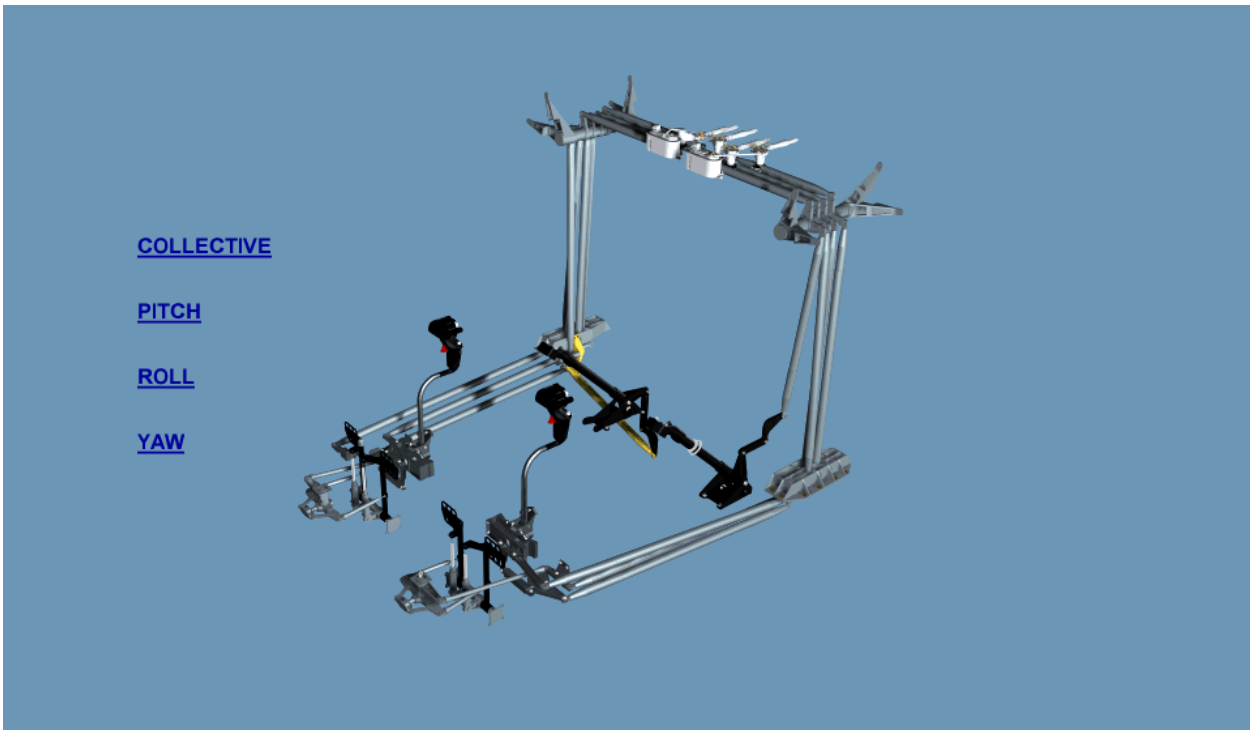


(1) Pilot and copilot controls are routed through the cockpit floor and control inputs intermix at the overhead connections.

(2) All controls are routed inside of the bulkhead.

(3) Inputs are made by push rods and bellcranks for both main and tail rotors to the forward quadrant, where the tail rotor inputs are changed to the cables until reaching the aft tail rotor quadrant, where they are changed to push rods.

Frame # 0056 (Flight Control Routing)



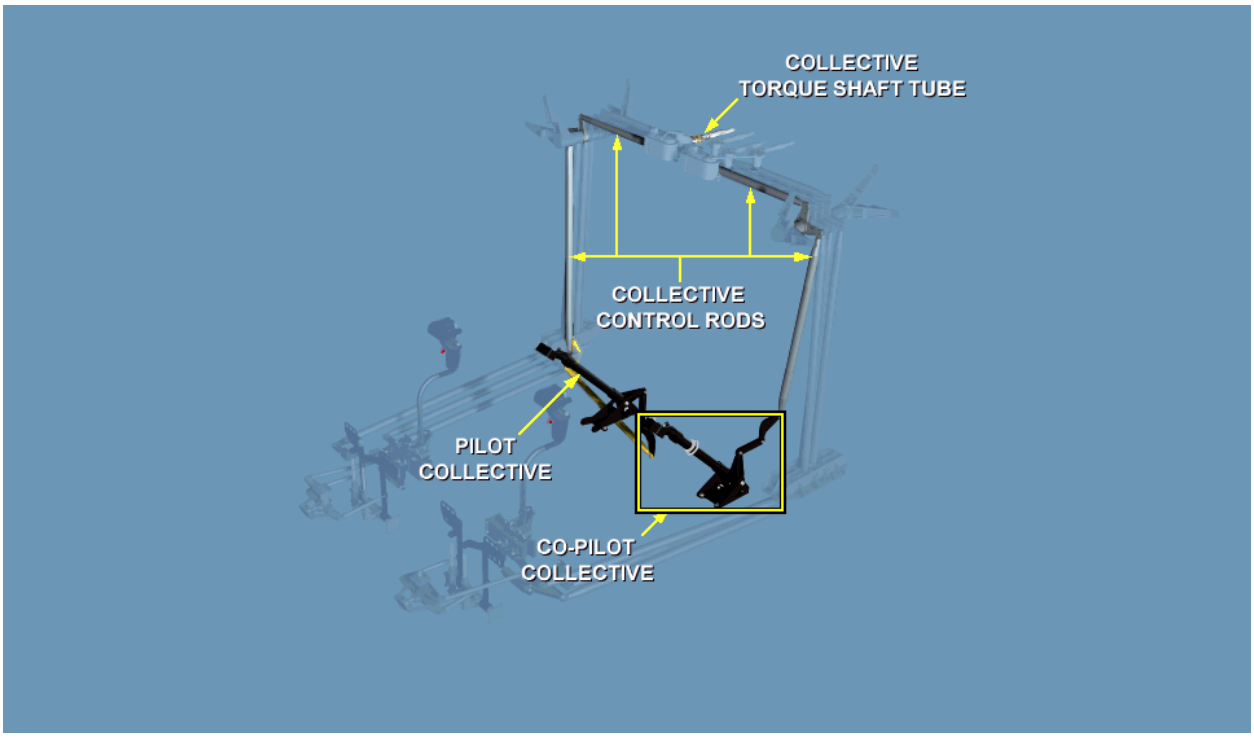
(4) Control inputs are transferred from the cockpit to the rotor blades by mechanical linkages, and hydraulic servos.

(5) Dual cockpit controls consist of the cyclic stick, collective stick and pedals.

(6) The pilot and copilot controls are routed separately to a combining linkage for each control axis.

(a) Collective Flight Control Routing

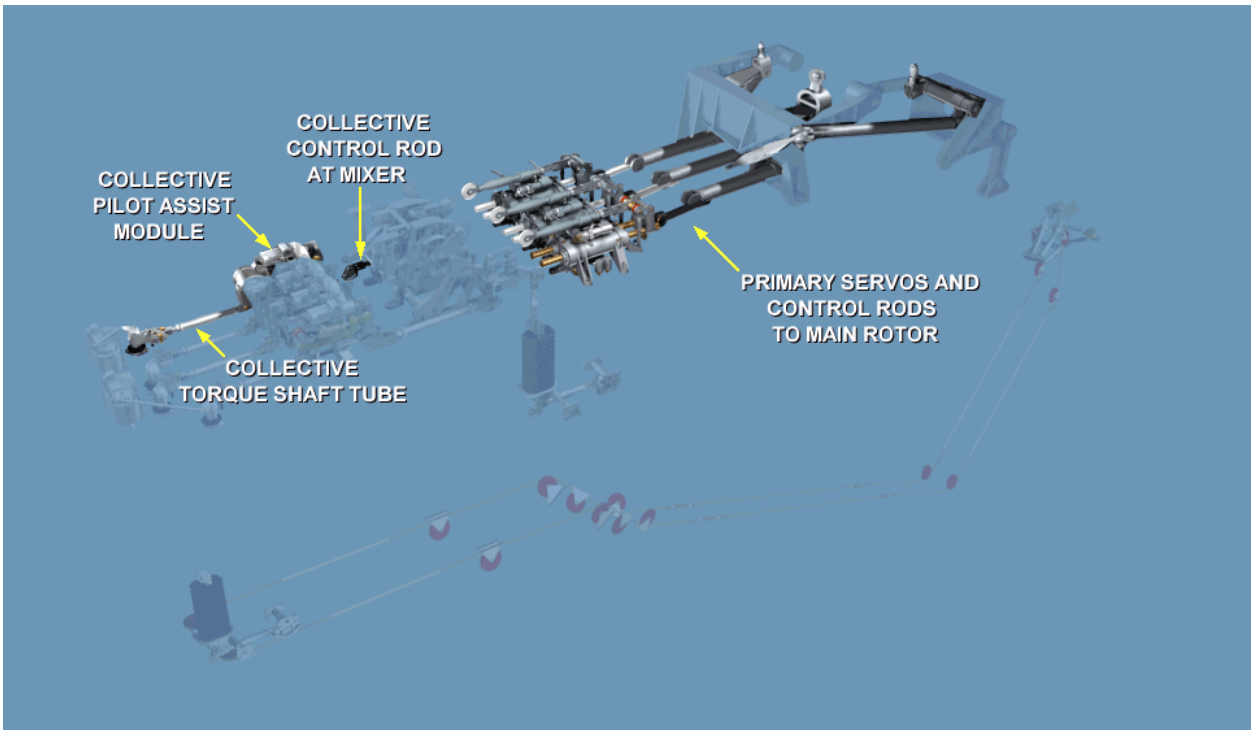
Frame # 0076 (Collective Flight Control Routing)



1) The collective flight control routing begins at the pilot, and co-pilot collective.

2) Control rods are attached at the collectives, routed to the forward cabin side walls, to the overhead forward cabin to the torque shaft tube.

Frame # 0076 (Collective Flight Control Routing)

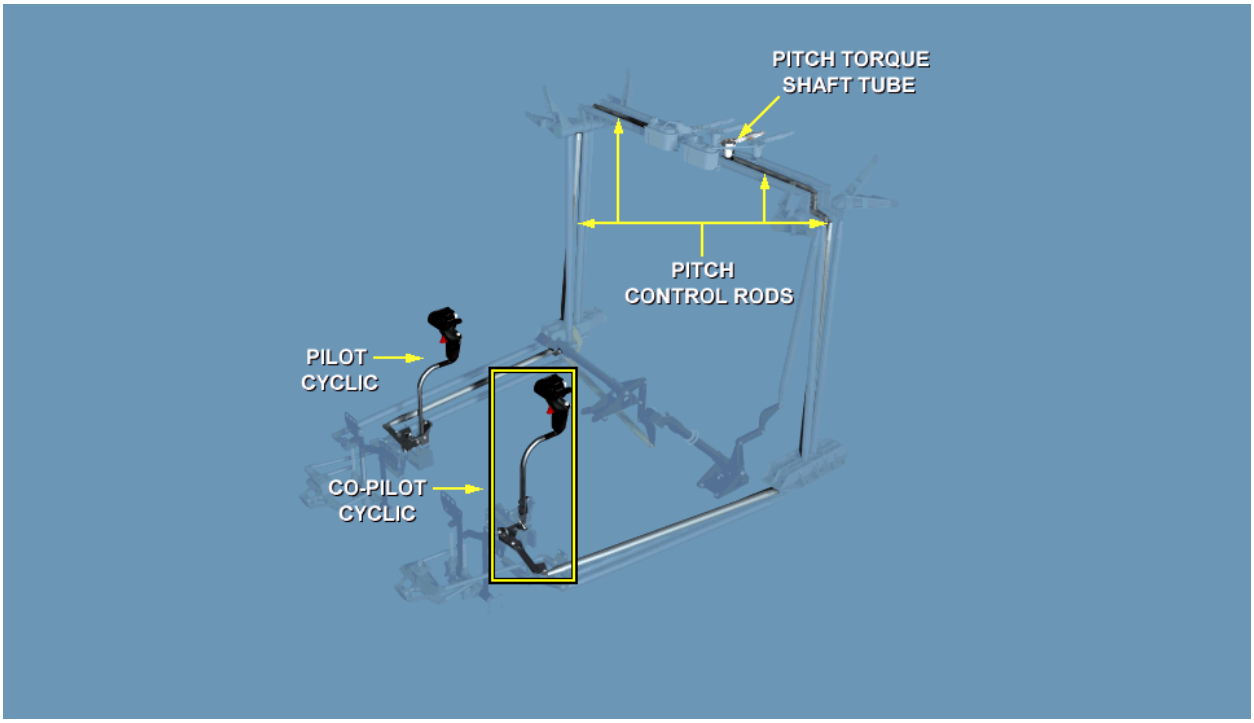


3) The collective torque shaft tube connects the control rod, on the hydraulic deck, to the collective pilot assist module, to a control rod at the mixer assembly.

4) From the mixer assembly, the controls are routed to the primary servos and control rods to the main rotor.

(b) Pitch Flight Control Routing

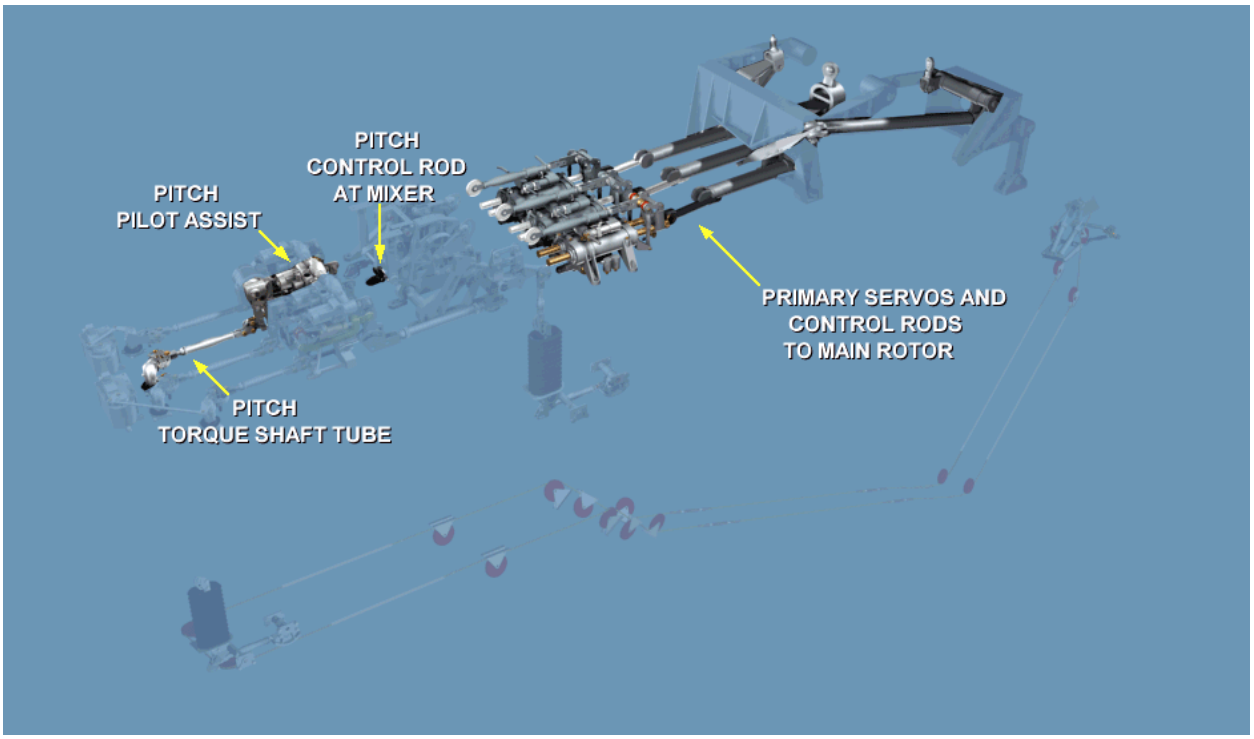
Fame # 0077 (Pitch Flight Control Routing)



1) The pitch flight control routing begins at the pilot, and co-pilot cyclic.

2) Control rods are attached at the cyclics, routed to the forward cabin side walls, to the overhead forward cabin to the torque shaft tube.

Fame # 0077 (Pitch Flight Control Routing)

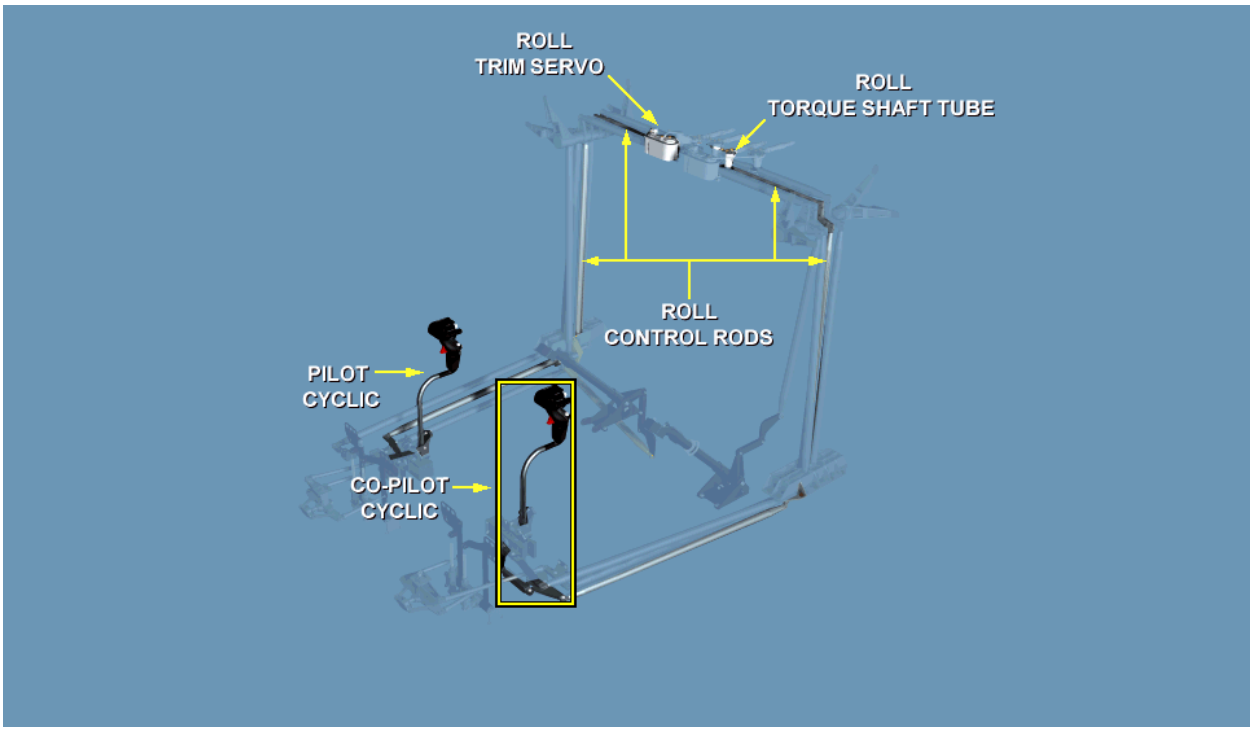


3) The pitch torque shaft tube connects the control rod, on the hydraulic deck, to the pitch pilot assist module, to a control rod at the mixer assembly.

4) From the mixer assembly, the controls are routed to the primary servos and control rods to the main rotor.

(c) Roll Flight Control Routing

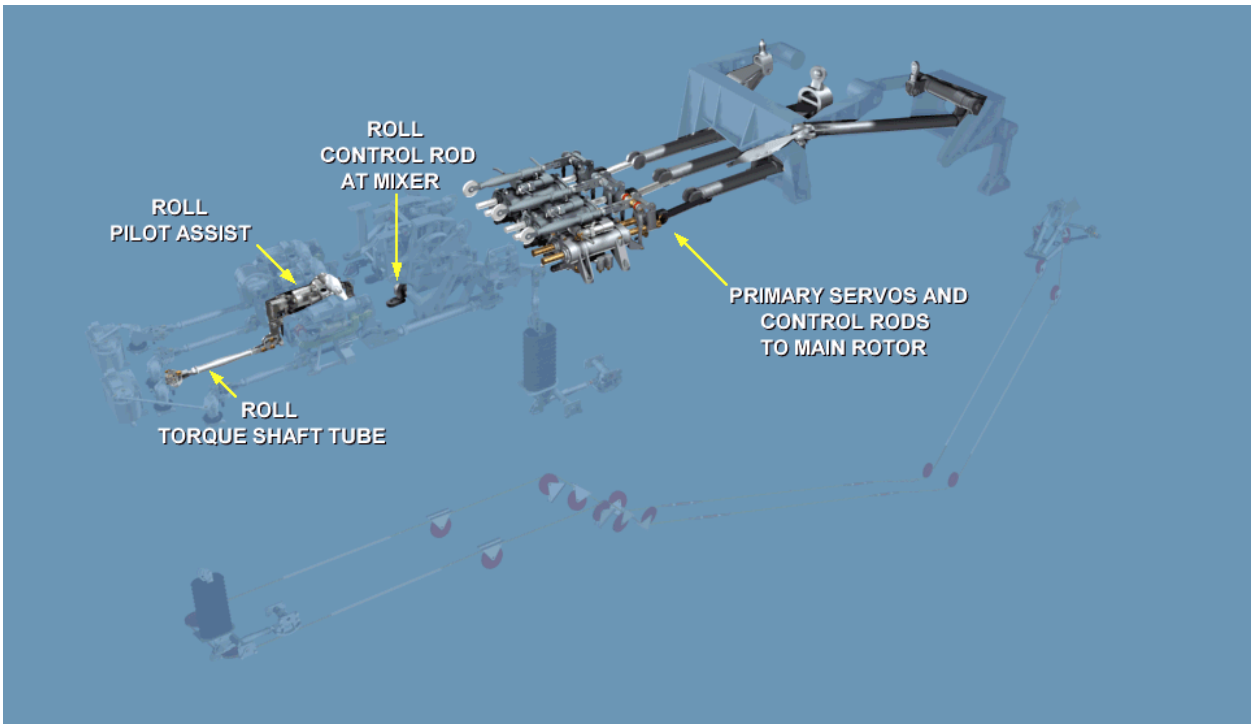
Fame # 0078 (Roll Flight Control Routing)



1) The roll flight control routing begins at the pilot, and co-pilot cyclic.

2) Control rods are attached at the cyclics, routed to the forward cabin side walls, to the overhead forward cabin to the torque shaft tube.

Fame # 0078 (Roll Flight Control Routing)

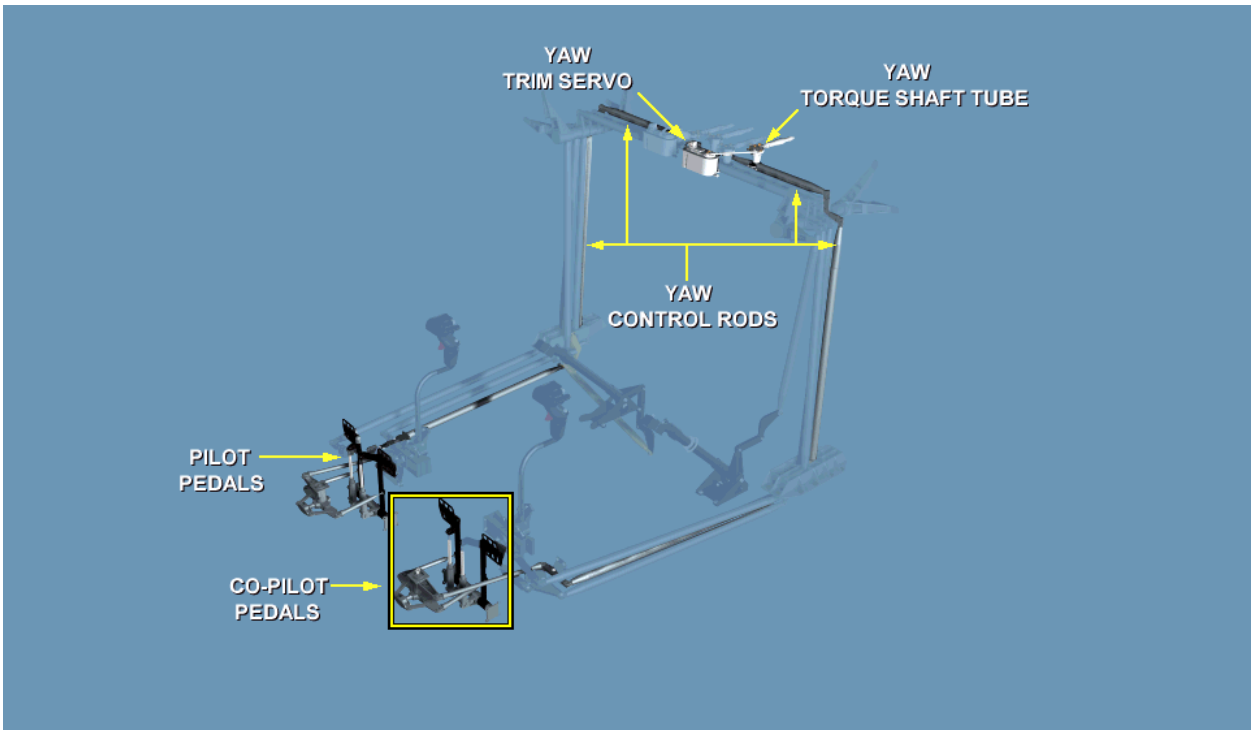


3) The roll torque shaft tube connects the control rod, on the hydraulic deck, to the roll trim servo and roll pilot assist module, to a control rod at the mixer assembly.

4) From the mixer assembly, the controls are routed to the primary servos and control rods to the main rotor.

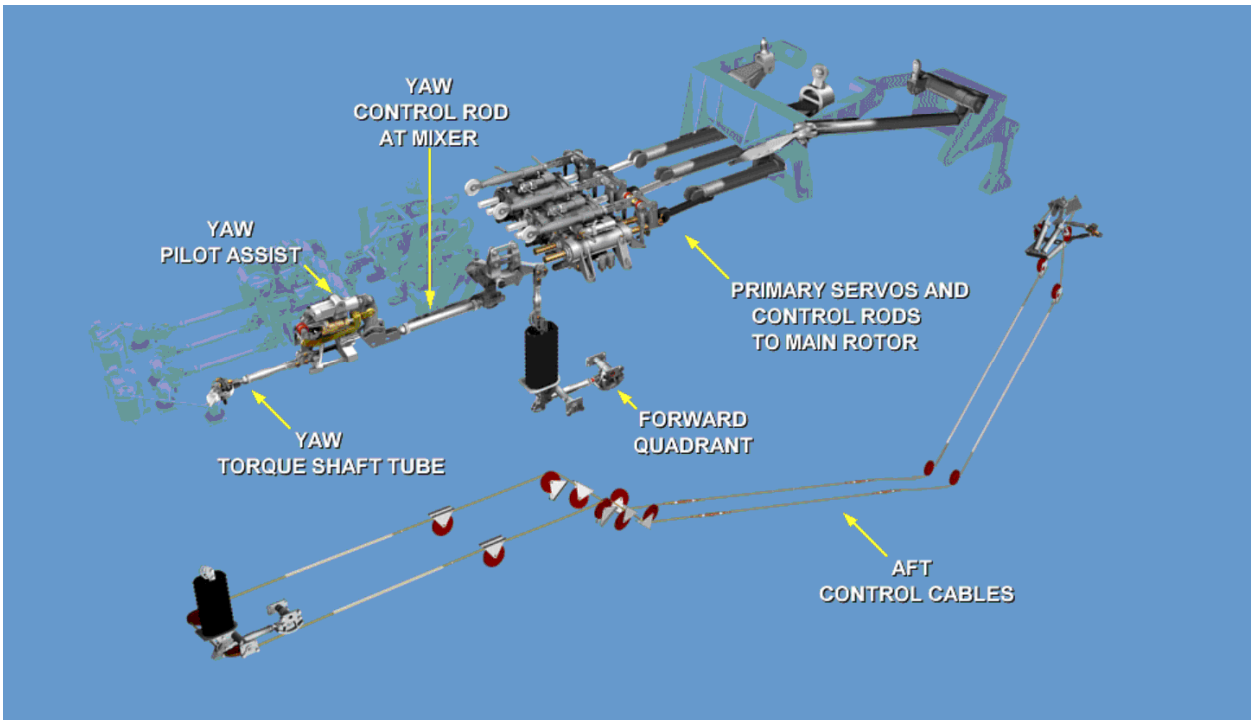
(d) Yaw Flight Control Routing

Fame # 0079 (Yaw Flight Control Routing)



1) The yaw flight control routing begins at the pilot, and co-pilot pedals. Control rods are attached at the pedals, routed to the forward cabin side walls, to the overhead forward cabin to the torque shaft tube.

Frame #0079 (Yaw Flight Control Routing)

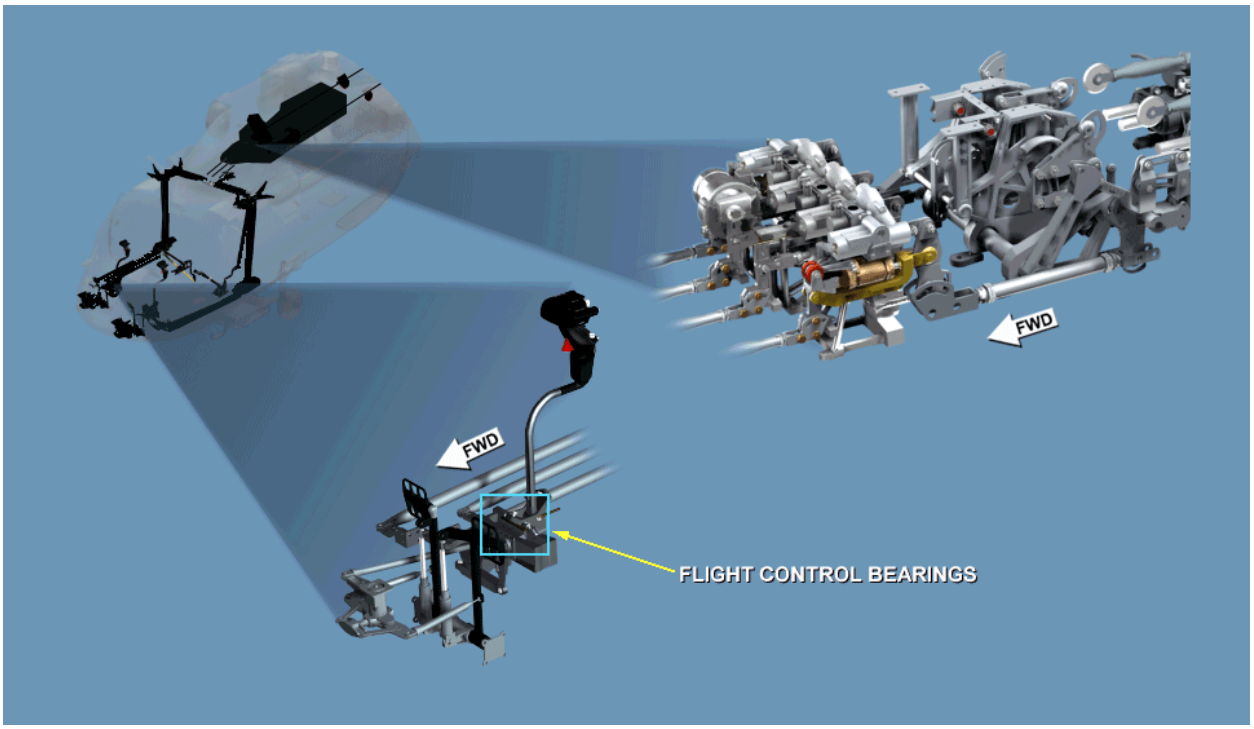


2) The yaw torque shaft tube connects the control rod, on the hydraulic deck, to the yaw trim servo and yaw pilot assist module, to a control rod at the mixer assembly.

3) From the mixer assembly, the controls are routed to the forward quadrant, to the aft control cables, to the tail rotor servo and quadrant.

c. Cabin Center Section Controls

Frame # 0067 (Cabin Center Section Controls)



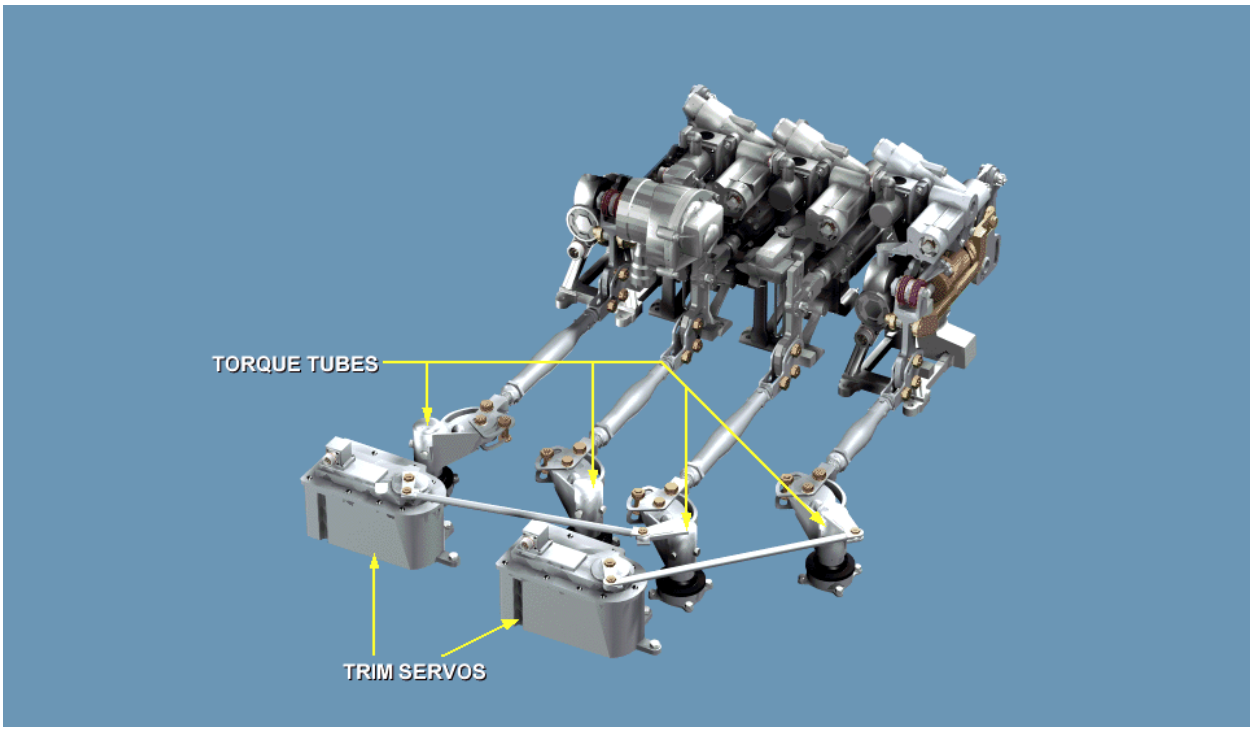
(1) When performing maintenance, if there is a need to remove the push-pull tubes, ensure to mark the tubes, to show correct installation.

(2) Flight control popping could be a result of worn or binding bearings.

(3) These bearings are checked during the MTP Flight Control Breakout Forces check.

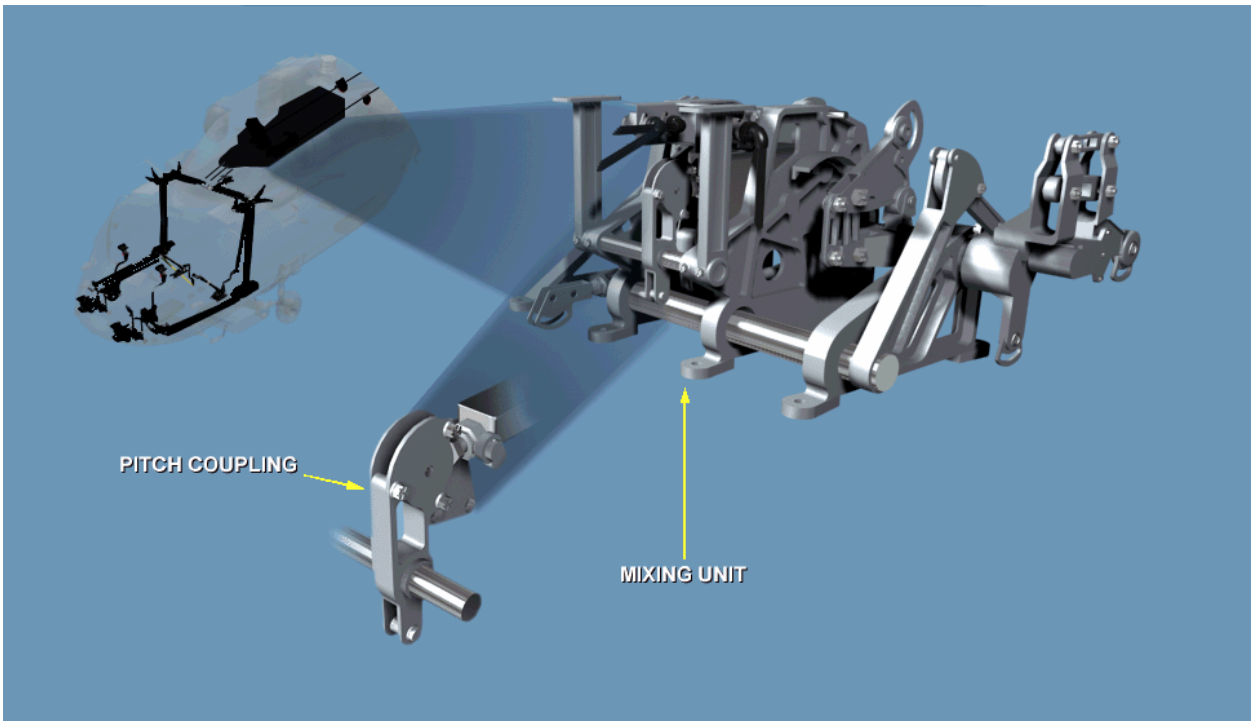
(4) Bearings are checked in all levers, bellcranks, and push-pull tubes, from the cockpit, troubleshoot IAW the bearing inspection, or “binding”, IAW the TM/IETM.

Frame # 0068 (Trim Servos)



(5) The Yaw and Roll torque tubes also go forward and attach to the Trim Servos.

Frame # 0070 (Mixing Unit)

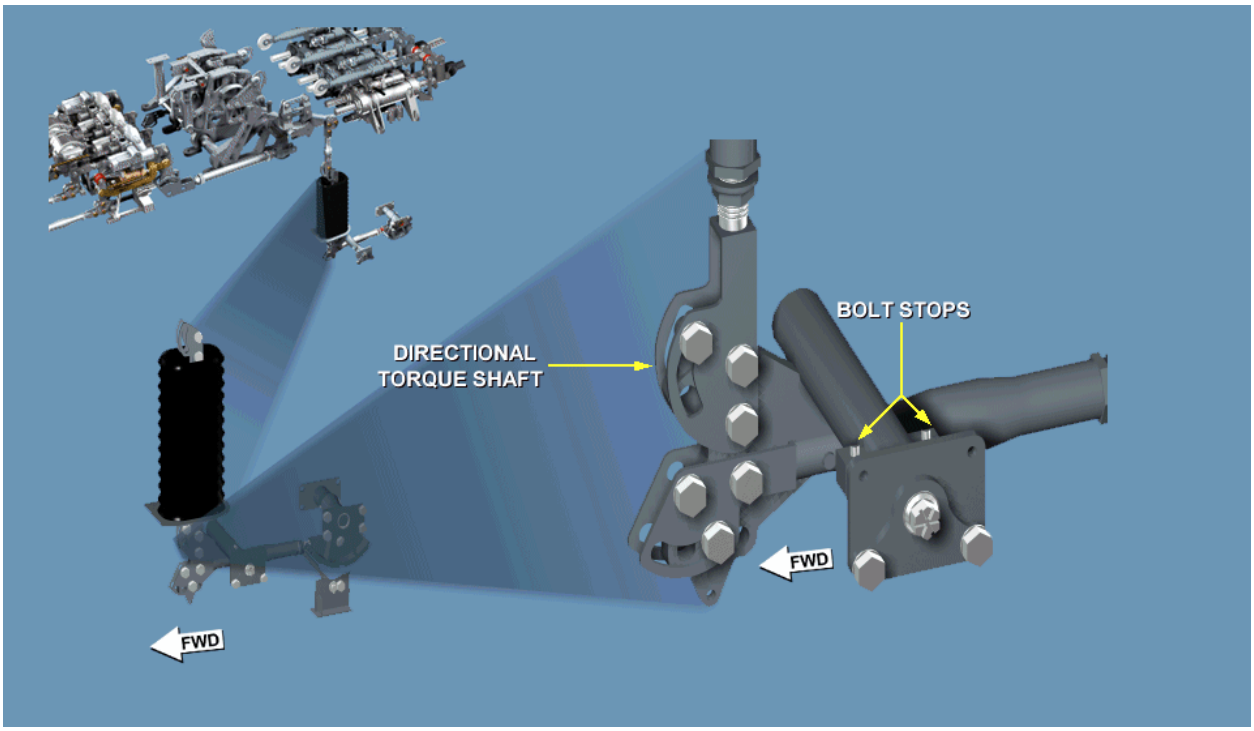


(6) The mixing unit mechanically combines inputs to the main rotor and provides proportional control movements to the tail rotor.

(7) This takes place through the collective to yaw coupling, and through the hydraulic primary servos.

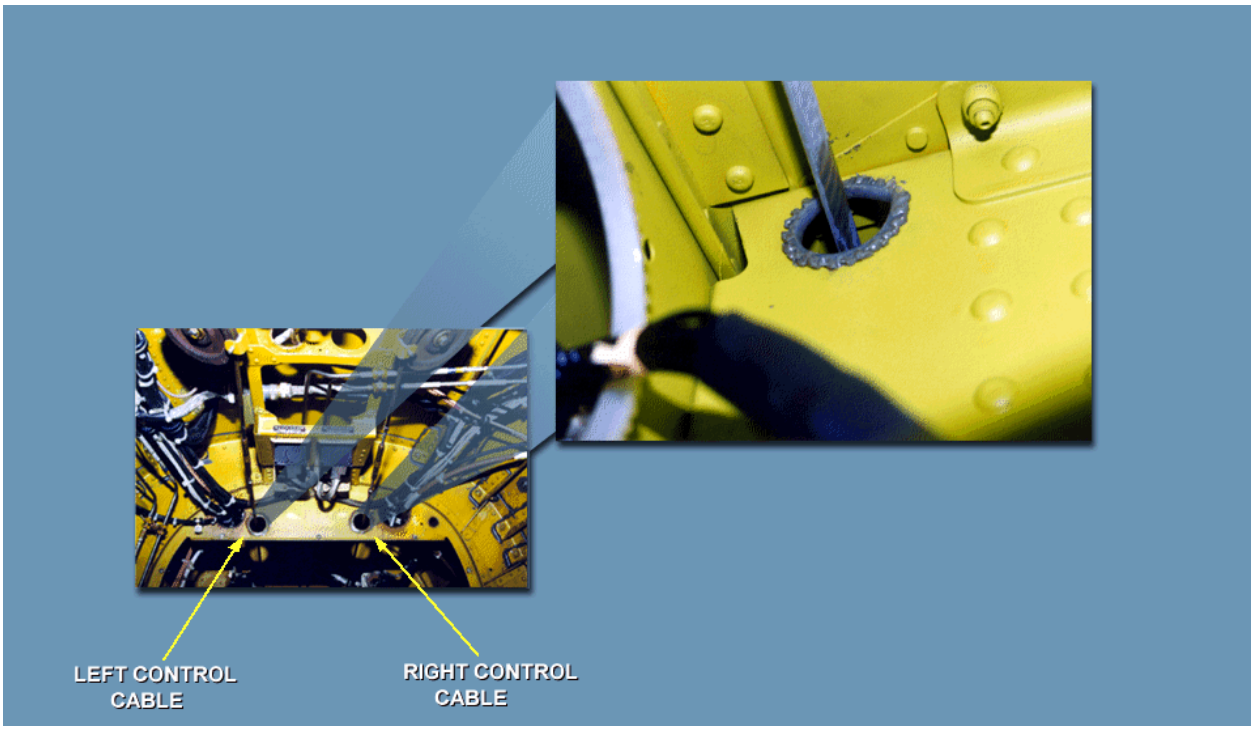
(8) The Main Rotor Swashplate receives input from the primary servos through control rods, which changes blade pitch.

Frame # 0072 (Directional Torque Shaft)



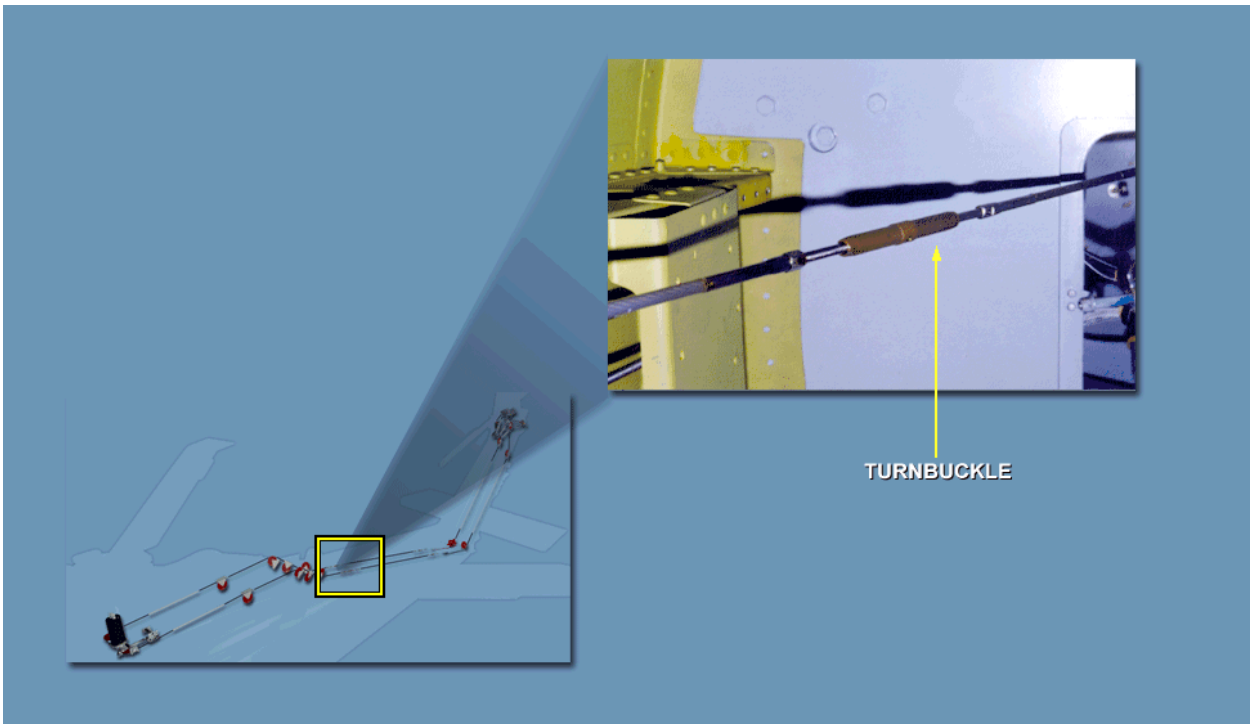
(9) From the mixing unit, flight controls are routed down through the cabin, to the directional torque shaft, that connects to the yaw lever shaft and then to the forward quadrant assembly.

Frame # 0075 (Control Cable Routing)



(10) The left and right control cables run from the forward quadrant to the aft quadrant.

Frame # 0075A (Control Cable)

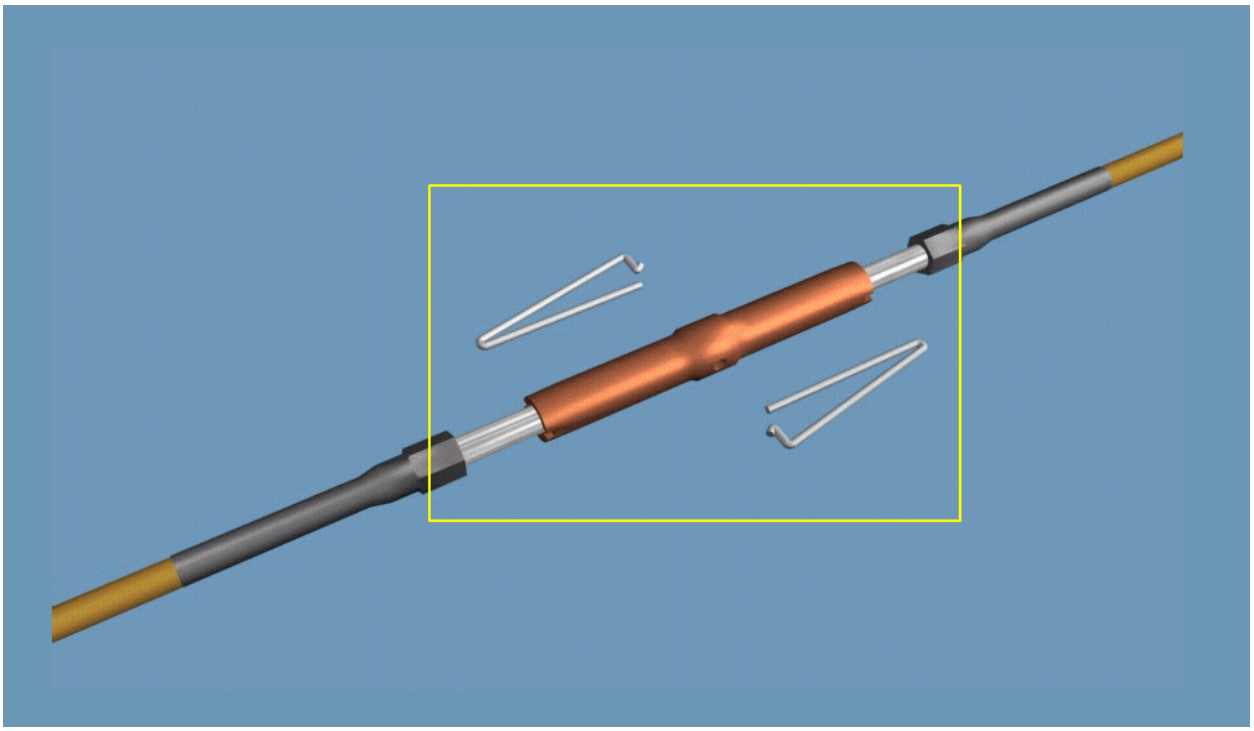


(11) Directional control is provided through a series of cables, pulleys, and turnbuckles.

(12) The turnbuckles are installed to ensure proper cable tension.

(13) Turnbuckles allow the cable tension to be adjusted so both cables will have equal tension with the pedals and collective centered.

Frame # 0075A2 (Locking Pins Operation; FLASH)



(14) The cable turnbuckle safety clips have to be removed to adjust the cable tension.

(15) The cables themselves, should not be disconnected unless the spring tension has been removed or locked out first.

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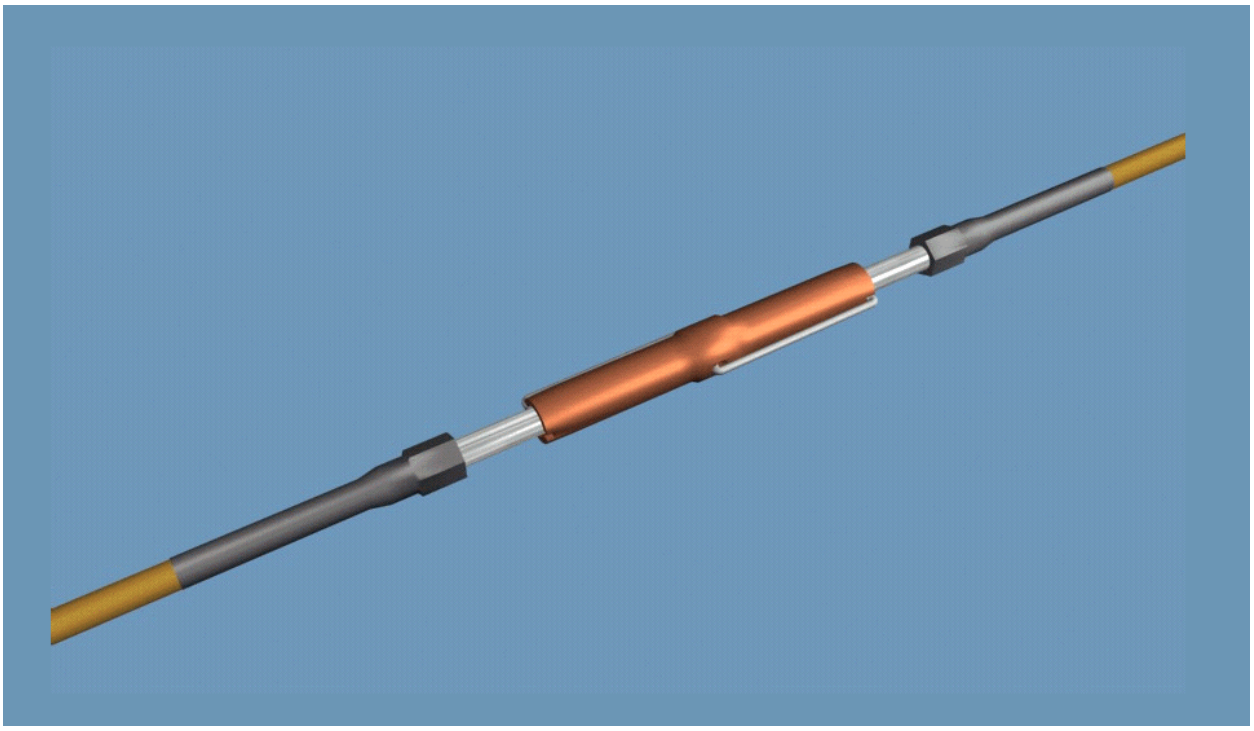
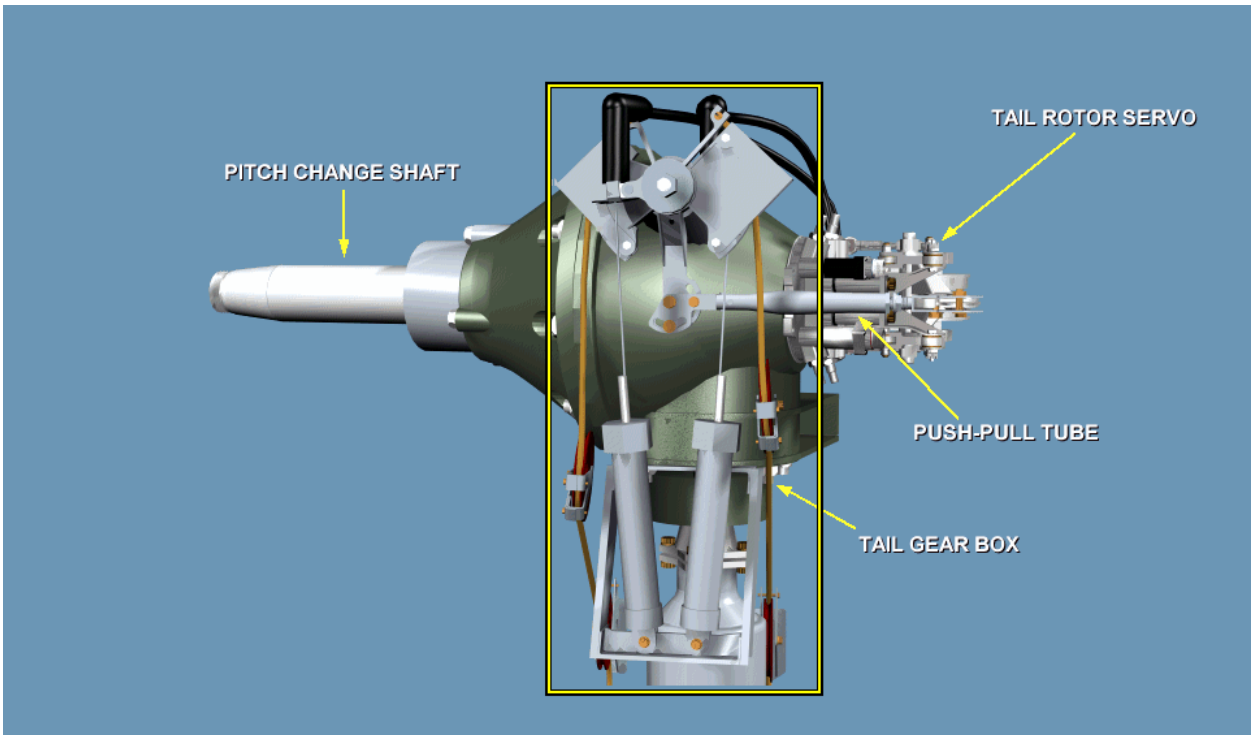
Frame # 0075A2 (Locking Pins Operation; FLASH)



(16) Locking pins are inserted in opposite holes.

Frame # 0075C (Tail Rotor Servo and Pitch Change Shaft)



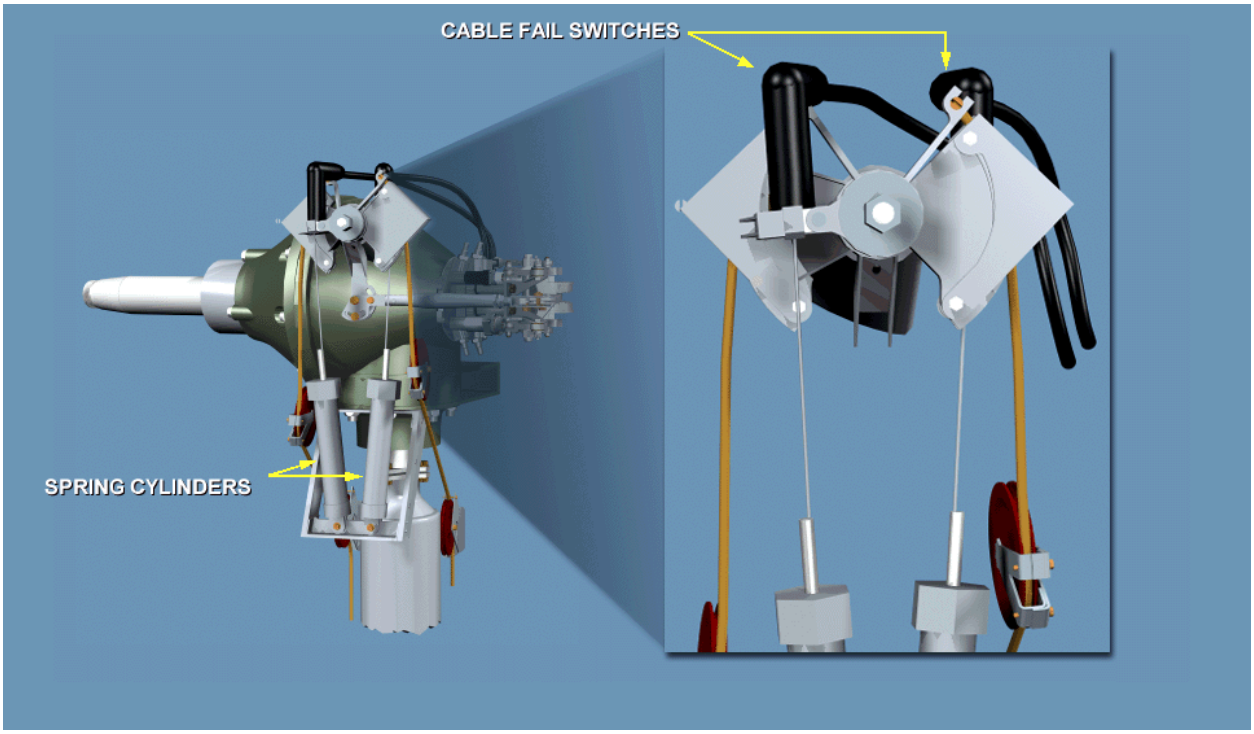
(17) The Tail Rotor (T/R) directional control system determines helicopter heading, or yaw, by controlling pitch of the tail rotor blades.

(18) The control pedals are connected through a series of control rods, bellcranks, the yaw boost servo, the mixing unit, cables, to the tail rotor servo.

(19) This moves the pitch change beam to change tail rotor blade angles.

(20) The tail rotor controls are powered by the first stage or backup hydraulic systems.

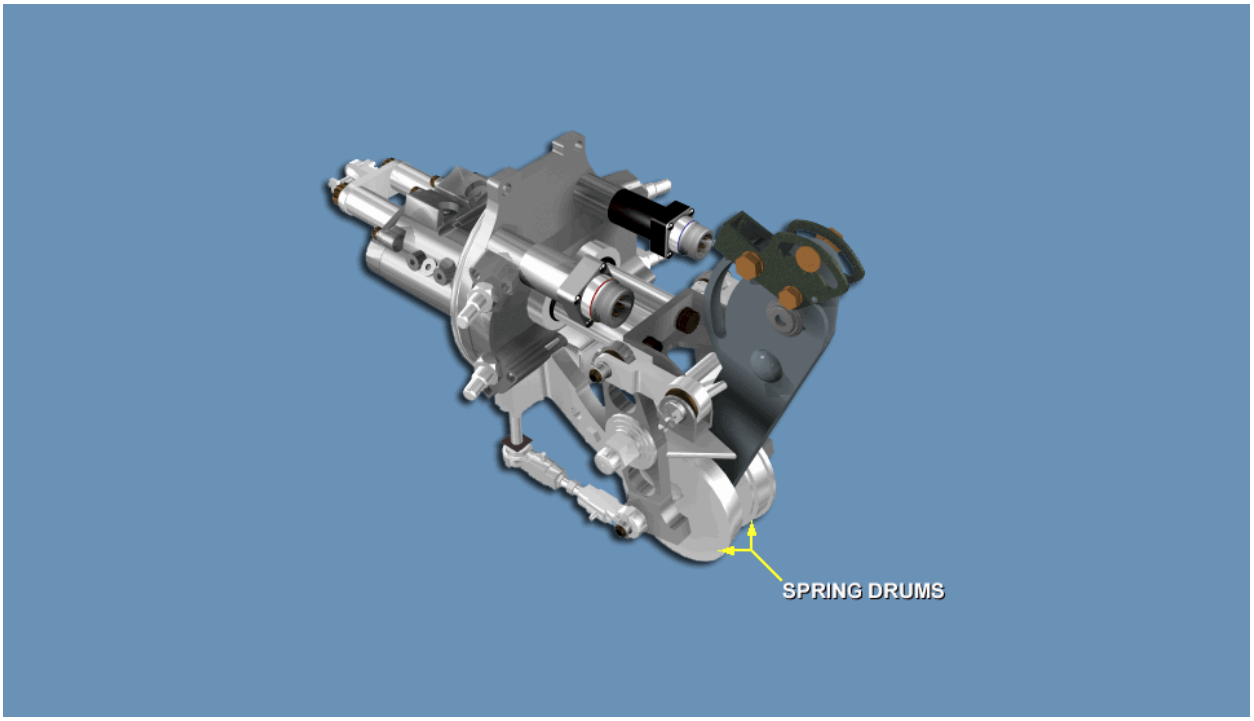
Frame # 0075C (Tail Rotor Servo and Pitch Change Shaft)



(21) The cables are attached to the AFT T/R Quadrant.

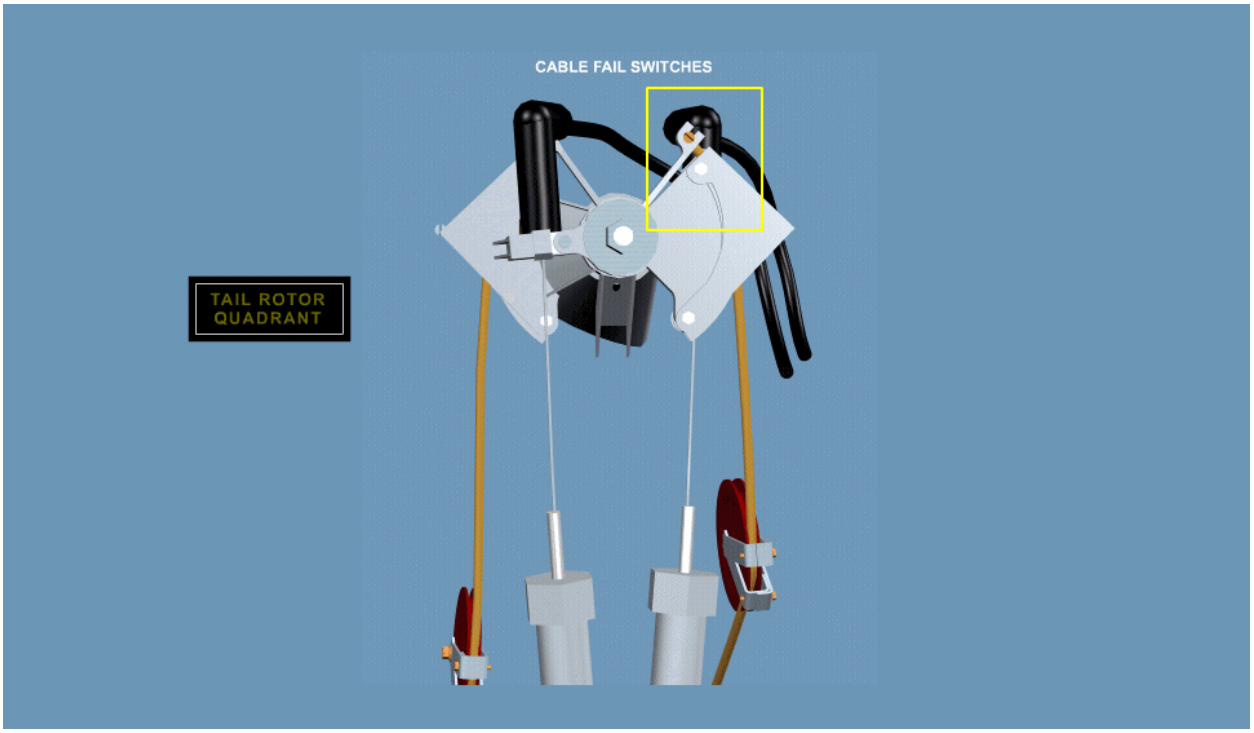
(22) If either cable breaks, the tail rotor servo can be controlled with the one remaining tail rotor cable, countered by one spring cylinder.

Frame # 0075C (Tail Rotor Servo and Pitch Change Shaft)



(23) The 10.5 degree pitch setting of the tail rotor, with the loss of both tail rotor cables, is attended due to the spring drums mounted on the tail rotor servo assembly that position the respective pilot valves.

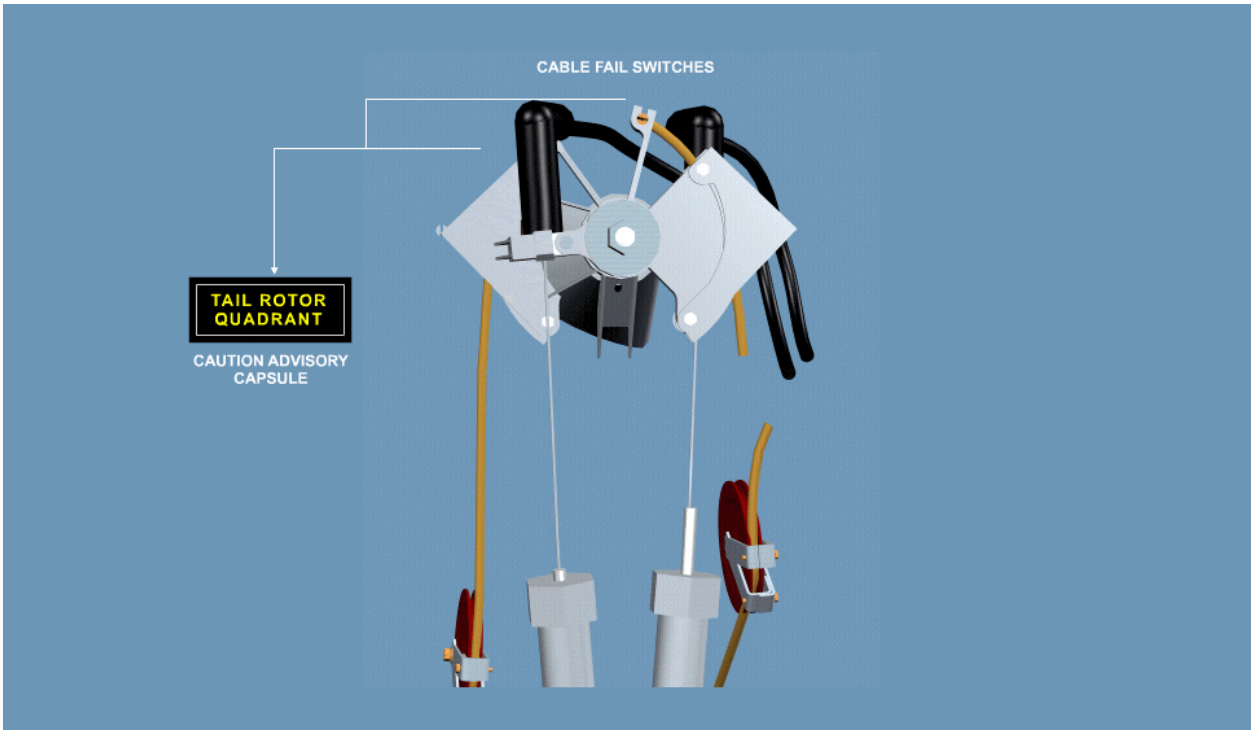
Frame # 0075D (Aft Quadrant FLASH)



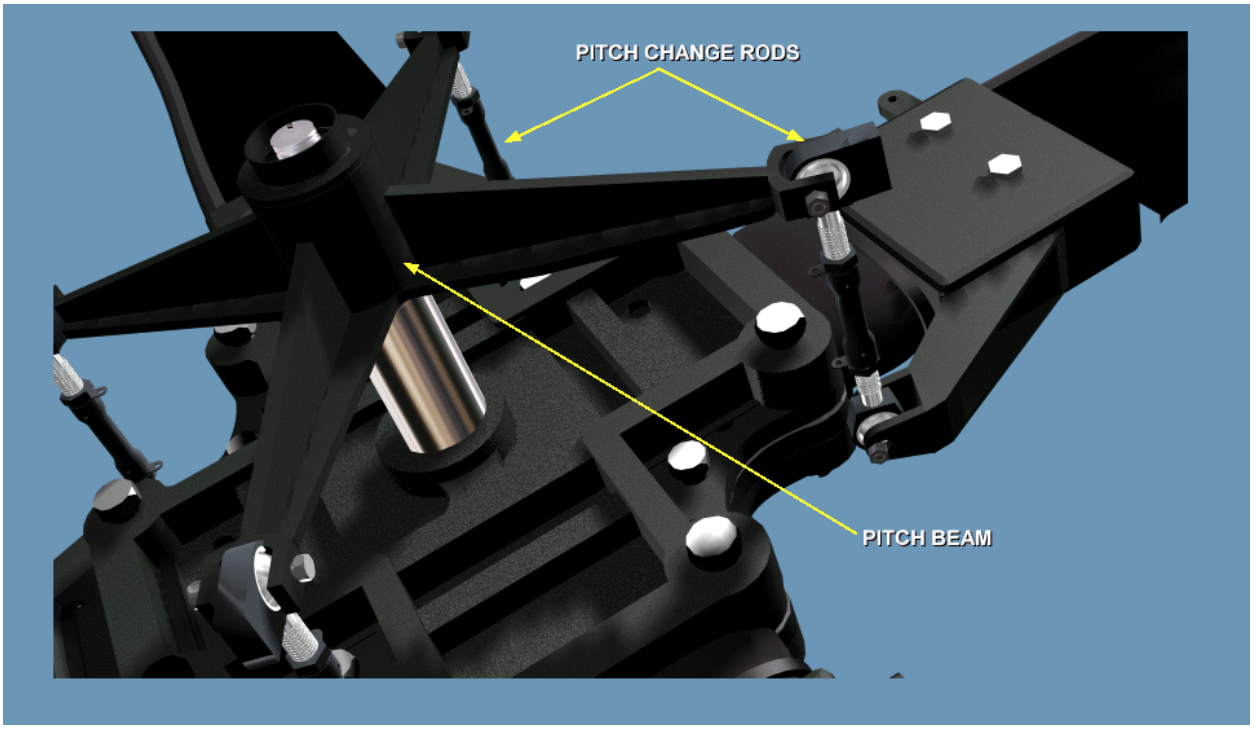
(24) The cables are attached to Cable Fail switches on the AFT quadrant.

(25) If the cable breaks, the switch will illuminate the caution advisory capsule, and the spring cylinders keep pressure on that side of the quadrant to maintain T/R control.

Frame # 0075D (Aft Quadrant FLASH)



Frame # 0075E (Tail Rotor)

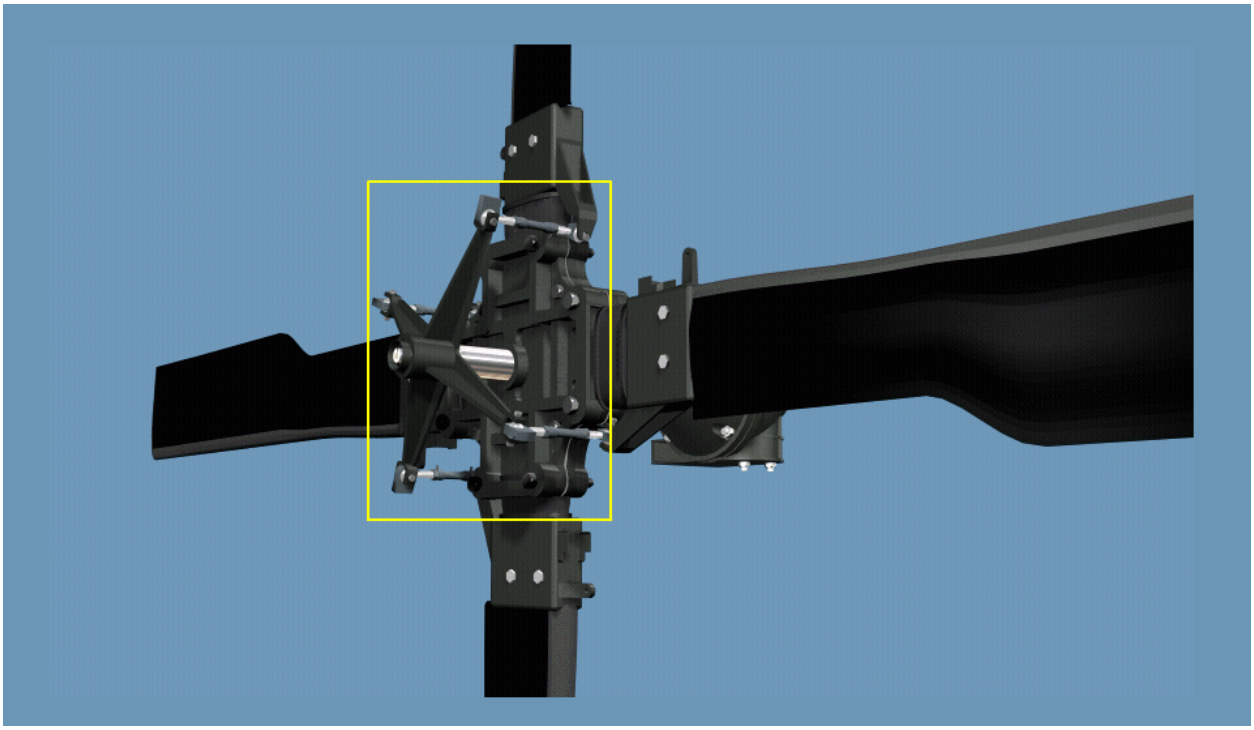


(26) The pitch beam uses pitch change rods to make inputs to the T/R blades.

(27) The angle that the T/R servo centers at is determined by the adjustment of the T/R pitch change rods, which adds another 3º of pitch to the blades if both T/R cables break.

d. Directional Controls

Frame # 0060 (Directional Controls FLASH)



(1) The tail rotor is connected by bellcranks, idlers, and control rods, to the hydraulic yaw boost servo for power assist, and then through the mixing unit, to the forward quadrant assembly to the control cables.

(2) Control cables transmit this movement to the rear control quadrant, then to a control rod to the hydraulic tail rotor servo.

(3) This moves the pitch change beam, which changes the tail rotor blade angles.

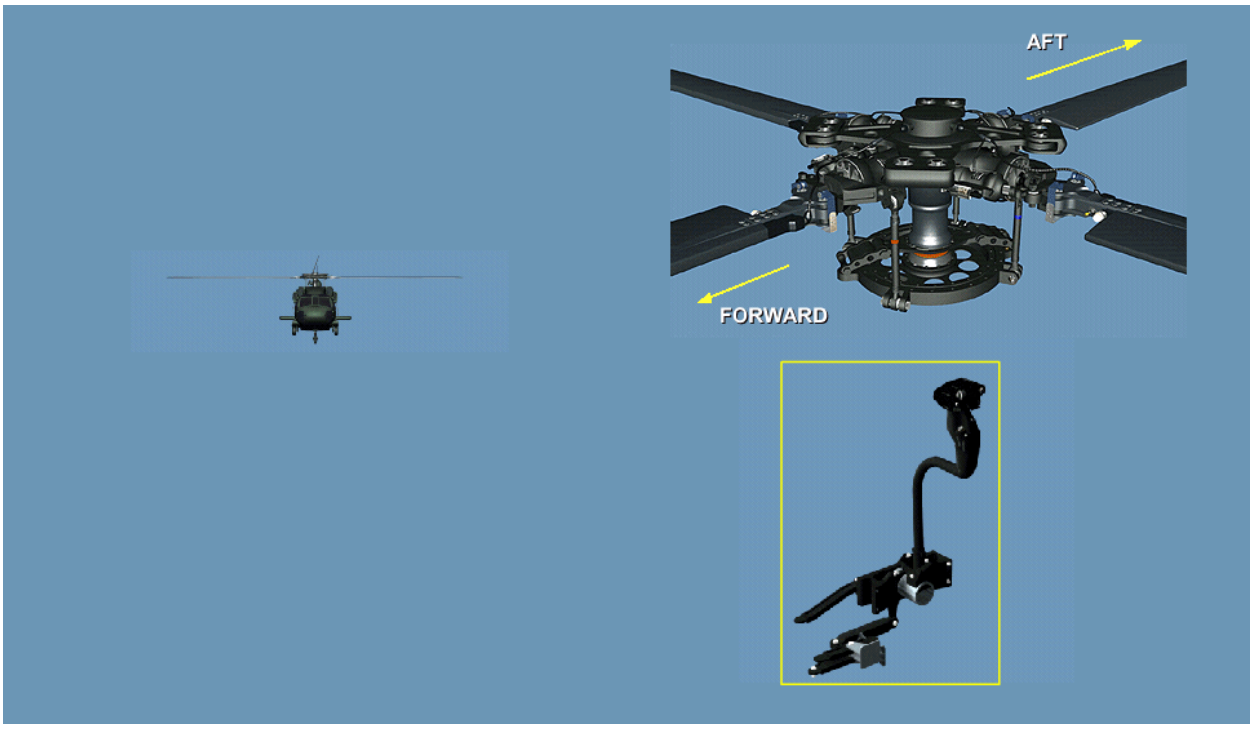
Frame #0061 (Collective Operation FLASH)

(4) The primary servos raise or lower the main rotor swashplate, which changes blade pitch.

(5) The swashplate moves, independently of the cyclic position of the Swashplate.

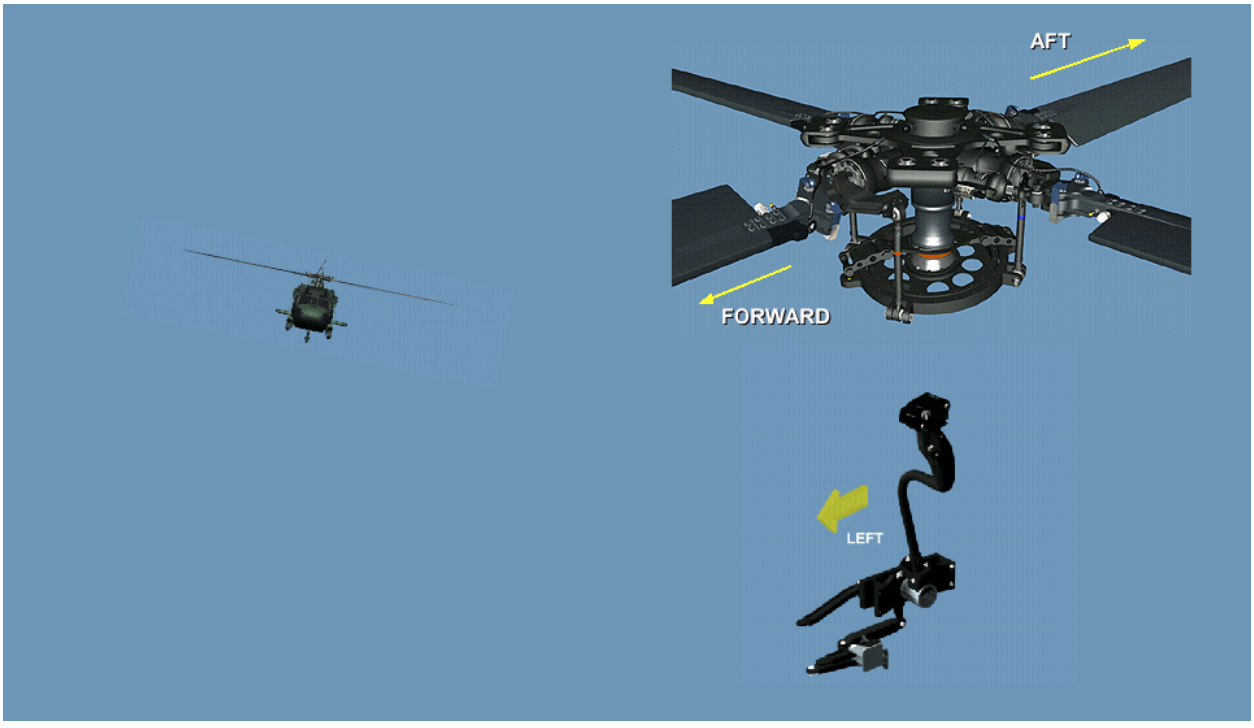
Frame # 0061 (Collective Operation FLASH)

Frame # 0062 (Cyclic Operation FLASH))



(6) The Swashplate links connect the Forward, Aft, and Lateral bellcrank inputs, which move the pitch control rods vertically to change pitch in the main rotor blades.

Frame # 0062 (Cyclic Operation FLASH))



CHECK ON LEARNING

1. Which of the following controls is routed from the hydraulic deck, back inside the cabin ceiling?

2. What is the purpose of the Cable fail switch?

3. The purpose of the tail rotor cable turnbuckles is to _____.

SECTION III. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Flight Controls System lesson of the UH-60 helicopter. The key points to remember are:

- The flight controls consist of the collective, cyclic, and tail rotor (directional) control systems.
- These systems use a series of push-pull rods, bellcranks, cables, pulleys, and servos that transmit control movements from the cockpit to the main and tail rotors.
- Hydraulic power is supplied by the first stage, second stage, and backup hydraulic systems. Electrical power is supplied by the AC and DC electrical system.
- Assistance for the pilot or copilot in pitch, roll, and yaw control is provided by the Stability Augmentation System (SAS), Flight Path Stabilization (FPS), and electromechanical trim.
- Pilot and copilot controls are routed through the cockpit floor and control inputs intermix at the overhead connections. All controls are routed outside of the bulkhead.
- If ever a need to remove push-pull rods, be sure to mark tubes from the front to rear and top to bottom.
- The AFT quadrant is connected to the T/R servo by a push-pull rod.

B. ENABLING LEARNING OBJECTIVE No.2

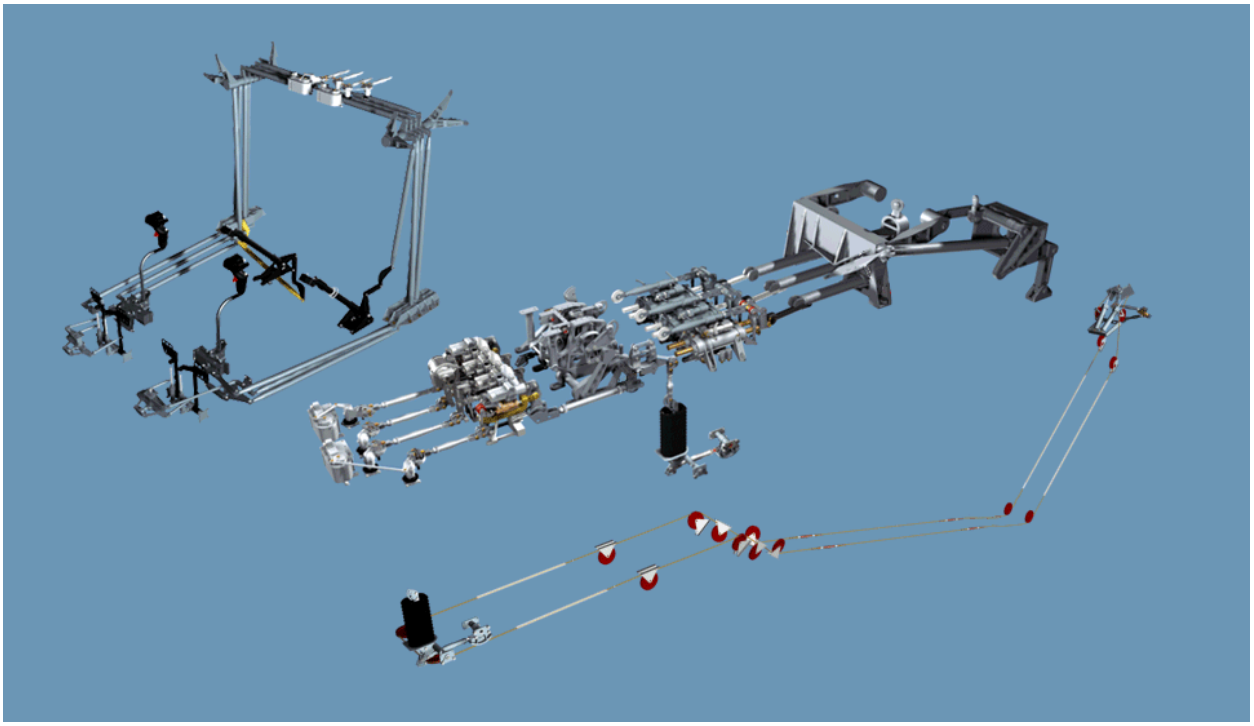
ACTION: Identify the characteristics of Flight Safety Critical Aircraft Parts and Self-retaining bolt used in the system.

CONDITIONS: Given a list as a UH-60 Maintenance test pilot.

STANDARDS: IAW UH-60 Technical Manuals.

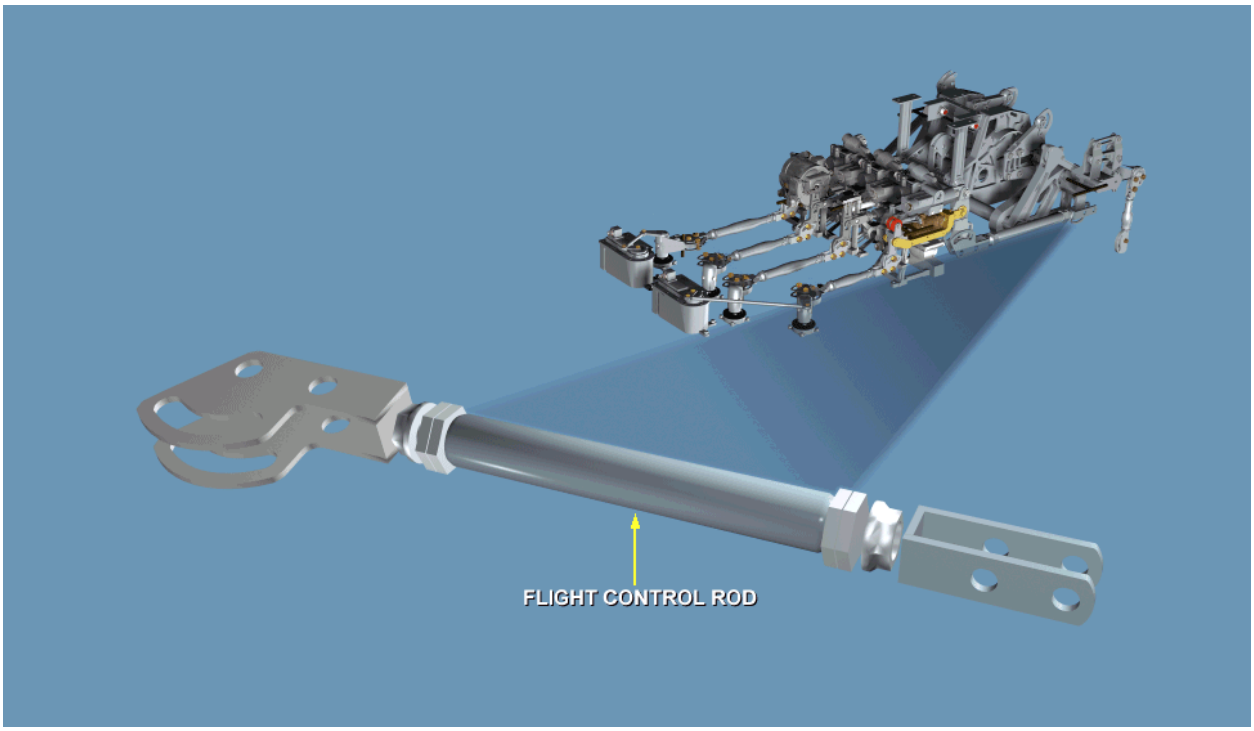
a. Flight Critical Safety Aircraft Parts

Frame # 0120 (Flight Critical Safety Aircraft Parts)



(1) A Flight Safety Part (FSP) or a Flight Safety Critical Aircraft Part (FSCAP) is defined as a part, assembly, or installation procedure with one or more critical characteristics that, if not conforming to the design data or quality requirements, could result in the serious injury or death of crew members and/or serious damage to the helicopter.

Frame # 0130 (Critical Characteristic)



(a) Flight control rods are some of many components listed as a Flight Safety Critical Aircraft Part FSCAP.

(b) They have critical characteristics and any dimension, tolerance, finish, material manufacturing, assembly or inspection process, or other feature which, if nonconforming or missing, could cause failure or malfunction.

(c) Critical characteristics produced during the manufacturing process are termed manufacturing critical characteristics.

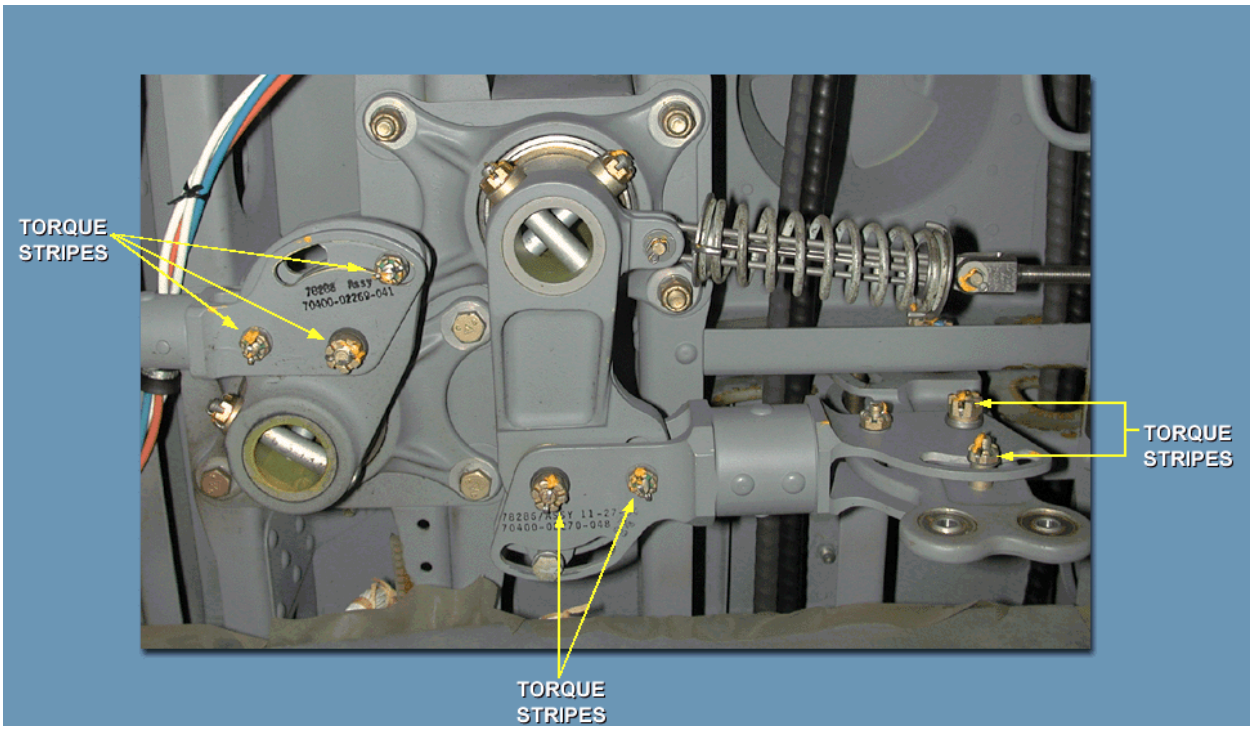
(d) Critical characteristics not introduced during manufacturing, but critical in terms of assembly/installation (e.g. proper torque), are termed installation critical characteristics.

(e) A list of FSCAP components are listed in the TM.

(f) Throughout the maintenance procedures, warnings appear emphasizing critical instructions to be followed.

(g) These warnings are identified as "FSCAP" warnings and are inserted whenever and wherever necessary.

Frame # 0150 (Critical Characteristic Connections)

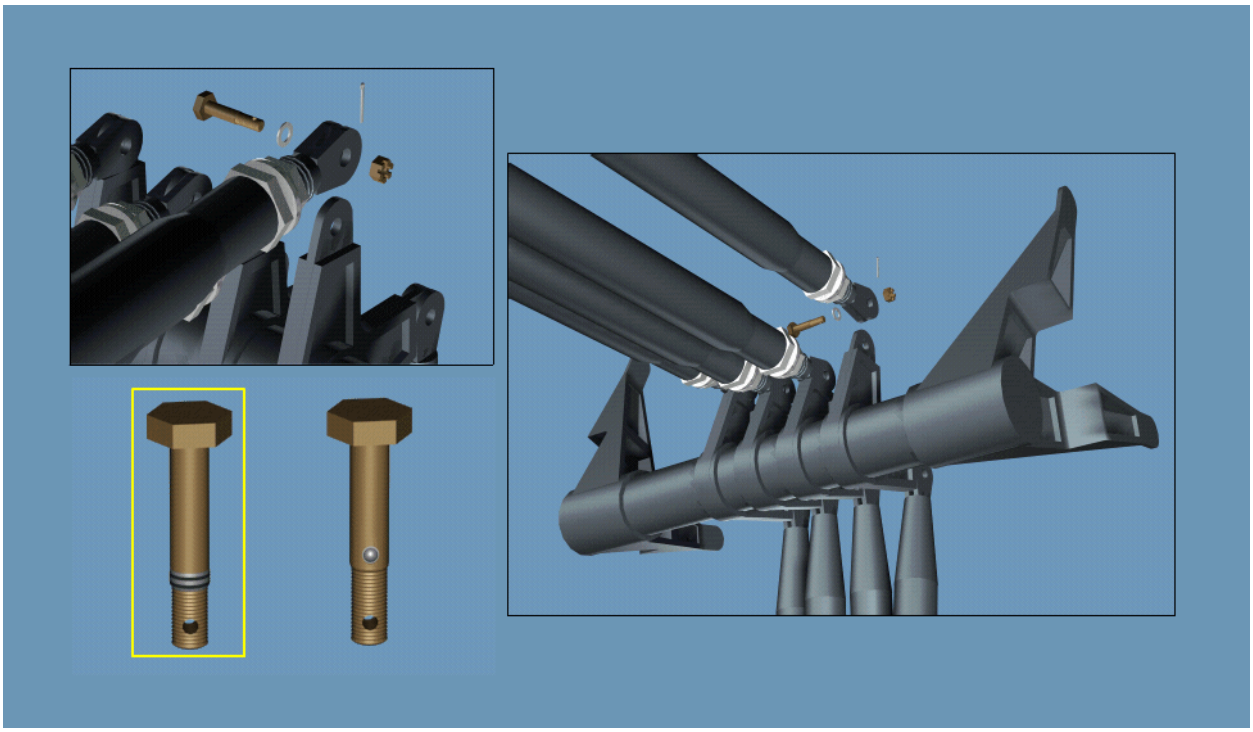


1) Torque stripes are used to identify all fasteners with critical characteristics torque or installation procedures.

2) Torque stripes are a painted on strip that is applied to either end of a fastener.

3) Torque stripes are similar to slippage marks, however, they are not used to show relative motion of fasteners, but rather stabilized torque.

Frame # 0175 (Impedance Bolts FLASH)



4) There are two types of self-retaining bolts used in the flight controls; Impedance Self-Retaining and Locking Type Self-Retaining bolts.

5) The Impedance Self-Retaining bolt may have a split collar or ball bearings and no plunger in the head of the bolt.

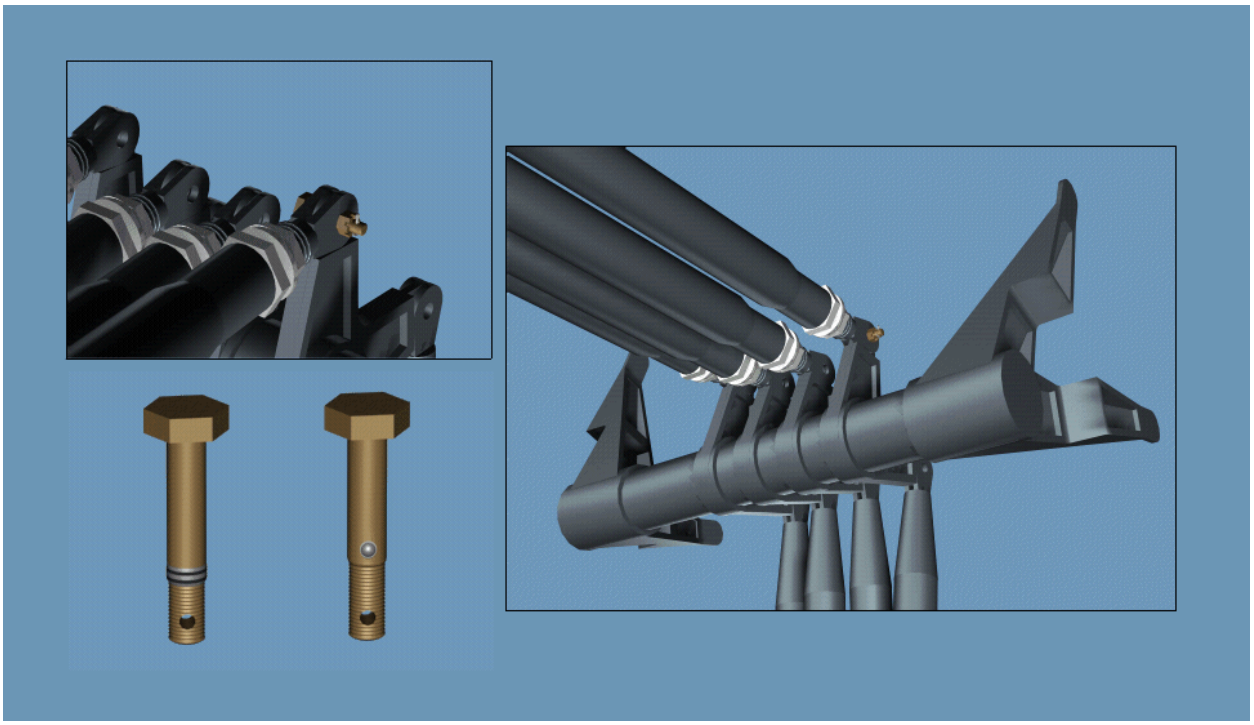
6) These bolts are used in flight control connections where bearings are attached.

7) When installing these bolts, check for free axial motion and the impedance feature is not restrained during connections.

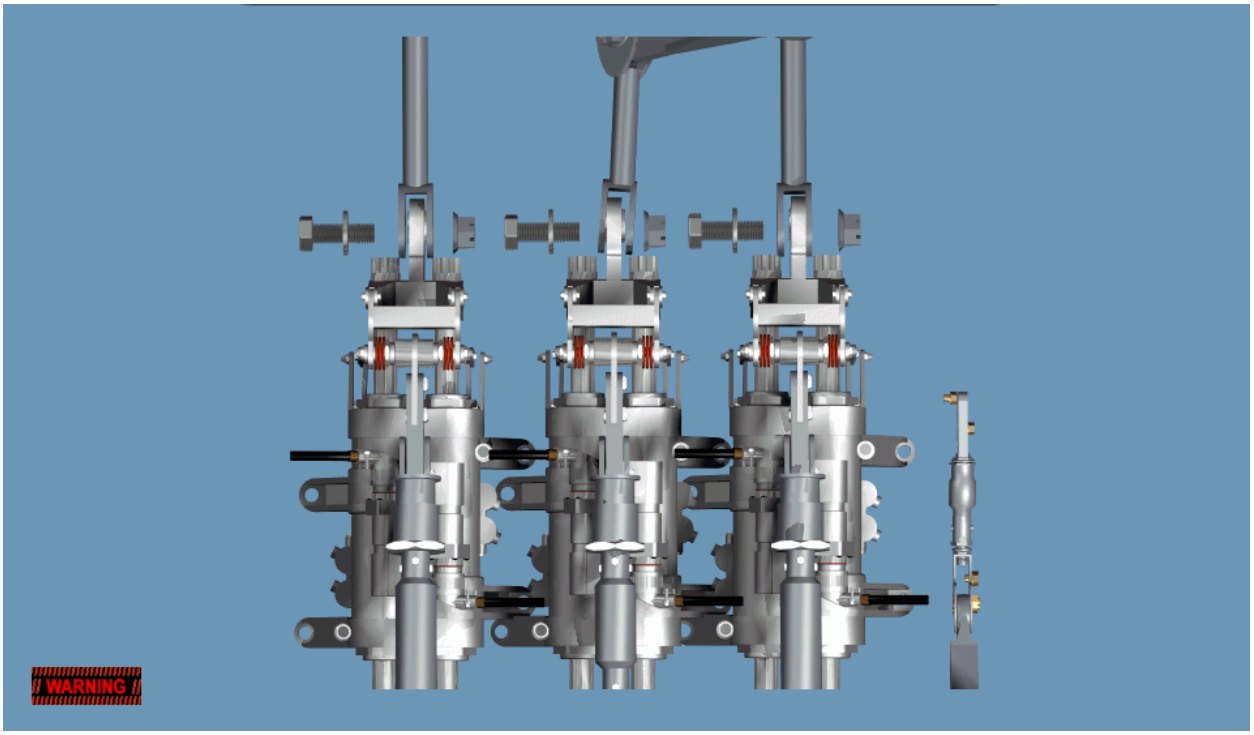
8) If the bolt binds or the impedance feature is depressed, change washer stack up, or use next longer or shorter bolt.

9) A complete list of FSP and FSCAP parts and components are listed in the TM.

Frame # 0175 (Impedance Bolts FLASH)



Frame # 0160 (Self-Retaining Bolts)

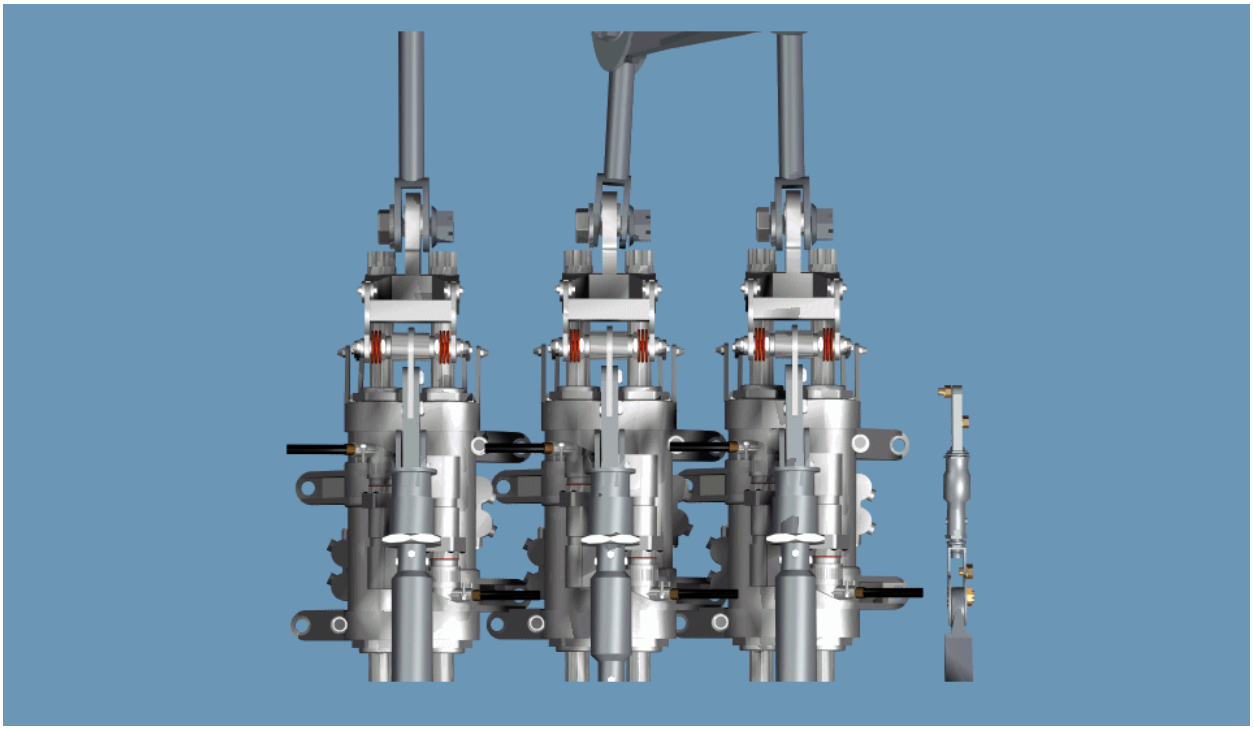


WARNING: FLIGHT SAFETY PARTS outside diameter and bolt head shoulder of self-retaining bolts are critical surfaces which must not be damaged.

10) Any of the Self-Retaining bolts must have a retaining ring or retaining ball intact during installation.

11) During inspection, or when installing any of the different type bolts, the retaining ring, split collar, or retaining balls, must provide resistance when going into the bolt hole.

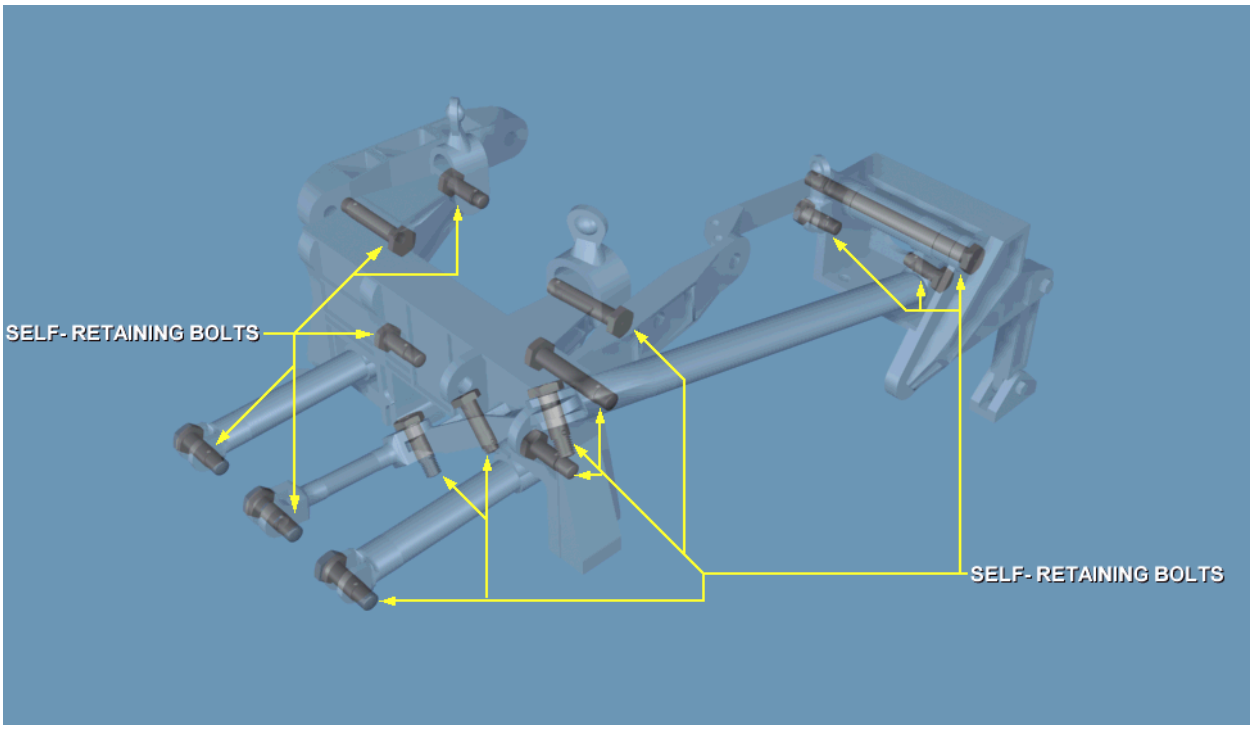
Frame # 0160 (Self-Retaining Bolts)



12) For ball-type bolts, ensure retaining balls cannot be pushed in without first depressing the button in center of bolt head.

13) Self-retaining bolts may be reused, provided the bolt shows no sign of corrosion, fretting, nicks, or damaged threads, and the retaining mechanism is not damaged.

Frame # 0170 (Self-Retaining bolts)

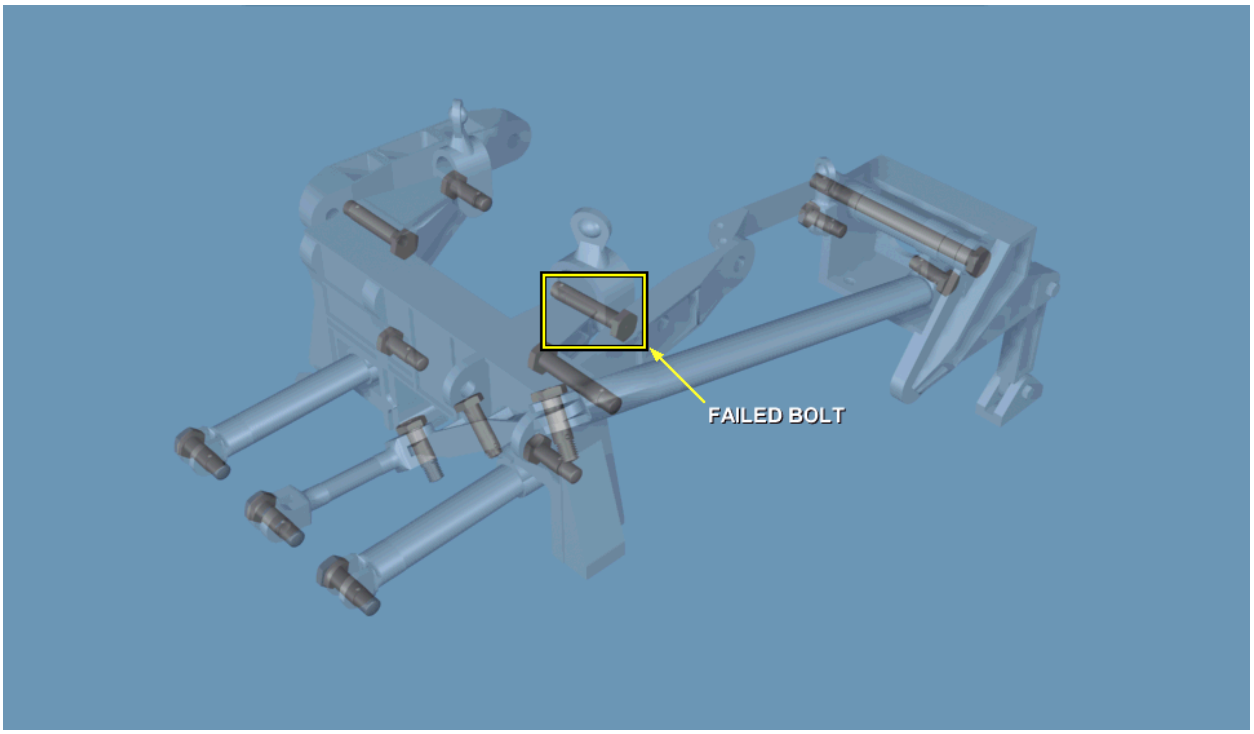


14) Locking type Self-Retaining bolts (Pivot-bolts) are used as the primary connections in the flight controls system, to prevent components from disconnecting accidentally.

15) The 15 different bolt connections are identified by the retaining balls, or a spilt collar, which are locked in place until the plunger head is depressed.

16) The split collar is compressed into a groove during installation, and expands on the outside of the hole when the bolt is completely installed.

Frame # 0171 (Self-Retaining bolts)



17) An example of a failed pivot bolt follows.

18) Following the aircrew hotseat, the HSL-46 aircrew attempted to lift into a hover and noticed the left strut came off the deck first.

19) The aircrew adjusted the cyclic three to four inches to the left and noticed a lack of cyclic authority.

20) The aircrew returned to the flightline for shutdown.

Frame # 0171 (Self-Retaining bolts)

21) During a post shutdown inspection of the flight controls, the maintenance technicians discovered the lateral swashplate link assembly self-locking bolt (P/N 70400-08159-104) was fractured.

22) The lateral link was damaged beyond repair and the spacer sleeve showed visible damage as well.

CHECK ON LEARNING

1. A Flight Safety Part (FSP) or a Flight Safety Critical Aircraft Part (FSCAP) is defined as?

2. What do torque stripes identify?

3. What types of self-retaining bolts are used in the flight controls?

SECTION IV. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Flight Safety Critical Aircraft Parts and Self-retaining bolts for the UH-60 helicopter.
The key points to remember are:

- A Flight Safety Part (FSP) or a Flight Safety Critical Aircraft Part (FSCAP) is defined as a part, assembly or installation procedure with one or more critical characteristics.
- If Flight Safety components do not conform to the design data or quality requirements, they could result in the serious injury or death of crew members and/or serious damage to the helicopter.
- A critical characteristic is any dimension, tolerance, finish, material manufacturing, assembly or inspection process, or other feature which, if nonconforming or missing, could cause failure or malfunction of the FSCAP.
- Throughout the maintenance procedures, warnings appear, emphasizing critical instructions to be followed. These warnings are identified as "FSCAP" warnings and are inserted whenever and wherever necessary.
- Critical characteristics not introduced during manufacturing, but critical in terms of assembly/installation (e.g. proper torque), are termed installation critical characteristics.
- All Torque stripes are used to identify all fasteners with critical characteristic torque or installation procedures.
- There are two types of self-retaining bolts used in the flight controls: Impedance Self-Retaining and Locking Type Self-Retaining bolts.
- Any of the Self-Retaining bolts must have a retaining ring or retaining ball intact during installation.
- During inspection or when installing any of the different type bolts, the retaining ring, split collar, or retaining balls, must provide resistance when going into the bolt hole.
- Locking type Self-Retaining bolts (Pivot-bolts) are used as the primary connections in the flight controls system to prevent components from disconnecting accidentally.
- The 15 different bolt connections are identified by the retaining balls or a spilt collar, which are locked in place until the plunger head is depressed.
- For ball-type bolts, make sure retaining balls cannot be pushed in without first depressing button in center of bolt head. Self-retaining bolts may be reused provided the bolt shows no sign of corrosion, fretting, nicks, or damaged threads, and the retaining mechanism is not damaged.
- Self-Retaining (impedance) bolts are used as the primary connections in the flight controls system to prevent components from disconnecting accidentally.
- Self-Retaining bolts are identified by a split collar on the bolt shank at the threaded end. The collar provides the self-retaining feature of the bolt.

C. ENABLING LEARNING OBJECTIVE No.3

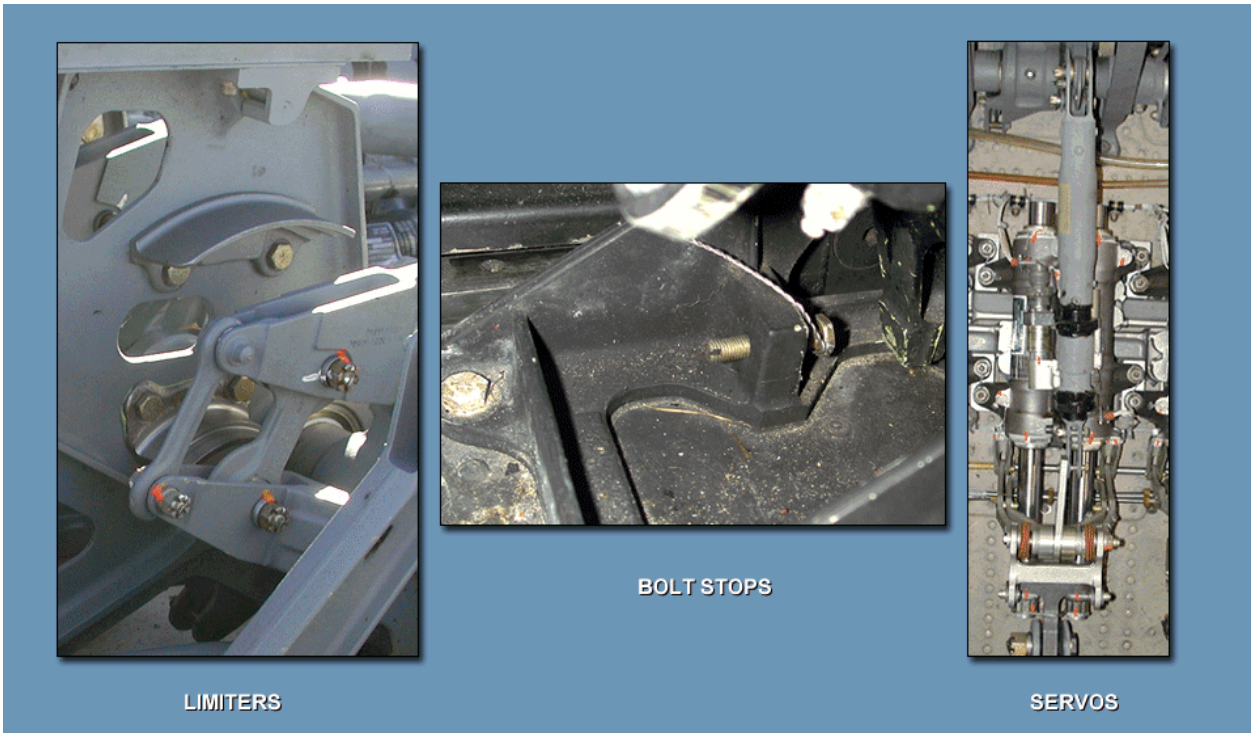
ACTION: Identify the Stops in the flight control system of the UH-60 helicopter.

CONDITION: Given a list as a UH-60 Maintenance Test Pilot.

STANDARD: IAW UH-60 Technical Manuals.

a. Flight Control stops

Frame # 0208 (Flight Control Stops)

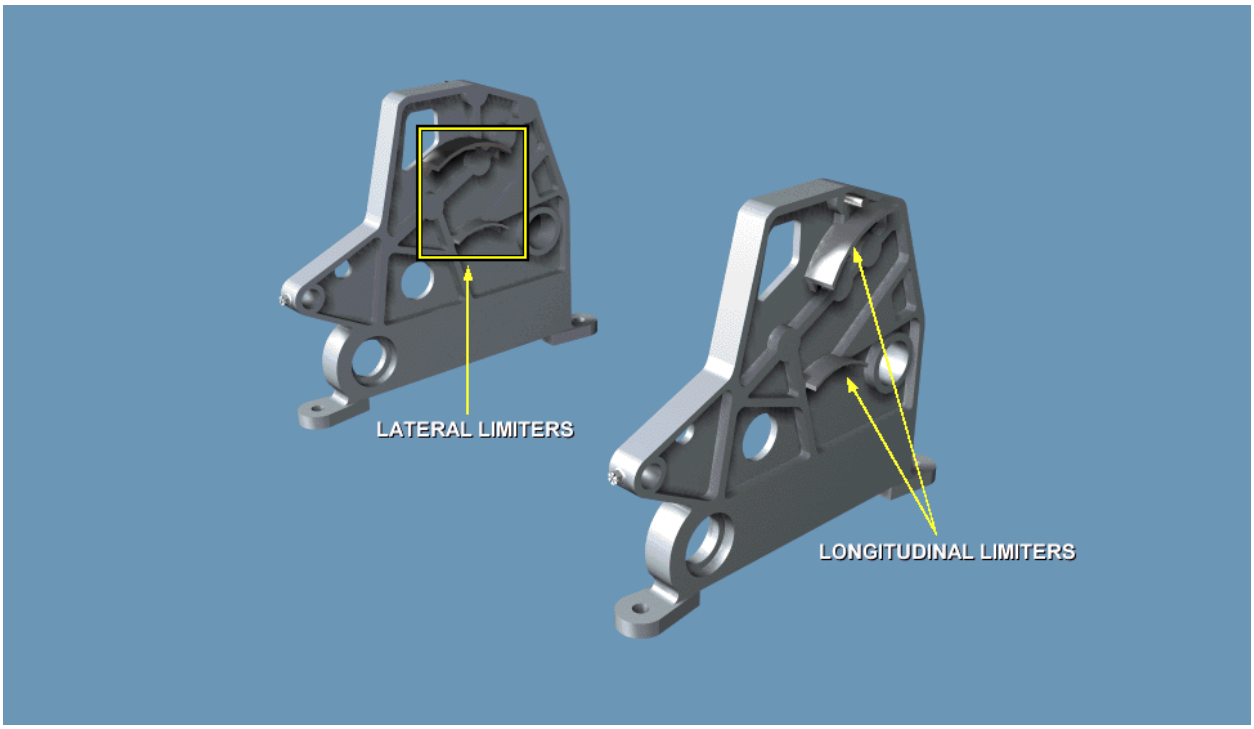


(1) There are three physical control stops throughout the flight control system, Bolt Stops, Limiters and the Servo pistons.

(2) Each type determines the maximum range and prevents over travel of the flight control movement.

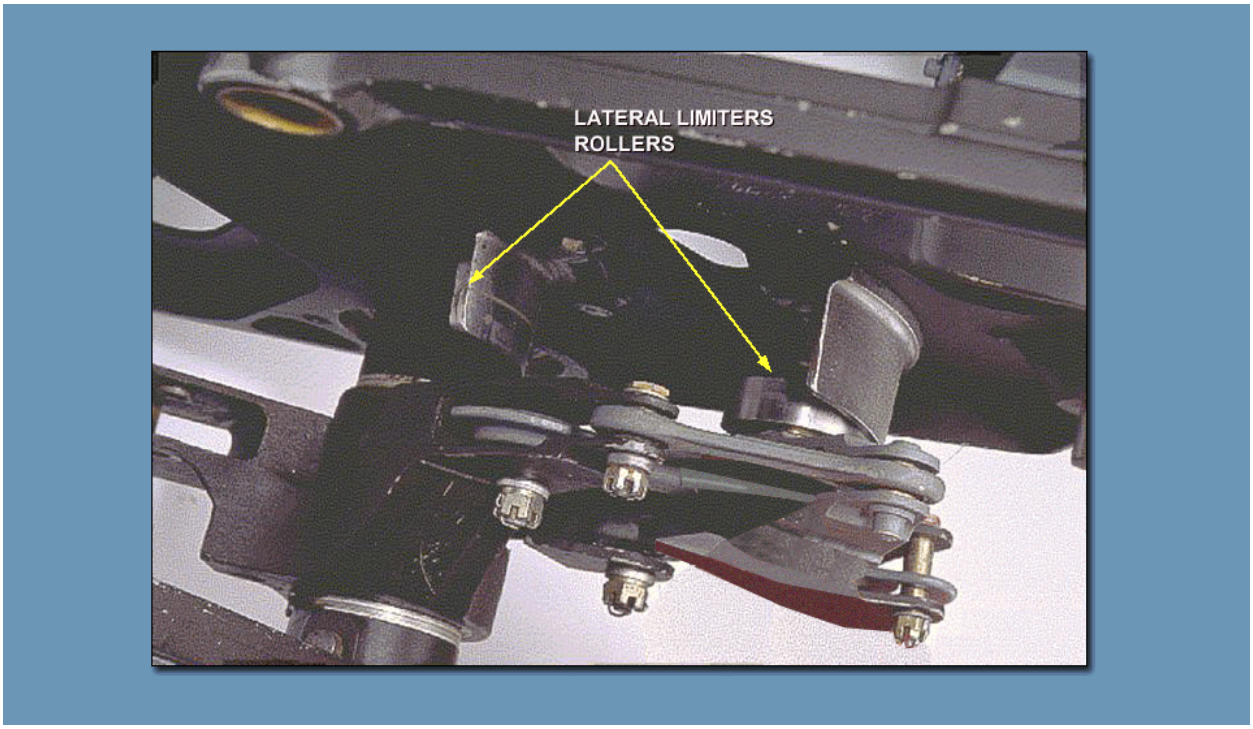
b. Mixer Limiters

Frame # 0210 (Mixer Limiters)



(1) Mixing unit roller limiters provide a spongy feel to the pilot and copilot when the control stick is moved full right, left, fore, and aft as the roller passes over the lateral (roll) and longitudinal (pitch) limiters in mixer.

Frame # 0210 (Mixer Limiters)

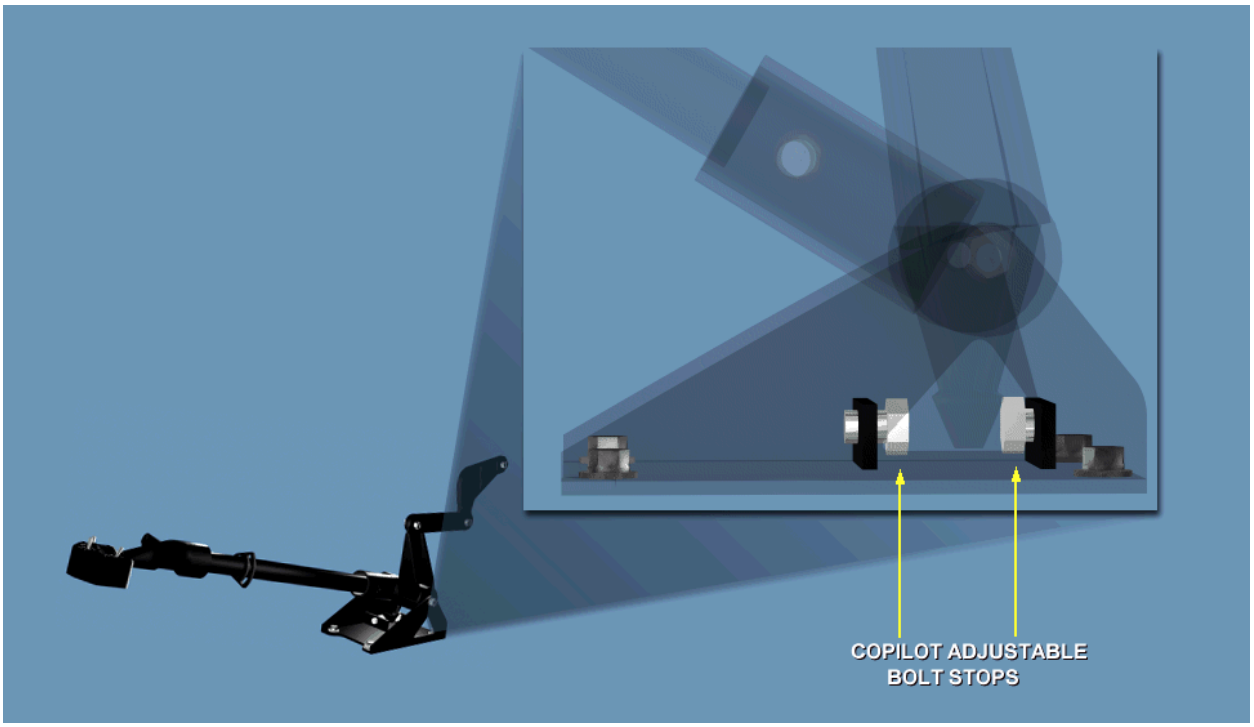


(2) Check to ensure that roller on mixer output crank is contacting aft limiter and that roller cannot be rotated using finger pressure.

(3) If the roller does not contact the either limiter in the mixer, check for interference with linkage forward of the mixer assembly, and clear it away.

c. Adjustable Collective Bolt Stop

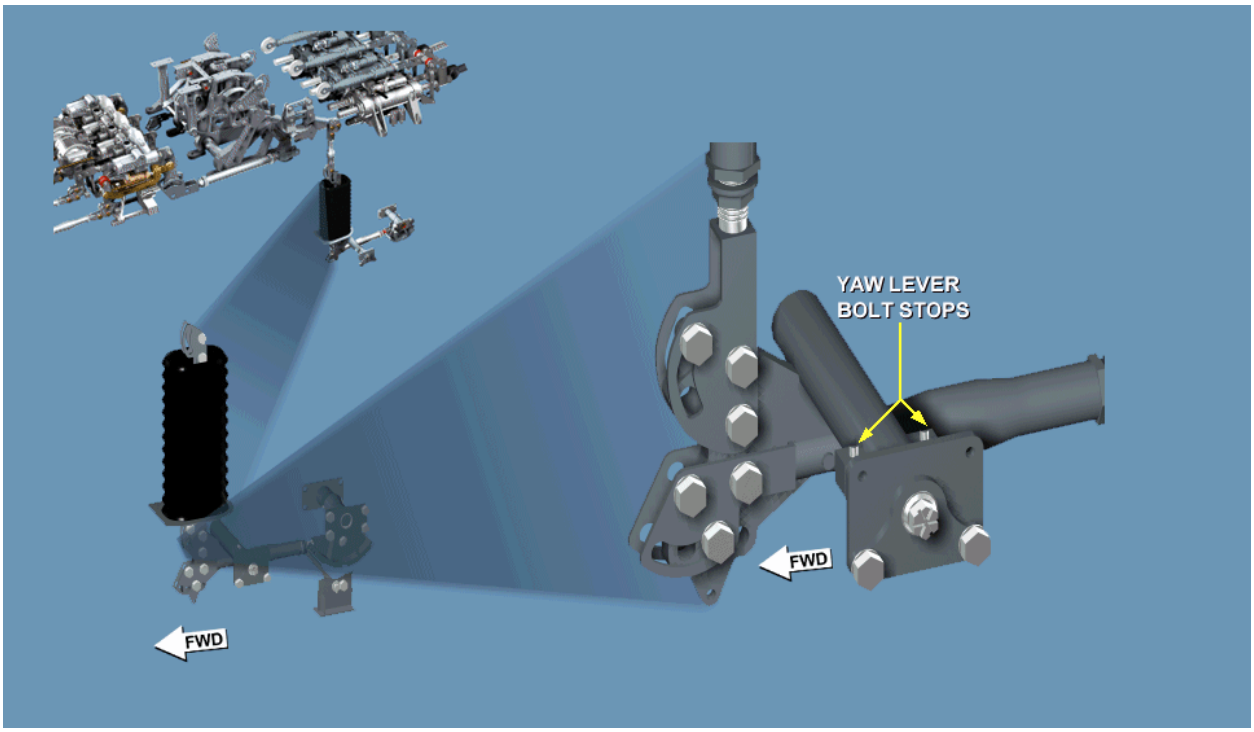
Frame # 0215 (Adjustable Collective Bolt Stop)



(1) The collective bolt stops are metal to metal contacts located on the base of the pilot and copilot collective stick.

d. Adjustable Directional Bolt Stop

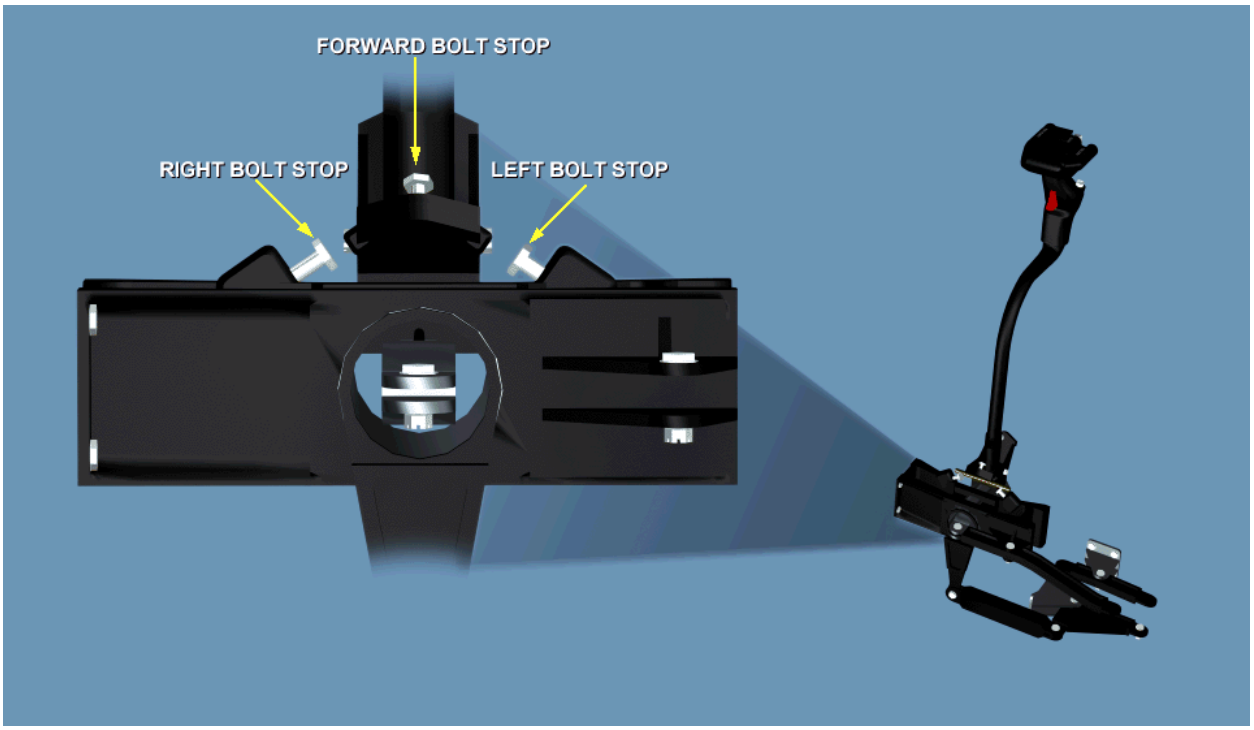
Frame # 0220 (Adjustable Directional Bolt Stop)



(1) The Yaw Lever Bolt stops (directional) are metal to metal contacts located at located on the Yaw lever assembly at cabin overhead station frame 300.

e. Adjustable Cyclic Bolt Stop

Frame # 0226 (Adjustable Cyclic Bolt Stop)



(1) The cyclic bolt stops are metal to metal contacts located at the base of the pilot and copilot cyclic stick.

CHECK ON LEARNING

1. What prevents over travel in the flight control system?

2. Where is the Direction control stop located?

SECTION V. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the stops in the flight control system lesson of the UH-60 helicopter. The key points to remember are:

- There are physical control stops in the flight control system called, Bolt Stops. Bolt stops determine the maximum range of the flight control movement.
- The Bolt stops are located at the base of the copilot collective stick.
- Proper adjustment of the Yaw stops are key to proper function of the Collective to Yaw, which compensates for changes in torque effect caused by changes in collective position.
- The Directional Pedal Bolt Stops are located on the Yaw lever assembly at cabin overhead station frame 300.
- The cyclic stick bolt stops are located at the base of the cyclic stick. The secondary stops for the pitch and roll axis are located at the yoke assembly and has a 0.010 to 0.030 gap.

D. ENABLING LEARNING OBJECTIVE No.4

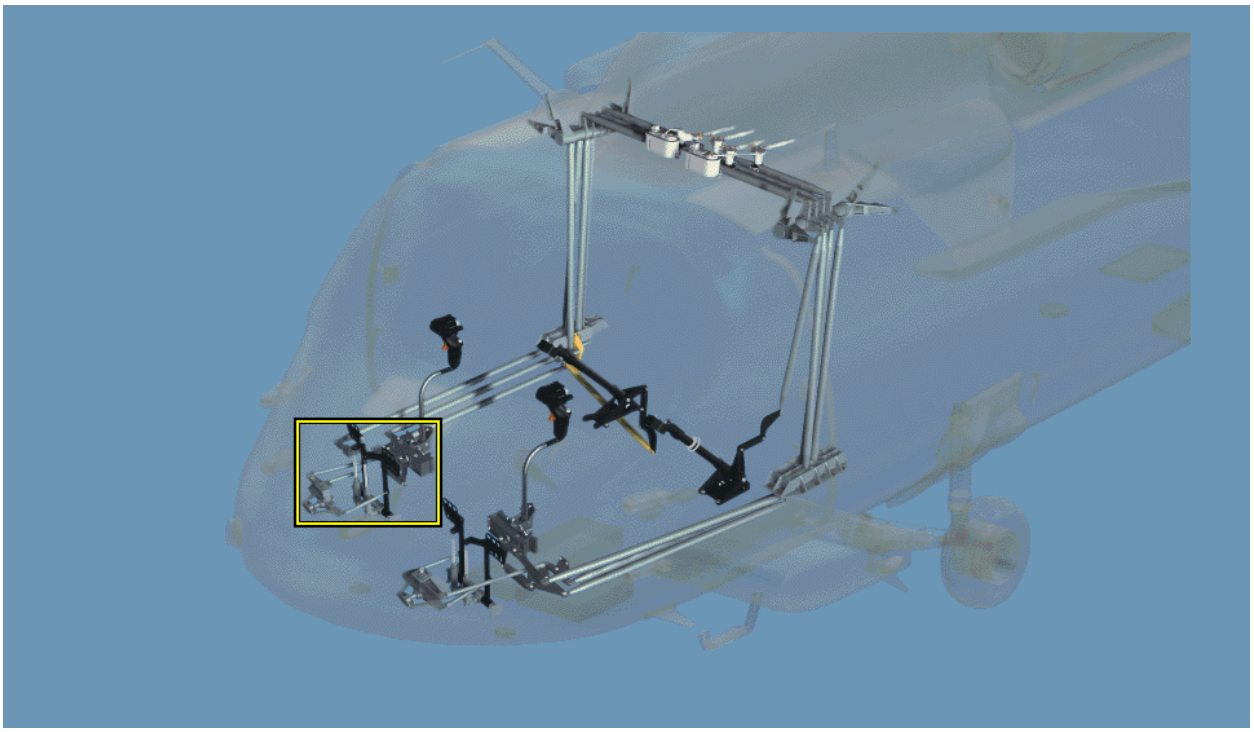
ACTION: Identify the Directional Control system from the cockpit to the tail rotor.

CONDITION: Given a description and related technical manuals.

STANDARD: IAW UH-60 Technical Manuals.

a. Directional Routing Flight Controls

Frame # 0275 (Directional Routing Flight Controls)



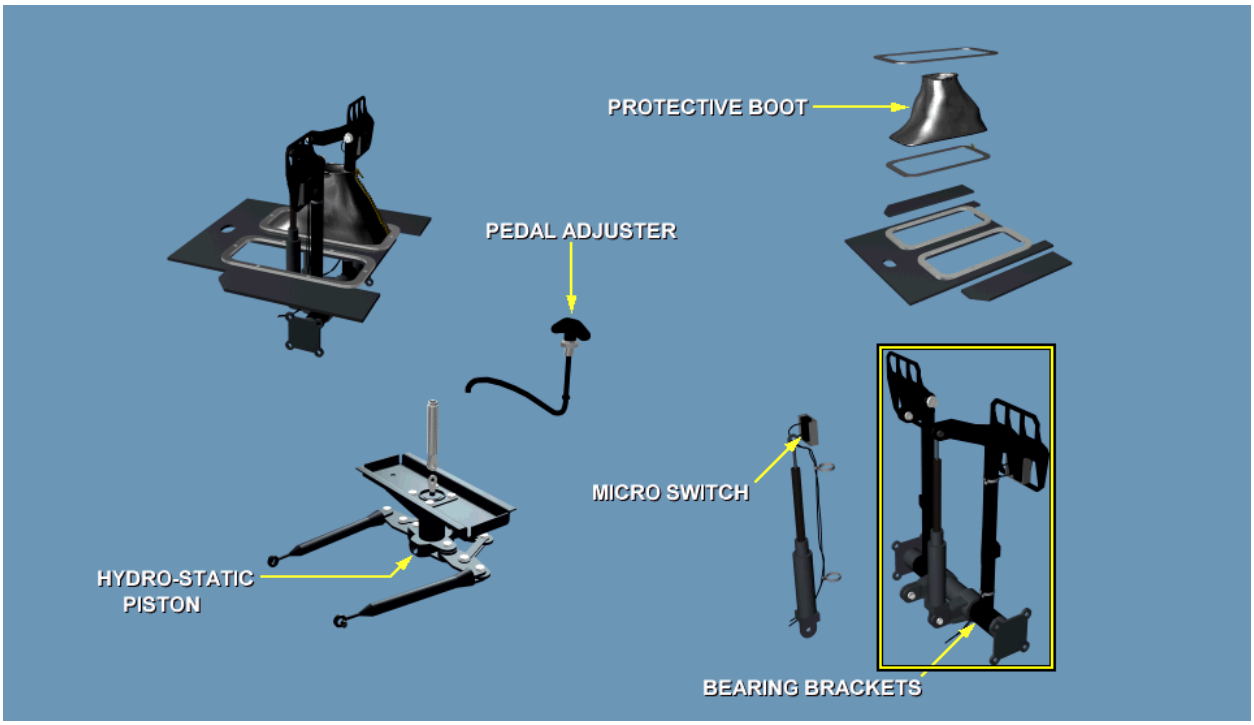
(1) The pedals are mechanically coupled and permit the pilot and copilot to control helicopter headings.

(2) The pedals contain independent toe-operated wheel brake controls.

(3) Each set of pedals can be adjusted to the pilot's leg length.

(4) The adjuster holds the pedals to a set position by use of a Hydrostatic Piston and spring assembly.

Frame # 0275 (Directional Routing Flight Controls)

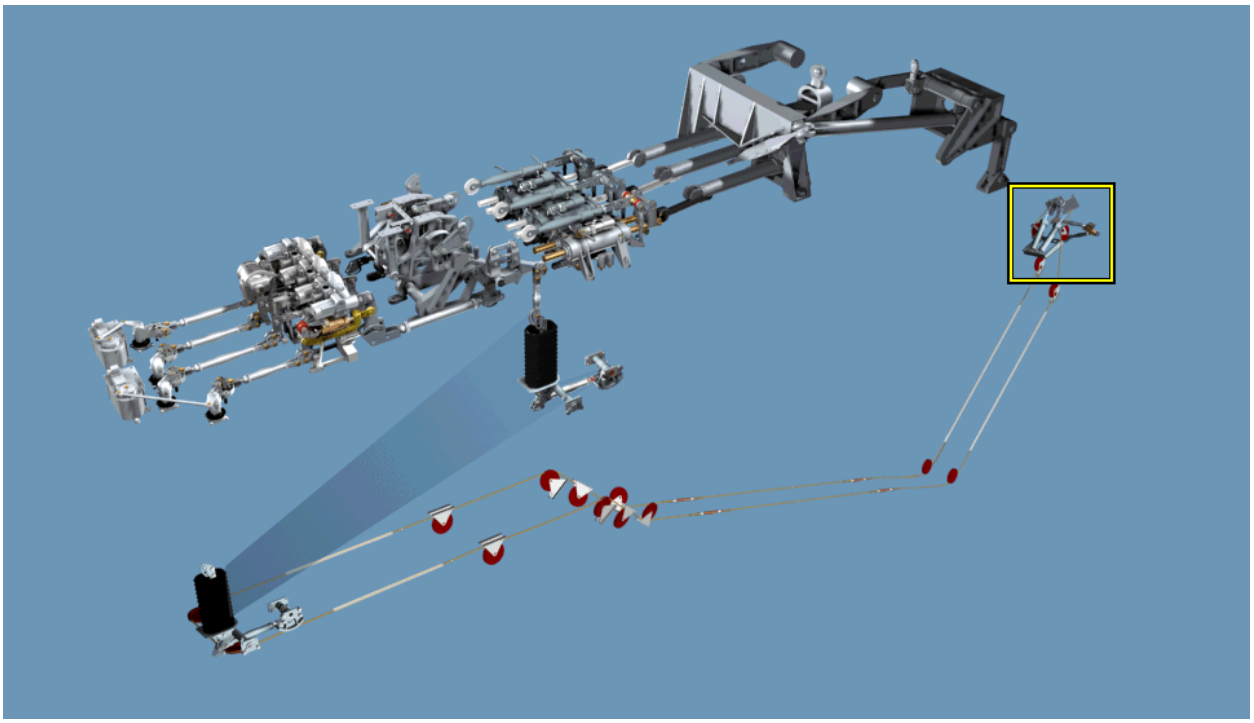


(5) The Yaw Pedals are held in place by bearing brackets.

(6) Trim release micro switches are located on each pedal along with the brake system master cylinders.

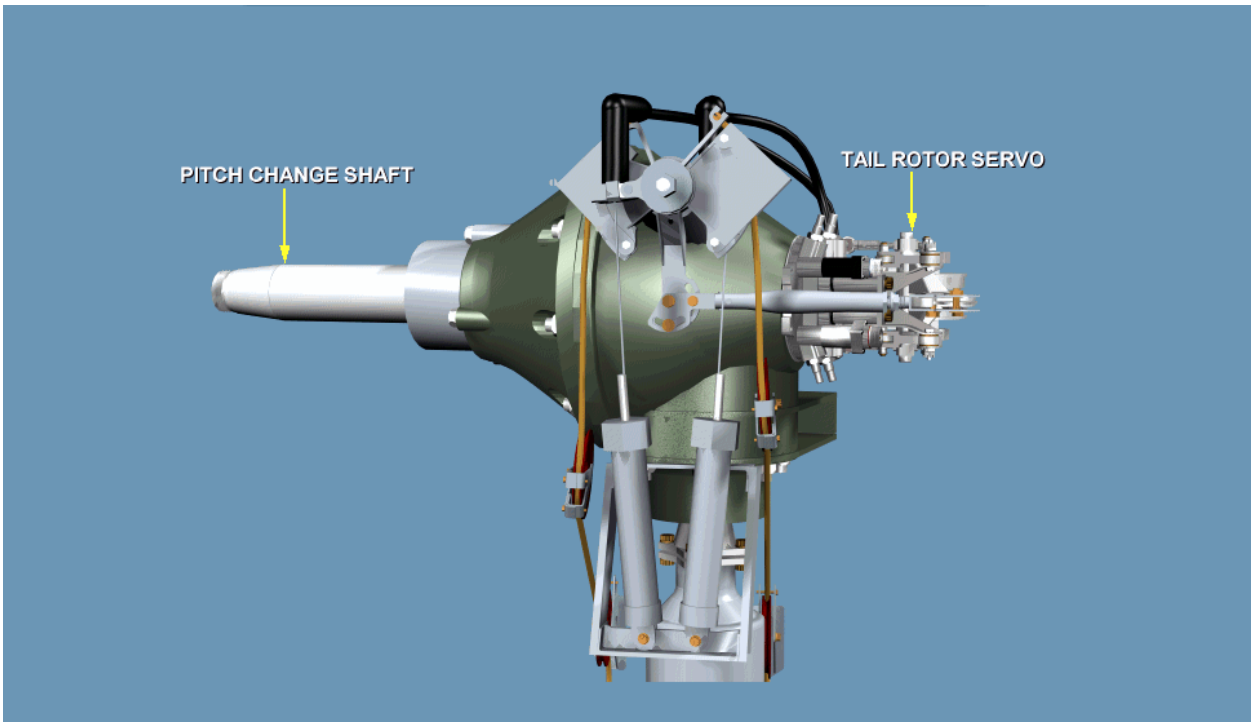
(7) However there are different pedal manufacturers and all pedal assemblies are interchangeable.

Frame # 0275 (Directional Routing Flight Controls)



(8) The horizontal control rods are routed through the cabin overhead torque shaft and lever, aft to the yaw boost servo control rod and to the mixing unit; from the mixing unit down through the airframe to the aft cables, to the second directional torque shaft, pushrods, and to the tail rotor quadrant.

Frame # 0275 (Directional Routing Flight Controls)



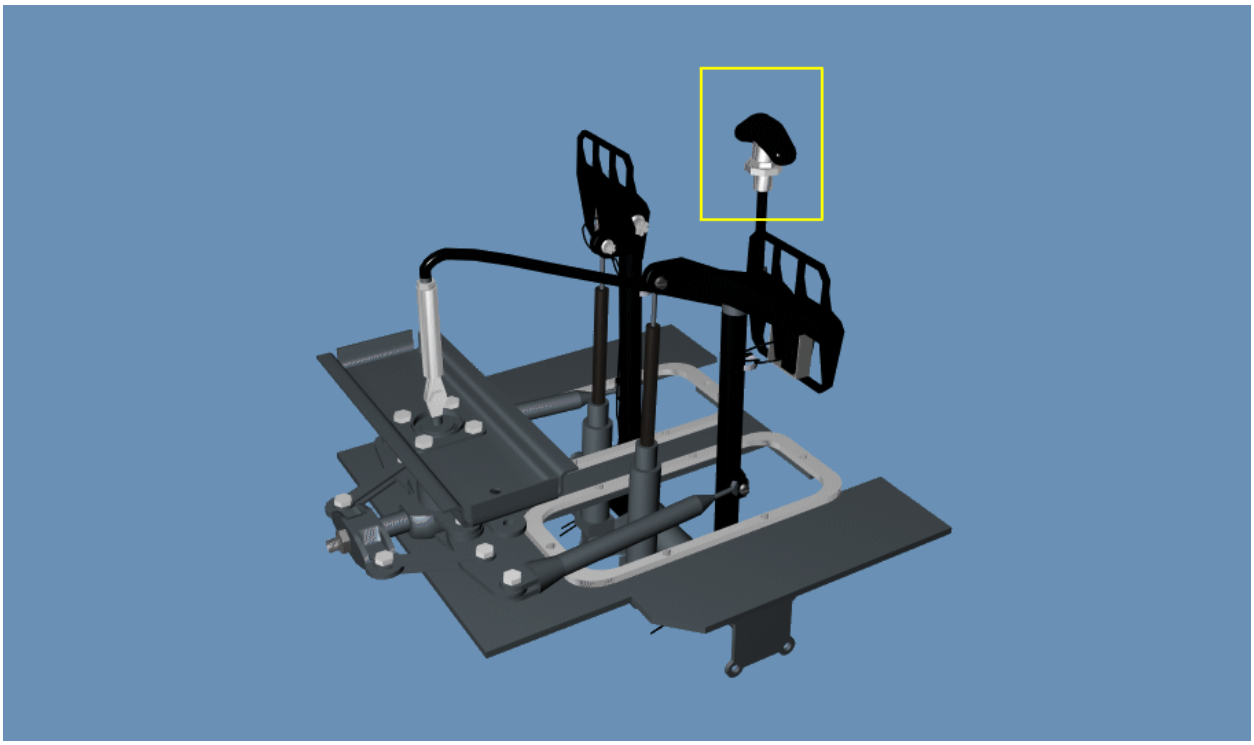
(9) A tail rotor quadrant, mounted on the tail gear box, transmits tail rotor cable movements into the tail rotor servo.

(10) This moves the pitch change shaft to change tail rotor blade angles.

(11) The tail rotor controls are powered by the first stage or backup hydraulic systems.

b. MTF Checks and Pedals

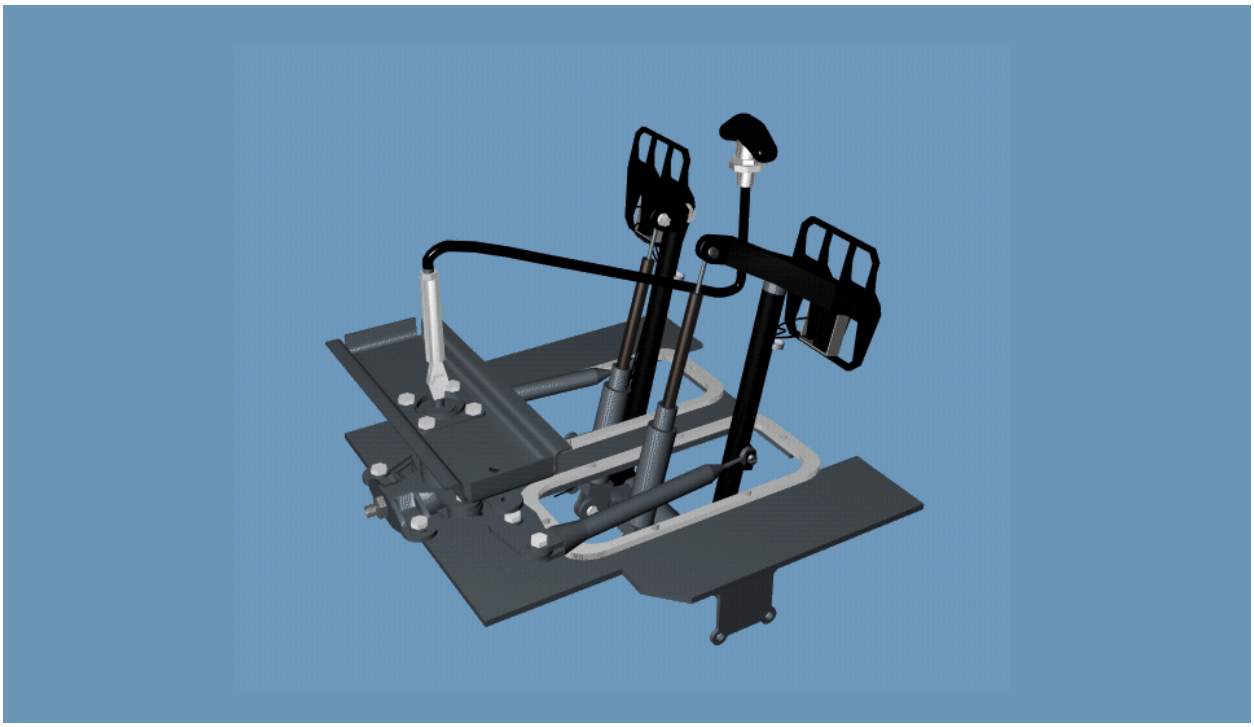
Frame # 0285 (MTF Checks and Pedals FLASH)



(1) A Maintenance Test Flight (MTF) is a functional test flight for which the primary purpose is to determine whether the airframe, power plant, accessories and other equipment are functioning in accordance with predetermined requirements.

(2) For the Yaw pedals, perform the following: pull the pedal adjust lock release, with both feet on pedals and allow the pedals to move slowly to the full aft position.

Frame # 0285 (MTF Checks and Pedals FLASH)



(3) Check for freedom of movement full forward with no binding.

(4) Check that the lock will hold pedals in different positions throughout full range of travel.

(5) Check that the lock will hold pedals in different positions throughout full range of travel.

(6) Check that the lock will hold pedals in different positions throughout full range of travel.

(7) Check that seat moves through full range smoothly. Once the check is complete, set the seat, pedals and adjust for flight.

CHECK ON LEARNING

1. What controls helicopter heading and yaw attitude?

2. What holds the Pedals in a set position?

SECTION VI. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Identify the Stops in the flight control system of the UH-60 helicopter.
The key points to remember are:

- The tail rotor control system determines helicopter heading or yaw attitude by controlling the pitch in the tail rotor blades.
- Pedal adjuster holds its set position by use of a Hydrostatic Piston and spring assembly. It is held in place by bearing brackets.
- Trim release micro switches are located on each pedal along with the brake system master cylinders.
- There are different pedal manufacturers and all pedal assemblies are interchangeable.
- When performing the MTF checks, follow all instructions according the latest Army MTF check list.

E. ENABLING LEARNING OBJECTIVE No.5

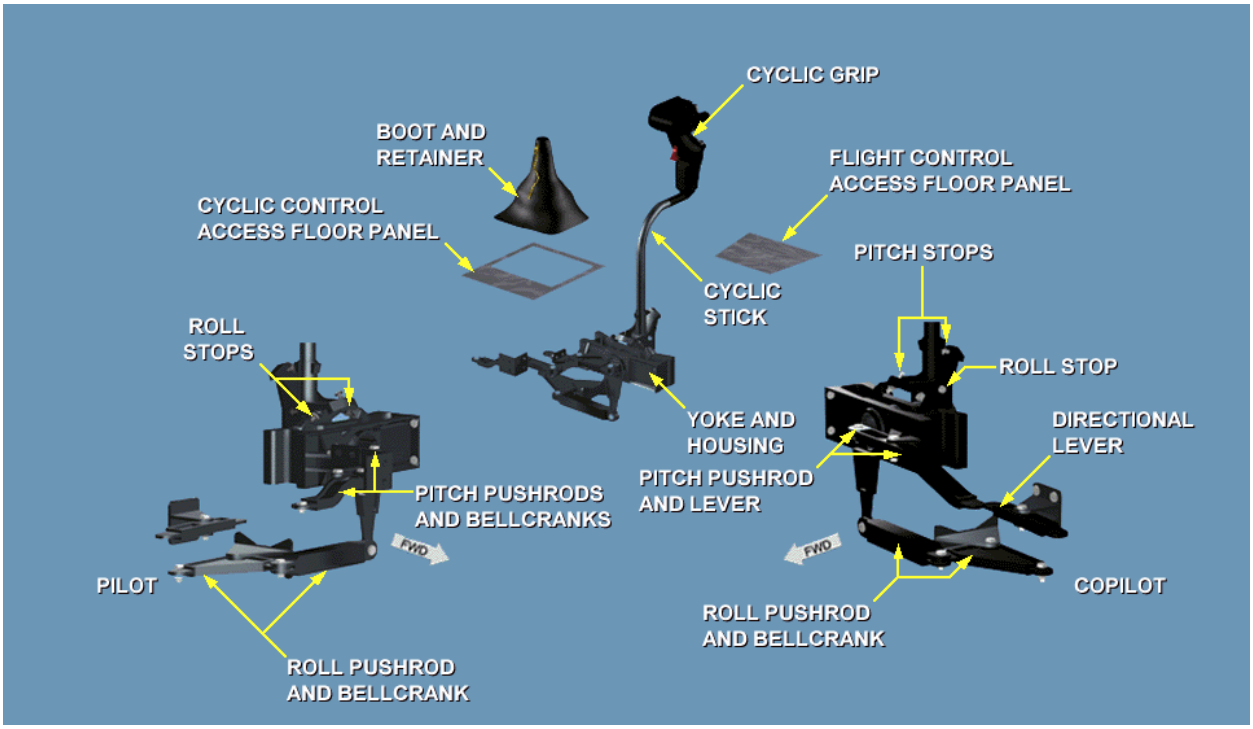
ACTION: Identify the Cyclic Controls system from the cockpit to the main rotor.

CONDITION: Given a description and related technical manuals.

STANDARD: IAW UH-60 Technical Manuals.

a. Cyclic Controls

Frame # 0310 (Cyclic Controls)



(1) The cyclic system provides forward, rear, and lateral control of the helicopter.

(2) The pilot and copilot cyclic sticks are mechanically-coupled, lever-type controls.

(3) Movement of the cyclic control stick is transmitted by mechanical linkage to hydraulic servos for power assist, and then to the mixing unit.

(4) Damage to pilot-assist servo module will result if dirt is allowed to enter components during disassembly.

(5) Replace pressure reducer only in a clean place.

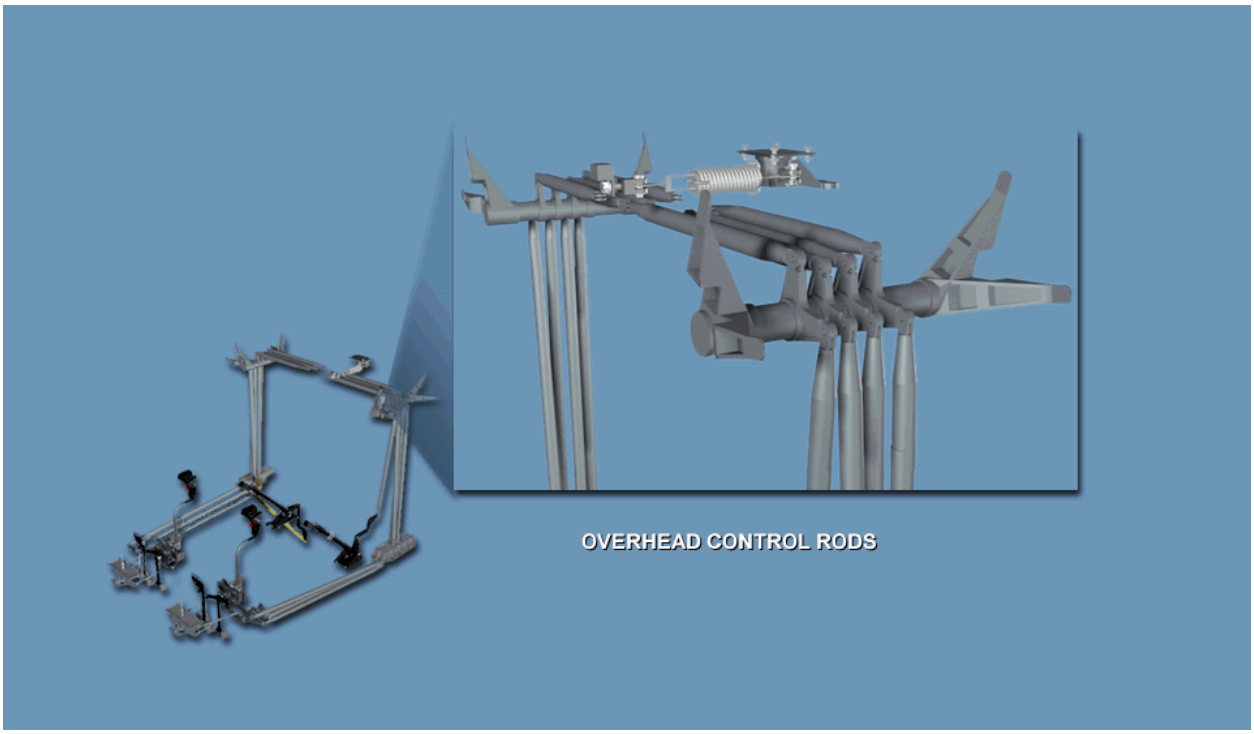
(6) Have replacement reducer ready for installation before old reducer is removed.

(7) At the base of the cyclic stick is a yoke assemblies (one within the other), which allow for FWD /AFT and LFT/RHT movement.

(8) The cyclic stick has a bow, instead of a straight shaft, to allow it to collapse down and forward in the event of a hard landing.

b. Cyclic Control Rods

Frame # 0315 (Cyclic Control Rods)

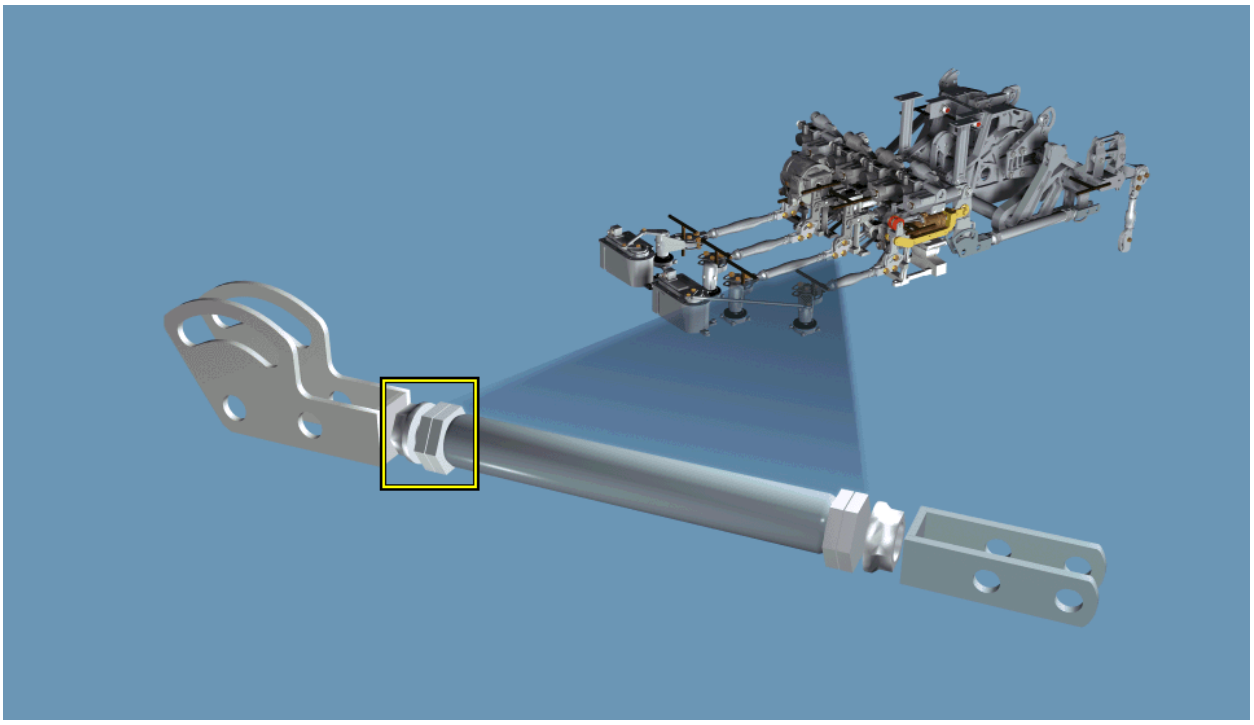


(1) Control rods and bellcranks are used to transmit cyclic inputs, both laterally and longitudinally, to the forward cabin lower bellcrank supports.

(2) Vertical control rods connect to the upper bellcrank supports.

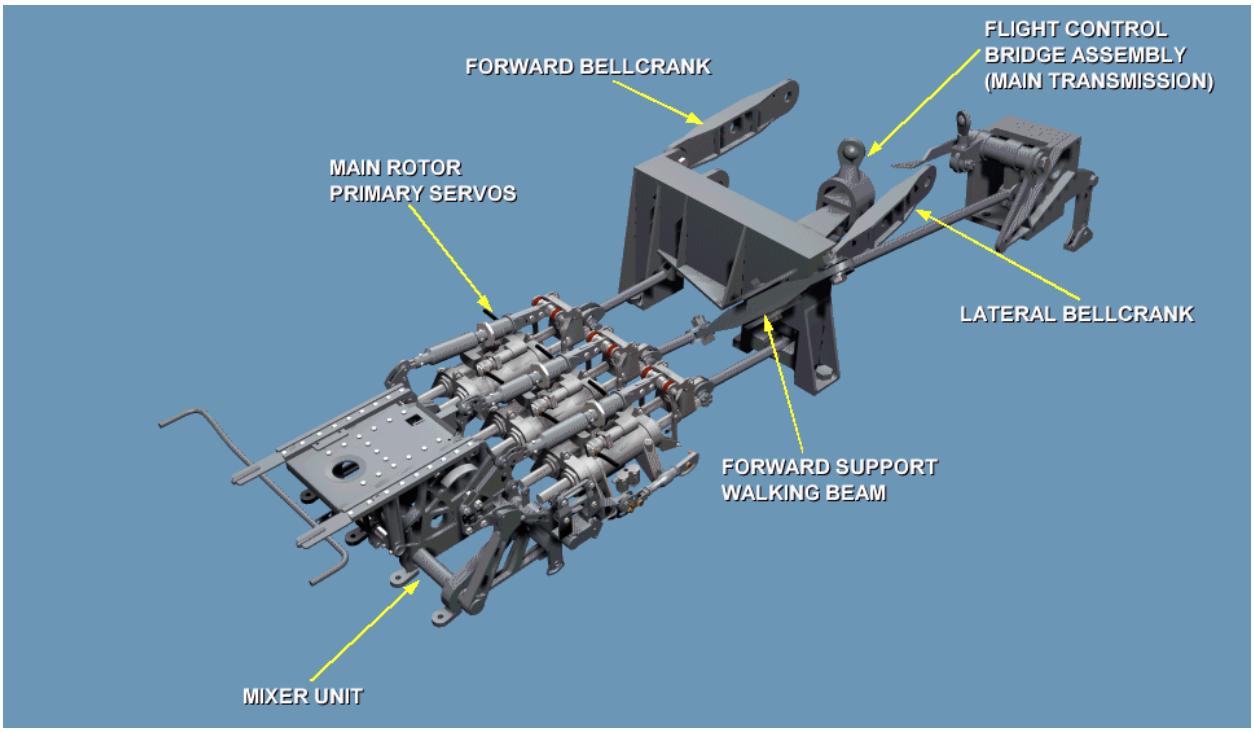
(3) Horizontal control rods are connected in the cabin overhead to longitudinal and lateral torque shafts and levers, which change the push-pull mechanical movement into a rotating force.

Frame # 0325 (Cyclic Controls Routing)



(4) The routing continues aft with the adjustable control rods to the Trim assemblies, and the Pilot Assists, SAS assemblies, to the mixing unit.

Frame # 0325 (Cyclic Controls Routing)



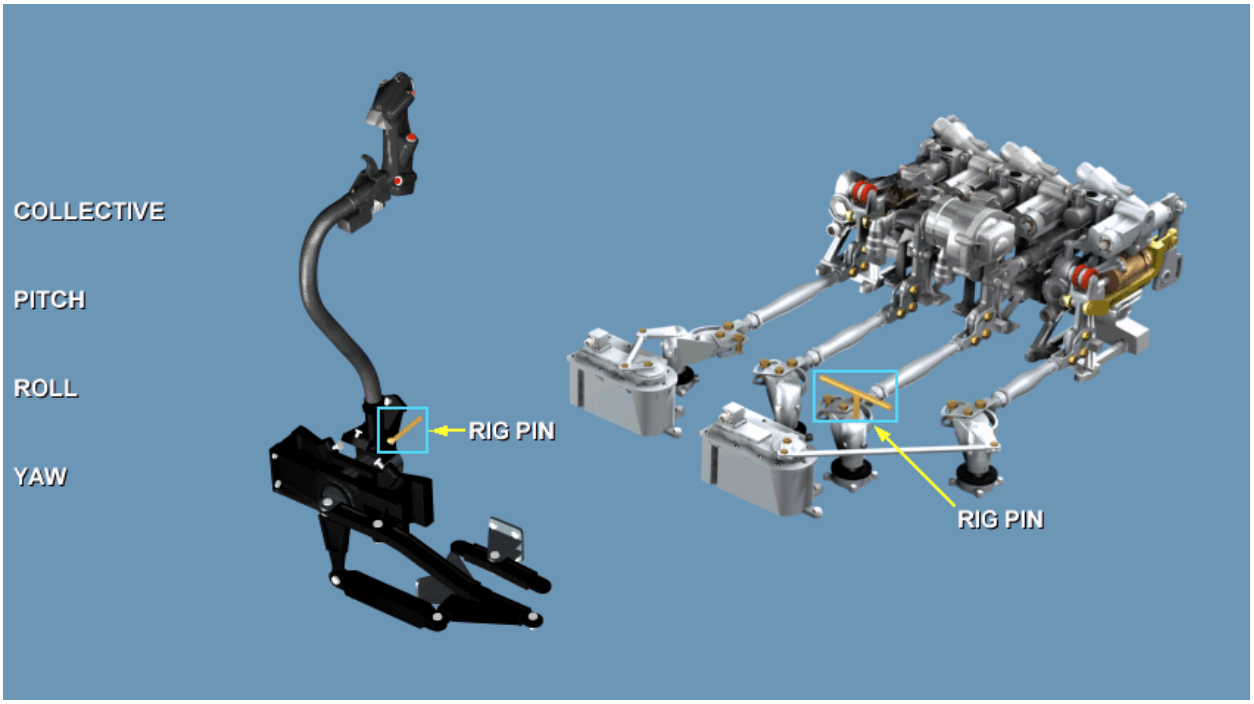
(5) The controls are routed aft to the mixing unit and primary servos, and then out to the bellcranks in the bridge support area.

(6) Inputs are made to the main rotor by bellcranks and pushrods connected to the swashplate assembly.

CHECK ON LEARNING

1. Select the correct axis listed above, that is isolated by the two rig pins.

Frame # 0335 (Cyclic on Learning; Flash)



2. What type of controls are the cyclic sticks?

3. Why is there a bow in the cyclic stick?

SECTION VII. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the correct routing of the cyclic controls from the cockpit to the main rotor lesson for the UH-60 helicopter.
The key points to remember are:

- The Cyclic Control controls longitudinal and lateral direction of the helicopter by differentially changing the pitch in the main rotor blades.
- Cyclic Controls are mechanically coupled lever type controls which have a forward center of gravity and a large bow to aid in collapsing down and forward in a crash sequence.
- Control rods and bellcranks are used to transmit cyclic inputs both laterally and longitudinally to the forward cabin lower bellcrank supports. Vertical control rods (adjustable) connect to the upper bellcrank supports.
- Horizontal control rods are connected in the cabin overhead to longitudinal and lateral torque shafts and levers which change the push-pull mechanical movement into a rotating force.
- Adjustable control rods continue aft to the Pitch Trim assembly and Roll SAS assembly in the pilot assist area.
- Swashplate links connect the Forward, Aft, and Lateral bellcrank inputs to the swashplate, which move the pitch control rods vertically to change pitch in the main rotor blades.

F. ENABLING LEARNING OBJECTIVE No. 6

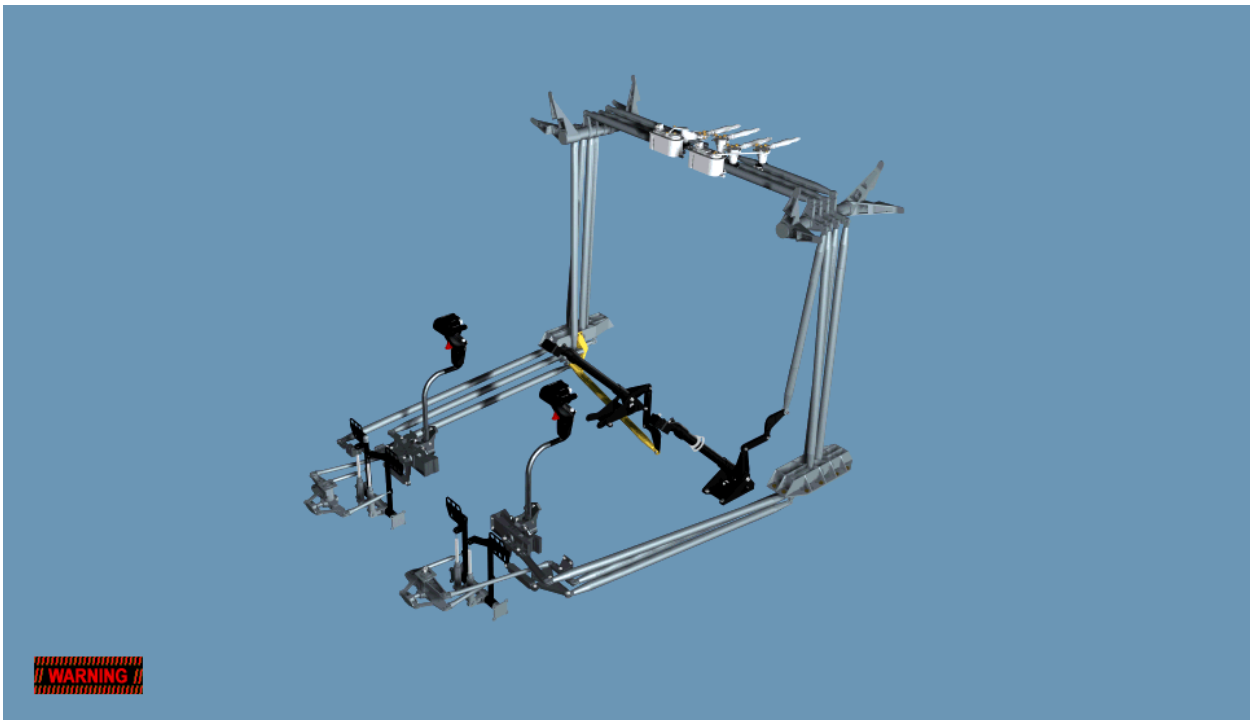
ACTION: Identify the Collective Controls System from the cockpit to the main rotor.

CONDITION: Given a Description and related technical manuals.

STANDARD: IAW UH-60 Technical Manuals.

a. Collective Controls

Frame # 0355 (Collective Controls)



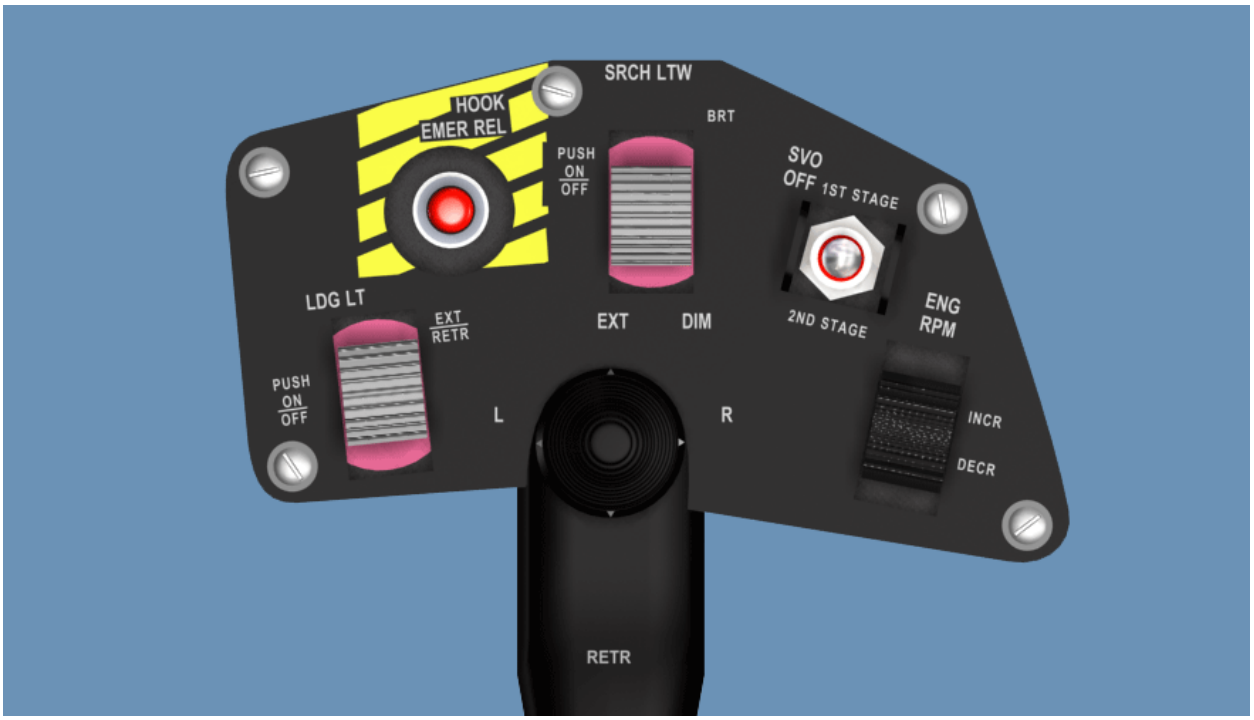
WARNING: Injury to personnel and damage to equipment will result if friction lock is adjusted incorrectly, resulting in a collective stick which cannot be moved with friction lock full on. Make sure friction lock is adjusted so that collective stick retains full range of motion when friction lock is full on.

(1) The pilot collective control stick assembly consists of a grip assembly, friction lock and boot assembly, tube assembly, socket assembly, drag strut assembly, and associated wiring.

(2) Vertical control rods connect to the upper bellcrank supports.

(3) Horizontal control rods are connected in the cabin overhead to longitudinal and lateral torque shafts and levers, which change the push-pull mechanical movement into a rotating force.

Frame # 0355 (Collective Controls)



(4) The copilot collective control stick assembly consists of a grip assembly, telescoping tube assembly, socket assembly, and associated wiring. Both stick assemblies use the same grip assembly.

(5) The grip assembly has:

(a) A LDG LT (Landing Light Control) push-button/toggle switch.

(b) SVO OFF (Servo Shutoff) toggle switch.

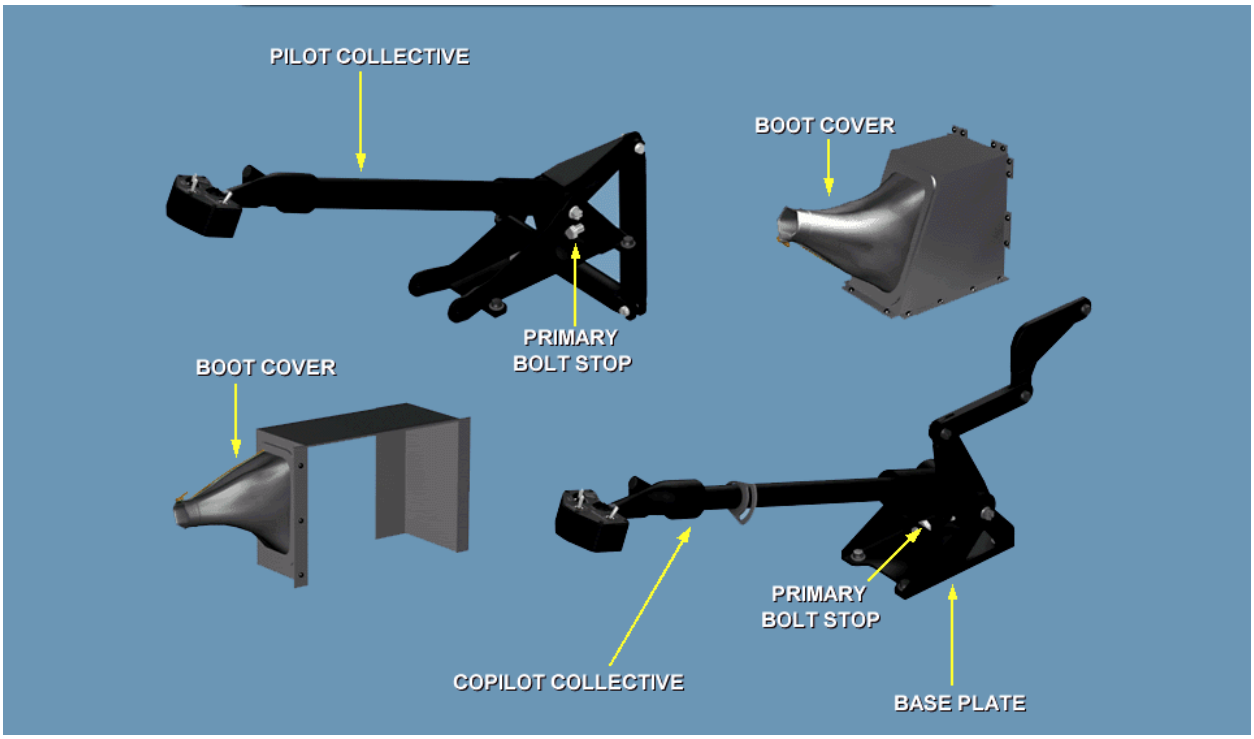
(c) A searchlight control thumb switch.

(d) SRCH LT (Search Light) toggle switch)

(e) ENG RPM Increase/Decrease switch.

(f) The HOOK EMER REL push-button.

Frame # 0065 (Collective Assembly)

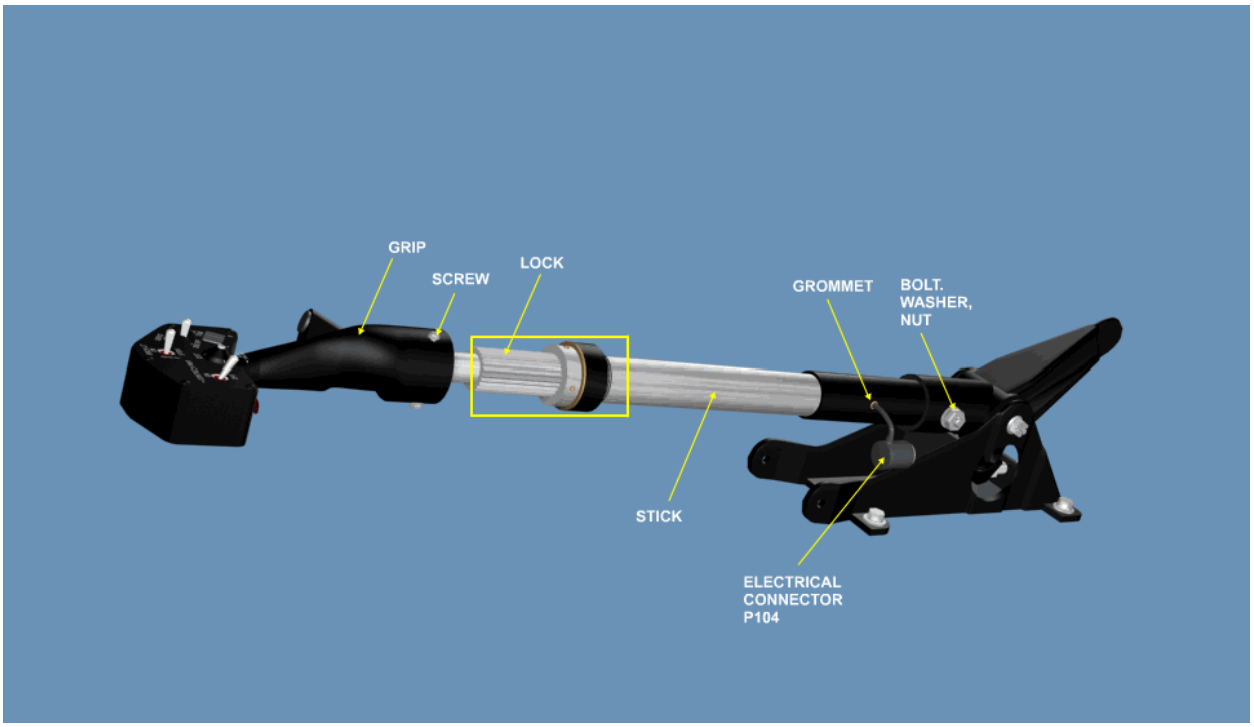


(6) The collective stick assemblies are mounted to the airframe by a base plate.

(7) The base plate has a cannon plug for the collective switches and two primary bolt stops.

(8) While performing collective friction checks, the force required to move the collective should not exceed 40 lbs of pressure.

Frame # 0360 (Collective Friction Lock FLASH)

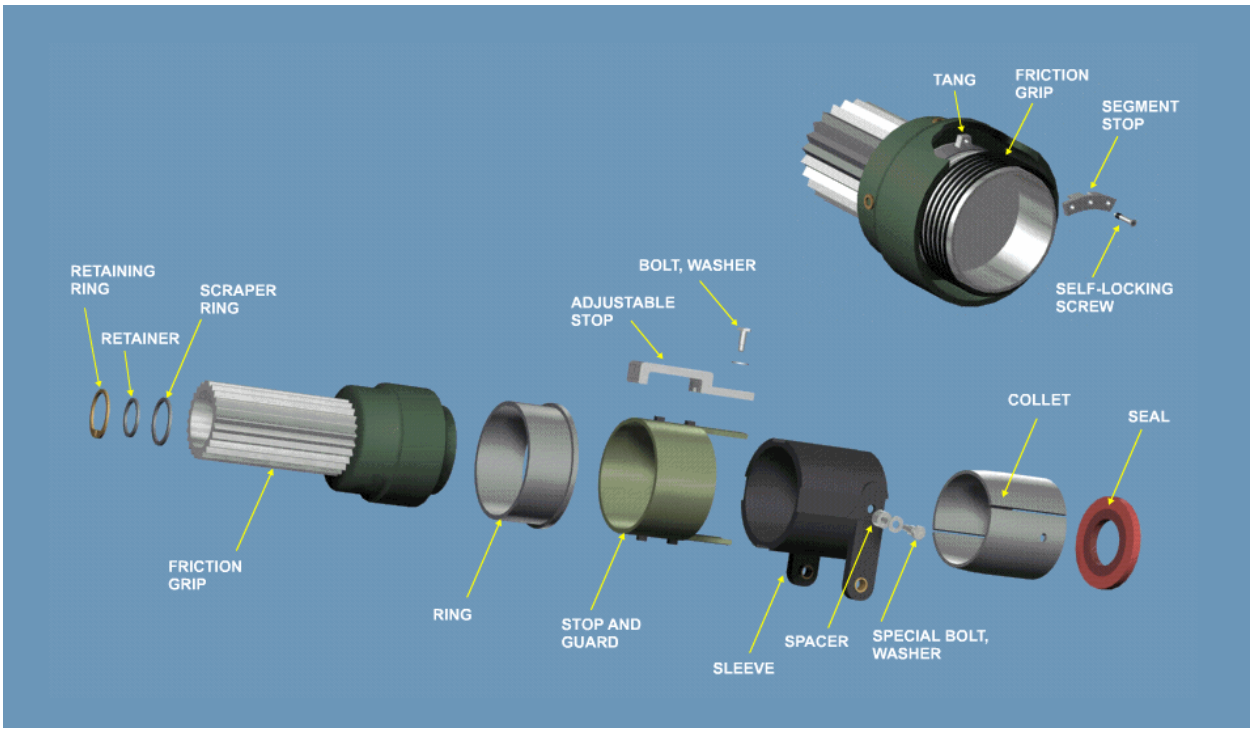


(9) The pilot collective stick contains the friction grip assembly and pivots on the base assembly.

(10) The friction grip has two mechanical stops, which are labeled full ON and RELEASE.

(11) Care must taken to check the collective control stick for dirt, nicks, scratches, corrosion, or other damage that could stop friction lock and sleeve from sliding smoothly on the stick.

Frame # 0360 (Collective Friction Lock FLASH)



(12) As the friction grip threads onto the sleeve, it collapses the collet halves on the collective stick.

(13) The amount of friction is set when the stop segment on the friction grip contacts the stop and guard.

(14) The amount of friction is increased by turning friction grip toward stop and guard, and decreased by turning the friction grip away from stop and guard.

CHECK ON LEARNING

1. Which control stick has a telescoping tube assembly?

2. What is the function of the collective?

3. The primary bolt stops are located where?

SECTION VIII. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Identify the correct routing of the collective controls from the cockpit to the main rotor lesson for the UH-60 helicopter.

The key points to remember are:

- The copilot collective stick assembly consists of a grip assembly, telescoping tube assembly, socket assembly, and associated wiring.
- The collective has a base plate which contains the bolt stops and socket assembly.
- The friction grip has two mechanical stops which are full ON and RELEASE. Check collective stick for dirt, nicks, scratches, corrosion, or other damage that could stop friction lock and sleeve from sliding smoothly on the stick.
- As the friction grip threads into sleeve, it squeezes the collet halves on the collective stick.
- The friction grip is turned toward the stop and guard to reduce friction.

G. ENABLING LEARNING OBJECTIVE No. 7

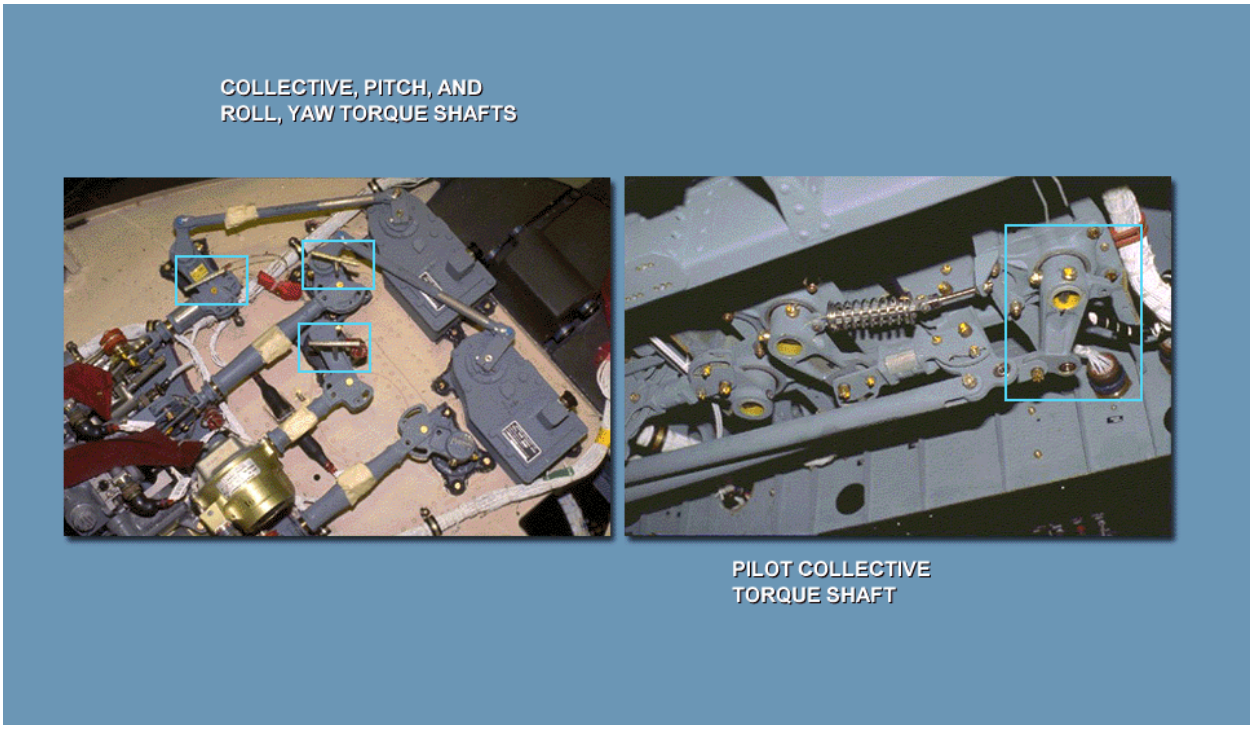
ACTION: Identify the characteristics of the Torque Shafts and their purpose.

CONDITION: Given a description and related technical manuals.

STANDARD: IAW UH-60 Technical Manuals.

a. Torque Shafts

Frame # 0400 (Torque Shafts)



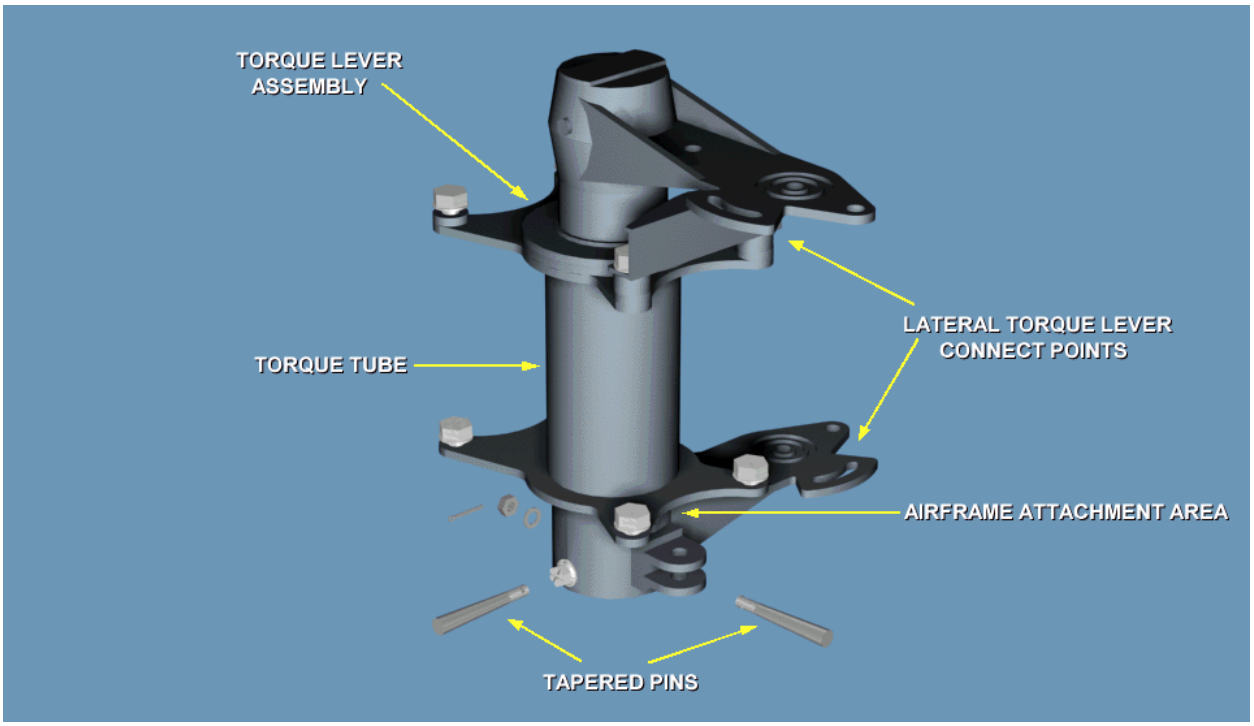
(1) The collective, pitch, roll, yaw torque shafts, located on the hydraulic deck, convert a push-pull movement into a rotating movement.

(2) The torque shaft consists of torque tubes and levers, which are serial numbered matched sets.

(3) They provide feedback to the control stick associated with that Torque shaft.

b. Torque Lever

Frame # 0405 (Torque Lever)



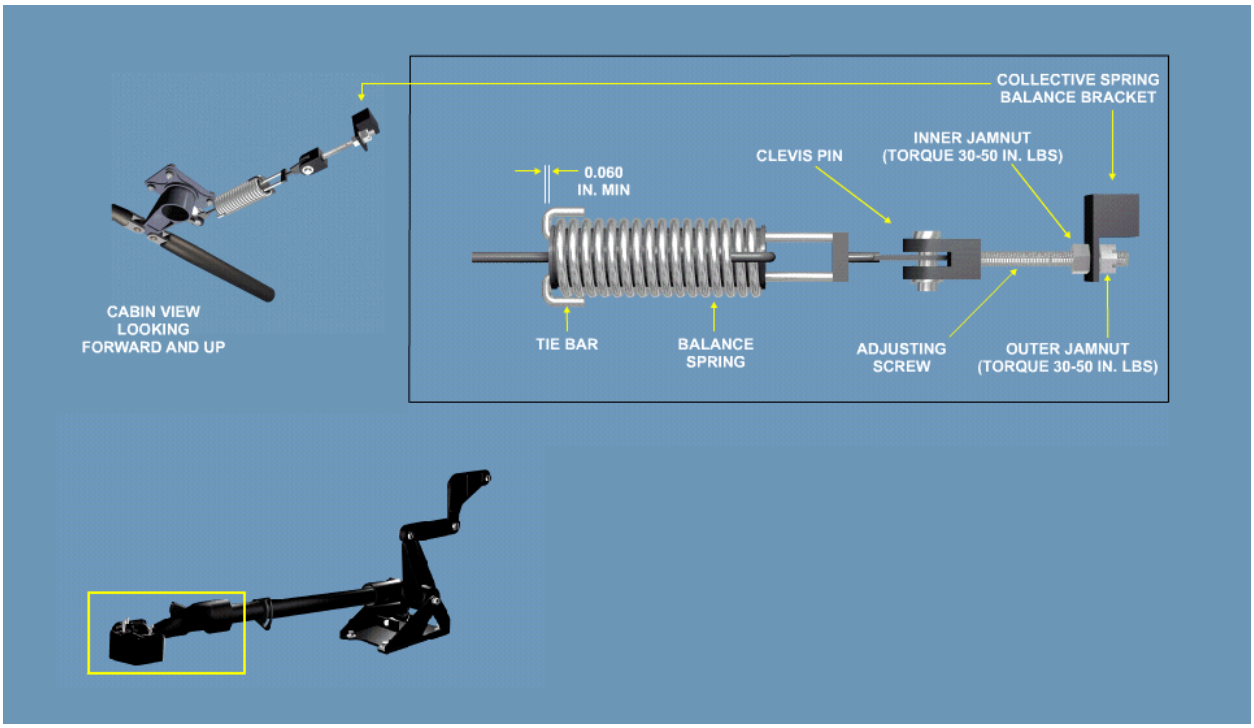
(1) The torque shaft assembly routes the flight control inputs through the airframe, using shims for precise alignment.

(2) The lever is attached to the torque tube using tapered pins, which allow precise fitting and prevent elongation.

(3) The yaw channel uses one torque shaft, which transmits the yaw input to the pilot assist area.

c. Balance Spring Operation

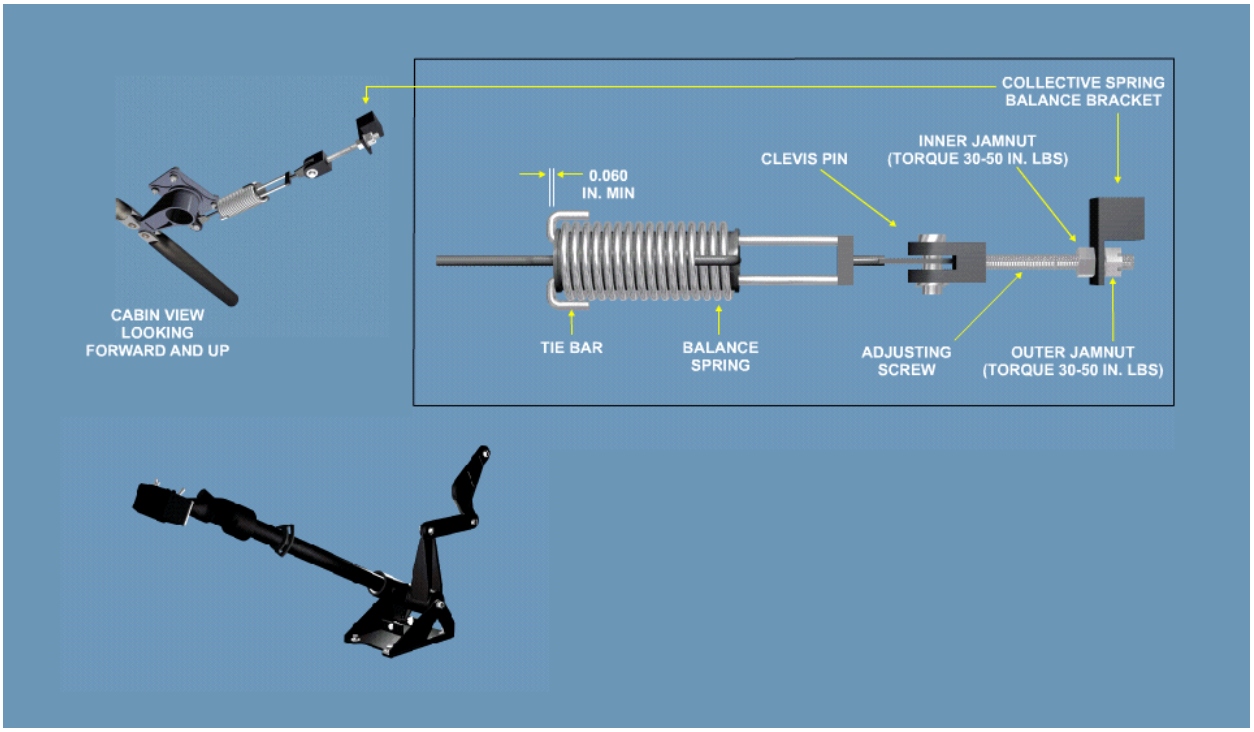
Frame # 0415 (Balance Spring Operation FLASH)



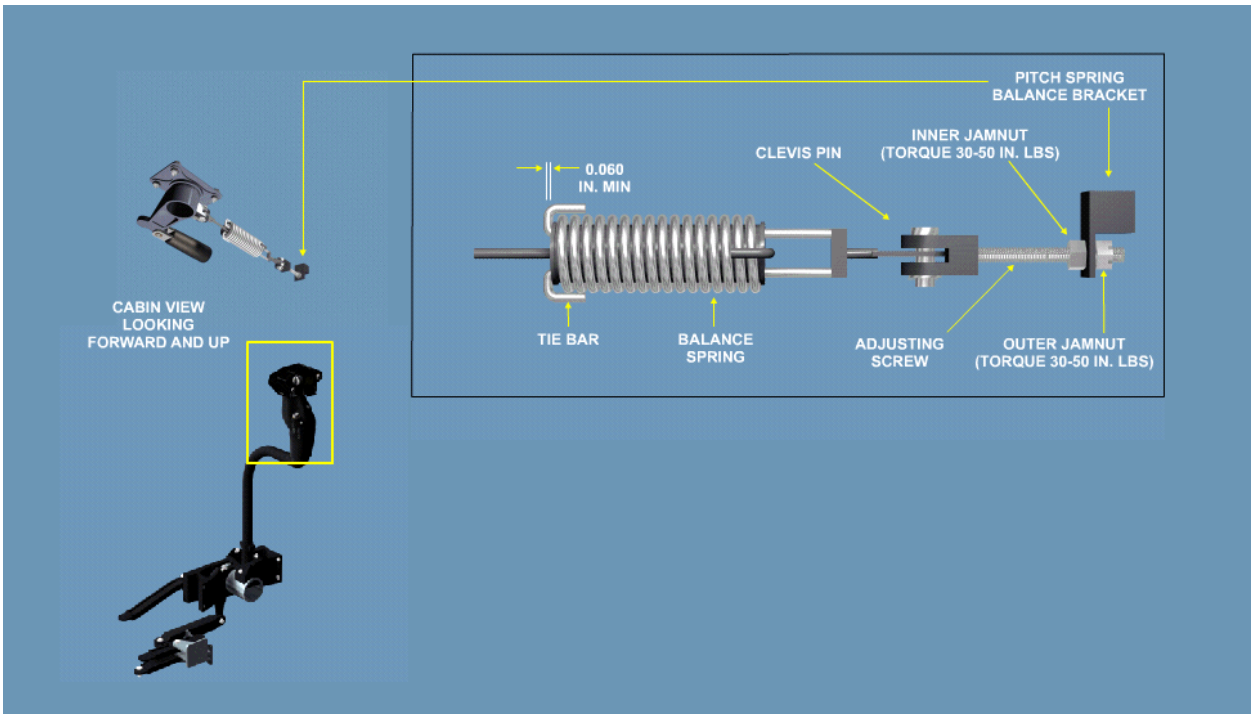
(1) The collective torque shaft works in conjunction with an adjustable balance spring that maintains the collective in position with the friction released, and counters the weight of the collective.

(2) When friction is full off, the collective will remain in position.

Frame # 0415 (Balance Spring Operation FLASH)

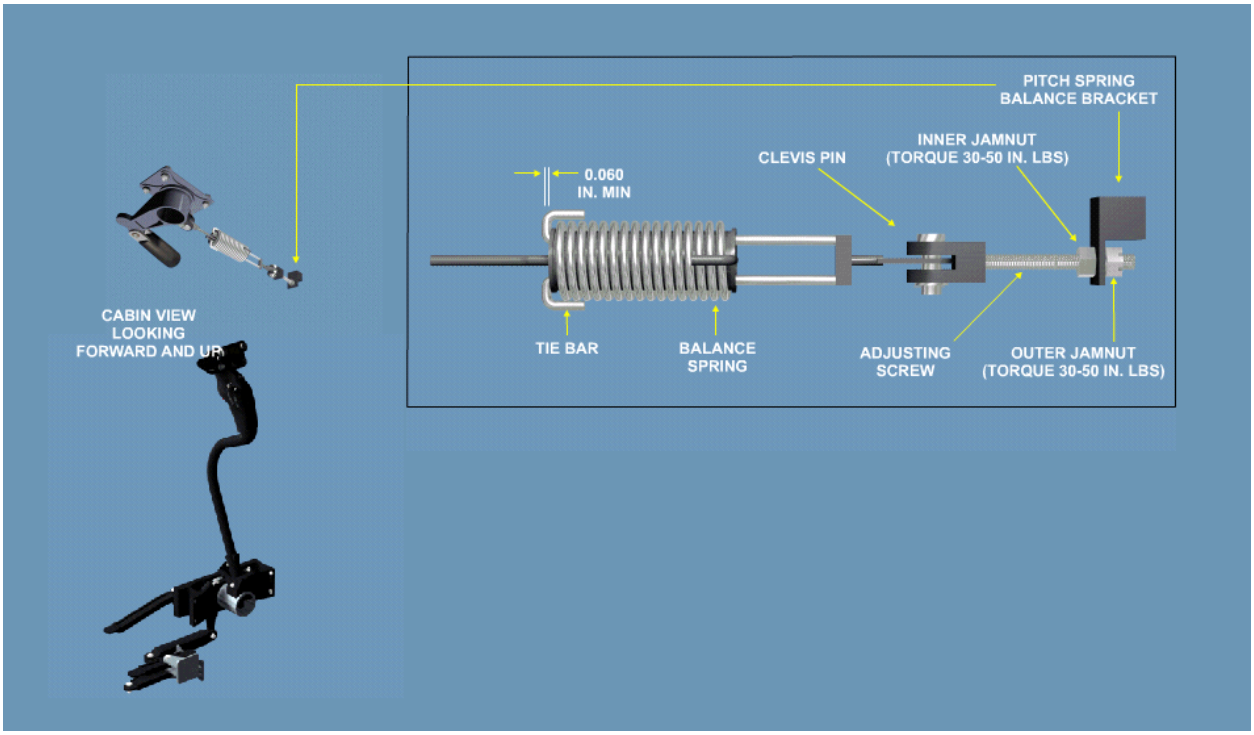


Frame # 0415 (Balance Spring Operation FLASH)



(3) The pitch torque shaft also works in conjunction with an adjustable balance spring that keeps the cyclic in position in the pitch axis.

Frame # 0415 (Balance Spring Operation FLASH)



CHECK ON LEARNING

1. How are the Torque Shafts matched together?

2. What is the function of the balance spring?

3. What function does the Torque shaft perform in the Flight Control system?

SECTION IX. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Torque shafts and their purpose lesson for the UH-60 helicopter. The key points to remember are:

- The collective, pitch, and yaw torque shafts convert a push-pull movement into a rotating movement.
- The torque shaft and lever are a serial numbered matched item.
- The lever is attached to the torque tube using tapered pins which allow precise fitting and prevent elongation.
- The torque shaft assembly routes the flight control inputs through the airframe. The torque shafts are attached to the airframe using shims for precise alignment.
- The yaw channel uses two torque shafts. The first brings the yaw input up to the pilot assist area and the second transfers the movement back down to the cabin overhead.
- The collective torque shaft works in conjunction with an adjustable balance spring that keeps the collective in position with the friction released.
- The pitch torque shaft also works in conjunction with an adjustable balance spring that keeps the cyclic in position in the pitch axis.

H. ENABLING LEARNING OBJECTIVE No. 8

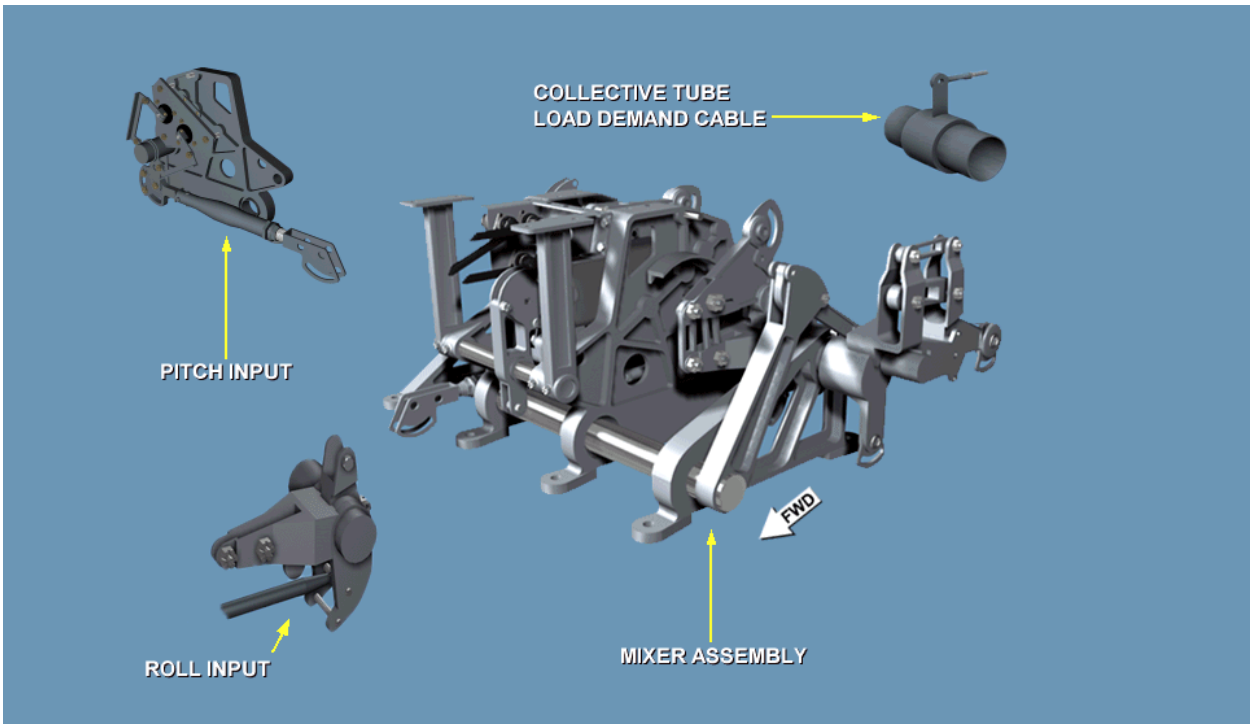
ACTION: Identify the functions of the Mixing Unit.

CONDITION: Given a description and related technical manuals.

STANDARD: IAW UH-60 Technical Manuals.

a. Mixer Assembly

Frame # 0445 (Mixer Assembly)



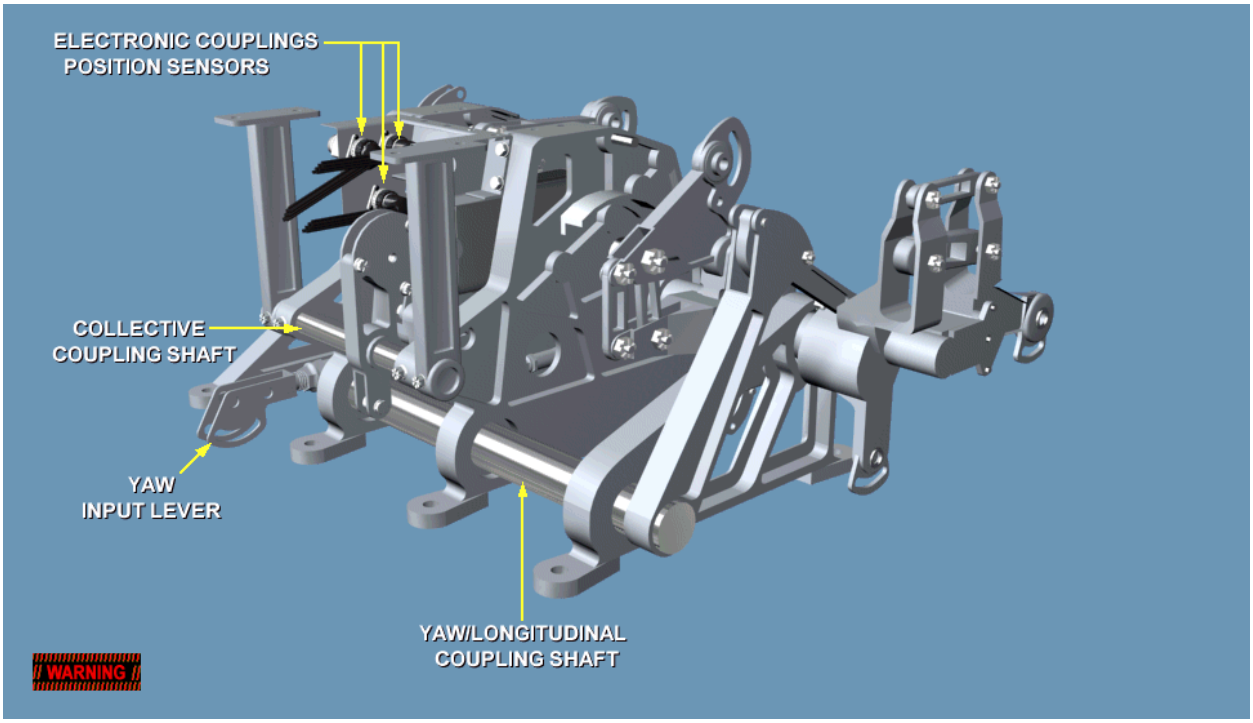
(1) The Mixer reduces inherent control coupling by mechanically coupling the collective inputs to the pitch, roll, and yaw channels and by coupling the yaw inputs to the pitch channel.

(2) With collective input, the primary servos will all move in the same direction to increase or decrease pitch in the main rotor blades, but will move at differing rates and distances.

(3) The two load demand cables/spindles adjust are connected to the collective control tube of the mixer and respective engines.

(4) The load-demand cable/spindle adjusts the engine gas generator (Ng) speed to a level about equal to the rotor load, thereby reducing transient droop.

Frame # 0450 (Mixer Assembly)



WARNING: FLIGHT SAFETY PARTS Verification of proper hardware installation, torque, safety installation, and proof torque of self-retaining bolts are critical characteristics.

(5) The mechanical couplings are collective to pitch, roll, and yaw and yaw to pitch.

(6) There is also an electronic coupling provided by the #1 collective position sensor.

(7) The mechanical couplings compensate for the torque effect caused by changes in collective position, and also has the ability to decrease tail rotor pitch as airspeed increases and the tail rotor and cambered fin becomes more efficient.

(8) As airspeed decreases, the opposite occurs.

(9) The collective stick position sensors are mounted on the right side of the mixer along with a third sensor on the UH-60L model.

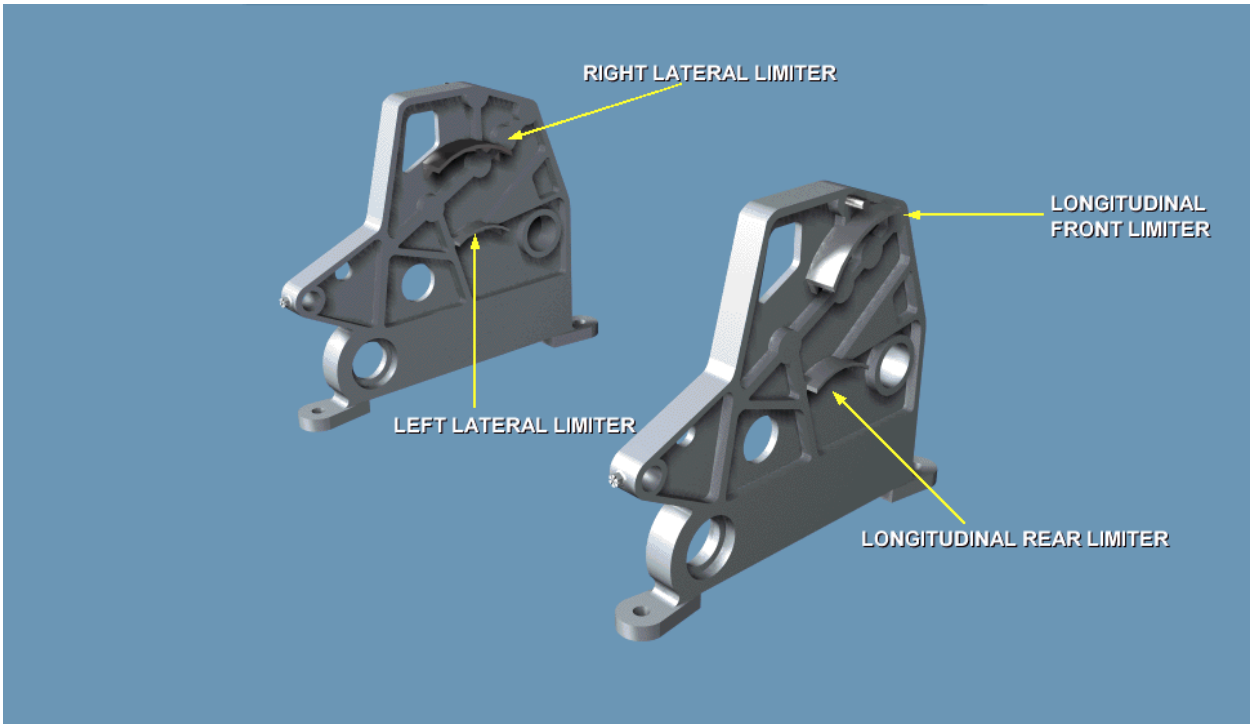
(10) The SAS/FPS computer commands the yaw trim actuator to change tail rotor pitch as collective position changes.

(11) The amount of tail rotor pitch change is proportional to airspeed.

(12) Maximum mixing occurs from 0 to 40 knots.

(13) As airspeed increases above 40 knots, the amount of mixing decreases until 100 knots, after which no mixing occurs.

Frame # 0455 (Mixer Assembly Limiters)



(14) The longitudinal and lateral Mixing Unit Roller Limiters are attached to the mixer assembly.

(15) The mixing is in addition to collective to yaw mechanical mixing and helps compensate for the torque effect caused by changes in collective position.

(16) It has the ability to decrease tail rotor pitch as airspeed increases and the tail rotor and cambered fin become more efficient.

CHECK ON LEARNING

1. What is the purpose of the Mixer in the Flight Control System?

2. Maximum mixing occurs at what airspeed range?

3. On what model helicopter can you find the third cannon plug for the position stick sensors?

SECTION X. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the function of the Mixing Unit lesson for the UH-60 helicopter. The key points to remember are:

- The Mixer reduces inherent control coupling by mechanically coupling the collective inputs to the pitch, roll, and yaw channels and by mechanically coupling the yaw inputs to the pitch channel.
- The load demand spindles are connected to the collective control tube of the mixer.
- The mechanical couplings are collective to pitch, roll, and yaw and yaw to pitch.
- The collective stick position sensors are mounted on the right side of the mixer along with a third sensor on the L model.
- The longitudinal and lateral limiters are located in the mixer.

I. ENABLING LEARNING OBJECTIVE No. 9

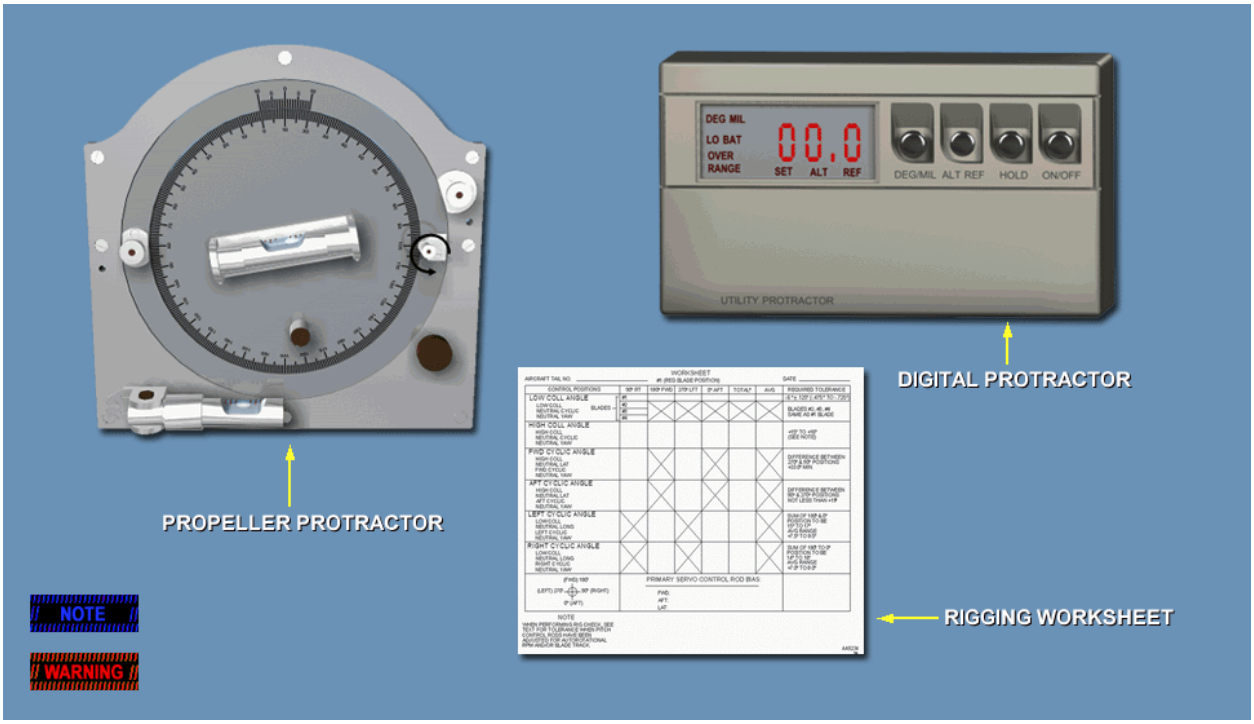
ACTION: Identify the procedures to complete a Main Rotor Complete Rigging.

CONDITION: Given a description and related technical manuals.

STANDARD: IAW UH-60 Technical Manuals.

a. Main Rotor System Complete Rig

Frame # 0481 (Main Rotor System Complete Rig)



WARNING: A maintenance test flight is an exceptionally demanding operation and requires a thorough flight readiness inspection (PREFLIGHT). The flight readiness inspection is prescribed in TM 1-1520-237-10 Operator's Manual and must be completed before each maintenance test flight. Emergency procedures are found in the applicable Operator's Manual (-10) or Checklist (-CL) and are not duplicated in this publication.

NOTE: A main rotor complete rig is required after any major helicopter flight controls have been overhauled, after an extensive repair has been done due to ballistic landing (hard landing), crash damage, after 1000 hour internal maintenance flight control rod inspection, or when directed by maintenance officer.

(1) Rigging of the flight control system consists of coordinating cyclic stick, collective stick, and yaw pedal movements, with correct blade angles at the main and tail rotors.

(2) Rigging procedures shall be done by qualified technicians who are familiar with the helicopter and flight control system.

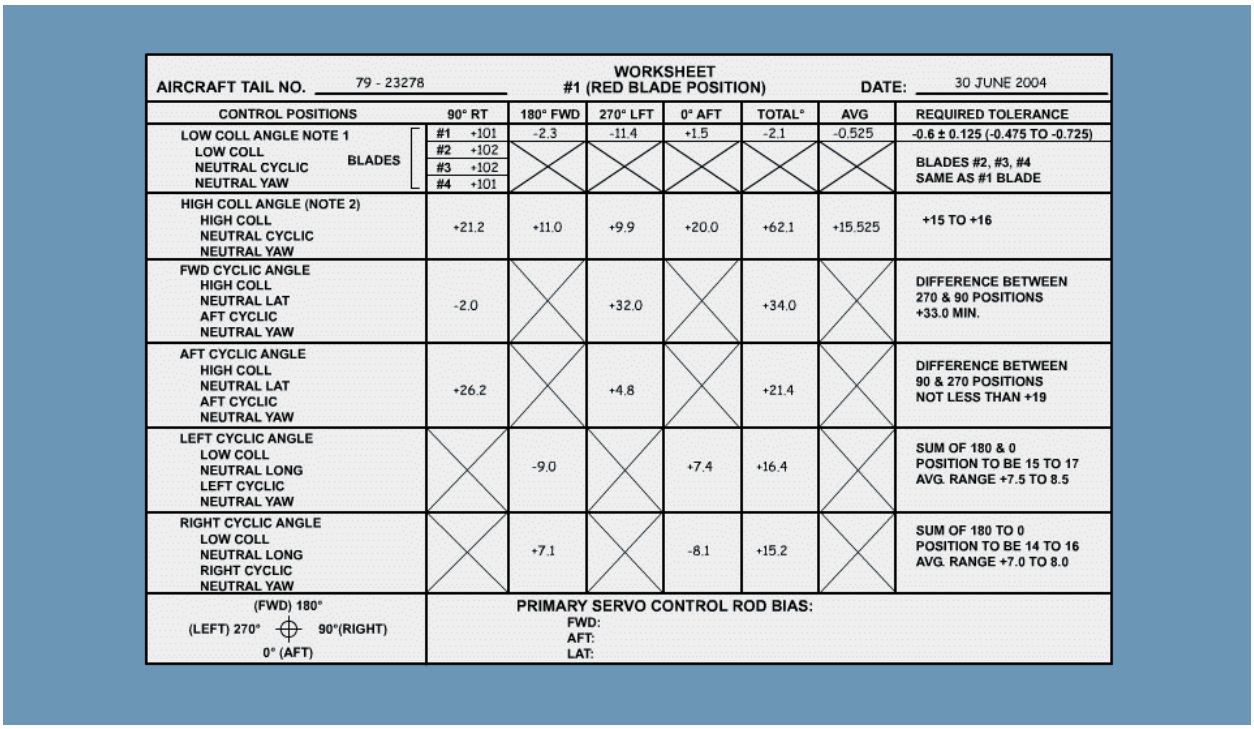
(3) It is essential to keep the helicopter perfectly still while zeroing and taking blade angle readings.

(4) The digital protractor, or the propeller protractor, is the preferred tool to accomplish this.

(5) A limit of three technicians are recommended on the helicopter at a time; one to take readings, one to assist in rotating blades, and one in the cockpit to position and cycle the controls.

(6) All calculations should be documented on a rigging worksheet and filed away.

Frame #0481 (Rig Worksheet)



AIRCRAFT TAIL NO. 79 - 23278 — WORKSHEET #1 (RED BLADE POSITION) — DATE: 30 JUNE 2004

CONTROL POSITIONS		90° RT	180° FWD	270° LFT	0° AFT	TOTAL°	AVG	REQUIRED TOLERANCE
LOW COLL ANGLE NOTE 1 LOW COLL NEUTRAL CYCLIC NEUTRAL YAW	BLADES	#1 +101 #2 +102 #3 +102 #4 +101	-2.3	-11.4	+1.5	-2.1	-0.525	-0.6 ± 0.125 (-0.475 TO -0.725) BLADES #2, #3, #4 SAME AS #1 BLADE
HIGH COLL ANGLE (NOTE 2) HIGH COLL NEUTRAL CYCLIC NEUTRAL YAW		+21.2	+11.0	+9.9	+20.0	+62.1	+15.525	+15 TO +16
FWD CYCLIC ANGLE HIGH COLL NEUTRAL LAT AFT CYCLIC NEUTRAL YAW		-2.0		+32.0		+34.0		DIFFERENCE BETWEEN 270 & 90 POSITIONS +33.0 MIN.
AFT CYCLIC ANGLE HIGH COLL NEUTRAL LAT AFT CYCLIC NEUTRAL YAW		+26.2		+4.8		+21.4		DIFFERENCE BETWEEN 90 & 270 POSITIONS NOT LESS THAN +19
LEFT CYCLIC ANGLE LOW COLL NEUTRAL LONG LEFT CYCLIC NEUTRAL YAW			-9.0		+7.4	+16.4		SUM OF 180 & 0 POSITION TO BE 15 TO 17 AVG. RANGE +7.5 TO 8.5
RIGHT CYCLIC ANGLE LOW COLL NEUTRAL LONG RIGHT CYCLIC NEUTRAL YAW			+7.1		-8.1	+15.2		SUM OF 180 TO 0 POSITION TO BE 14 TO 16 AVG. RANGE +7.0 TO 8.0
(FWD) 180° (LEFT) 270° 90°(RIGHT) 0° (AFT)		PRIMARY SERVO CONTROL ROD BIAS: FWD: AFT: LAT:						

(7) The rigging worksheet is used to record all alignment readings.

(8) Cycle all controls a minimum of three times, do not recycle controls until all readings have been taken for a particular position or component.

b. Complete Rig Pin Set

Frame # 0485 (Complete Rig Pin Set)

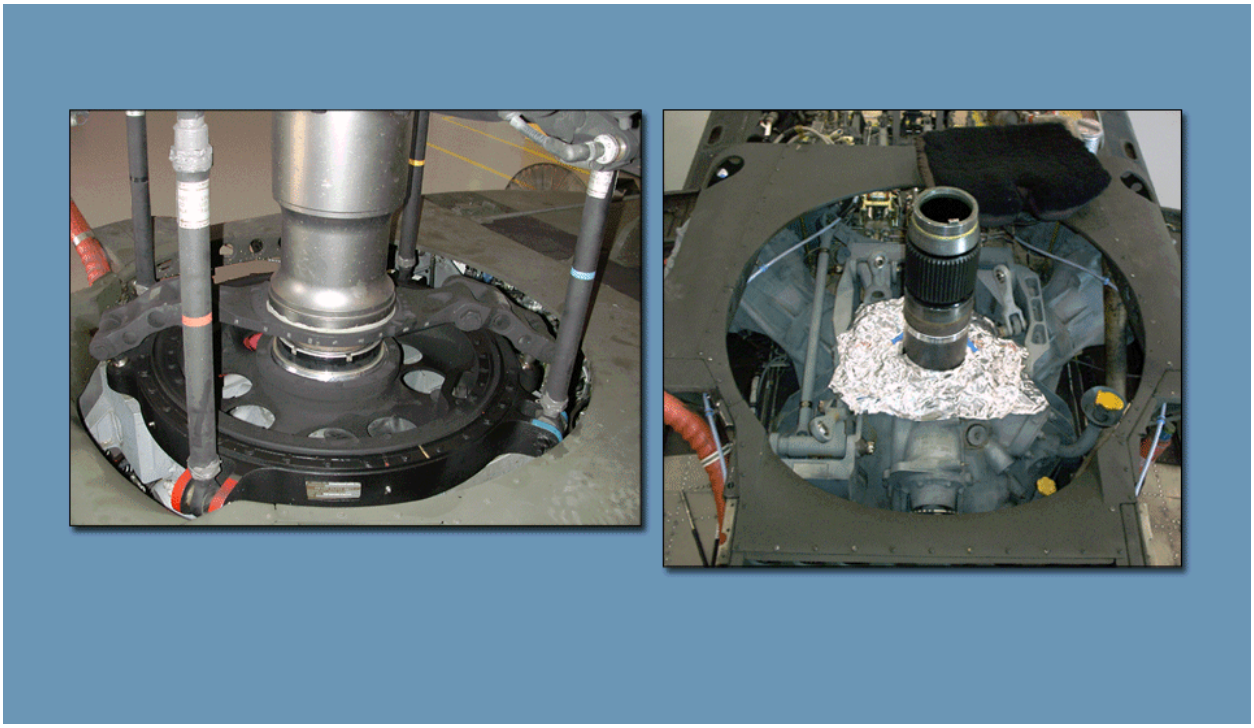
(1) There are five different rigging procedures for flight controls on the UH-60 helicopter: a Main Rotor Complete rig, Main Rotor rig check, Primary Servo Four-point rig check, Tail Rotor Complete rig, and Tail Rotor rig check.

(2) A Main Rotor Complete rig is required if the Main Rotor rig check fails, or by direction of the maintenance officer.

(3) To properly accomplish a rig, utilize rig kit, 70700-20389-042, which consists of all rigging pins, and rigging blocks required to complete the rig.

c. Main Rotor Rig Check Requirements

Frame # 0490 (Main Rotor Rig Check Requirements)



(1) A main rotor complete rigging is required after major helicopter flight controls overhaul, after extensive repair has been done due to ballistic or crash damage, after 1000 hour internal flight control rod inspection, or when directed by the maintenance officer.

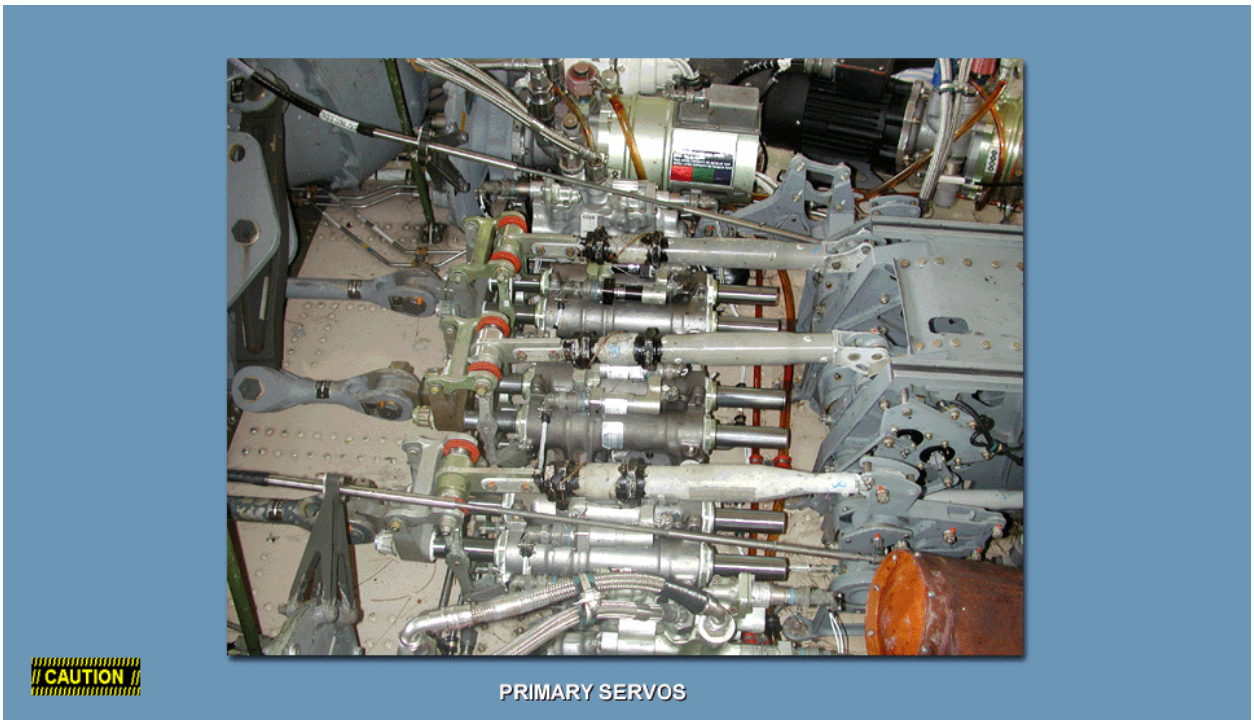
(2) A Main Rotor rig check is required whenever a main gear box, rotor head, bellcrank support, or when any flight control component is replaced.

(3) Fixed length pushrods, bellcranks, and idlers are interchangeable without a rigging check.

(4) Adjustable length rods may be changed without a rigging check, provided replacement is trammeled to exact length (set to dimension measured pivot bolt hole to pivot bolt hole).

d. Primary Servo Four-Point Rig Check Requirements

Frame # 0495 (Primary Servo Four-Point Rig Check Requirements)



CAUTION: When rigging is being accomplished with the blades OFF, restrain the anti flap assembly cams. Damage to the anti flap assembly will result if the anti flap assembly cams are not restrained prior to any collective input.

(1) A Primary Servo four point rig check is required when a primary servo has been replaced.

(2) Whenever possible, all flight control linkage should be pinned immediately fore and aft of component being replaced.

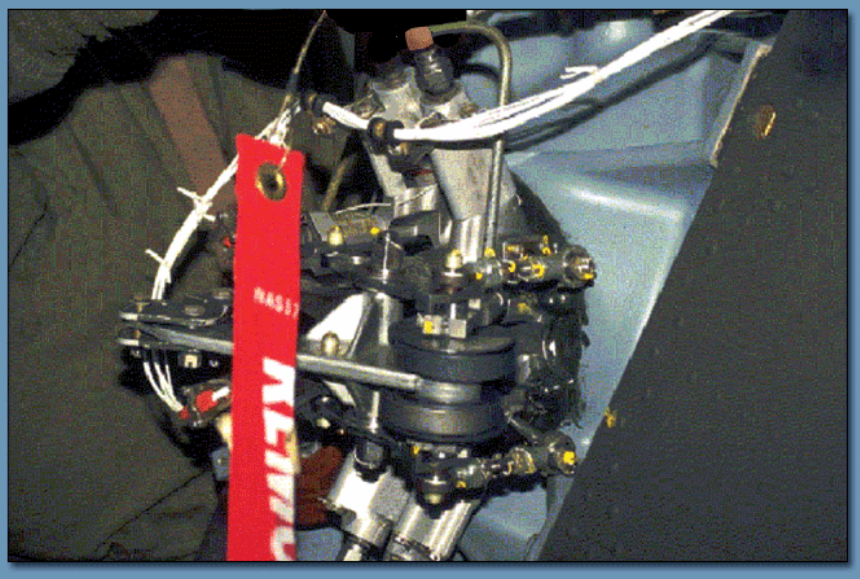
(3) Any work done on longitudinal and collective requires a recheck of yaw system due to the coupling in mixer.

(4) If a forward servo or aft servo was replaced, both the longitudinal and lateral blade angle checks are to be performed.

(5) If only a lateral servo was replaced, only the lateral blade angle check is to be performed.

e. Tail Rotor Complete Rig Check Requirements

Frame # 0500 (Tail Rotor Complete Rig Check Requirements)



TAIL ROTOR SERVO

(1) A tail rotor complete rig is required whenever any major changes in tail rotor flight controls are made, or adjustments are made to flight controls not covered in the tail rotor rig check.

(2) The main rotor must be in proper rig before any rigging is to be completed on the tail rotor section.

(3) Perform a tail rotor rig check if cable tensioning is required, or removal/replacement of the following parts:

(a) forward quadrant

(b) torque lever to forward quadrant pushrod

(c) control cables

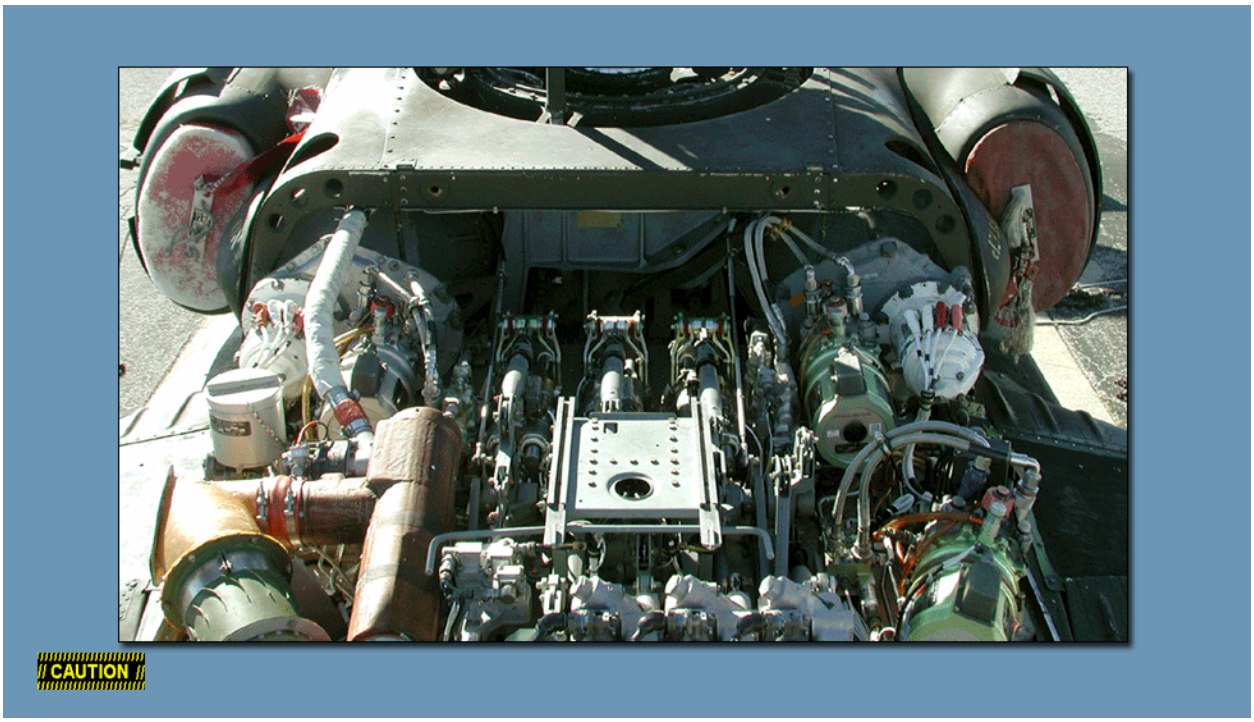
(d) cable pulleys

(e) tail rotor gear box

(f) certain tail rotor components as specified in chapter 5 and the tail rotor servo.

f. Main Rotor System Complete Rig

Frame # 0508 (Main Rotor System Complete Rig)



CAUTION: Damage to flight control components will result if hydraulic power is shut down during rigging with rigging pins still installed. Make sure all rigging pins are removed before shutting down hydraulic power.

(1) To begin a Main Rotor system complete rig, remove the main rotor pylon sliding cover and mixer work platform.

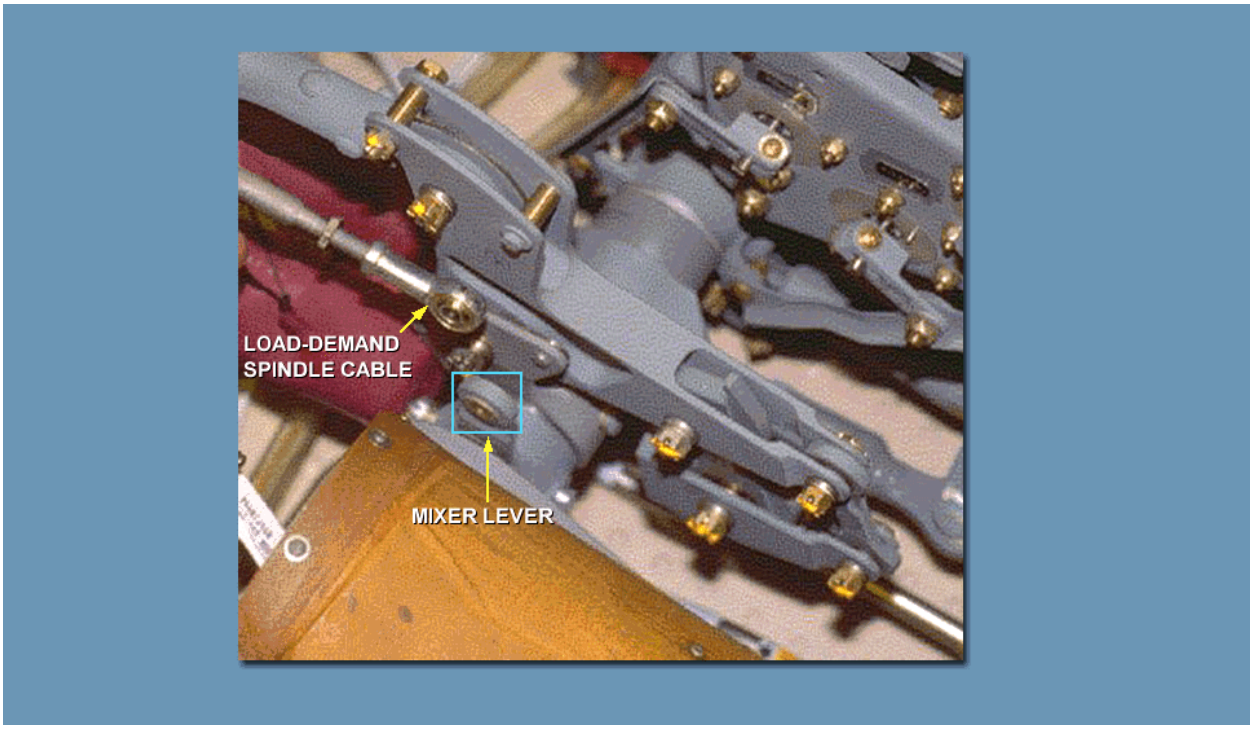
(2) The main rotor complete rig can be separated into two separate parts.

(3) The first is commonly referred to as a dry rig (hydraulics OFF). The dry rig, centers the flight controls, allows for full range of motion (as required) for flight, and ensures the flight control rods have adequate clearance.

(4) The second part, commonly referred to as a wet rig (hydraulics ON) consists of setting the swashplate to a nominal angle and adjusting the fwd, aft and lateral control as necessary to achieve the proper main rotor blade angles.

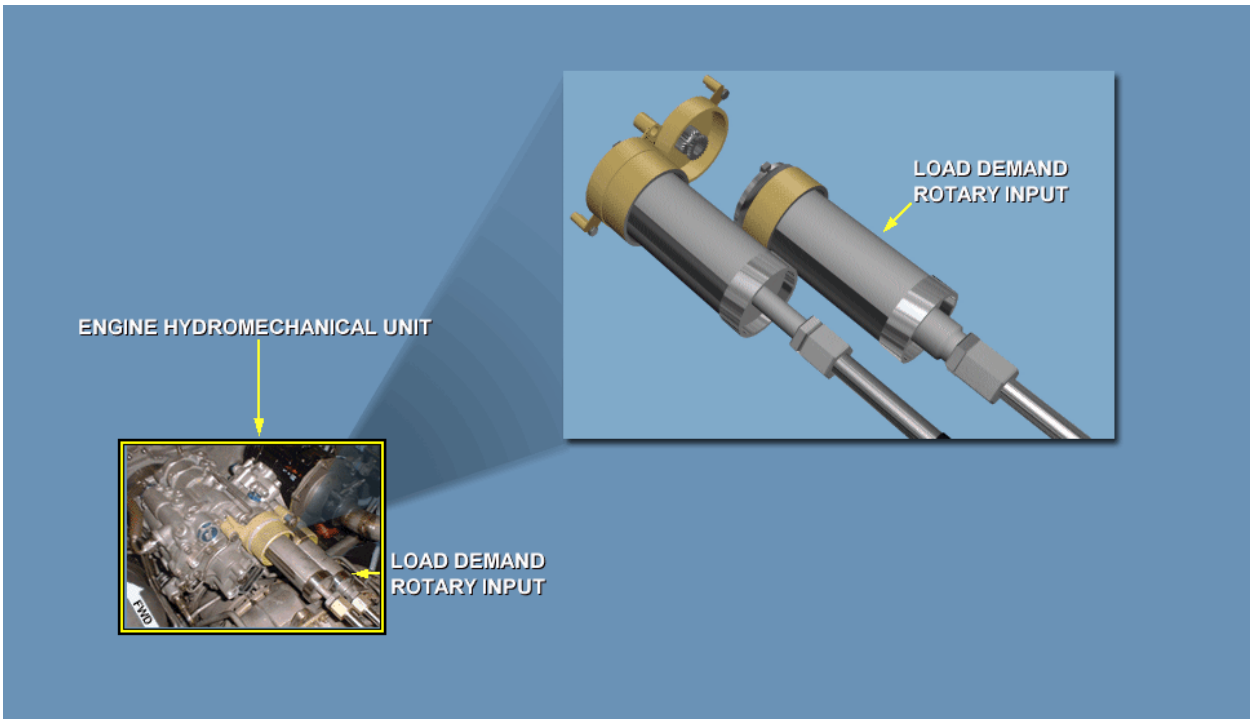
g. Main Rotor System Complete Rig

Frame # 0510 (Main Rotor System Complete Rig)



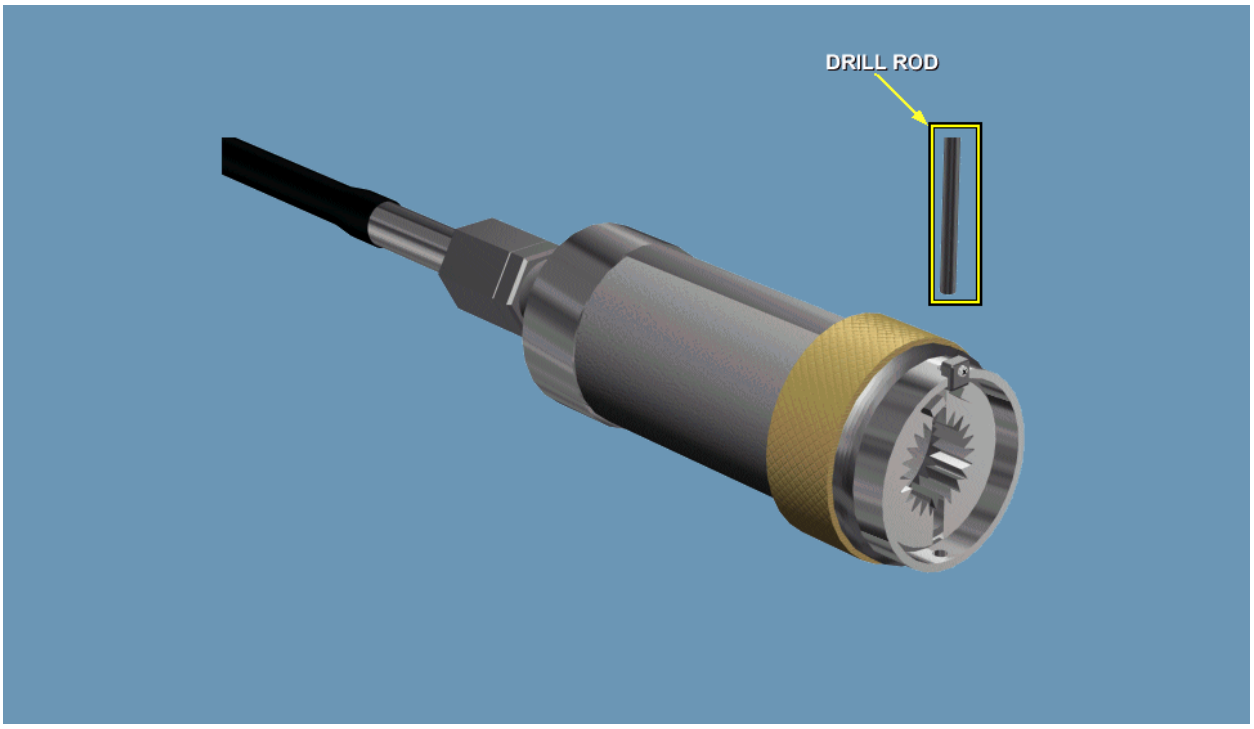
(1) Disconnect the engine Load-Demand Spindle (LDS) cables from the mixer levers.

Frame # 0515 (Main Rotor System Complete Rig)



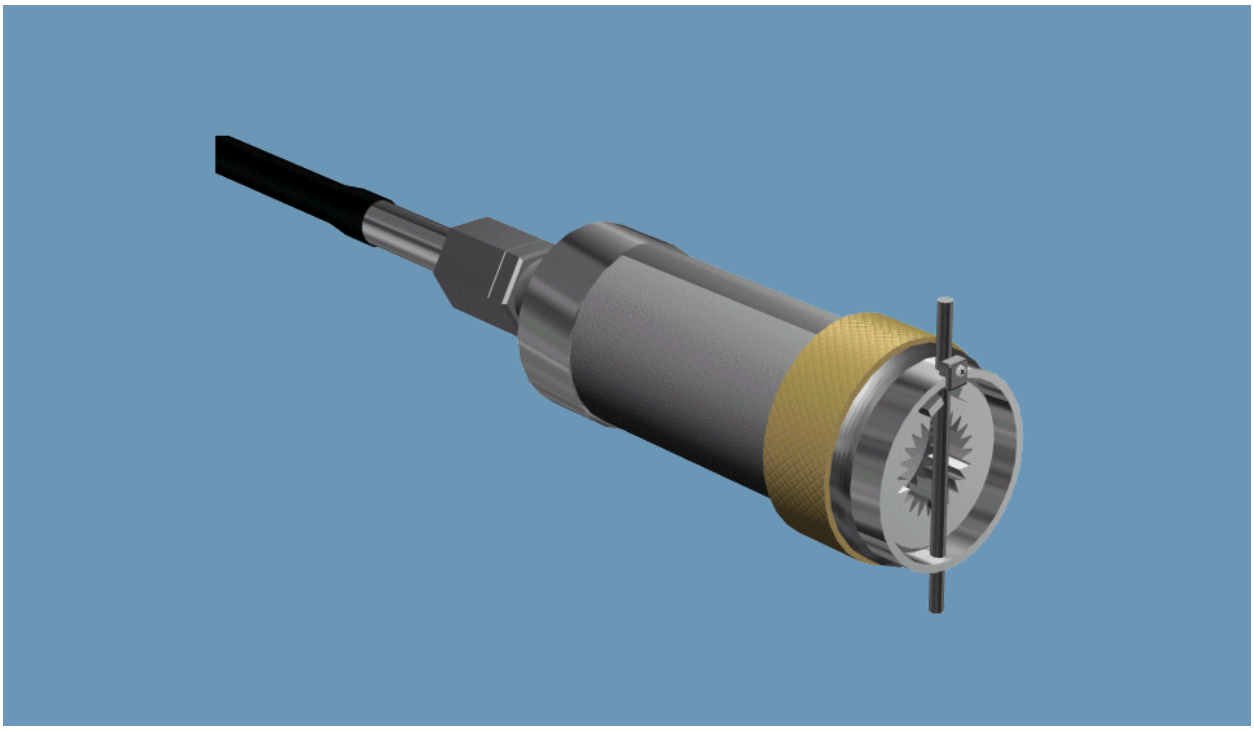
(a) Disconnect load-demand rotary inputs from the ENGINE HYDROMECHANICAL UNIT.

Frame # 0515 (Main Rotor System Complete Rig)



(b) Install 0.125-inch diameter drill rod to hold springs compressed.

Frame # 0515 (Main Rotor System Complete Rig)

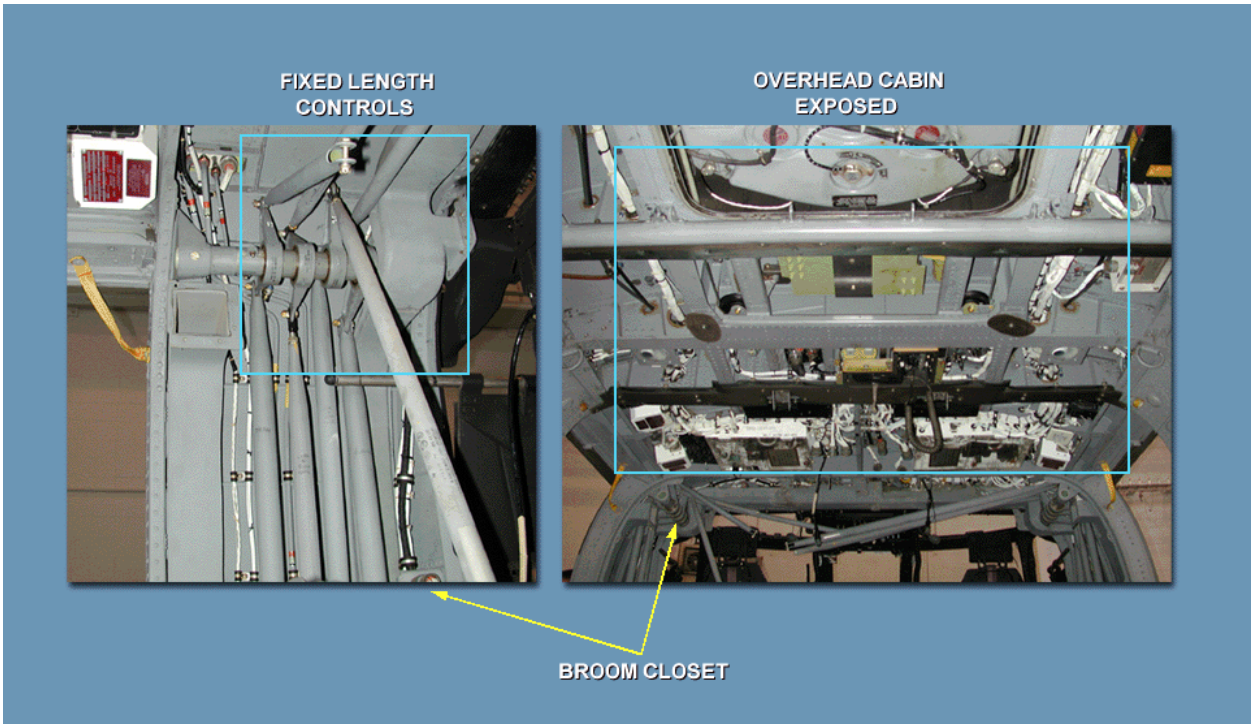


(c) Shearing of the spring pin in collective bias tube will result if collective stick is moved while drill rod is installed.

(d) Do not move collective stick when drill rod is installed.

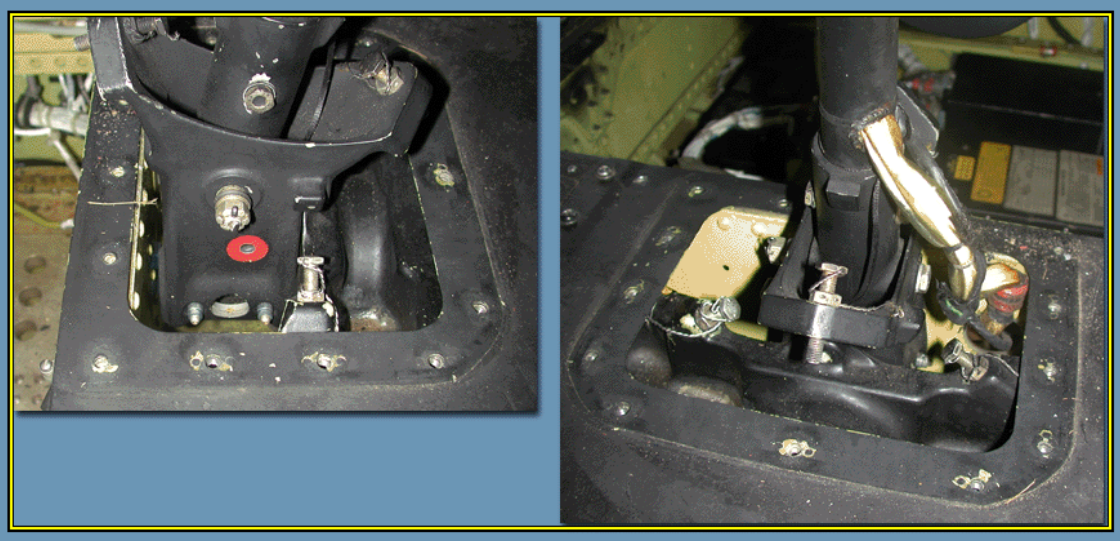
1) Flight Control Access Panel

Frame # 0517 (Flight Control Access Panel)



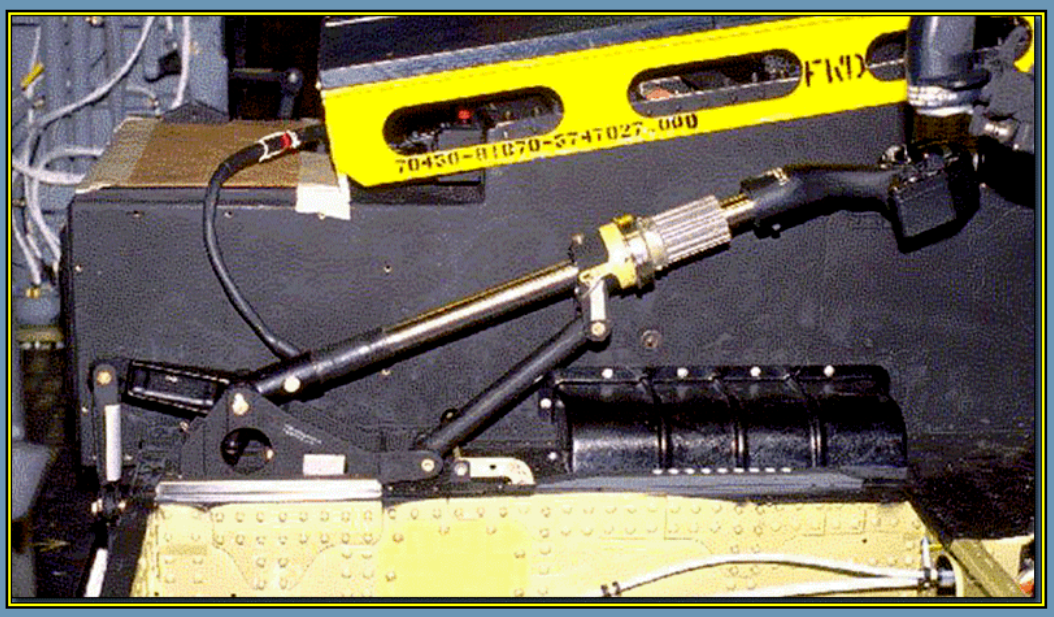
a) Also in the preparation for a Main rotor system complete rig, remove the overhead soundproofing panels at STA 247.0 to STA 295.0, and left and right flight control covers at STA 247.0 to STA 265.0 to reveal the broom closet flight controls.

Frame # 0520 (Main Rotor System Complete Rig)



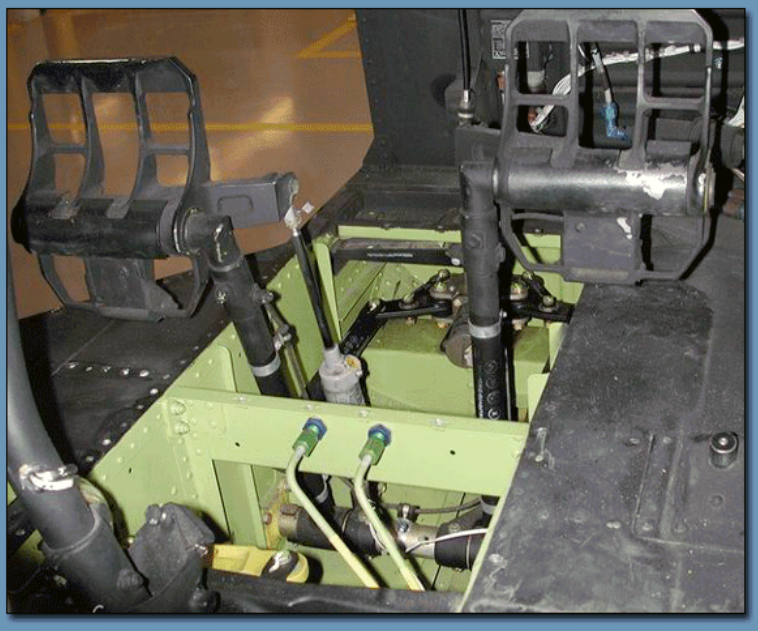
(e) Remove pilot and copilot cyclic stick boots.

Frame # 0520 (Main Rotor System Complete Rig)



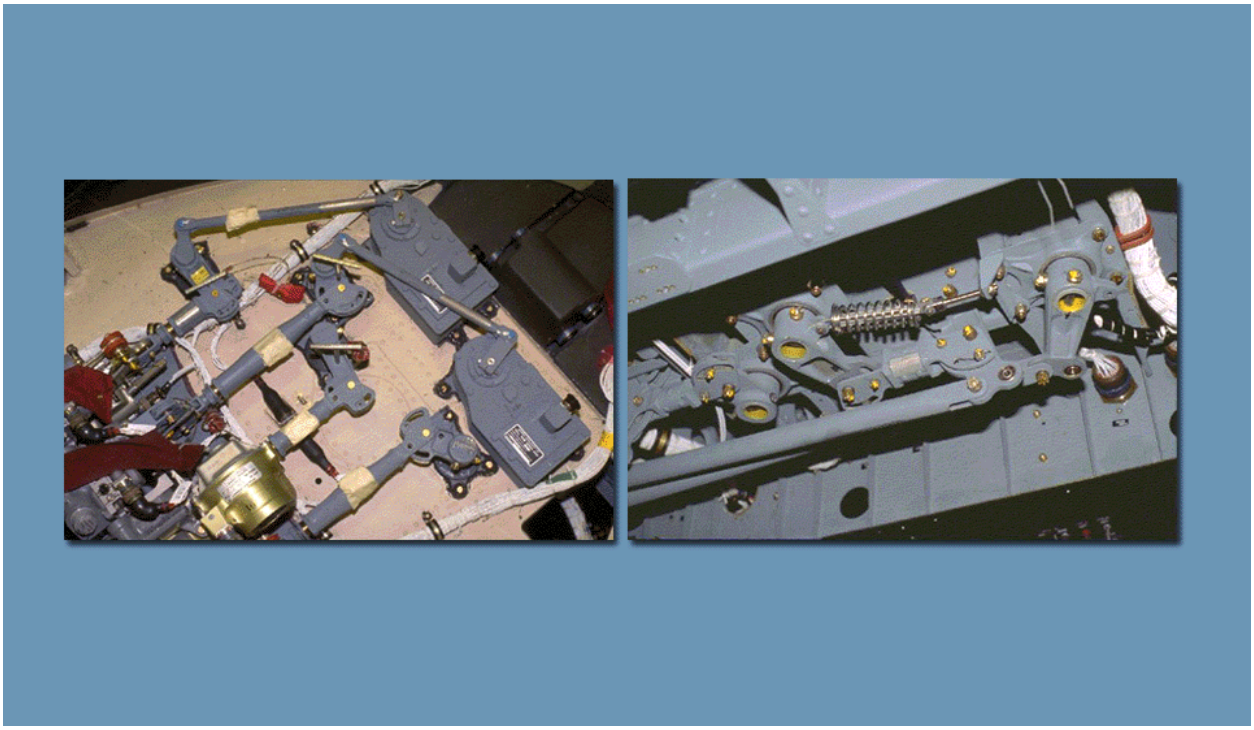
(f) Remove pilot and copilot collective stick covers and boots.

Frame # 0520 (Main Rotor System Complete Rig)



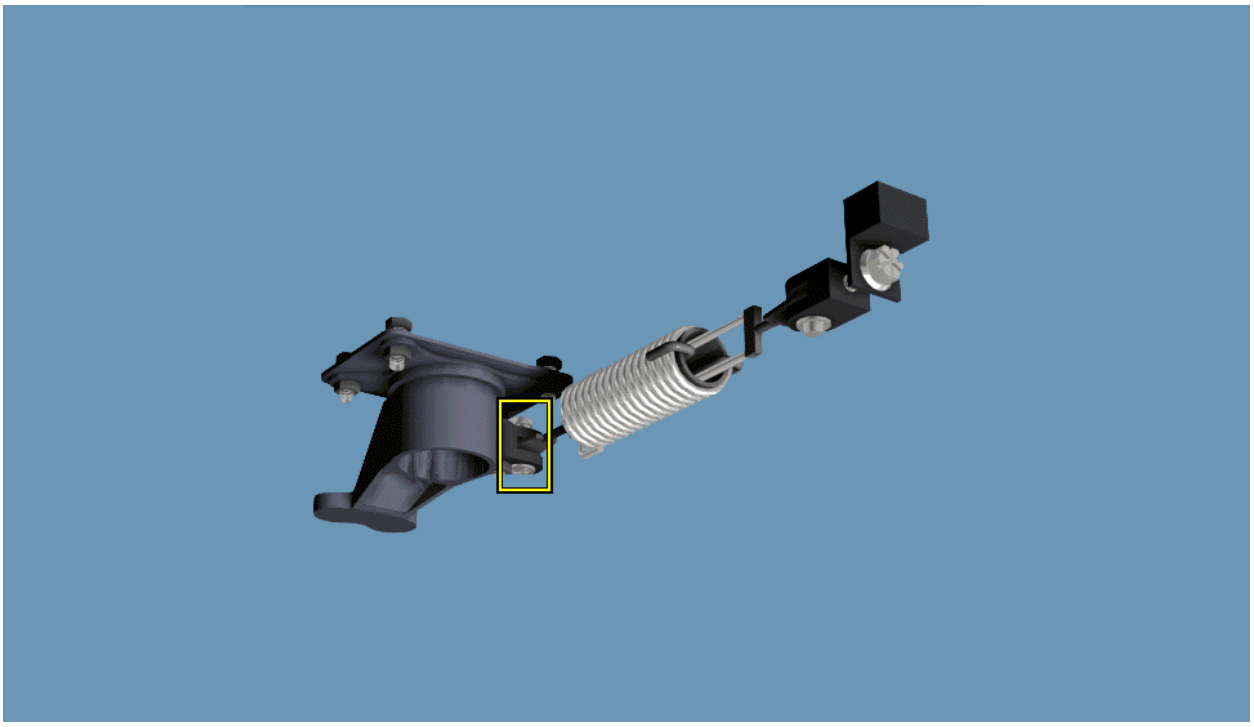
(g) Remove boots and center floor panels around pilot and copilot pedal assemblies.

Frame # 0525 (Main Rotor System Complete Rig)



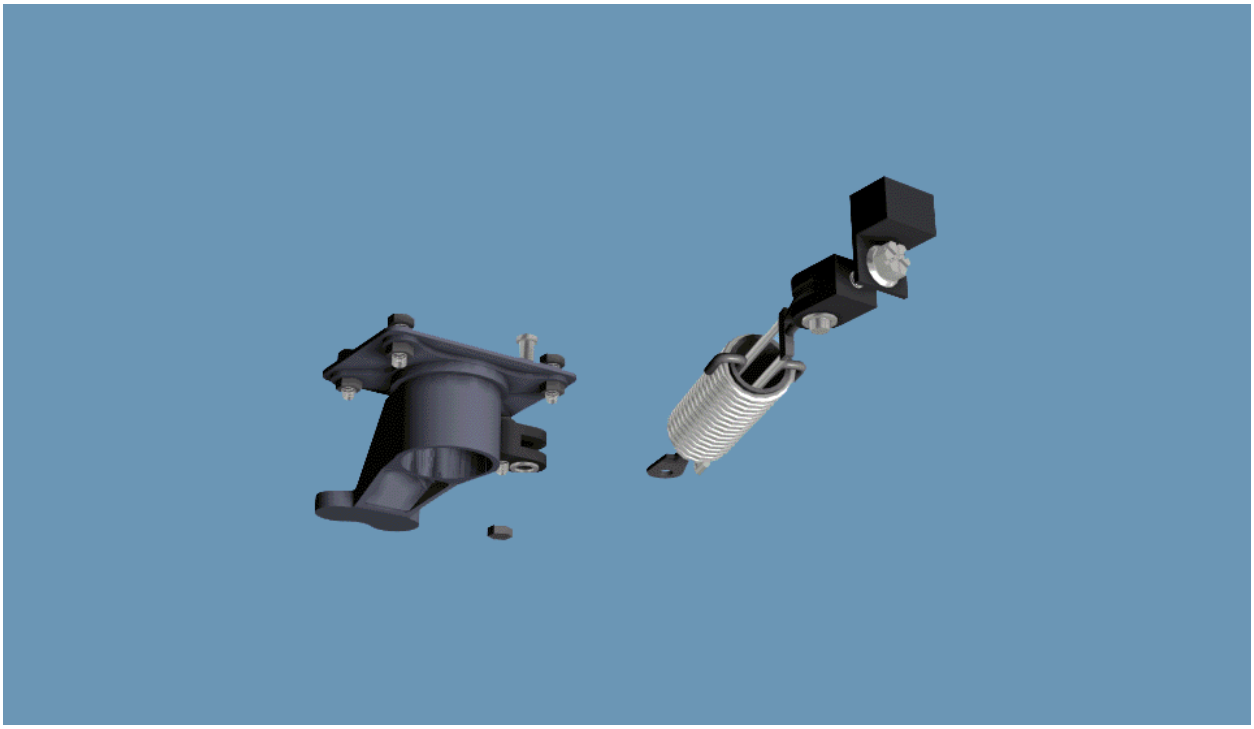
(h) Remove self-retaining bolts, washers, and nuts securing collective, pitch, roll, and yaw torque shaft output control rods to torque shafts.

Frame # 0530 (Main Rotor System Complete Rig)

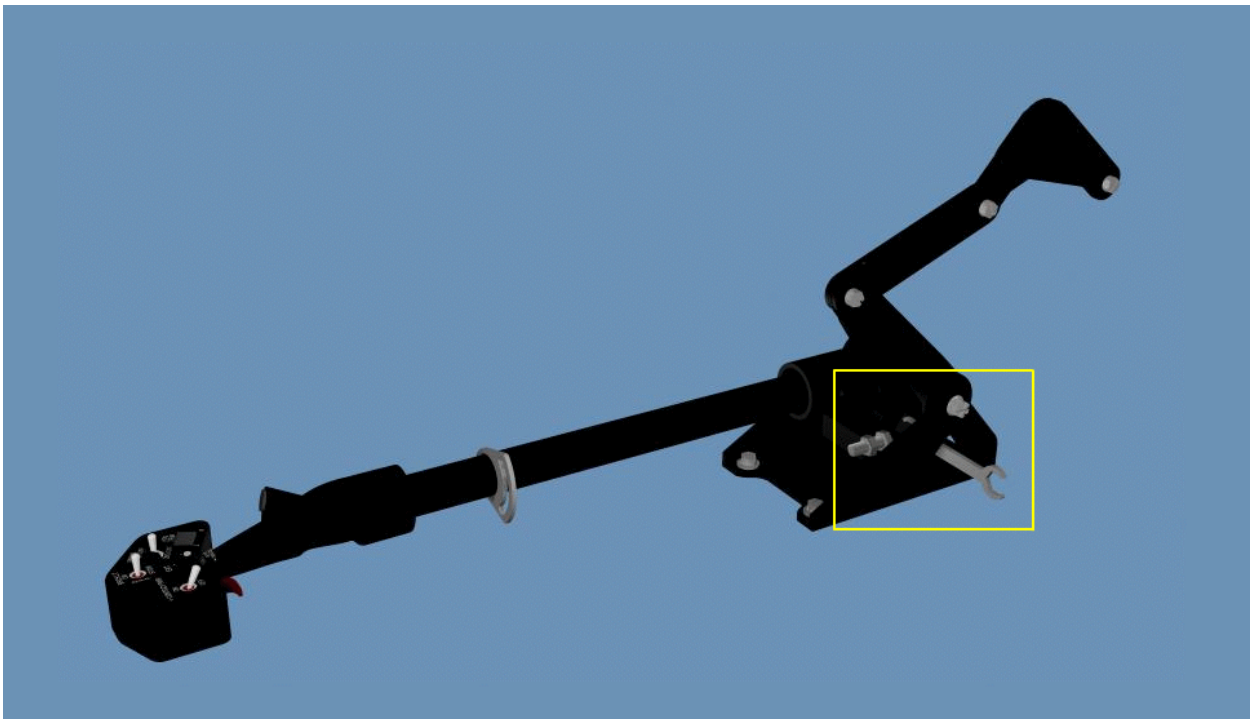


(i) Disconnect collective balance spring.

Frame # 0530 (Main Rotor System Complete Rig)



Frame # 0535 (Main Rotor System Complete Rig FLASH)



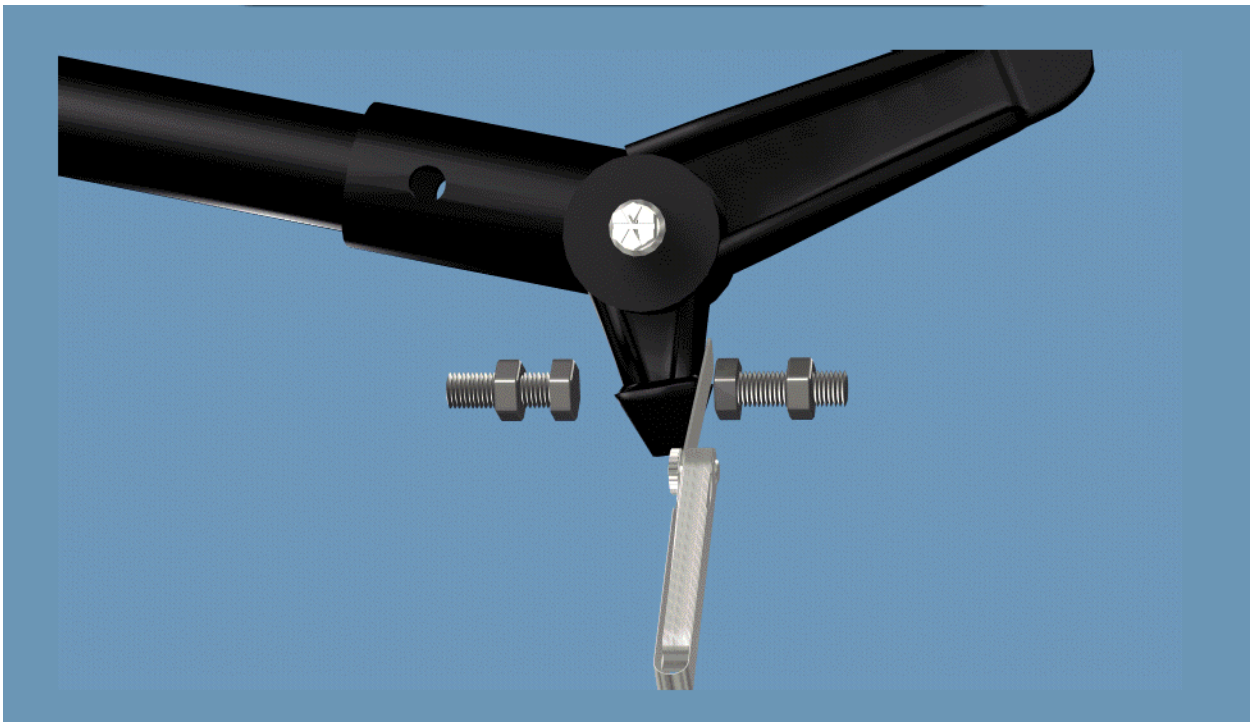
(j) Extend the copilot collective stick to its flight ready position.

(k) On the copilot collective stick, check that the collective low pitch stop bolt head is at 0.630 to 0.700 inches above support.

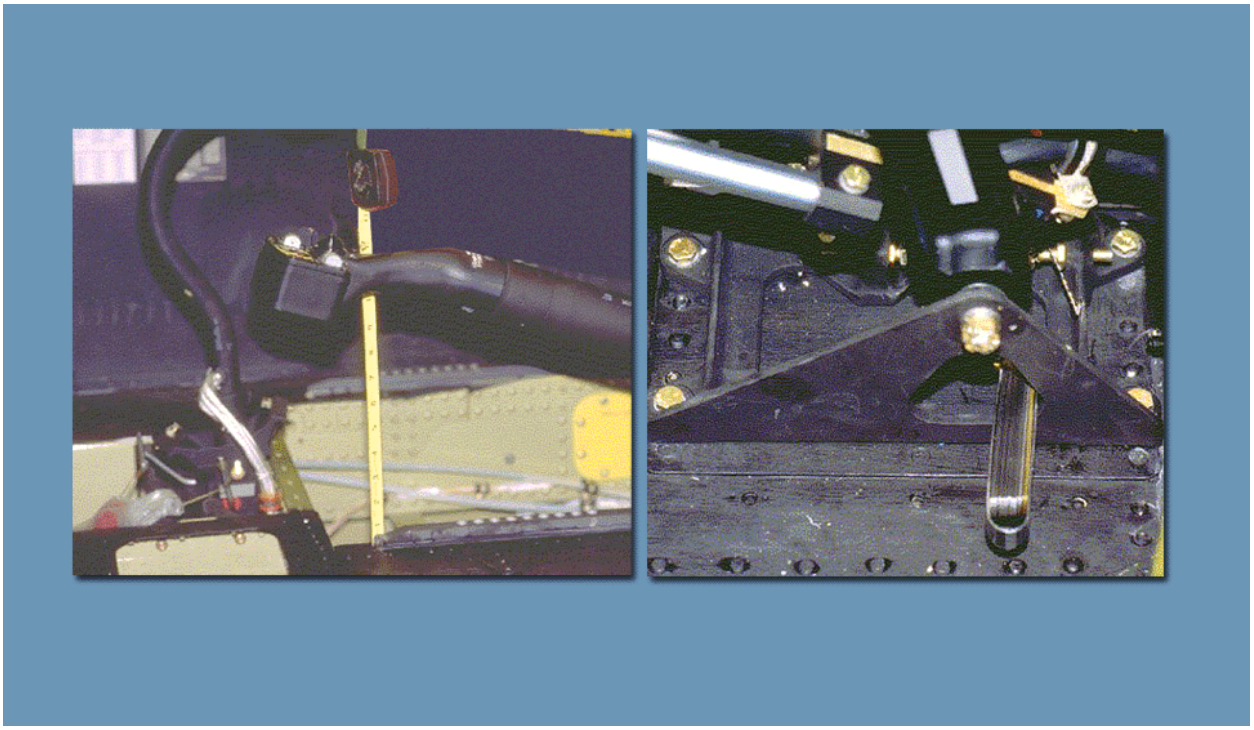
(l) If the copilot low collective stop bolt is beyond limits, back off jam nut on copilot low collective stop bolt.

(m) Adjust stop bolt to obtain 0.630 to 0.700 -inch gap between bolt head and support.

Frame # 0535 (Main Rotor System Complete Rig FLASH)



Frame # 0540 (Main Rotor System Complete Rig)

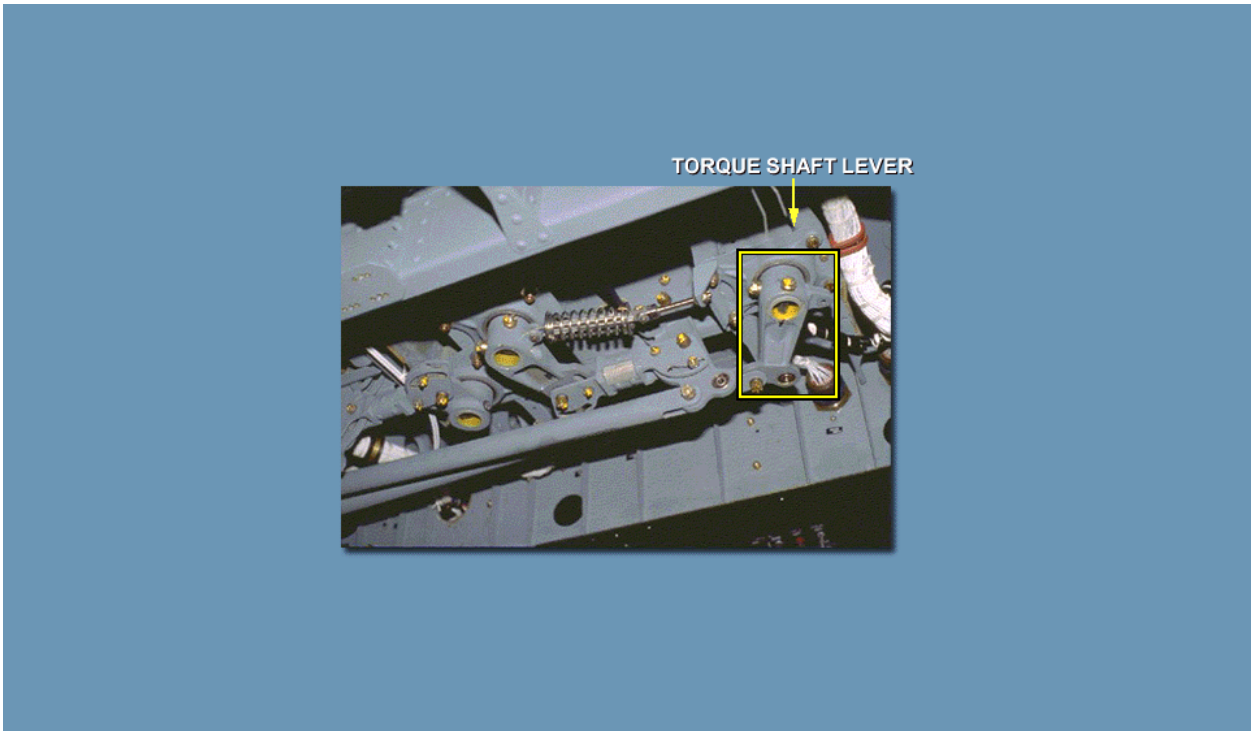


(n) Insert a 0.020-inch feeler gauge between the copilot collective stick and the collective low pitch stop bolt.

(o) With the collective sticks in the full down position, check that grip height of the pilot stick is the same as grip height of the copilot stick ± 1/16-inch.

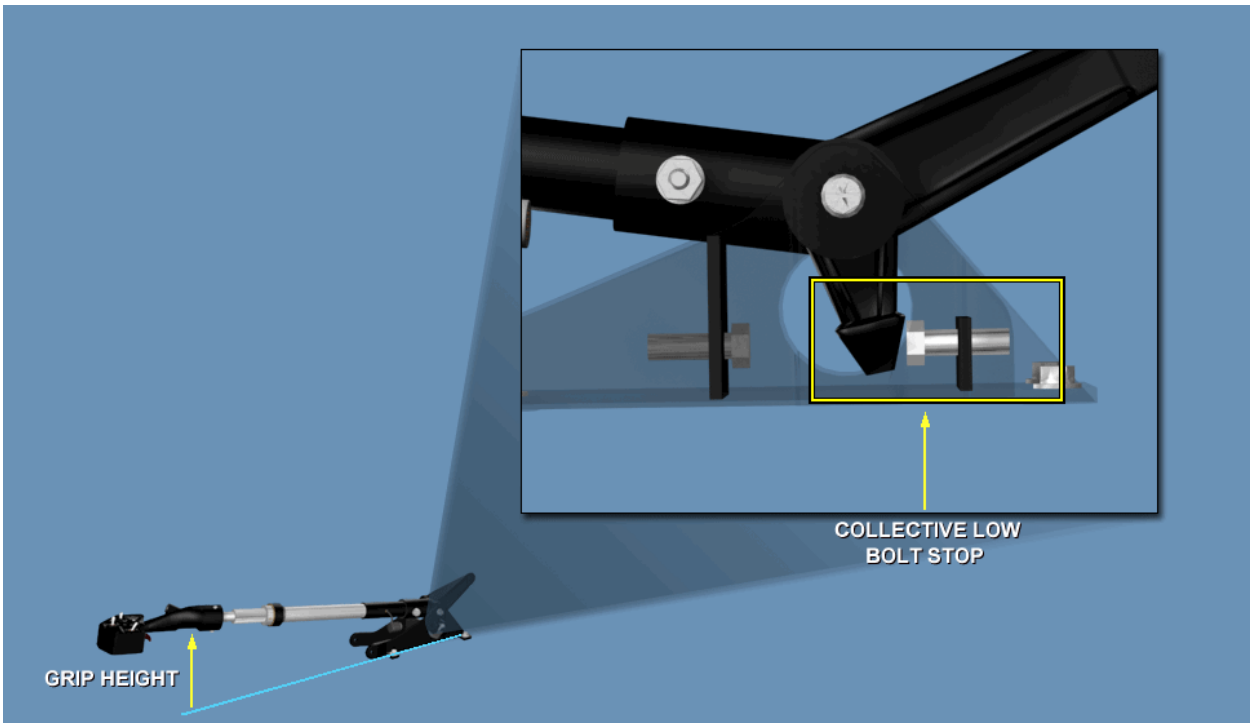
(p) If the pilot stick grip height is beyond limits, adjust as required.

Frame # 0545 (Main Rotor System Complete Rig)



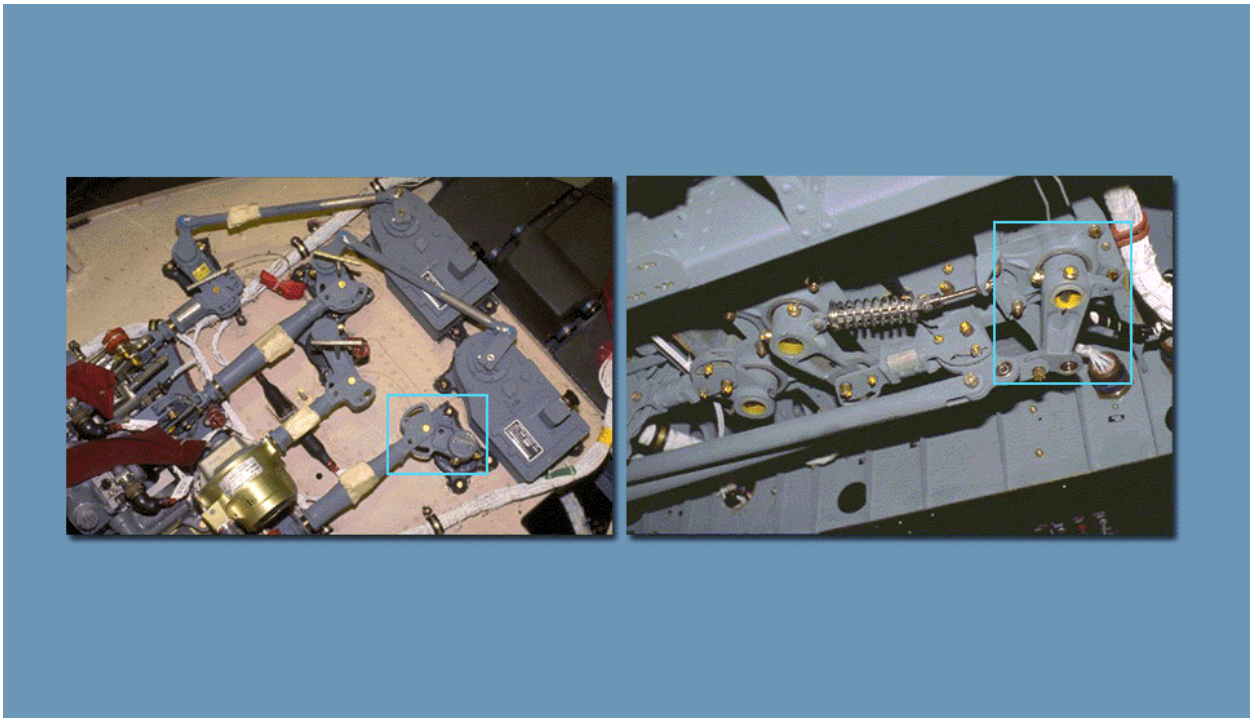
(q) If the collective measurements are not within limits, disconnect the pilot and copilot collective overhead control rods at the torque shaft lever, located in the cabin ceiling behind the pilot seat.

Frame # 0545 (Main Rotor System Complete Rig)



(r) Adjust the pilot collective low pitch stop bolt until the grip height of the pilot collective stick is same as the grip height of copilot collective stick ± 1/16-inch.

Frame # 0545 (Main Rotor System Complete Rig)



(s) Install the collective torque shaft rigging pin, 70700-20380-043, in collective torque shaft.

(t) Adjust and connect the pilot and copilot overhead control rod to the collective torque shaft lever.

Frame # 0550 (Main Rotor System Complete Rig)

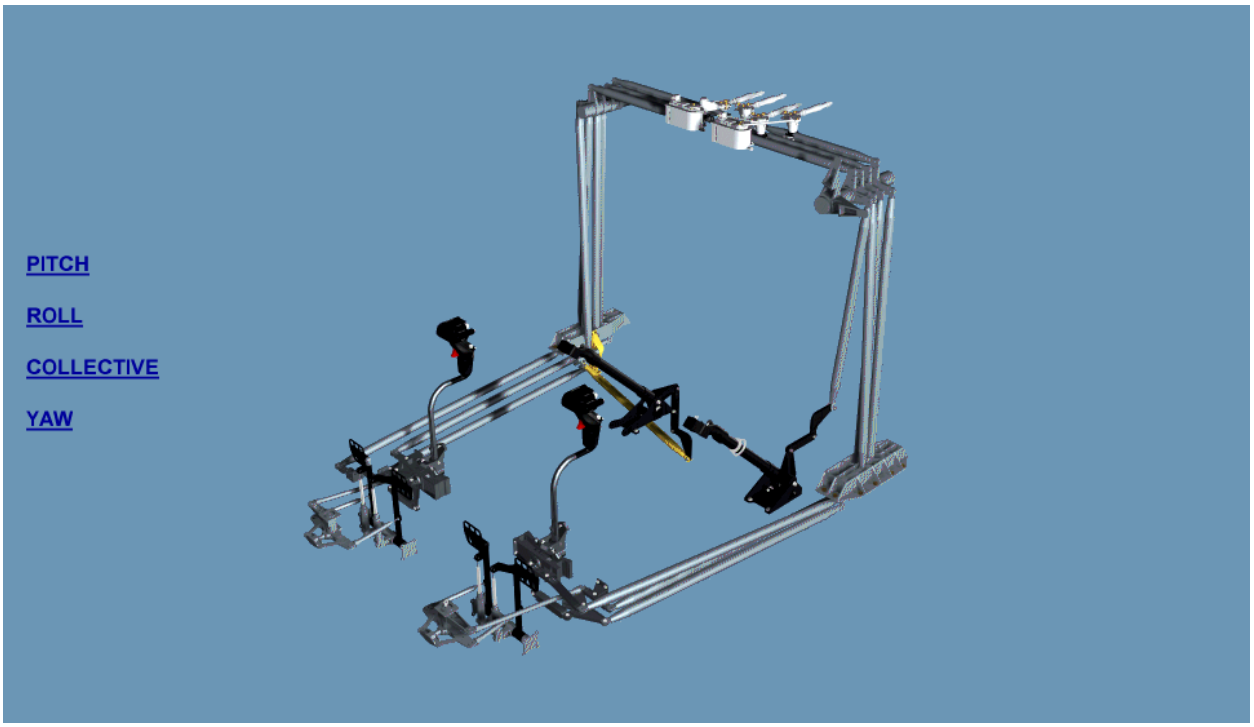
(u) Throughout these rigging procedures, you will be asked to make adjustments to rod ends.

(v) Once an adjustment has been made to any of the rod ends, check to make sure that 0.020-inch lock wire will not pass through inspection hole in rod end.

(w) This same inspection criteria will apply in each case.

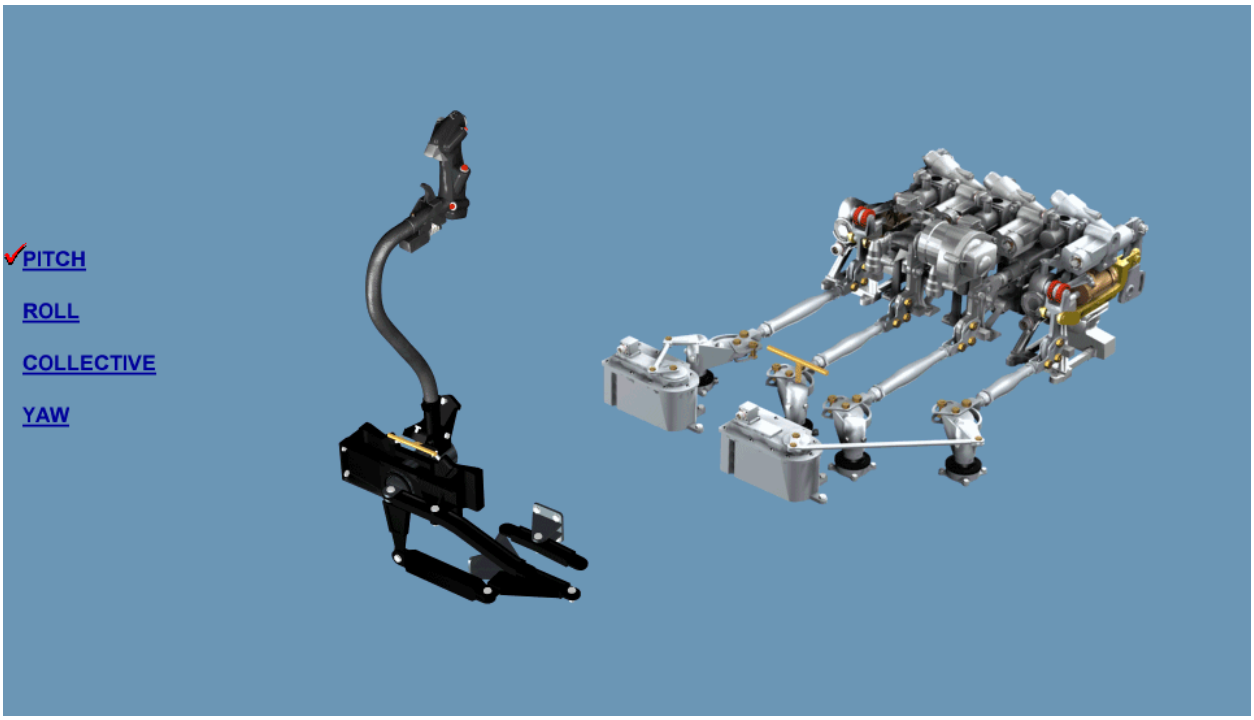
(x) If the 0.020-inch lock wire passes through the inspection hole, readjust control rods until all control rods are within limits.

Frame # 0555 (Main Rotor System Complete Rig)



(y) Install rigging pins from kit, 70700-20389-042, for the following axis: Pitch, Roll, Collective, and Yaw.

Frame # 0555 (Main Rotor System Complete Rig)



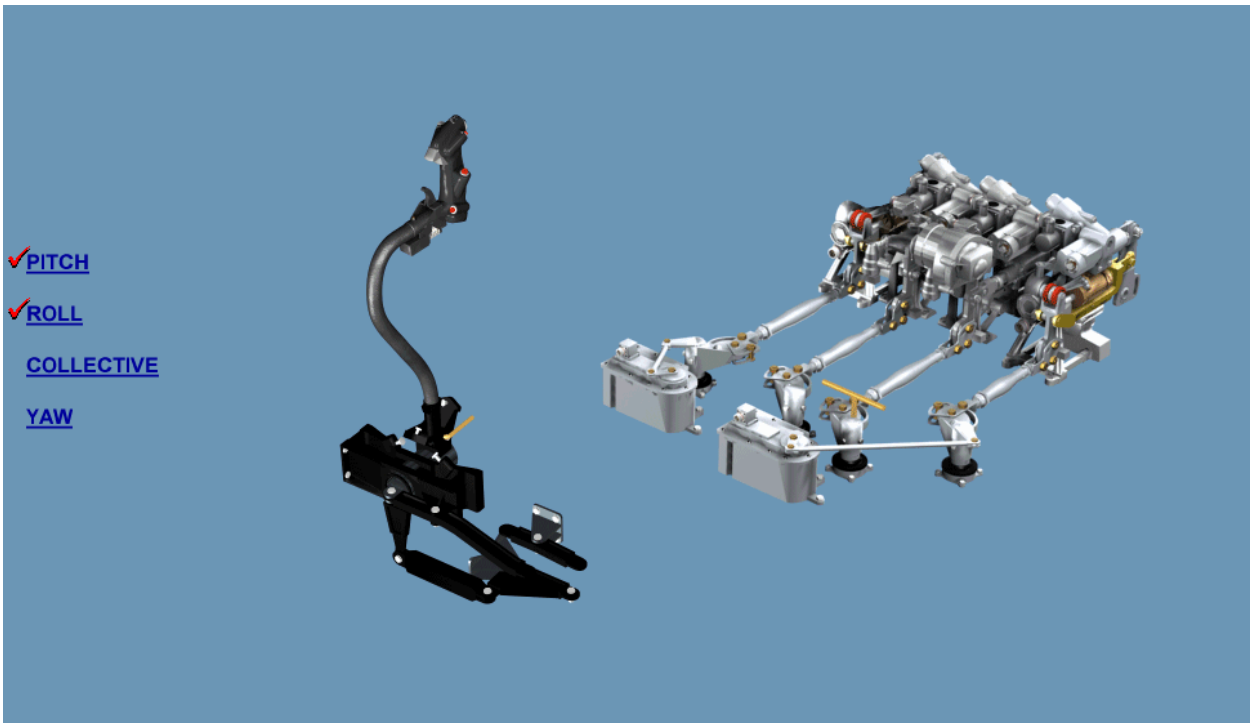
(z) For the Longitudinal (Pitch) System, install the following:

1) Pilot's cyclic, 70700-20380-065.

2) Copilot's cyclic, 70700-20380-065.

3) Torque shaft at top of cabin, 70700-20380-043.

Frame # 0555 (Main Rotor System Complete Rig)



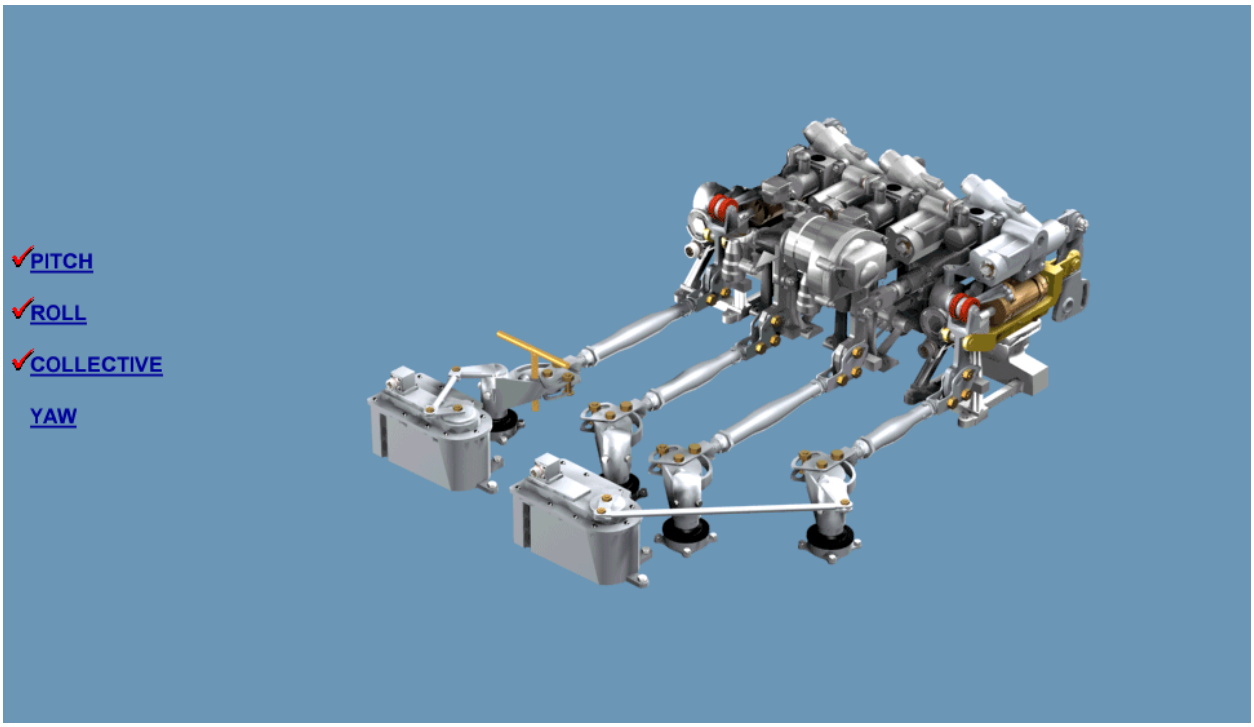
(aa) For the Lateral (Roll) System, install the following:

1) Pilot's cyclic, 70700-20380-066.

2) Copilot's cyclic, 70700-20380-066.

3) Torque shaft at top of cabin, 70700-20380-043.

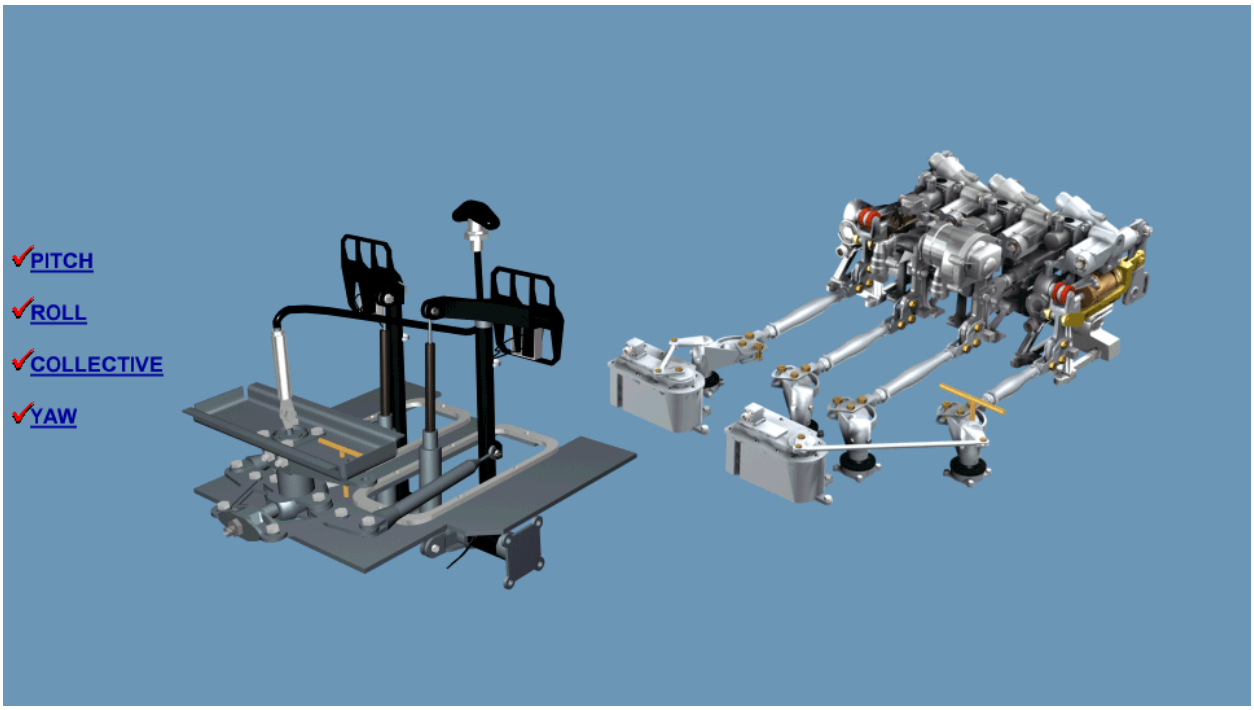
Frame # 0555 (Main Rotor System Complete Rig)



(bb) For the Collective System, install the following:

1) torque shaft at top of cabin, 70700-20380-043 (if not already installed).

Frame # 0555 (Main Rotor System Complete Rig)



(cc) For the Directional (Yaw) System, install the following:

1) Arm between pilot's pedals, 70700-20380-042.

2) Arm between copilot's pedals,70700-20380-042.

3) Torque shaft at top of cabin, 70700-20380-043.

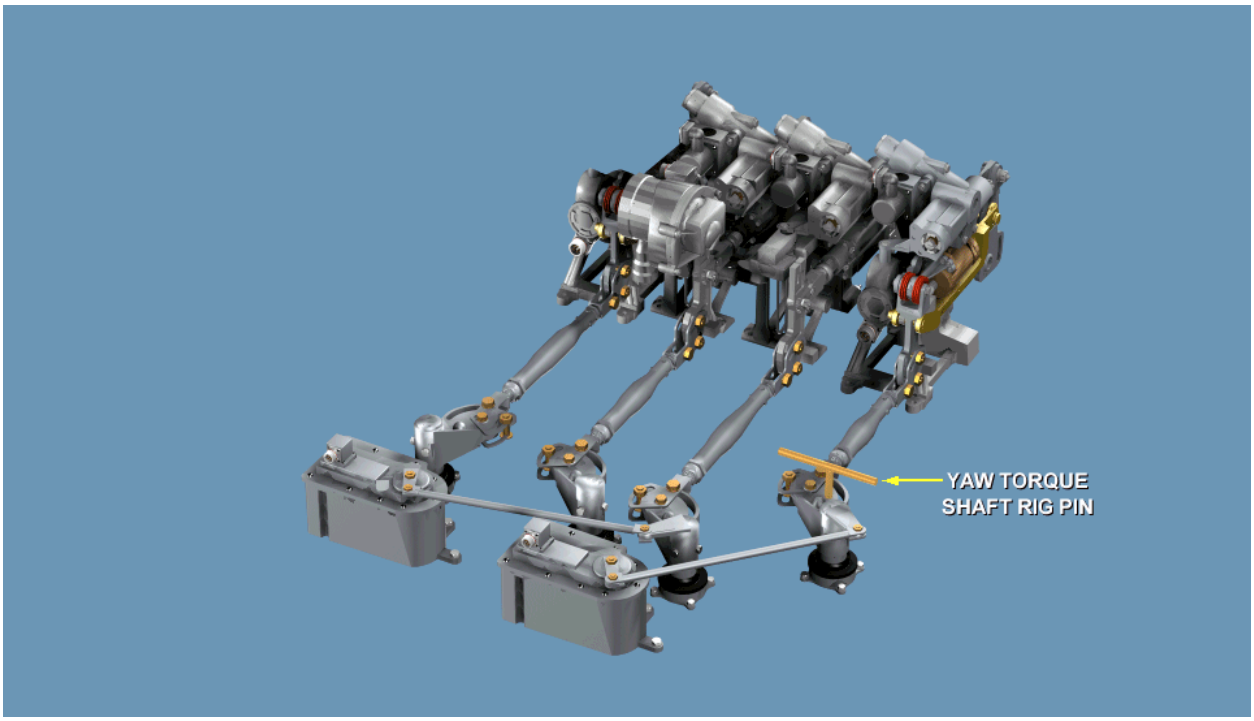
Frame # 0560 (Main Rotor System Complete Rig)

(dd) With pedal rigging pins installed in both pedal adjustors, adjust control rods, if necessary, for pedal alignment.

(ee) If adjustments are required, adjust the rod ends 1/2 turn in one control rod and 1/2 turn out in other.

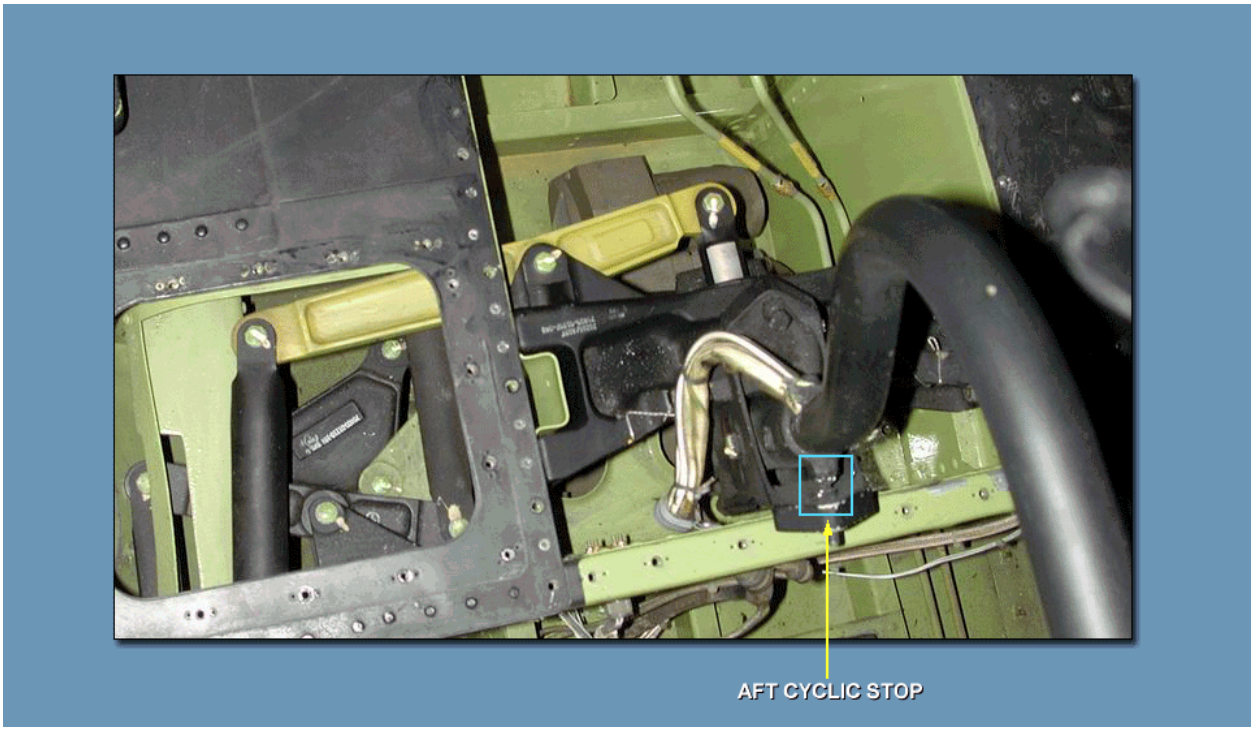
(ff) Check to make sure that 0.020-inch lock wire, will not pass through inspection hole in rod end.

Frame # 0563 (Main Rotor System Complete Rig)



(gg) If the yaw torque shaft rigging pin will not slide in and out easily, adjust collective, pitch, roll, or yaw channel overhead control rods as necessary.

Frame # 0565 (Main Rotor System Complete Rig)



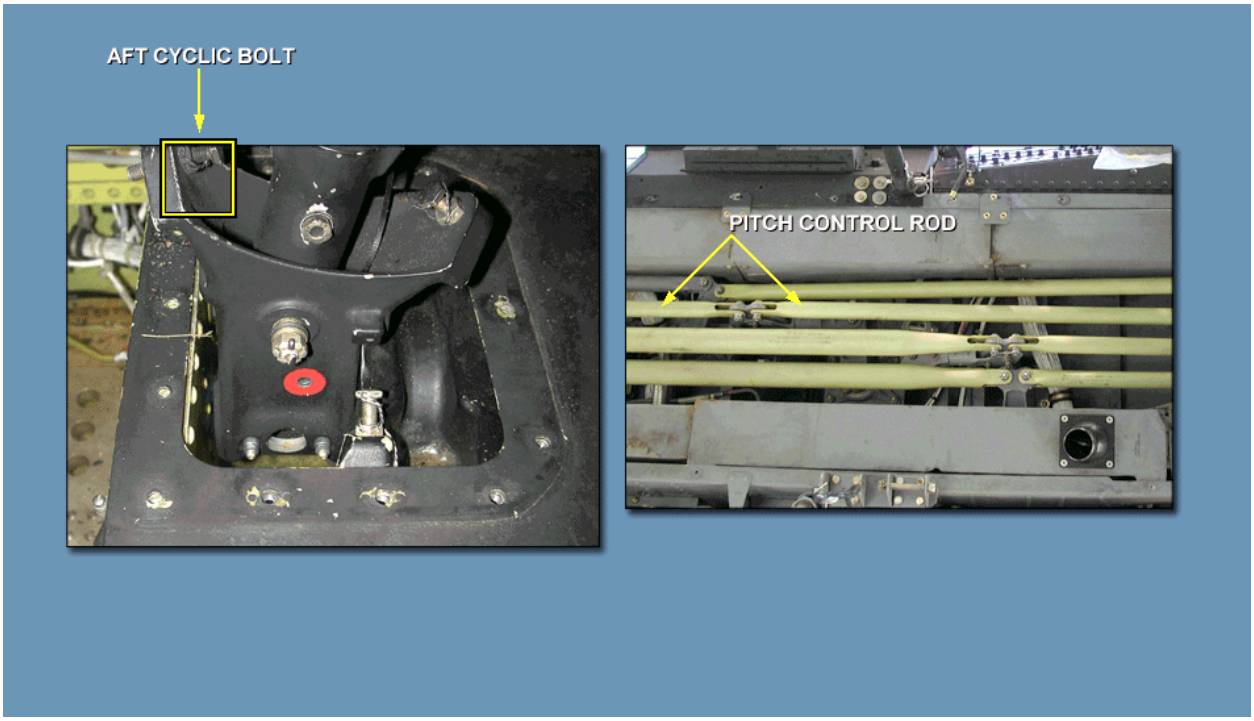
(hh) Set the cyclic stick for maximum aft longitudinal (pitch) range of travel.

(ii) Remove the pilot and copilot longitudinal (pitch) rigging pins from the cyclic sticks.

(jj) Remove the pitch torque shaft rigging pin.

(kk) Loosen the pilot and copilot aft cyclic stick stops and move the cyclic stick aft until binding is felt.

Frame # 0570 (Main Rotor System Complete Rig)

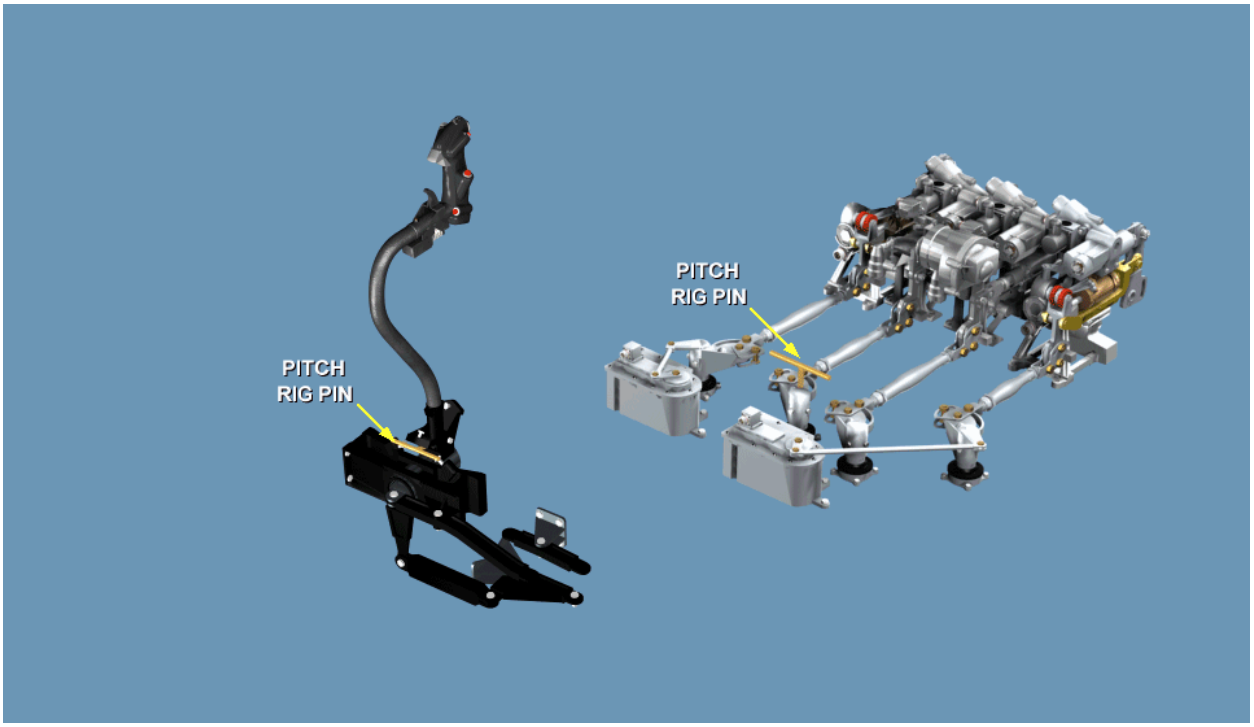


(ll) Adjust longitudinal (pitch) control rods between pitch torque shaft and cyclic stick until binding occurs at pitch link/pitch control lever connection.

(mm) While holding aft cyclic, adjust pilot cyclic rear stop bolt until it touches the stick; then turn out approximately 1/2-turn more until binding is removed.

(nn) Adjust the copilot's aft stop bolt until it touches as the same time as the pilot's.

Frame # 0570 (Main Rotor System Complete Rig)

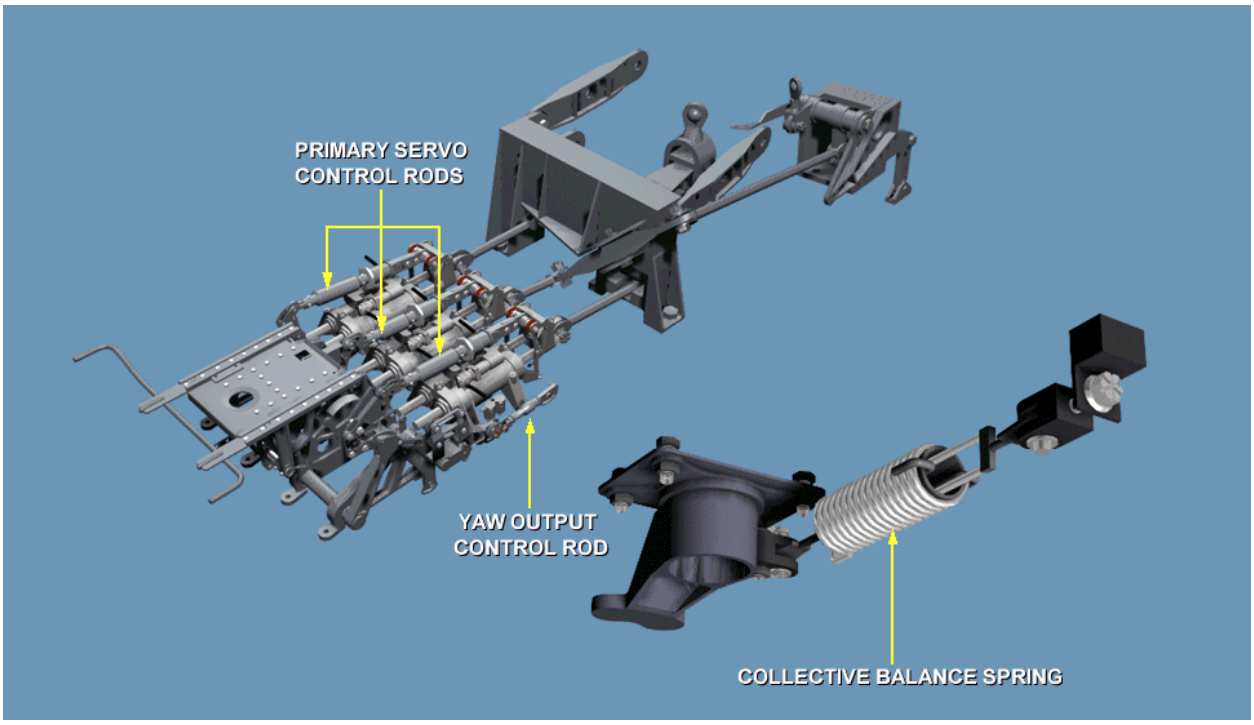


(oo) Reinstall the pilot and copilot longitudinal (pitch) rigging pins in the cyclic sticks.

(pp) Install the pitch torque shaft rigging pin in the pitch torque shaft.

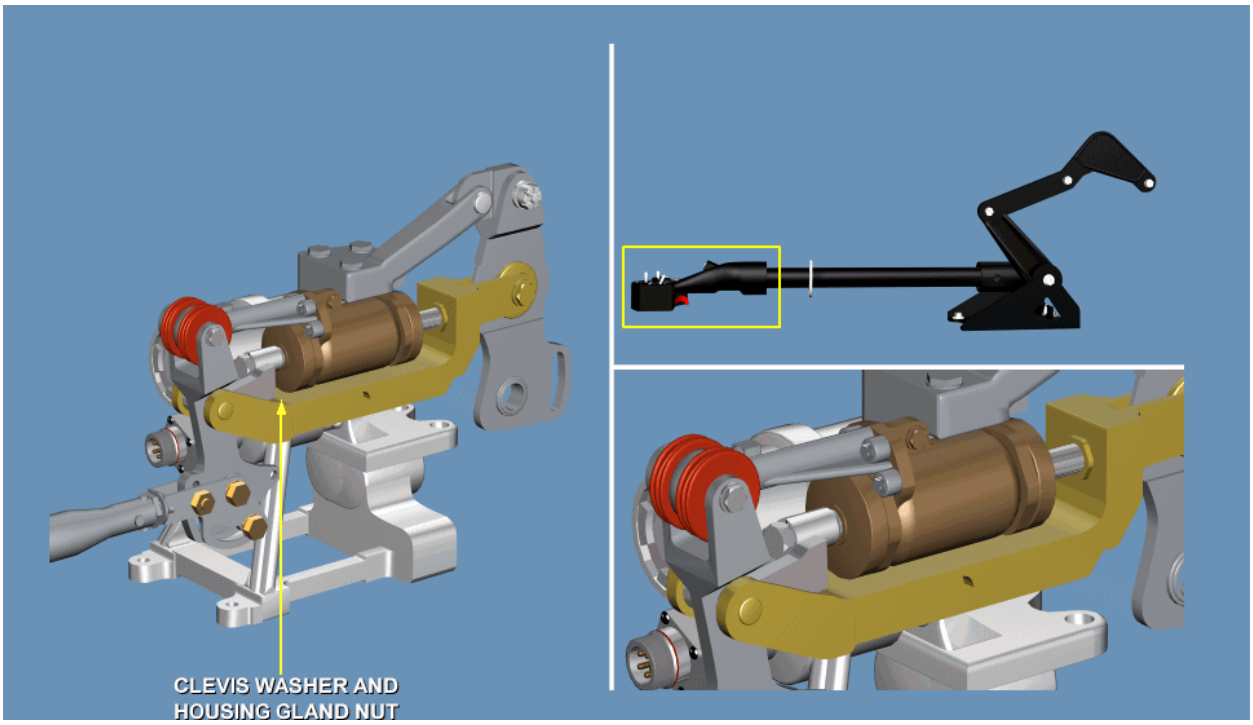
(qq) If the rigging pin will not go into the torque shaft, repeat as required for the pitch channel.

Frame # 0572 (Main Rotor System Complete Rig)



(rr) Disconnect the mixer to primary servo control rods at primary servos, the vertical yaw output control rod at output side of mixer, and connect the collective balance spring to collective torque shaft.

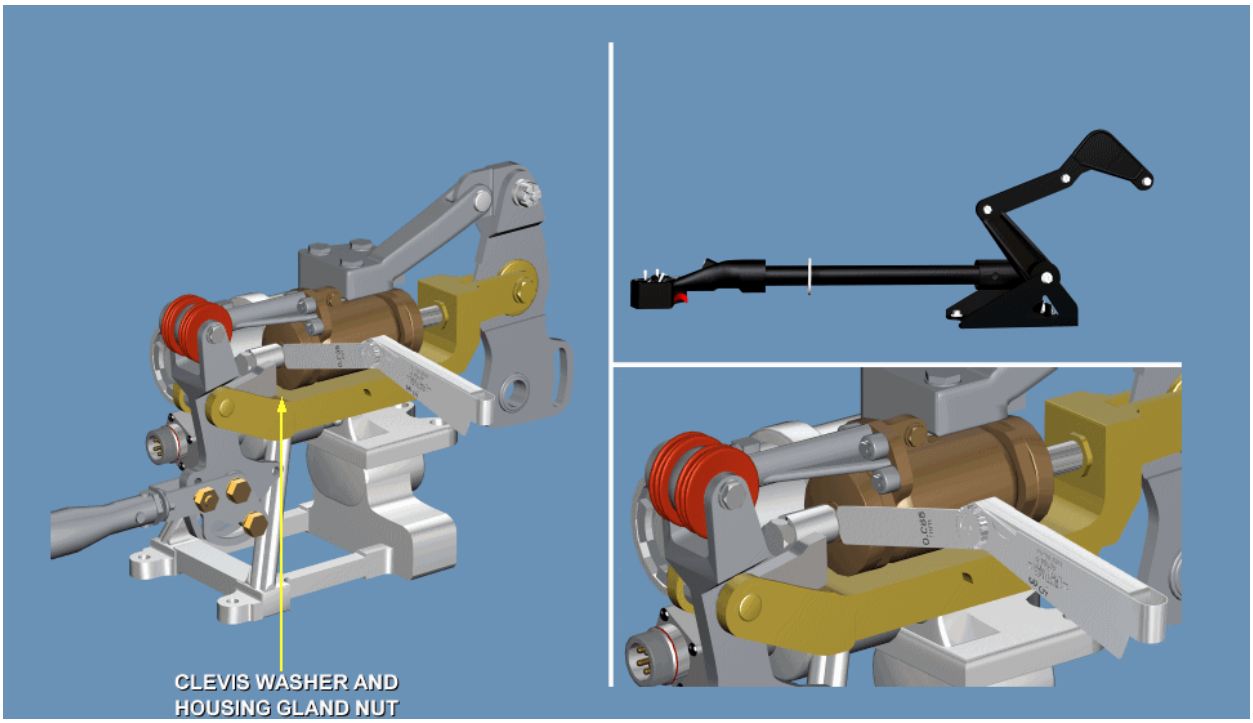
Frame # 0575 (Main Rotor System Complete Rig)



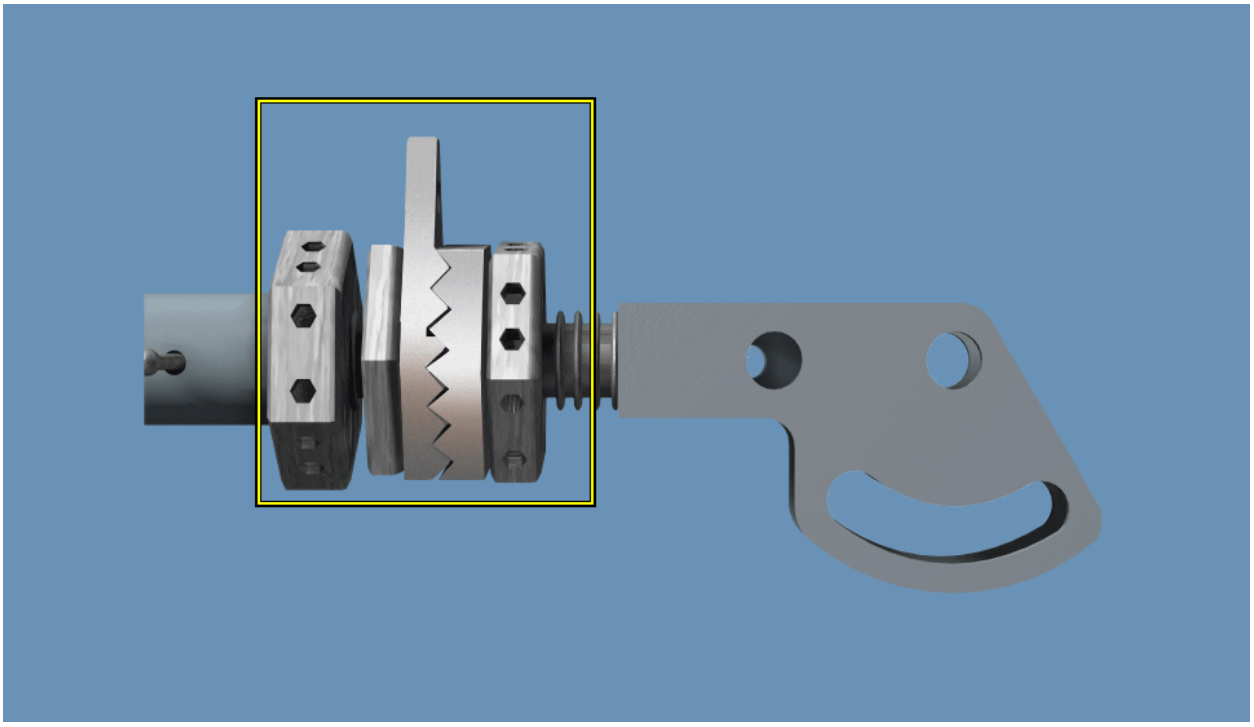
(ss) Bottom collective boost servo in full low collective position (push control rod to rear until piston bottoms internally in the servo housing).

(tt) The internal gap between the input clevis washer and housing gland nut should be 0.035 ± 0.013-inch.

Frame # 0575 (Main Rotor System Complete Rig)



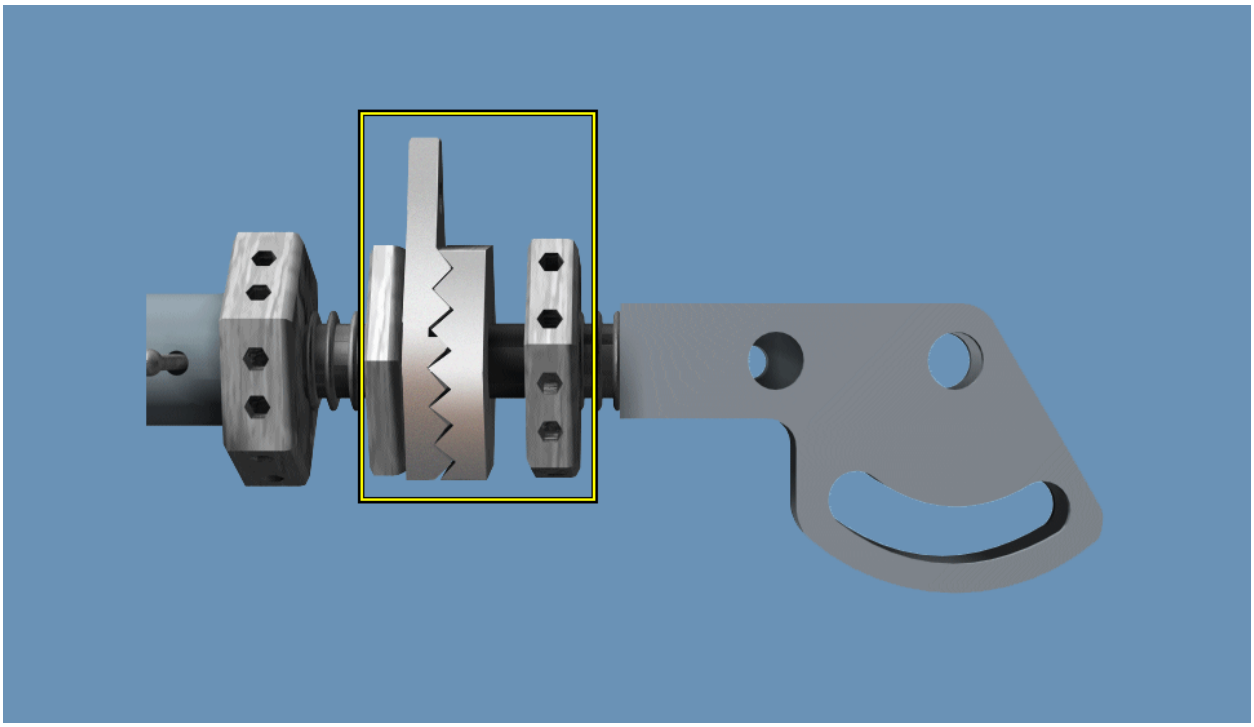
Frame # 0580 (Main Rotor System Complete Rig)



(uu) The following adjustment procedures are made throughout the rigging procedure.

(vv) Use these steps to adjust any of the control rod ends.

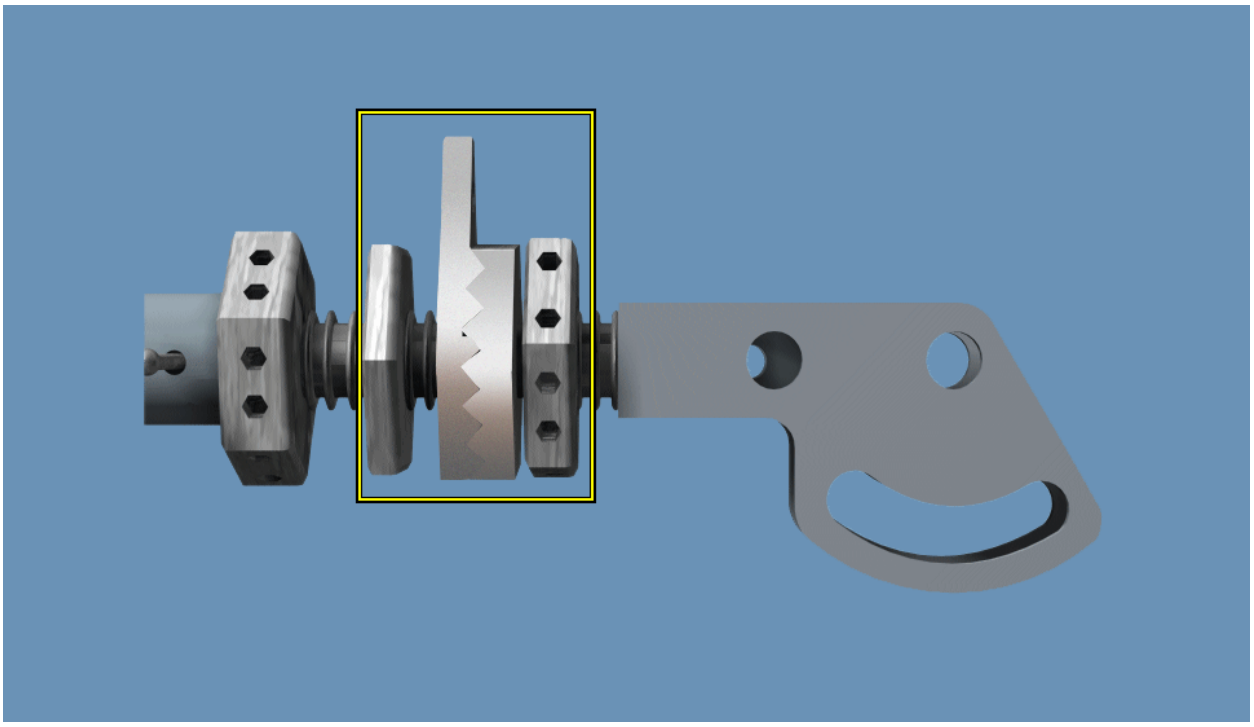
Frame # 0580 (Main Rotor System Complete Rig)



(ww) Loosen the jam nut and sleeve jam nut, slide locking device away from sleeve.

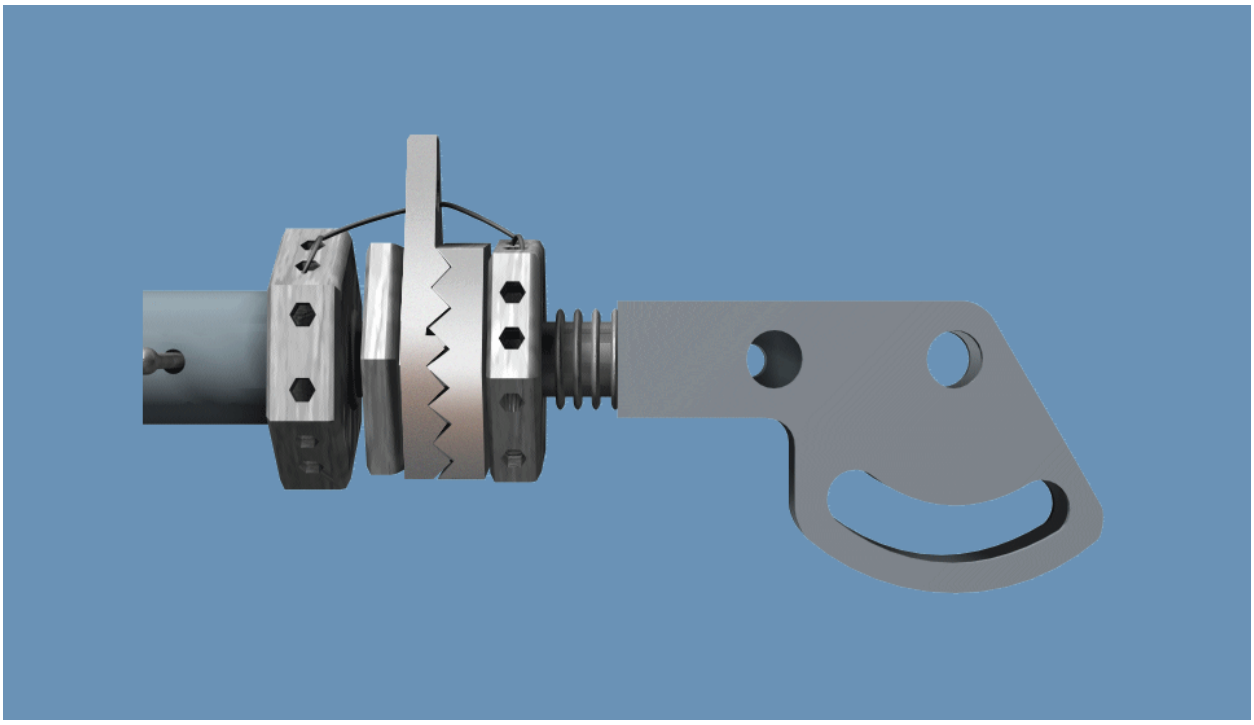
(xx) Thread sleeve into the tube assembly to make the control rod shorter or out to make the rod longer.

Frame # 0580 (Main Rotor System Complete Rig)



(yy) Tighten the sleeve jam nut until a sharp rise is felt, then tighten 1/3 to 1/6 more.

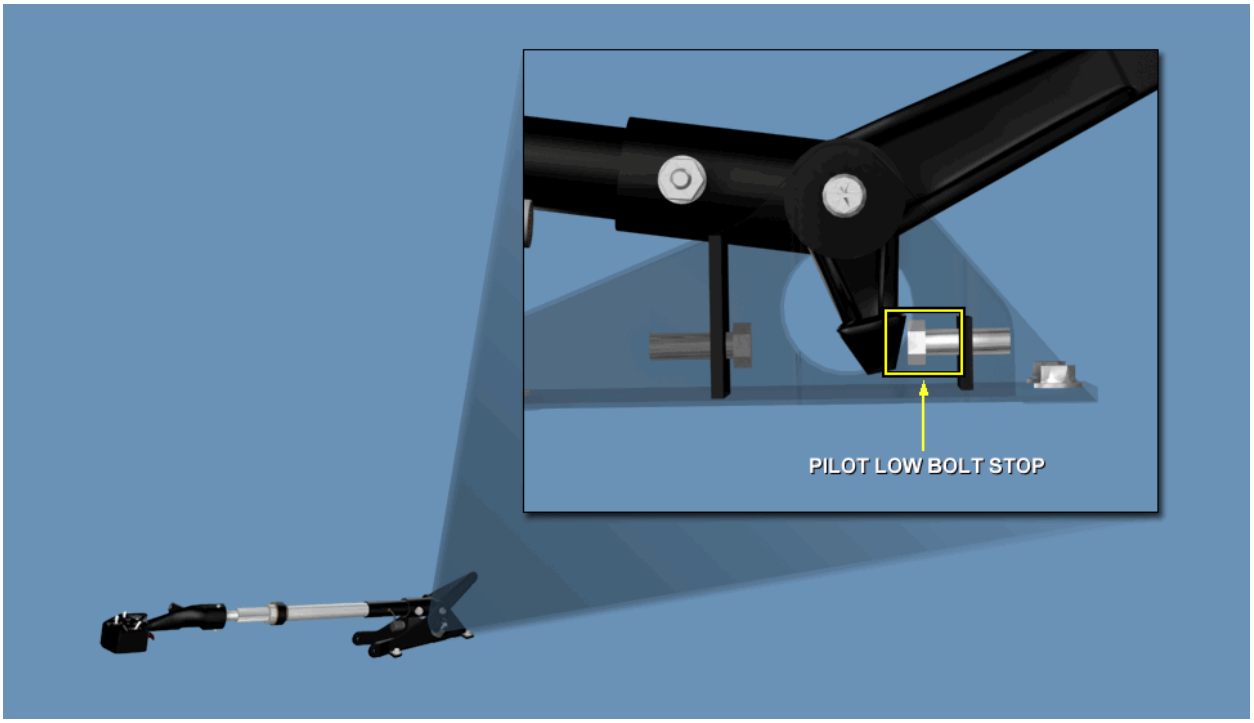
Frame # 0580 (Main Rotor System Complete Rig)



(zz) Line up the key of locking device on the sleeve side of the control rod with keyway in sleeve.

(aaa) Line up the mesh end side of the locking device with the sleeve side of the locking device, and tighten the jam nut, torque rod end jam nut IAW TM and lock wire.

Frame # 0585 (Main Rotor System Complete Rig)



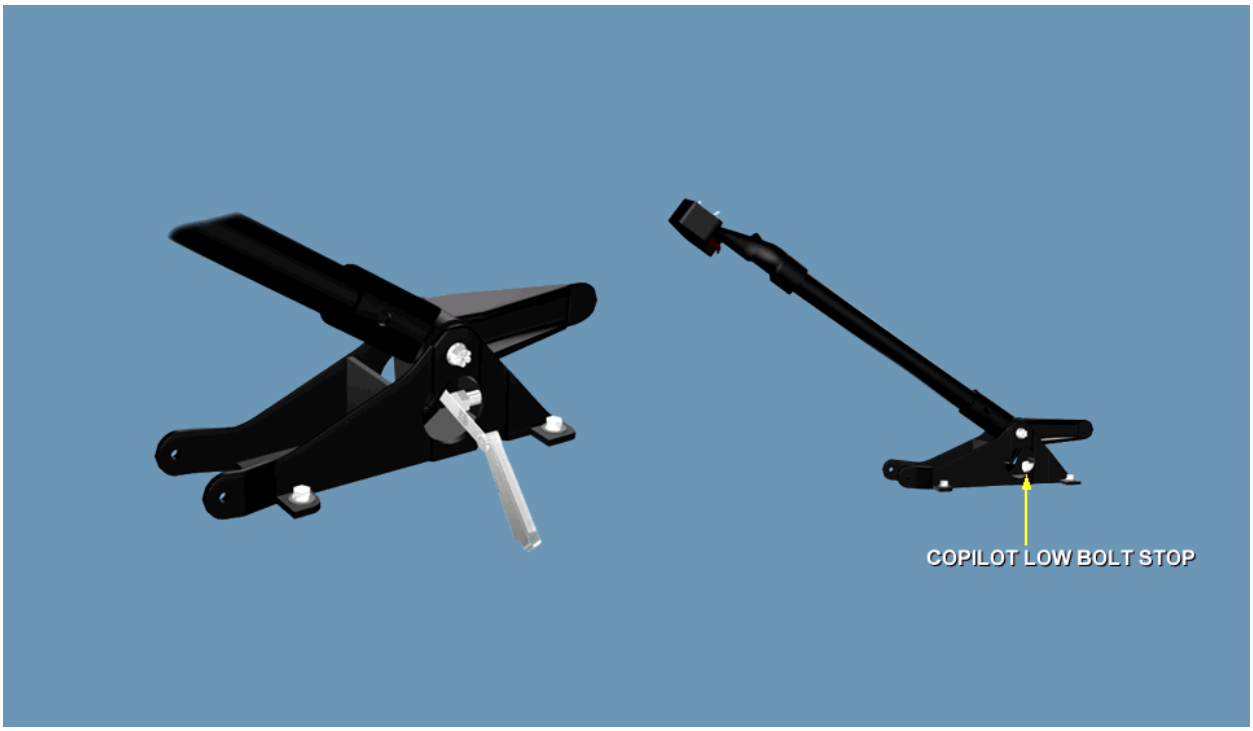
(bbb) The following adjustment is required to ensure the collective control bottoms out on the collective stick bolt stop and not at the collective boost servo.

(ccc) Ensure the pilot collective stick is resting on the low collective bolt stop.

(ddd) If the pilot collective stick is touching the low collective bolt stop, no adjustment is required.

(eee) If the pilot collective stick is not touching the low collective bolt stop, adjust the bolt stop until the stick touches, then lengthen 1/4 turn more.

Frame # 0585 (Main Rotor System Complete Rig)



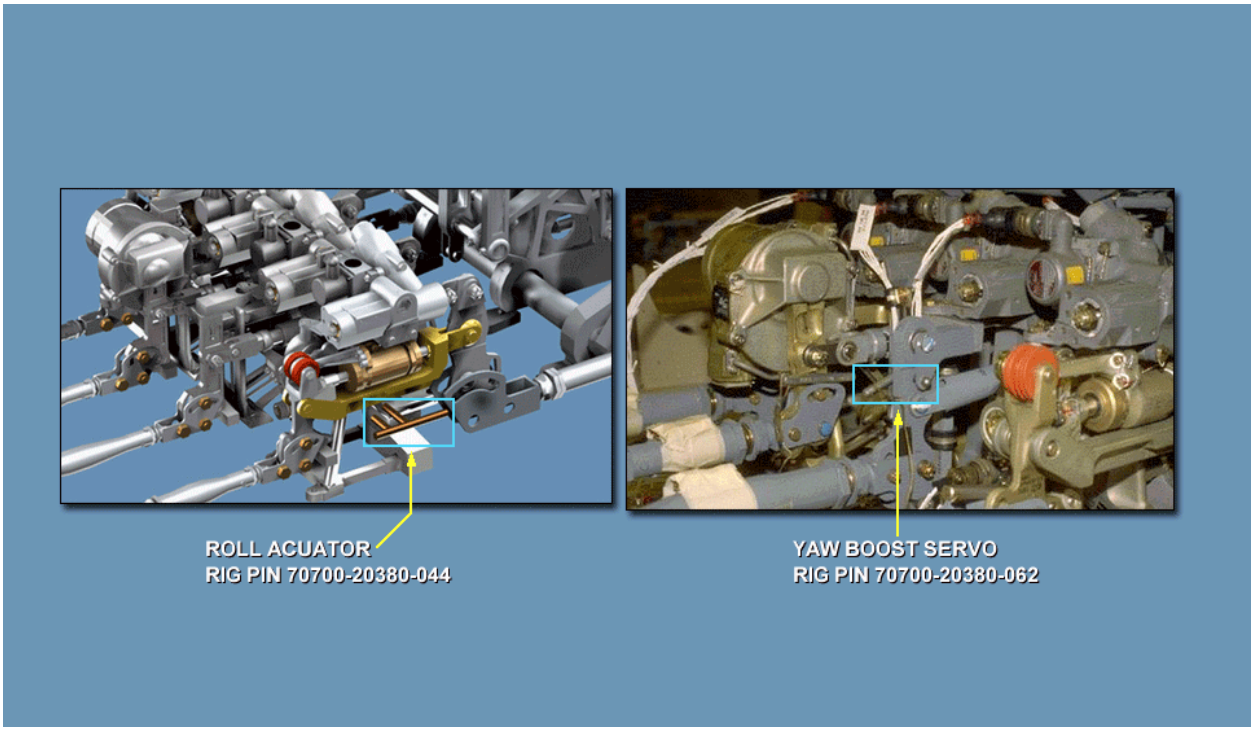
(fff) Check for 0.010 to 0.030-inch gap between the copilot collective stick and the low collective bolt stop.

(ggg) If the gap is beyond limits, adjustment as required.

1) Insert a 0.030-inch feeler gauge between the copilot collective stick and the low collective bolt stop.

2) Adjust the copilot low collective bolt stop to obtain 0.030-inch gap between the copilot collective stick and the low bolt stop.

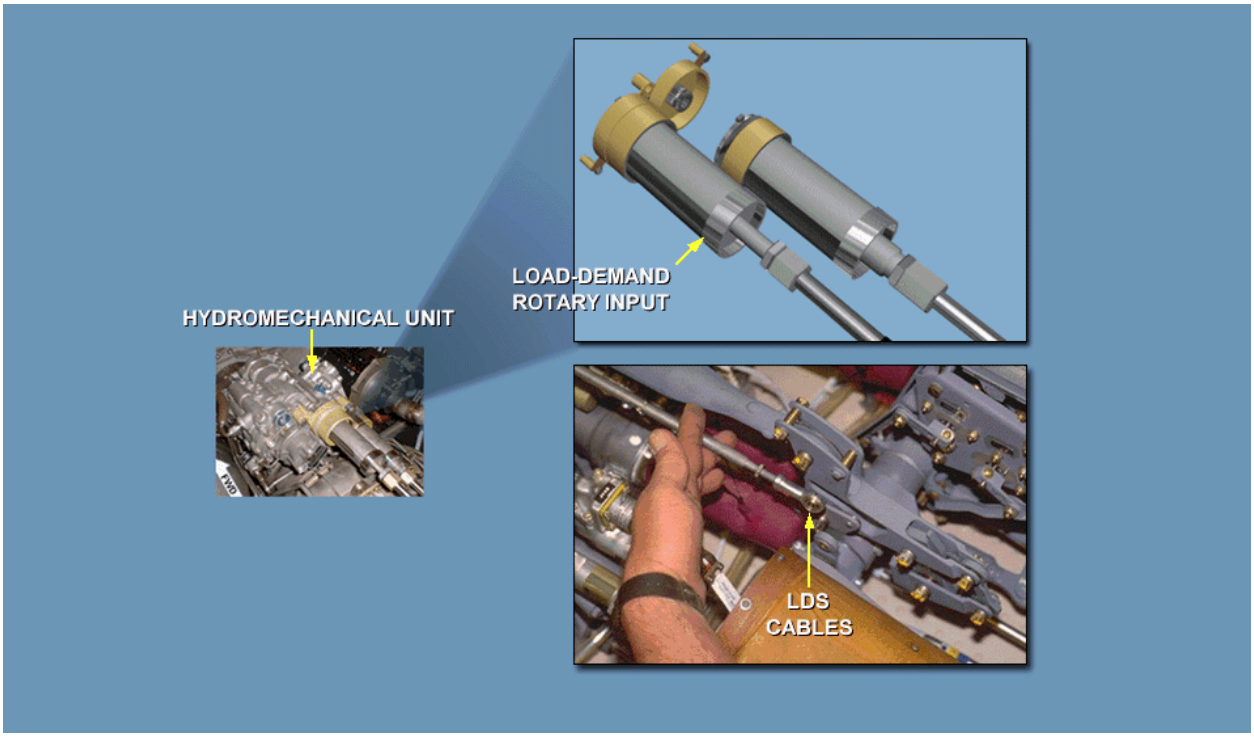
Frame # 0590 (Main Rotor System Complete Rig)



(hhh) Install the following rigging pins, Roll actuator, 70700-20380-044, and Yaw boost servo, 70700-20380-062.

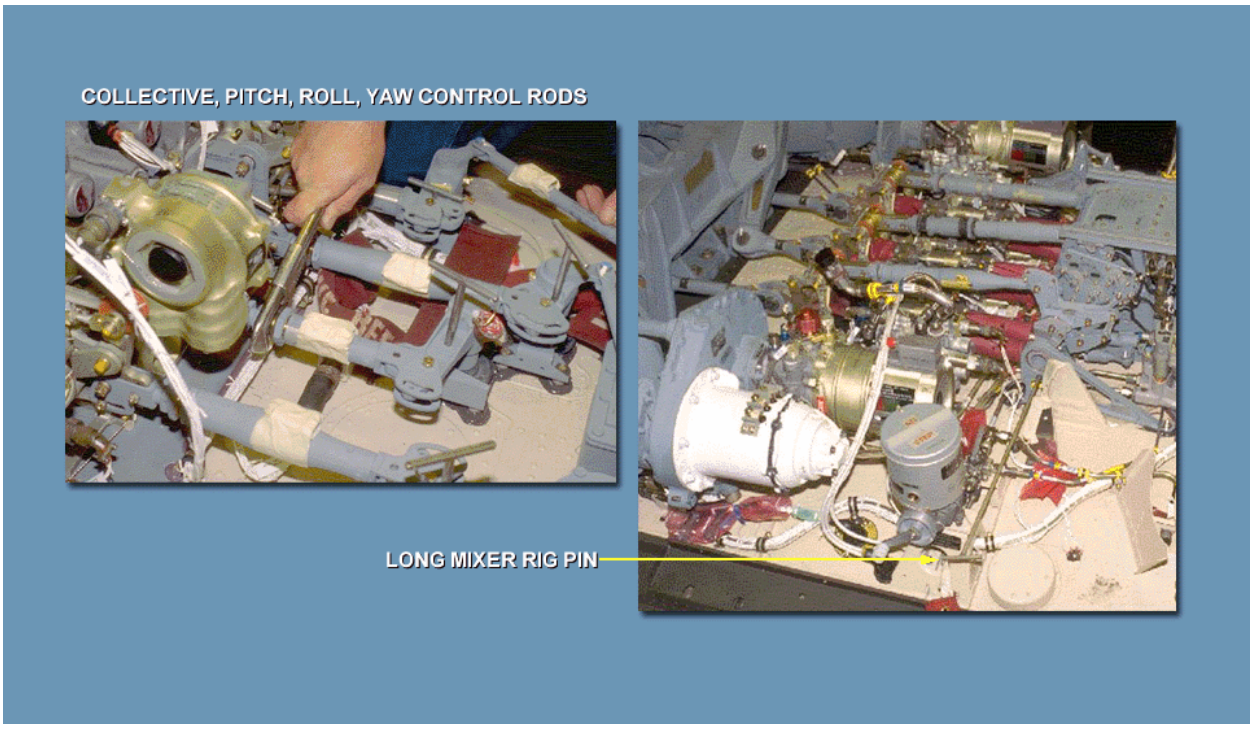
(iii) If necessary, adjust pitch, roll, and yaw input control rods as required.

Frame # 0595 (Main Rotor System Complete Rig)



(jjj) Connect load-demand rotary inputs to the engine hydro mechanical unit and the engine LDS cables to the mixer levers.

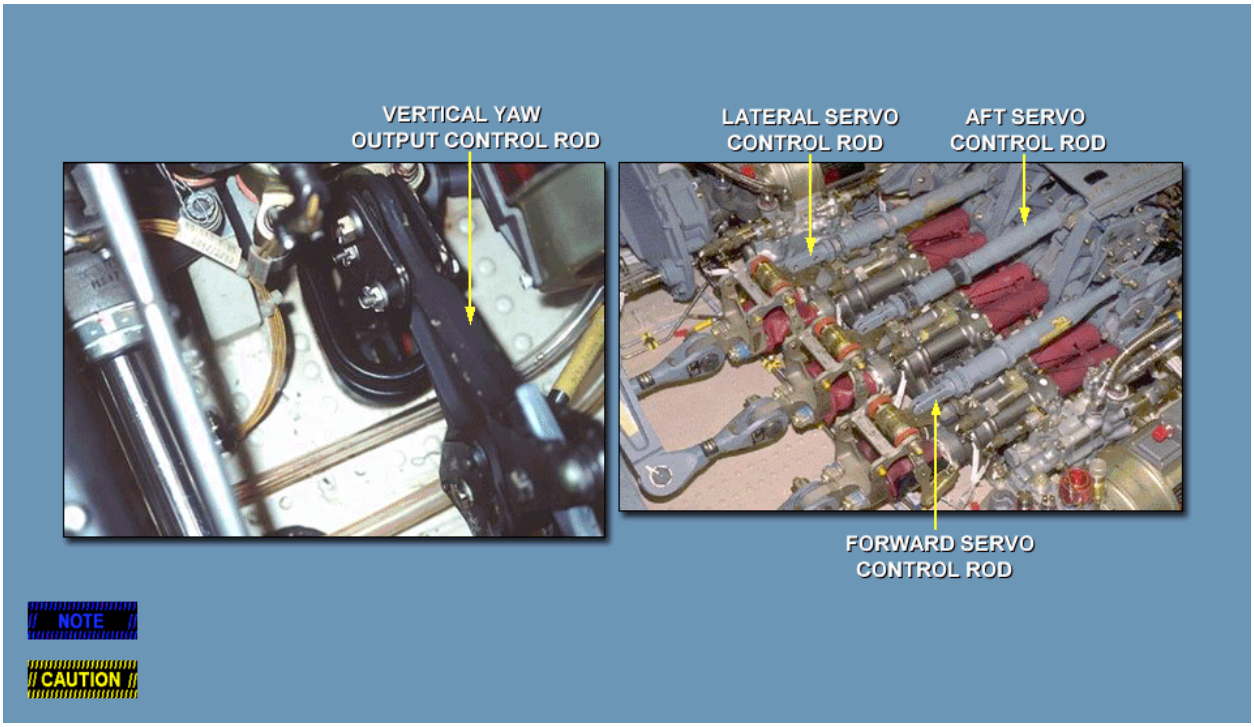
Frame # 0600 (Main Rotor System Complete Rig)



(kkk) Install long mixer rigging pin, 70700-20380-046, in the right side of the mixer.

(lll) If long mixer rigging pin cannot be installed, adjust collective, roll, and yaw boost servo to mixer control rods and pitch input control rods until long mixer rigging pin can be installed.

Frame # 0605 (Main Rotor System Complete Rig)



CAUTION: Damage to flight control components will result if normal cockpit control forces are applied against a pin point aft of boost servos when not restrained by an intermediate pin point. Make sure all rigging pin requirements are carefully followed when hydraulic pressure is applied to helicopter.

Damage to flight control components will result if hydraulic power is shut down during rigging with rigging pins still installed. Make sure all rigging pins are removed before shutting down hydraulic power.

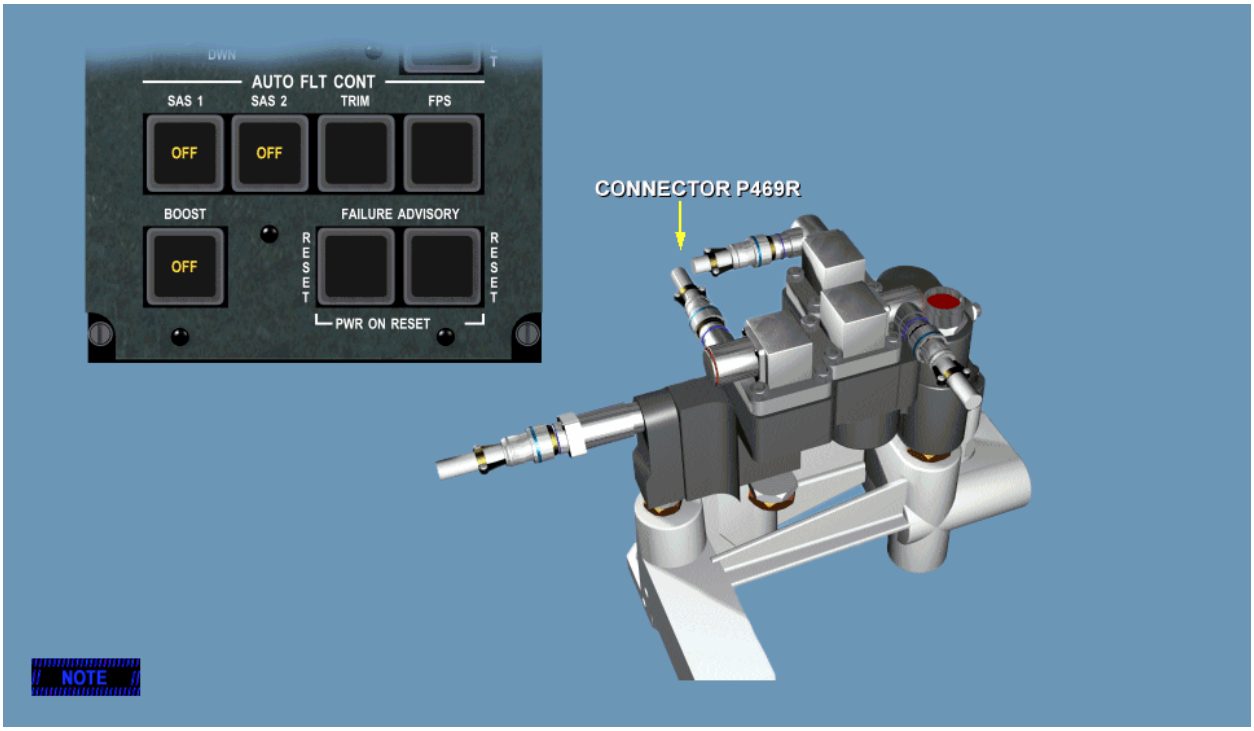
NOTE: Do not adjust primary servo input control rods when connecting them to servos. Move controls as required to align control rod to servo mounting holes.

Backup pump should be used only as an alternate source to power hydraulic systems. External hydraulic power should be applied whenever available.

(mmm) Remove all rigging pins and connect the forward, aft, and lateral main rotor primary servo input control rods to the servos.

(nnn) Connect the vertical yaw output control rod to the mixer.

Frame # 0610 (Main Rotor System Complete Rig)



NOTE: When connector, P469R, is disconnected, AUTO FLT CONT panel BOOST ON light does not illuminate when boost is on. Connector, P469R, is disconnected to prevent inadvertent boost disengagement during rig. If BOOST SERVO OFF capsule is on, no hydraulic boost servo pressure exists.

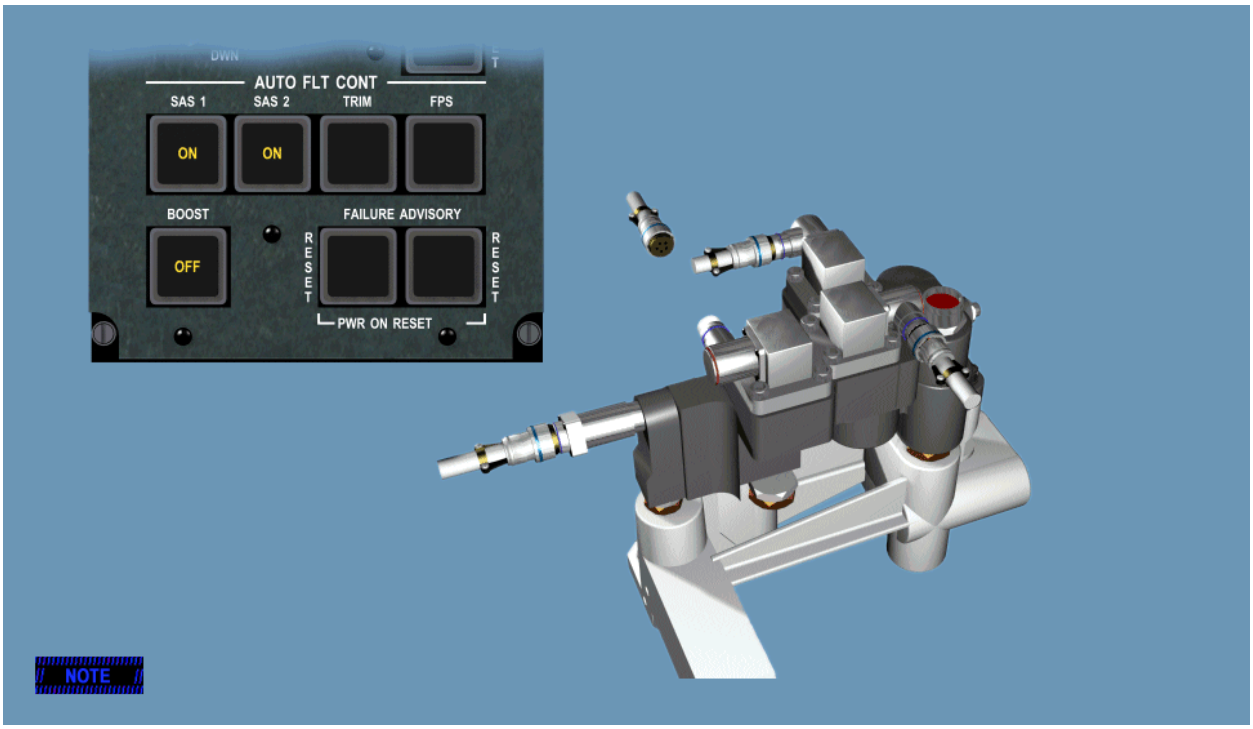
(ooo) Turn on all hydraulic and electrical power.

(ppp) To perform the BOOST ON, SAS OFF procedure, locate and identify the AUTO FLT CONTROL panel, and disengage the BOOST, SAS 1, and SAS 2 switches.

(qqq) Verify that BOOST SERVO OFF and SAS OFF capsules are illuminated.

(rrr) Turn off all electrical power.

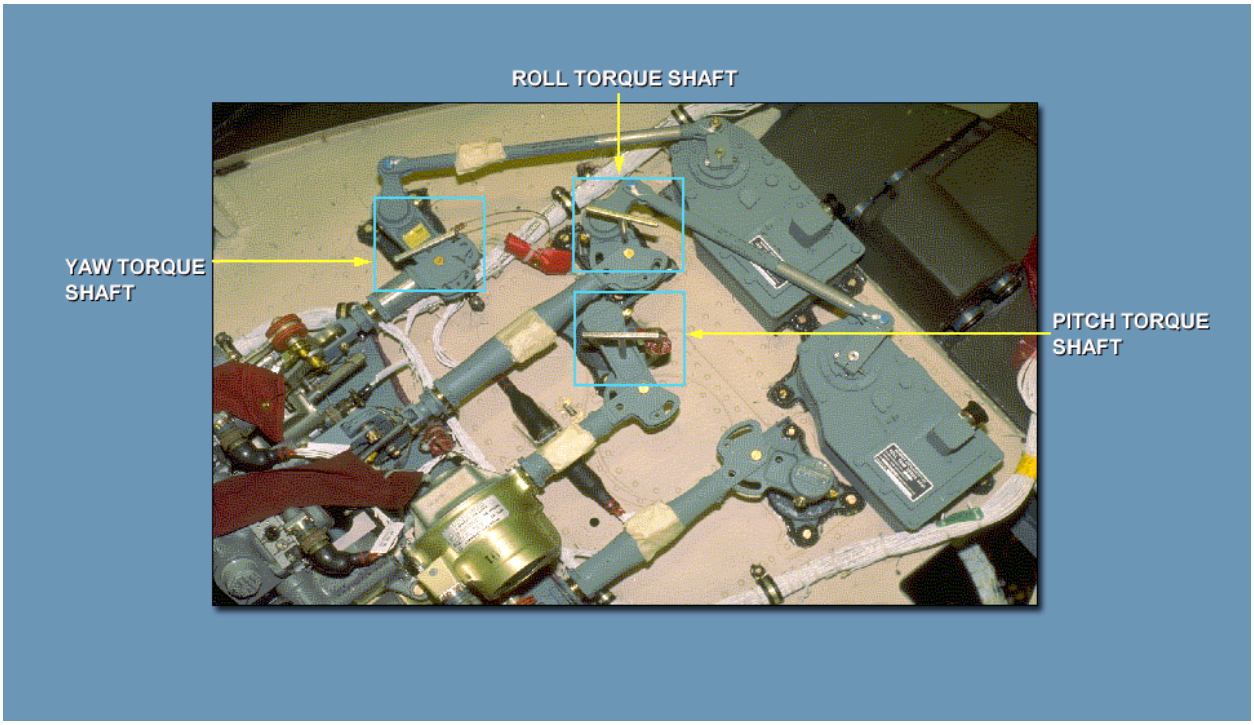
Frame # 0610 (Main Rotor System Complete Rig)



(sss) Disconnect BOOST SHUTOFF valve electrical connector, P469R, on top of pilot-assist module.

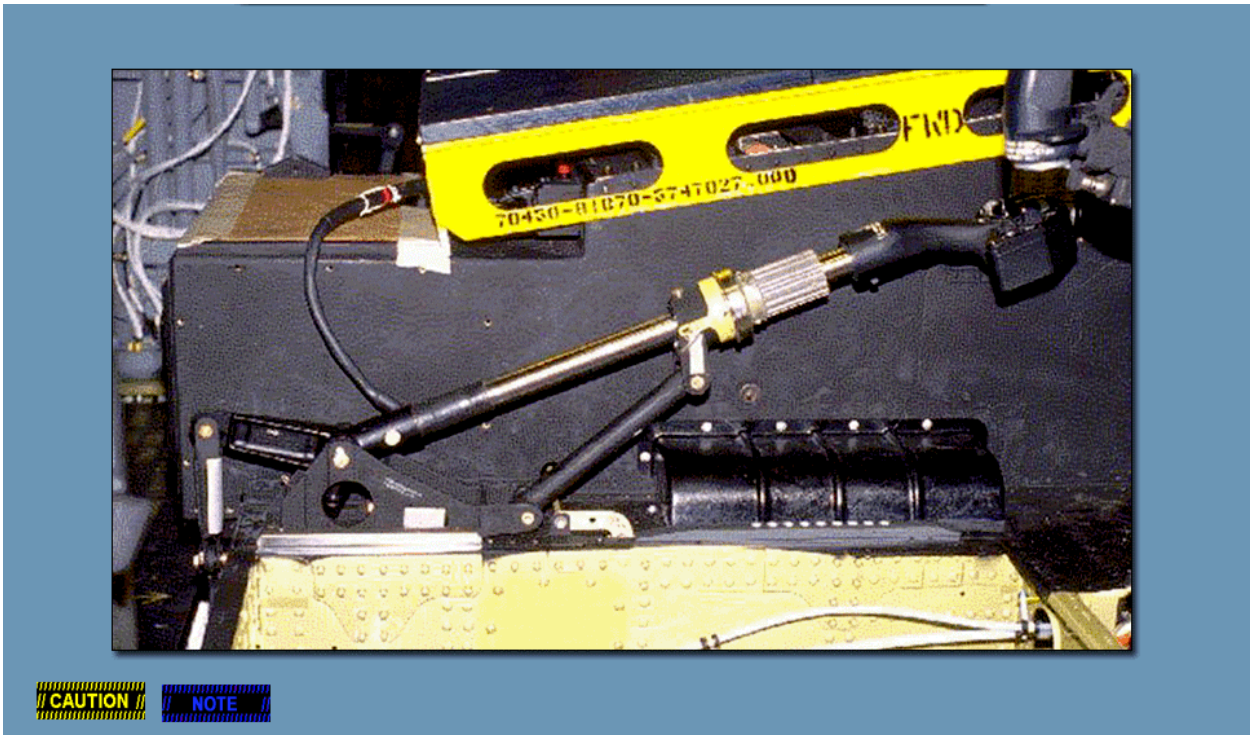
(ttt) Apply electrical power and verify that SAS OFF capsule is on and BOOST SERVO OFF capsule is off.

Frame # 0615 (Main Rotor System Complete Rig)



(uuu) Install the following rigging pins, Pitch torque shaft, 70700-20380-043, Roll torque shaft, 70700-20380-043, Yaw torque shaft, 70700-20380-043, and Yaw boost servo, 70700-20380-062.

Frame # 0620 (Main Rotor System Complete Rig)

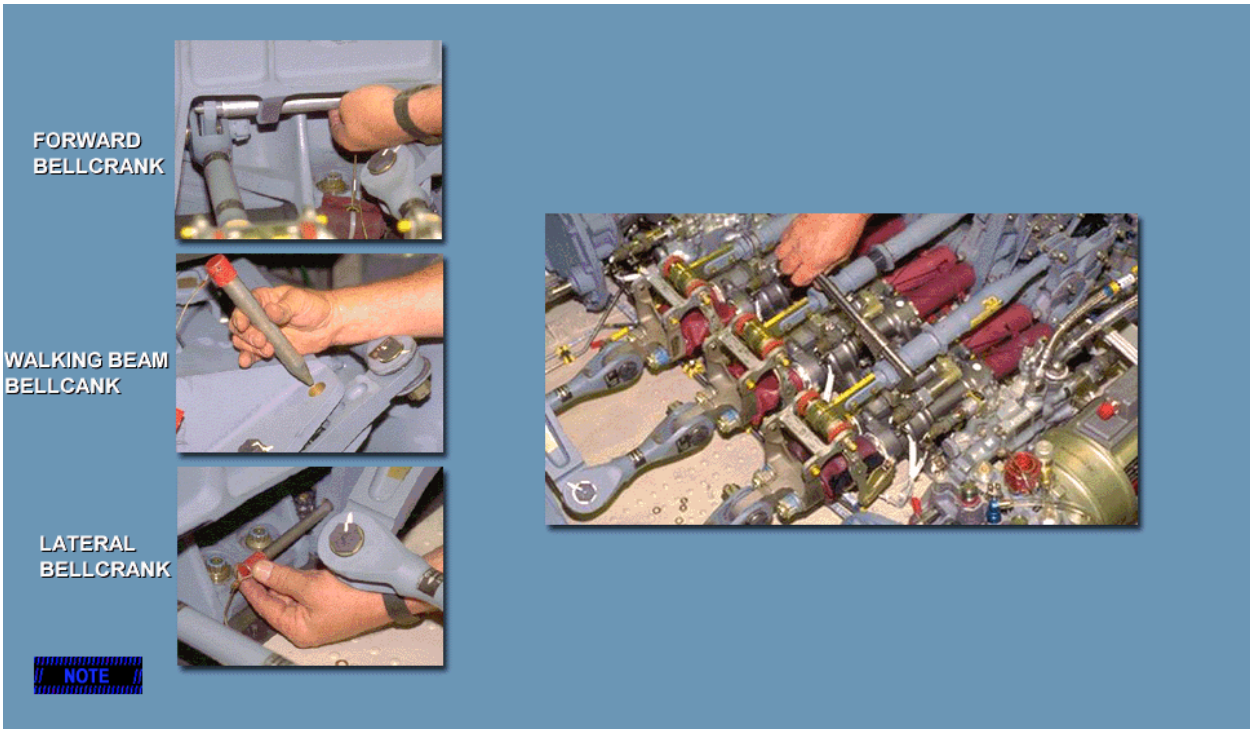


CAUTION: Damage to flight controls will result if controls in cockpit are moved while attempting to install three large rigging pins. Make sure all personnel are out of cockpit before attempting to install any of the three large rigging pins.

NOTE: Correct alignment of rigging pin holes in forward bellcrank support with holes in forward bellcrank, lateral bellcrank, and walking beam is required to properly set initial position of swashplate relative to cockpit controls. This is only a preliminary adjustment and any future changes in length to primary servo input control rods will result in the inability to install one or more of the three large rigging pins.

(vvv) Position the collective stick full down and lock in place.

Frame # 0625 (Main Rotor System Complete Rig)

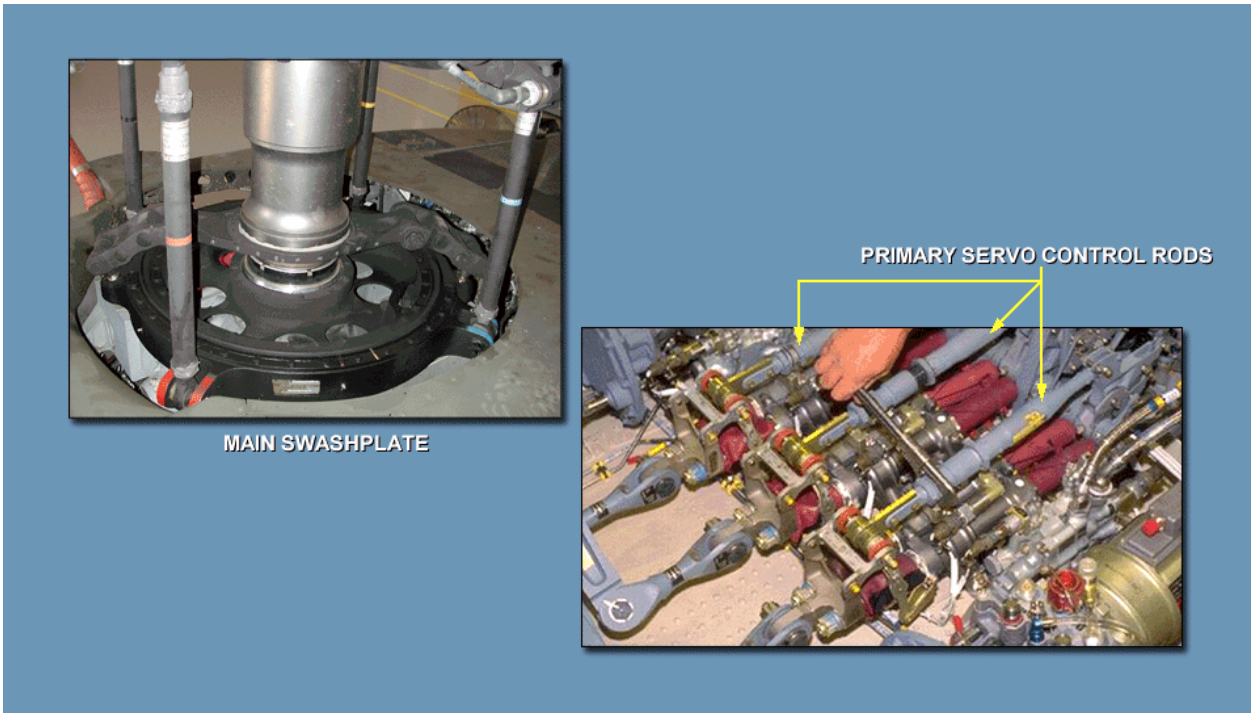


NOTE: Do not leave any of the three large rigging pins installed in forward bellcrank support. The following checks are for slip-fit only and pin should be removed after attempting to install it.

(www) To set the swashplate to its initial position, adjust primary servo input control rods so that rigging pin holes in forward bellcrank support can be visually seen to line up with rigging pin holes in forward bellcrank, lateral bellcrank, and walking beam.

(xxx) Attempt to install the following rig pins; Forward bellcrank support to forward bellcrank rigging pin, 70700-20342-041, Forward bellcrank support to walking beam rigging pin, 70700-20342-041, Forward bellcrank support to lateral bellcrank rigging pin, 70700-20342-042.

Frame # 0630 (Main Rotor System Complete Rig)

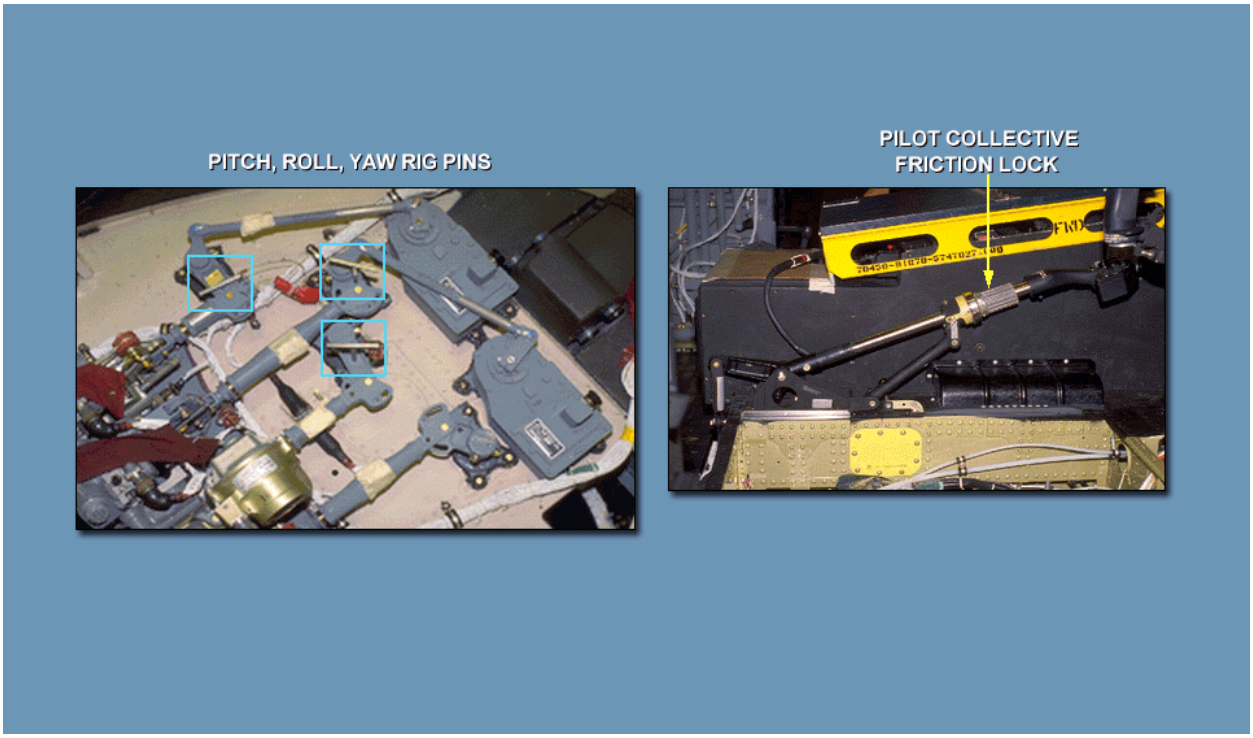


(yyy) If the rig pins will not slide in easily, adjust primary servo input control rod(s) until all three large rigging pins will slide easily into rigging pin hole.

(zzz) Once all three large rigging pins will slide easily into rigging pin holes, setting of swashplate initial position is complete.

(aaaa) Initially bias is set and the forward and aft primary servo input control rods are adjusted as follows: adjust the forward primary servo input control rod 1/2-turn in, and then adjust the aft primary servo input control rod 1/2-turn out.

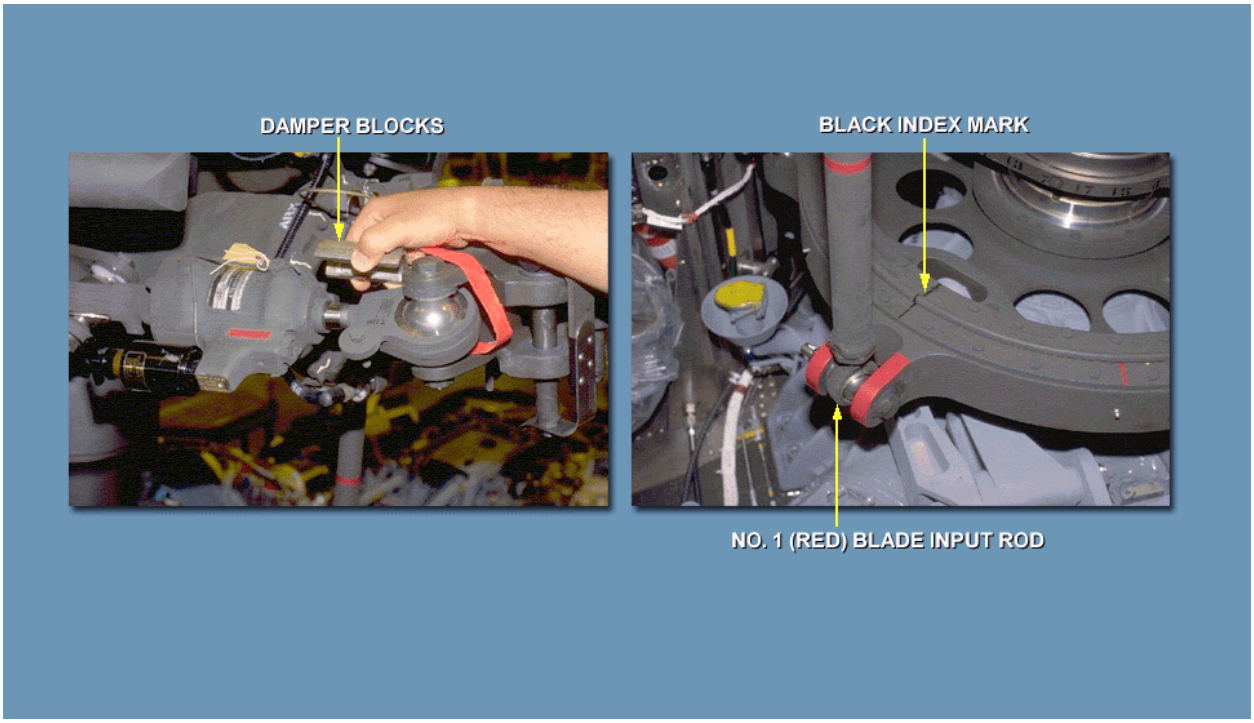
Frame # 0635 (Main Rotor System Complete Rig)



(bbbb) Remove rigging pins from the pitch torque shaft, roll torque shaft, and yaw torque shaft.

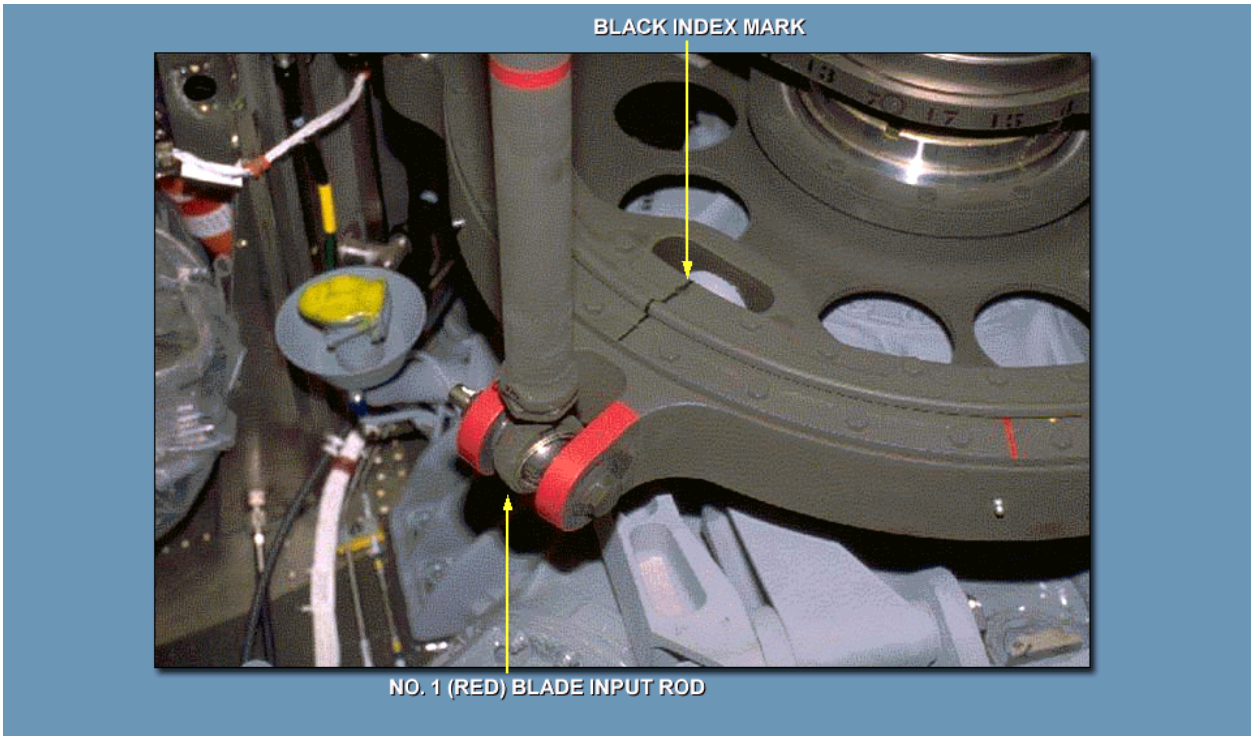
(cccc) Release the friction lock on the pilot collective stick.

Frame # 0637 (Main Rotor System Complete Rig)



(dddd) Install damper blocks and turn main rotor head until the black index marks on the swashplate line up and No. 1 (red) blade, (master blade) in the 90° position, with the pitch control rod over front longitudinal (pitch) input.

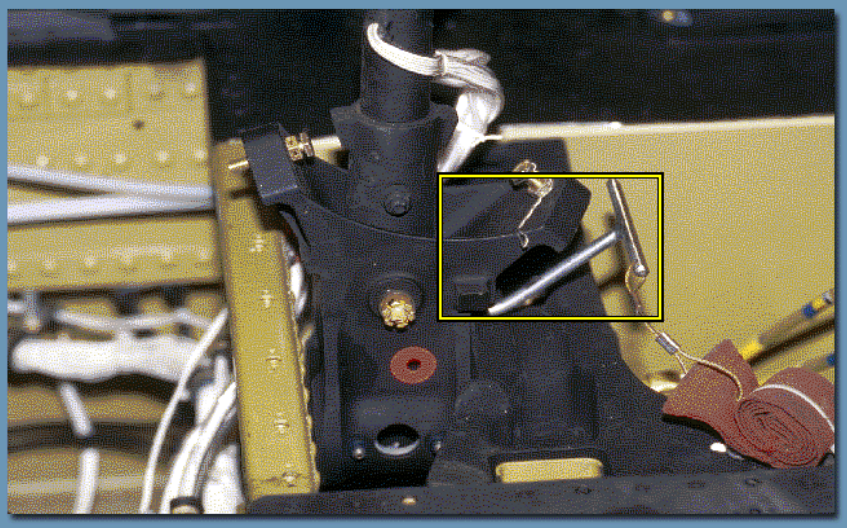
Frame # 0640 (Main Rotor System Complete Rig)



(eeee) It is essential to keep the helicopter perfectly still while zeroing and taking blade readings with protractor.

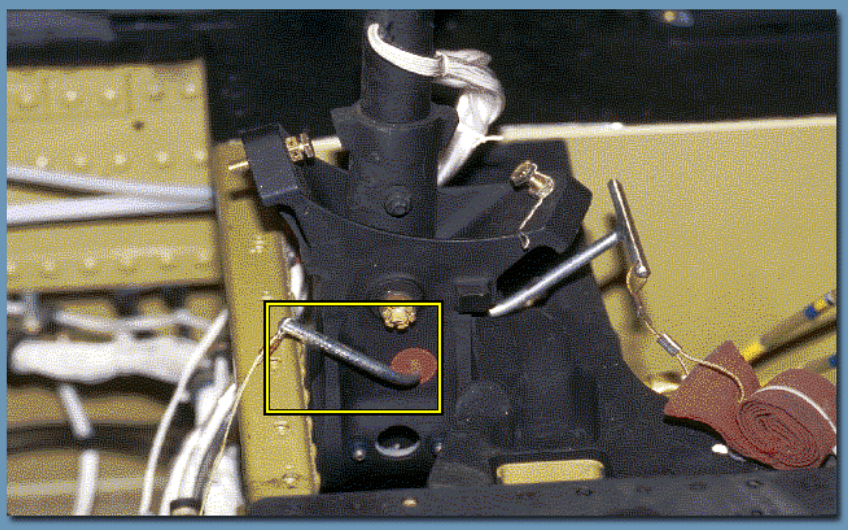
(ffff) A limit of three technicians are recommended on the helicopter, one to position controls in cockpit, one to take readings, and one to assist in rotating of the blades to the 90°, 180°, 270°, and 0° positions.

Frame # 0645 (Main Rotor System Complete Rig)



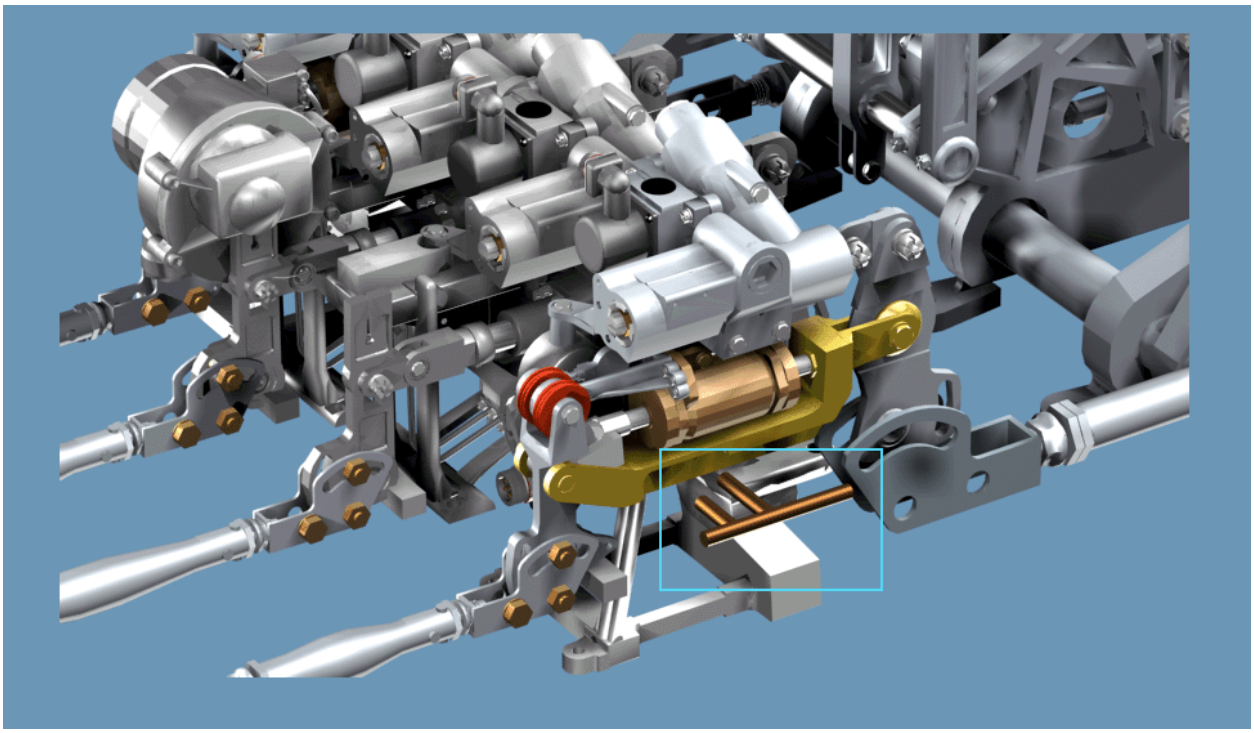
(gggg) Install a rig pin in the pilot cyclic control stick, in the fore-and-aft (pitch) direction rig pin position, 70700-20380-065.

Frame # 0645 (Main Rotor System Complete Rig)



(hhhh) Install a rig pin in the pilot cyclic stick lateral (roll) direction rig pin, 70700-20380-066.

Frame # 0645 (Main Rotor System Complete Rig)



(iiii) Install a rig pin in the yaw boost servo F-pin, rig pin, 70700-20380-062.

Frame # 0650 (Main Rotor System Complete Rig)

NOTE: If jacks are available, jack helicopter slightly (just enough to relieve load on landing gear struts) so that helicopter will not rock if personnel enter or exit helicopter while blade angle readings are being taken.

Use main rotor rigging worksheet to record readings. Refer to the general reading instructions for sample rigging worksheet with calculations.

Cycle collective at least three times before taking collective pitch readings. After cycling controls three times, do not recycle controls until all readings have been taken for a particular cyclic/collective control position.

(jjjj) Turn the main rotor until the stationary and rotating swashplate alignment marks line up at 90° position for No. 1 (red) blade.

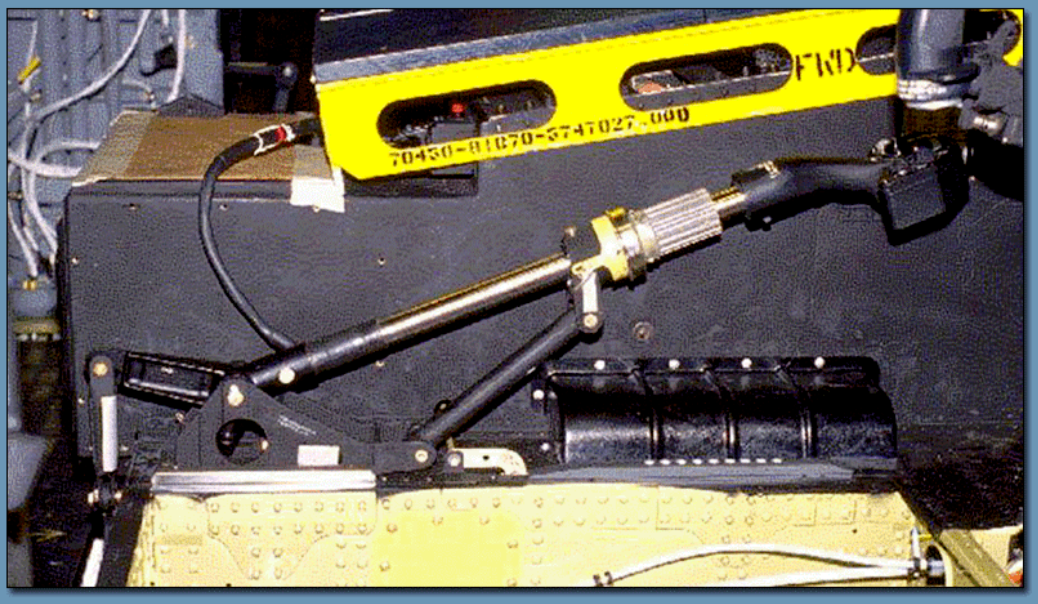
(kkkk) Unless otherwise instructed, apply 2 - 5 pounds hand/foot force, in following directions, while taking blade angle readings.

(llll) Pull and hold cyclic stick left and rear.

Frame # 0650 (Main Rotor System Complete Rig)

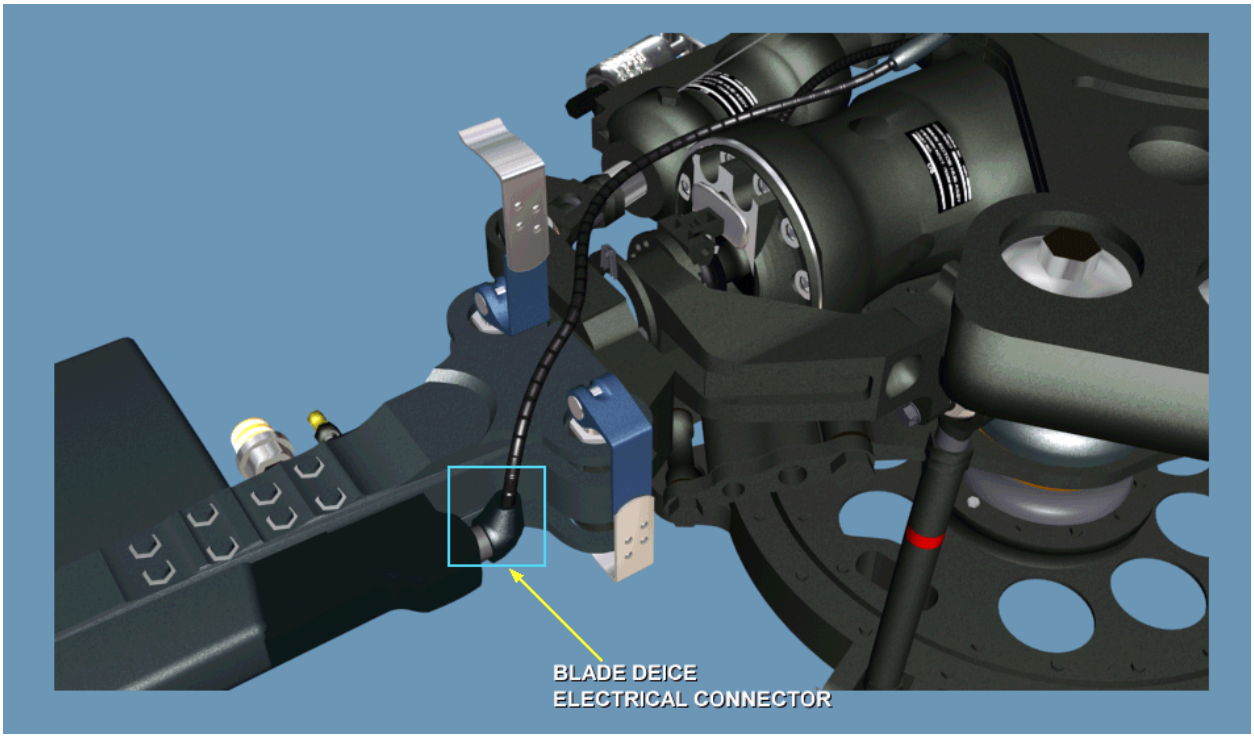
(mmmm) Push and hold the yaw pedals left.

Frame # 0650 (Main Rotor System Complete Rig)



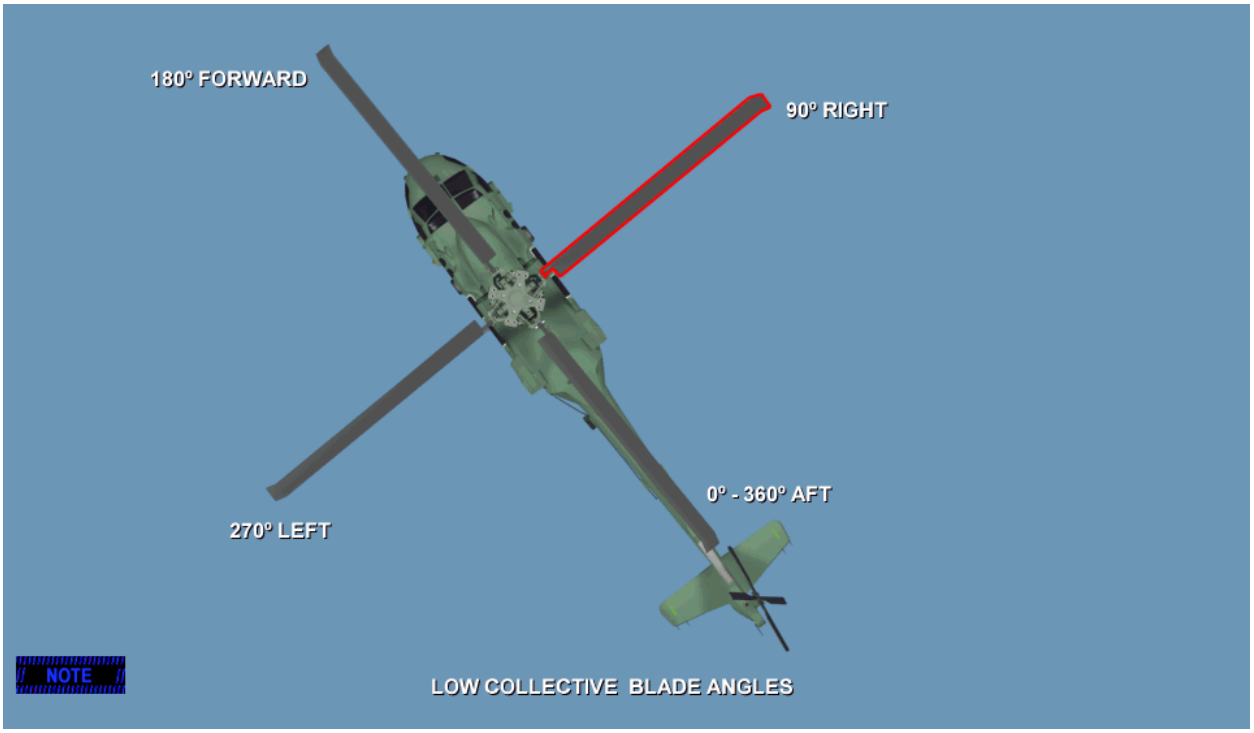
(nnnn) Push the pilot collective full down and engage the friction lock.

Frame # 0655 (Main Rotor System Complete Rig)



(oooo) Disconnect blade deice electrical connector from the main rotor blades.

Frame # 0660 (Main Rotor System Complete Rig)



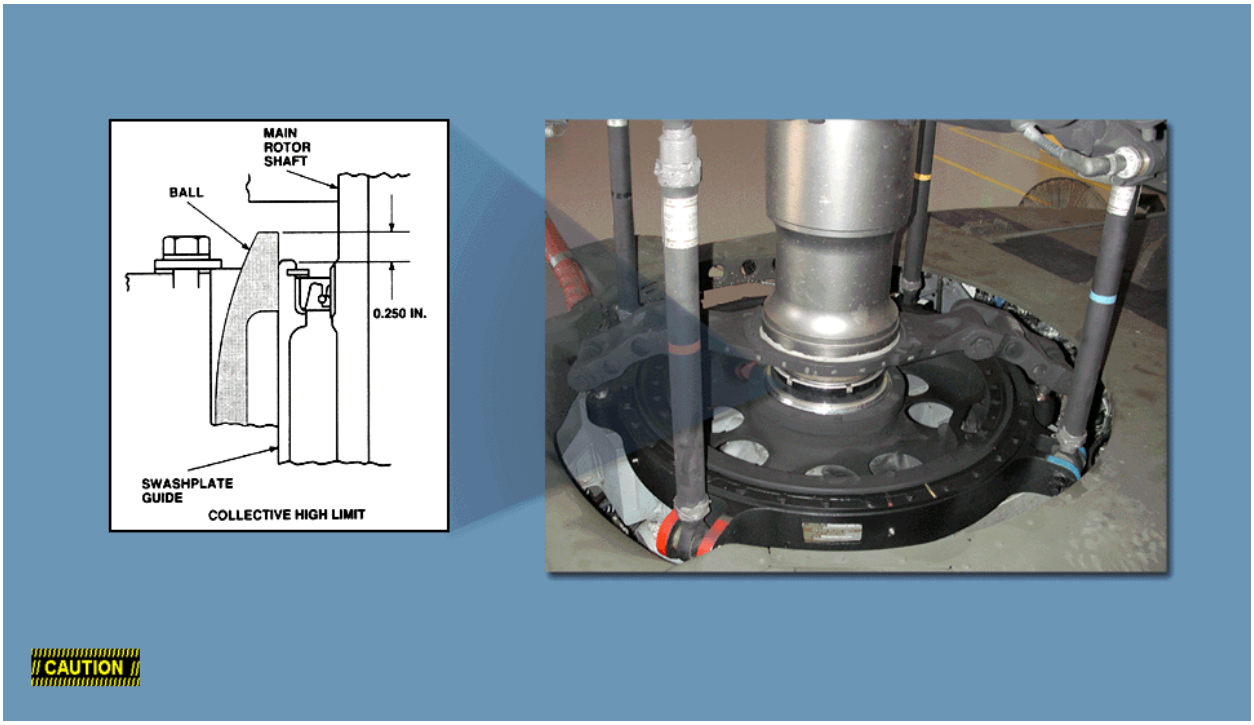
NOTE: One turn of rotating pitch control rod is equal to about 0.5° blade pitch

(pppp) Position the collective stick full down and adjust pitch control rod of #1 (red) blade until average blade angle (as each blade is positioned at 90°, 180°, 270°, and 0- 360° locations) is -0.6° ± 0.125°.

(qqqq) Once this angle is satisfied for the red blade, turn each of the remaining three blades to 90° location and adjust each pitch control rod to be same as the red blade angle ± 0.1º.

(rrrr) Ensure that exposed threads on each pitch control rod are not more that 0.75-inch.

Frame # 0665 (Main Rotor System Complete Rig)



CAUTION: Damage to swashplate ball will result if ball is allowed to extend past transmission guide by more than 0.250-inch when applying full up collective. Swashplate duplex bearing retainer may also be damaged if ball is allowed to extend past transmission guide by more than 0.250-inch when applying full up collective and full forward cyclic. Make sure that swashplate ball does not extend past transmission guide by more than 0.250-inch at any time.

(ssss) Back off copilot collective stick high pitch stop so that they will not interfere with adjustment of pilot stick stop.

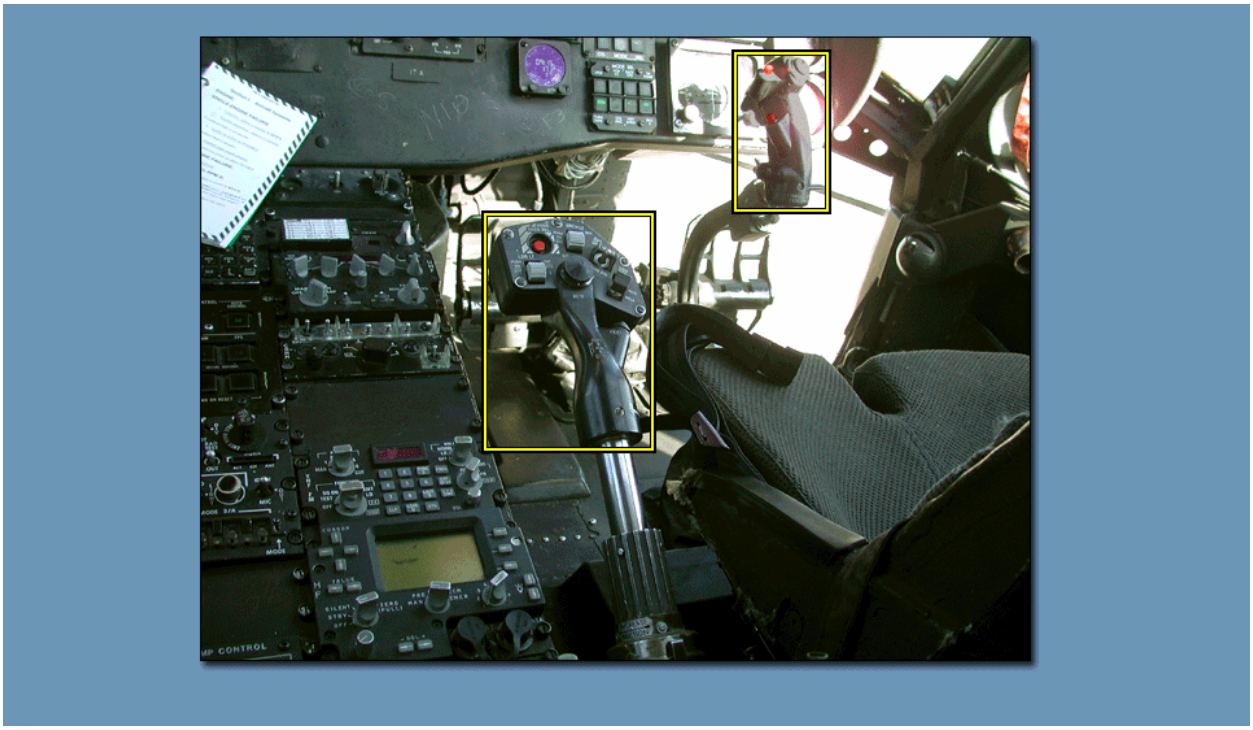
(tttt) Raise and hold the collective stick in the full up position.

(uuuu) While maintaining upward pressure on stick, adjust the pilot collective stick bolt stop until four reading average (taken as blade is positioned at 90°, 180°, 270°, and 0° locations) is between 15.0° to 16.0°.

(vvvv) After adjusting the pilot stick stop, adjust the copilot collective stick stop to agree with pilot stick stop.

(wwww) Check that the stationary swashplate ball does not extend past guide by more than 0.250-inch with the collective stick held against high stick stop.

Frame # 0670 (Main Rotor System Complete Rig)



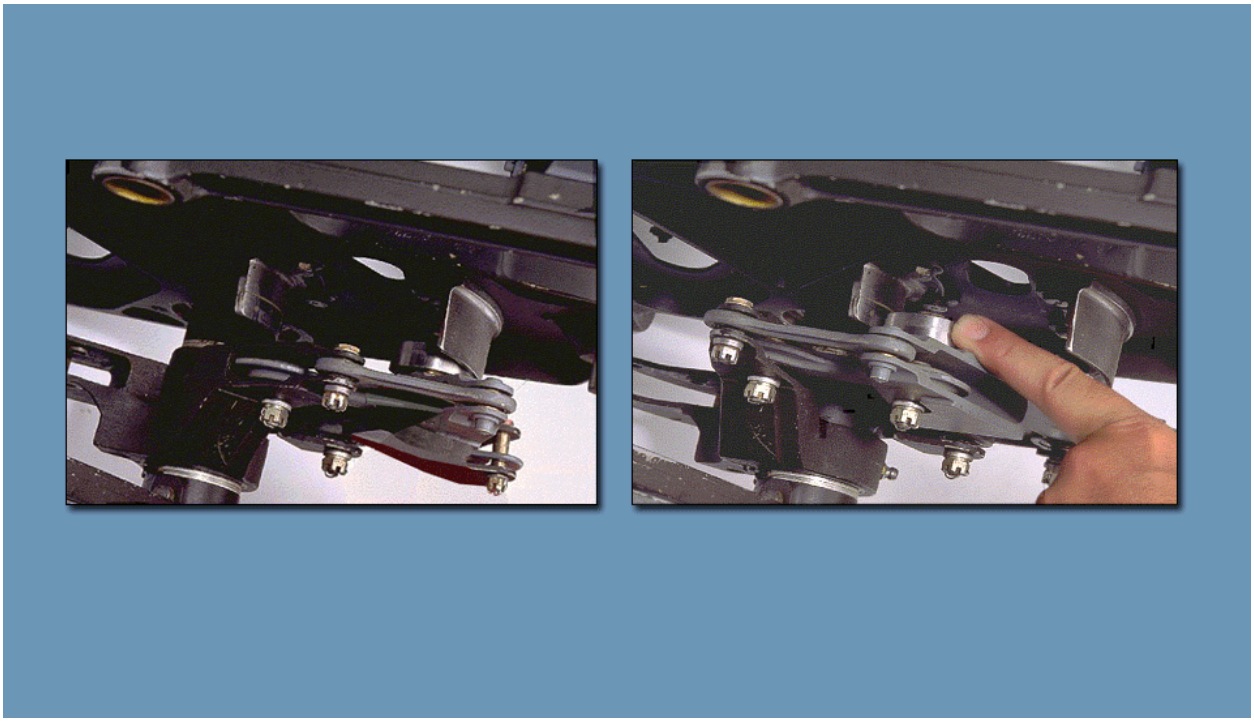
(xxxx) To adjust the cyclic stick forward (pitch) angle, raise and hold the collective stick to the full up position and move the cyclic stick to the full forward position.

(yyyy) Check to ensure that the pitch forward limiter roller on the mixer cannot be freely turned by hand and that the cyclic stick is not touching the front stop bolt on yoke.

(zzzz) Measure the blade angle at 90° and 270° locations.

(aaaaa) If range difference between both readings is 33.0° or greater and pitch forward limiter roller cannot be freely turned, no further adjustment is required.

Frame # 0670 (Main Rotor System Complete Rig)



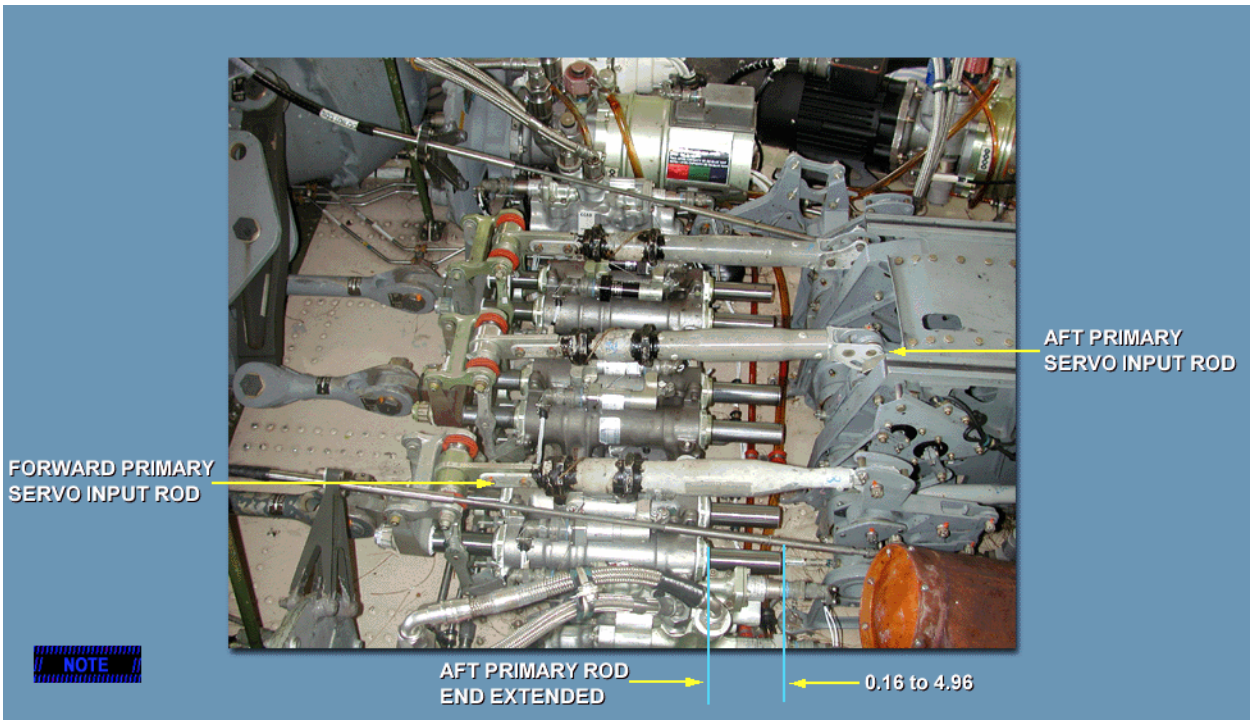
(bbbbb) If the forward limiter roller can be turned by hand, check for interference with the linkage forward of the mixer.

(ccccc) If no interference with the linkage forward of the mixer can be found, check aft primary servo for bottoming in the extend direction.

(ddddd) The forward end of the aft primary servo piston rod must extend 0.16 to 4.96-inches beyond the servo piston gland.

(eeeee) If the servo is bottomed, verify all pitch system rig pins were properly installed per assembly procedures.

Frame # 0675 (Main Rotor System Complete Rig)



NOTE: Cyclic stick grip is allowed to touch glare shield padding or instrument knobs with forward stop on cyclic stick properly set.

Make sure that forward and aft primary servo control rods are adjusted in equal and opposite directions. If one rod is lengthened by 1/2 turn, the other must be shortened by 1/2 turn.

(fffff) If the forward limiter is bottomed and the roller cannot be turned by hand, but the blade angle is less than 33.0°, adjust by shortening the forward primary servo control rod by turning barrel to right (while facing rear) and lengthen aft primary servo control rod by turning the barrel to left, same amount (while facing rear).

(ggggg) Do this adjustment until difference between both readings is not less than 33.0° at high collective/forward cyclic.

(hhhhh) Enter the amount of the adjustment's) (bias), initial and additional, that was made to forward and aft primary servo control rods at bottom of rigging worksheet.

(iiiii) Check to make sure the main rotor aft primary servo is not bottomed in the extend direction (the rod must extend 0.16 to 4.96-inches beyond servo piston gland).

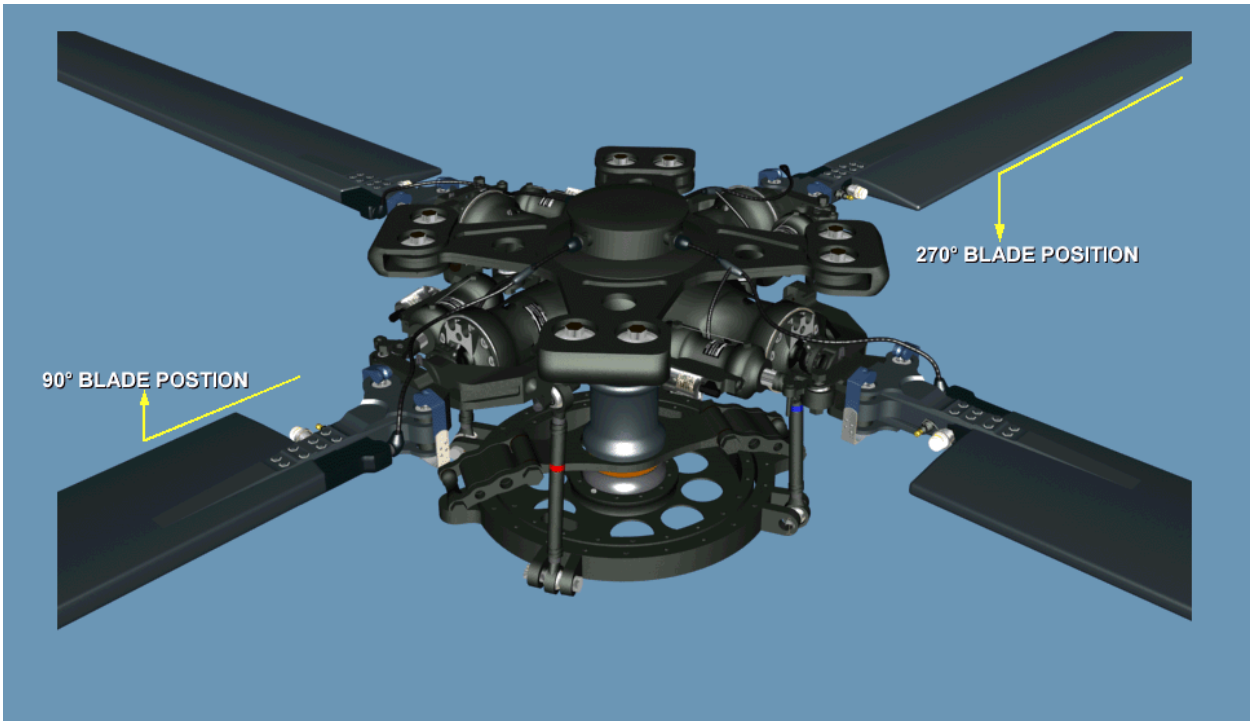
(jjjjj) If the servo is bottomed, verify all pitch system rig pins were properly installed per procedures.

Frame # 0678 (Main Rotor System Complete Rig)

(kkkkk) While holding high collective, pull cyclic stick to full aft position.

(lllll) Verify the cyclic stick is contacting the aft stick stop. If the stick stop is not contacted, check the control system for interference.

Frame # 0680 (Main Rotor System Complete Rig)



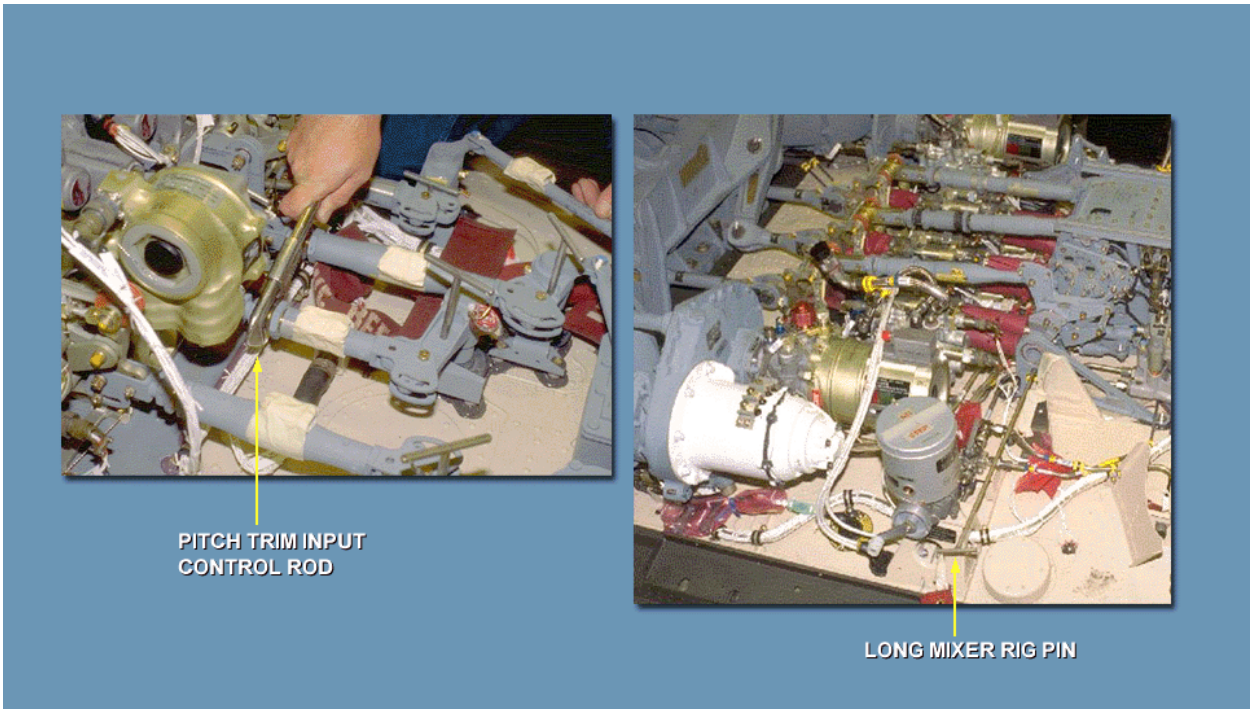
(mmmmm) Position the No. 1 (red) blade in 90° and 270° position, and read the blade angles in each position.

(nnnnn) The difference between the 90° and 270° position must be 19.0° or greater. If the difference between 90° and 270° positions is not 19.0° or greater, verify the aft cyclic control sticks were properly set; if not adjust as required.

(ooooo) If correct forward and aft cyclic readings cannot be obtained, check for interference in the control system between torque shafts and the primary servos.

(ppppp) Repeat adjustments as required until the correct readings are obtained.

Frame # 0685 (Main Rotor System Complete Rig)

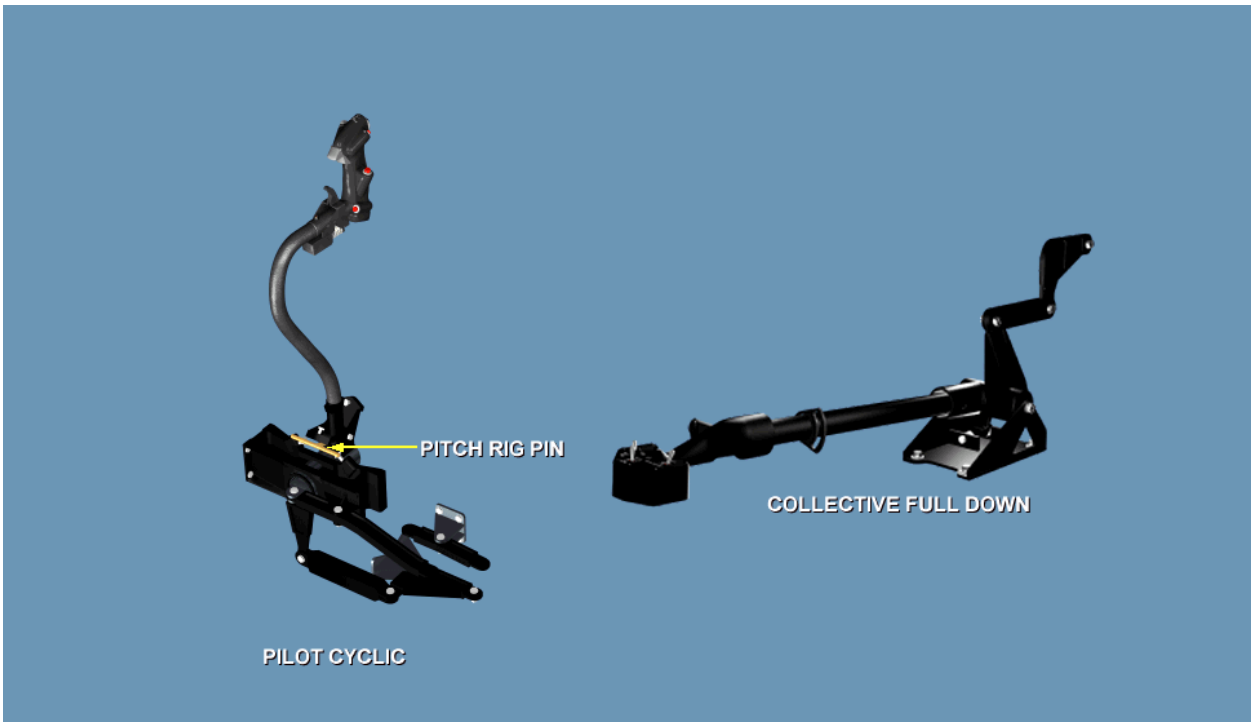


(qqqqq) The adjustment of the pitch/trim assembly input control rod may result in the inability to install long mixer rigging pin in the right side of the mixer.

(rrrrr) If the control rod was adjusted, check long mixer rigging pin installation.

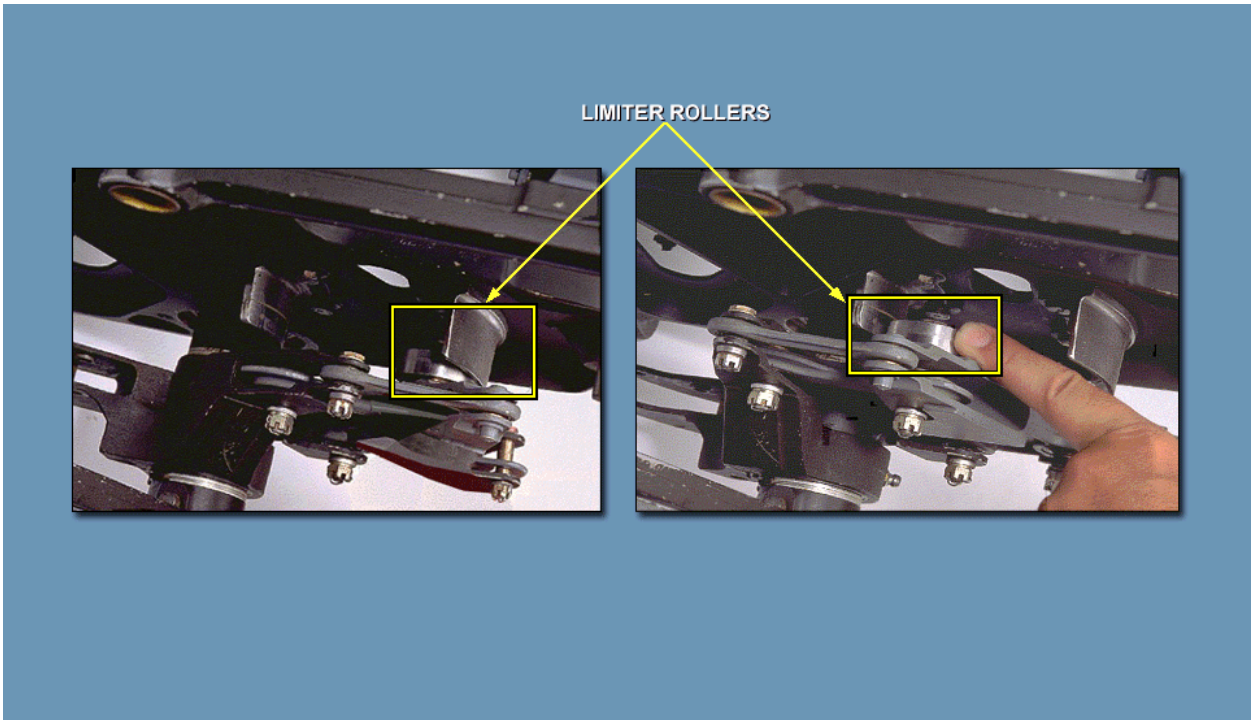
(sssss) While attempting to install the long mixer rigging pin in the right side of the mixer you are unable to install the rigging pin, record this in the helicopter logbook for future reference.

Frame # 0686 (Main Rotor System Complete Rig)



(ttttt) Move the collective to the full down position and hold in place. Install the pilot's cyclic pitch rigging pin and remove the pilot's cyclic roll rigging pin.

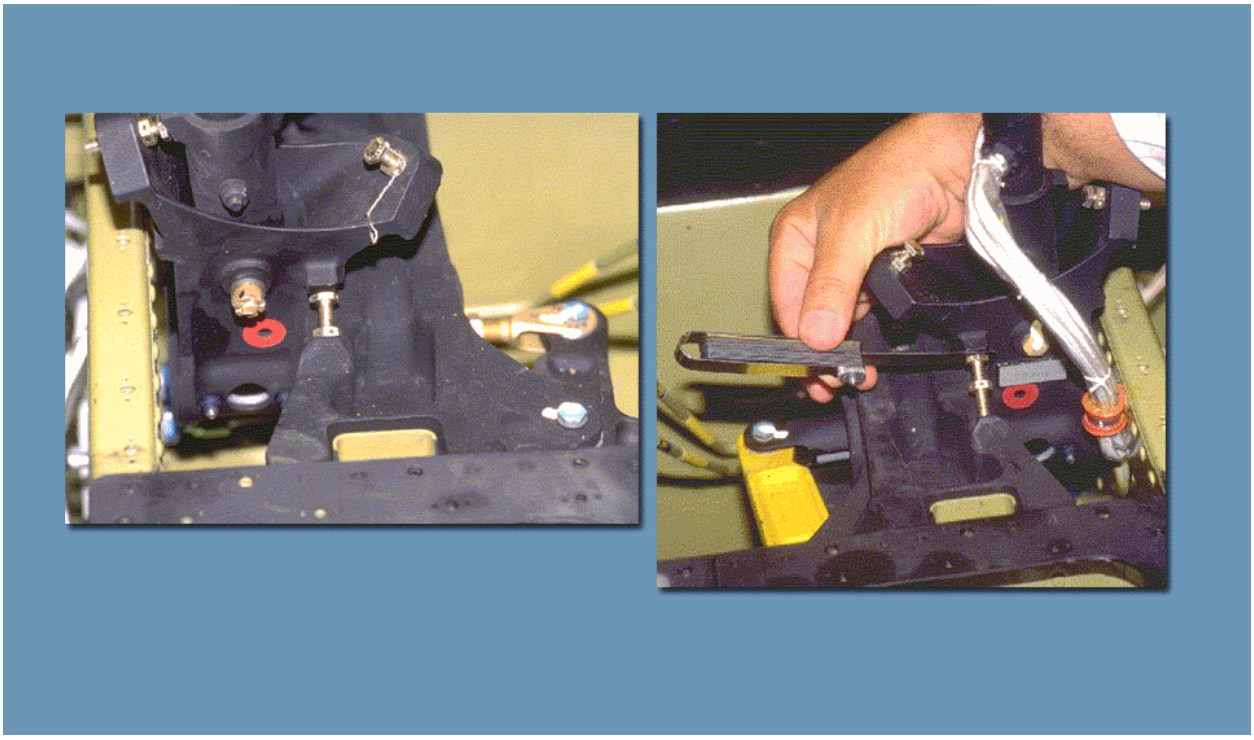
Frame # 0690 (Main Rotor System Complete Rig)



(uuuuu) Move the cyclic stick full left until the roller touches the lateral (roll) left limiter in the mixer.

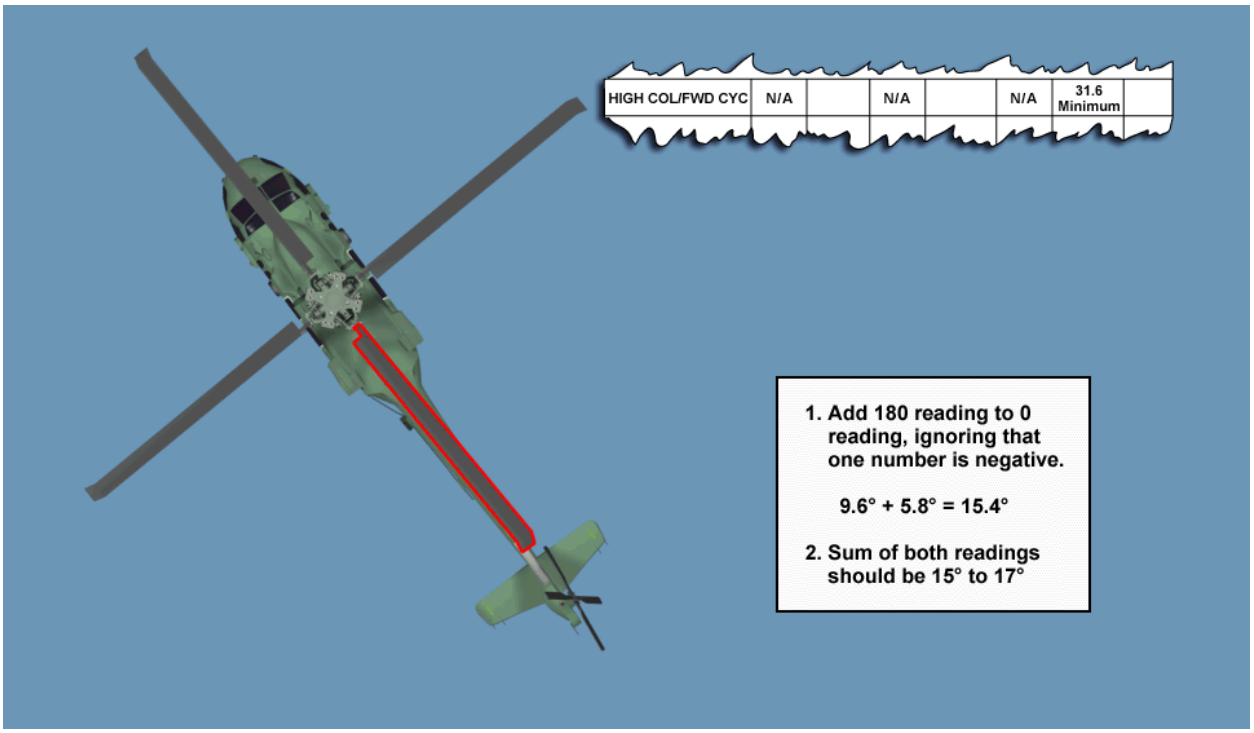
(vvvvv) If the roller does not contact the lateral left limiter in the mixer, check for interference with the linkage forward of the mixer, and clear before proceeding.

Frame # 0690 (Main Rotor System Complete Rig)



(wwwww) With the roller contacting the limiter, adjust the pilot and copilot cyclic left stick stops at the base of the cyclic stick, 0.010 - 0.030 inch clearance between bolt and yoke.

Frame # 0695 (Main Rotor System Complete Rig)



(xxxxx) Place the cyclic stick in full left position, position the No. 1 (red) blade to 180° and 0° locations, and measure the blade angle at each location.

(yyyyy) The left roll cyclic range is found by adding 180° reading to 0° reading, ignoring that one reading is a negative number.

(zzzzz) The sum of both readings should be 15° to 17º.

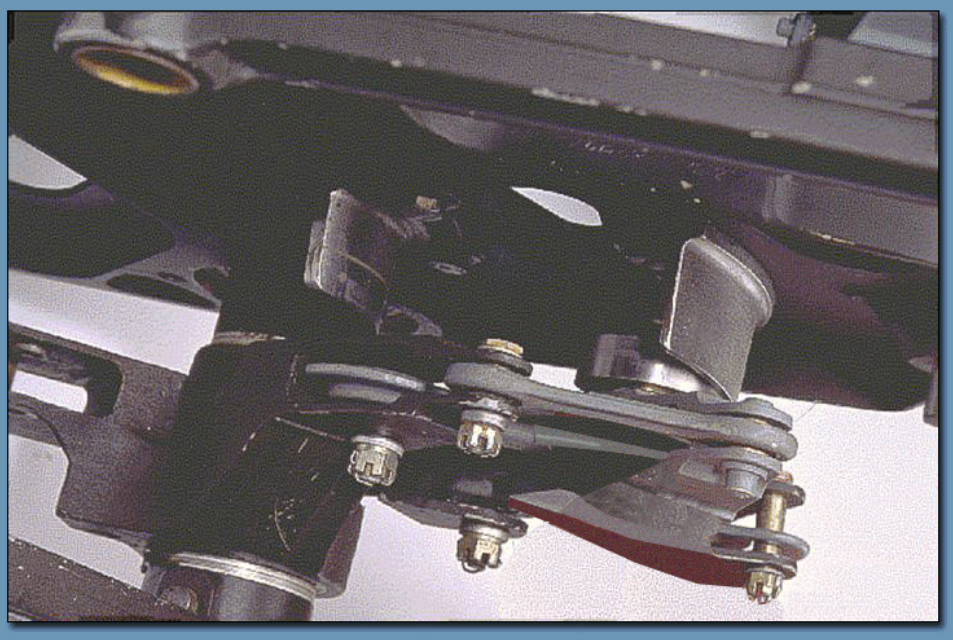
(aaaaaa) If the sum of both readings is less than 15°, adjust the lateral primary servo input control rod.

(bbbbbb) Shorten the lateral primary servo control rod by turning the barrel to right (while facing rear).

(cccccc) Continue to shorten the control rod in small increments until the total angle between 0° and 180° positions reads 15° to 17°.

(dddddd) Enter the amount of adjustment (bias) that was made to the lateral primary servo control rod at bottom of the rigging worksheet.

Frame # 0700 (Main Rotor System Complete Rig)

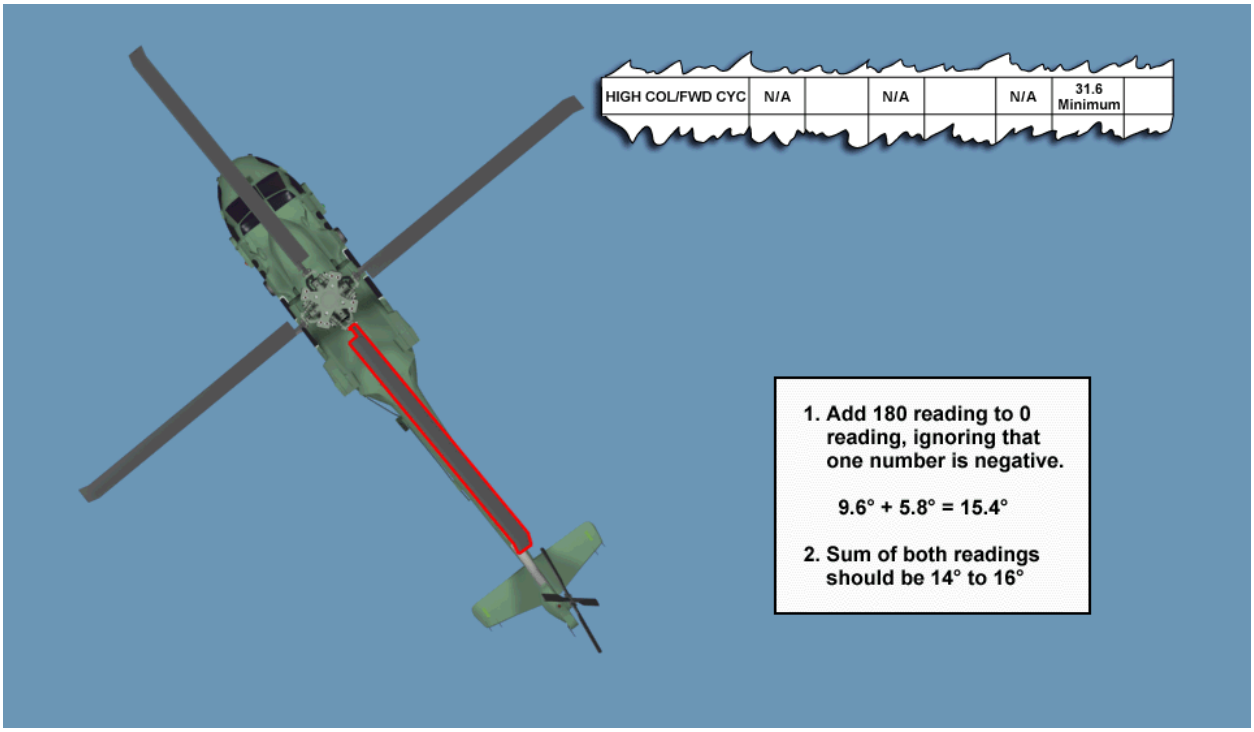


(eeeeee) Move the cyclic stick full right until the roller touches the lateral (roll) right limiter in the mixer.

(ffffff) If the roller does not contact the lateral left limiter in the mixer, check for interference with linkage forward of the mixer, and clear before proceeding.

(gggggg) With the roller contacting the limiter, adjust the pilot and copilot right stick stops, at base of each cyclic stick, 0.010 to 0.030 inch clearance between bolt and yoke.

Frame # 0705 (Main Rotor System Complete Rig)



(hhhhhh) Place the cyclic stick in full right position, move the No. 1 (red) blade to 180° and 0° locations, and measure the blade angle at both locations.

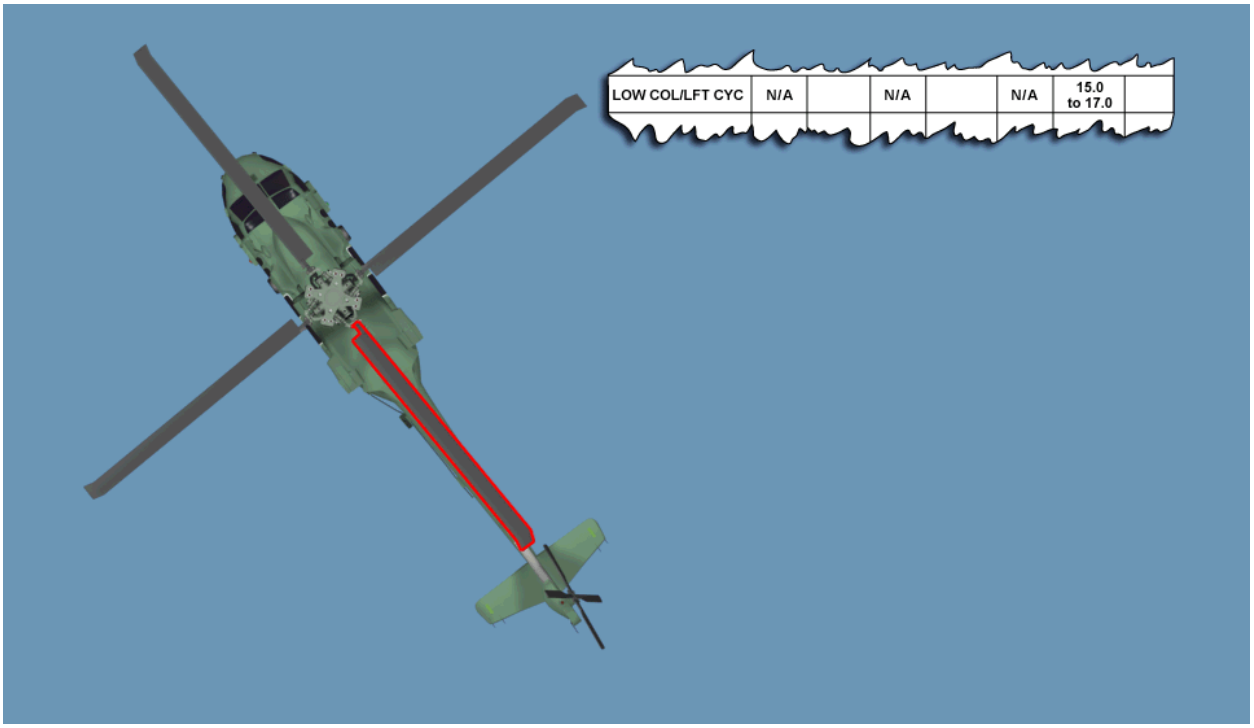
(iiiiii) Add 0° reading to 180° reading, ignoring that this reading is negative. The sum of both readings should be 14° to 16°.

(jjjjjj) If the sum of both readings is less than 14°, adjust the lateral primary servo input control rod as required.

(kkkkkk) Lengthen the lateral primary servo control rod by turning the barrel to the left (while facing aft).

(llllll) Continue to lengthen the control rod in small increments until the total angle between 0° and 180° positions reads 14° to 16°.

Frame # 0710 (Main Rotor System Complete Rig)



(mmmmmm) Recheck the low collective left cyclic range to make sure it is still within limits.

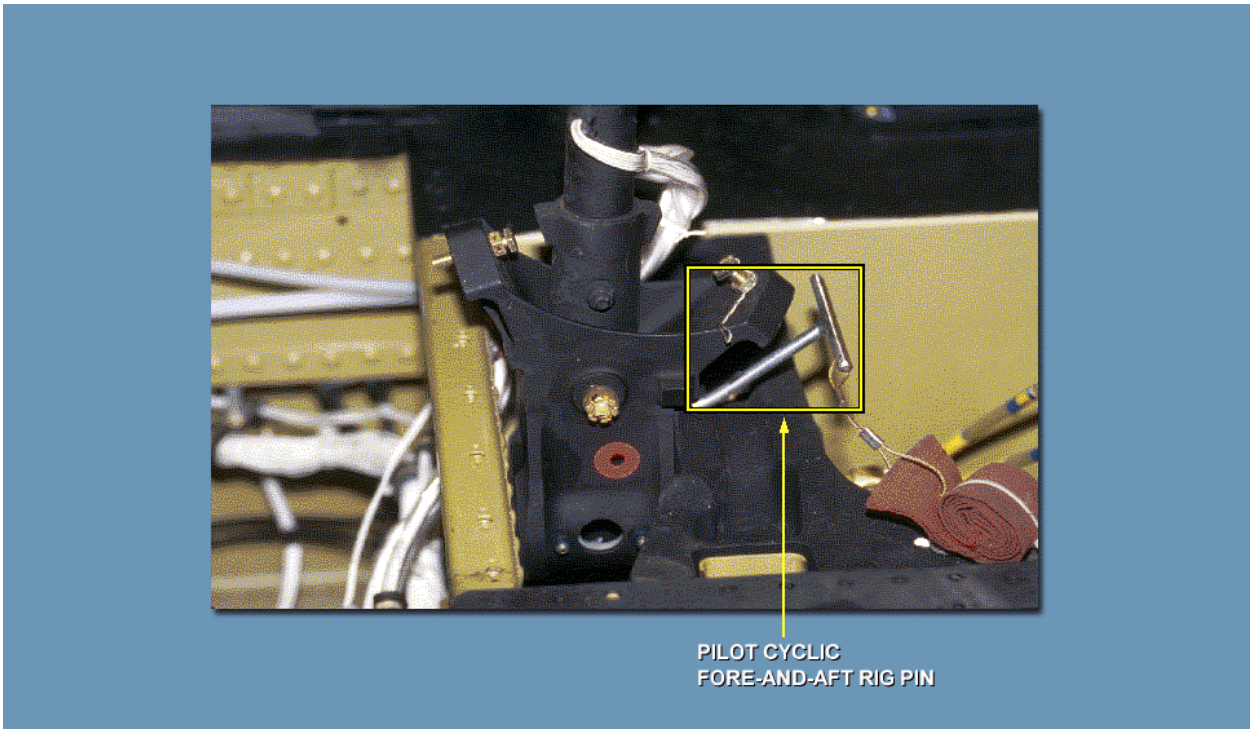
(nnnnnn) Adjust the lateral primary servo input control rod until both lateral range requirements are within limits.

(oooooo) Enter the amount of adjustment (bias) that was made to the lateral primary servo control rod at the bottom of the rigging worksheet.

(pppppp) Lock wire the jam nuts to the locking device tab on the lateral primary servo input pushrod.

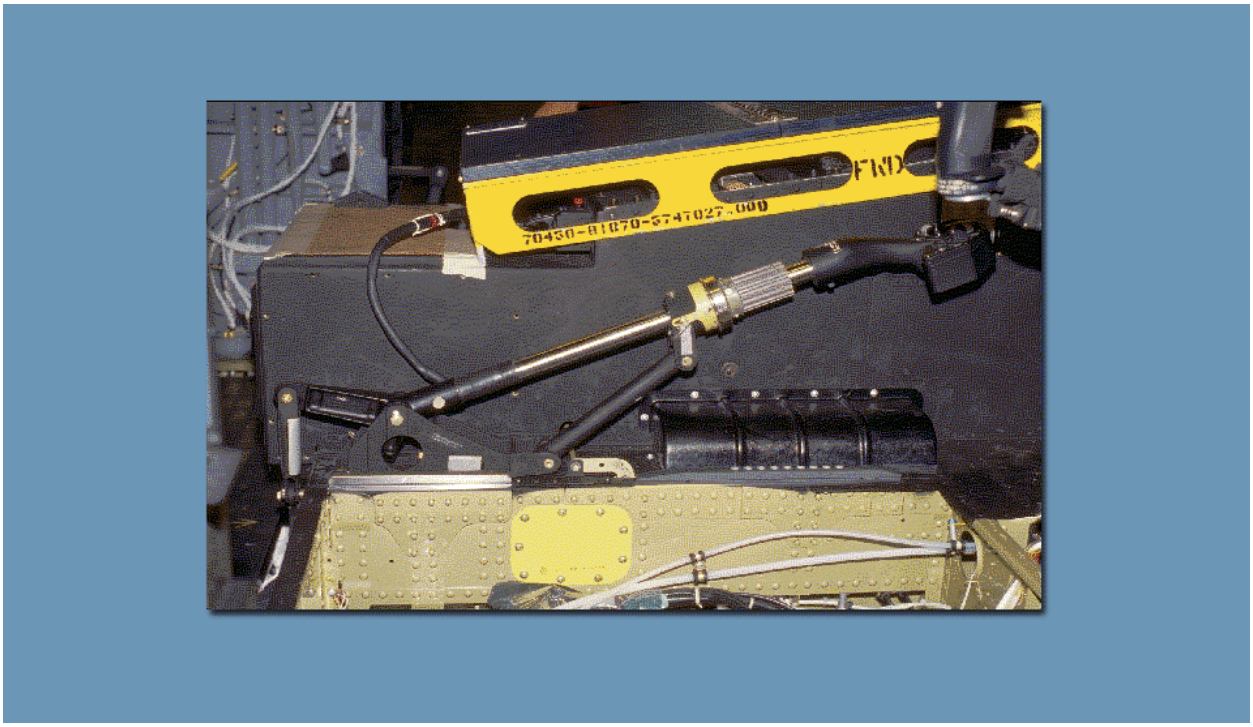
(qqqqqq) Place a copy of the rigging worksheet with aircraft historical records.

Frame # 0715 (Main Rotor System Complete Rig)



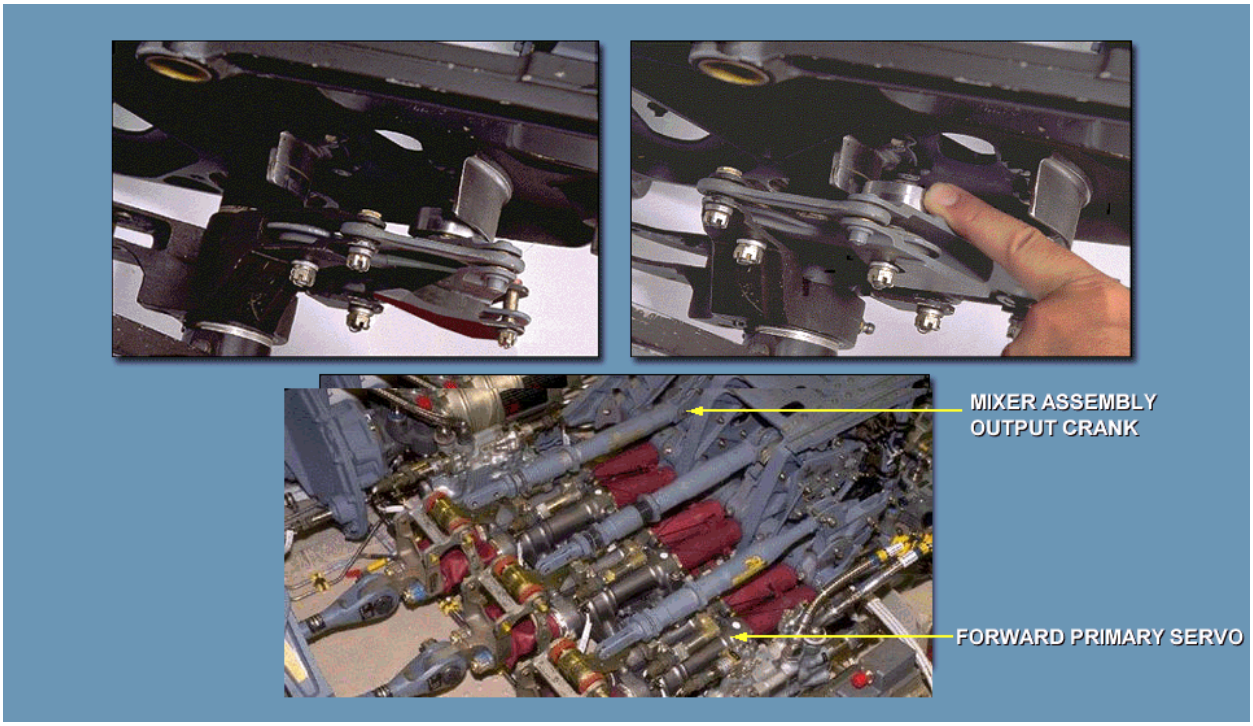
(rrrrrr) Remove the pilot fore-and-aft (pitch) cyclic rigging pin.

Frame # 0715 (Main Rotor System Complete Rig)



(ssssss) Move the collective stick to the full down position.

Frame # 0720 (Main Rotor System Complete Rig)

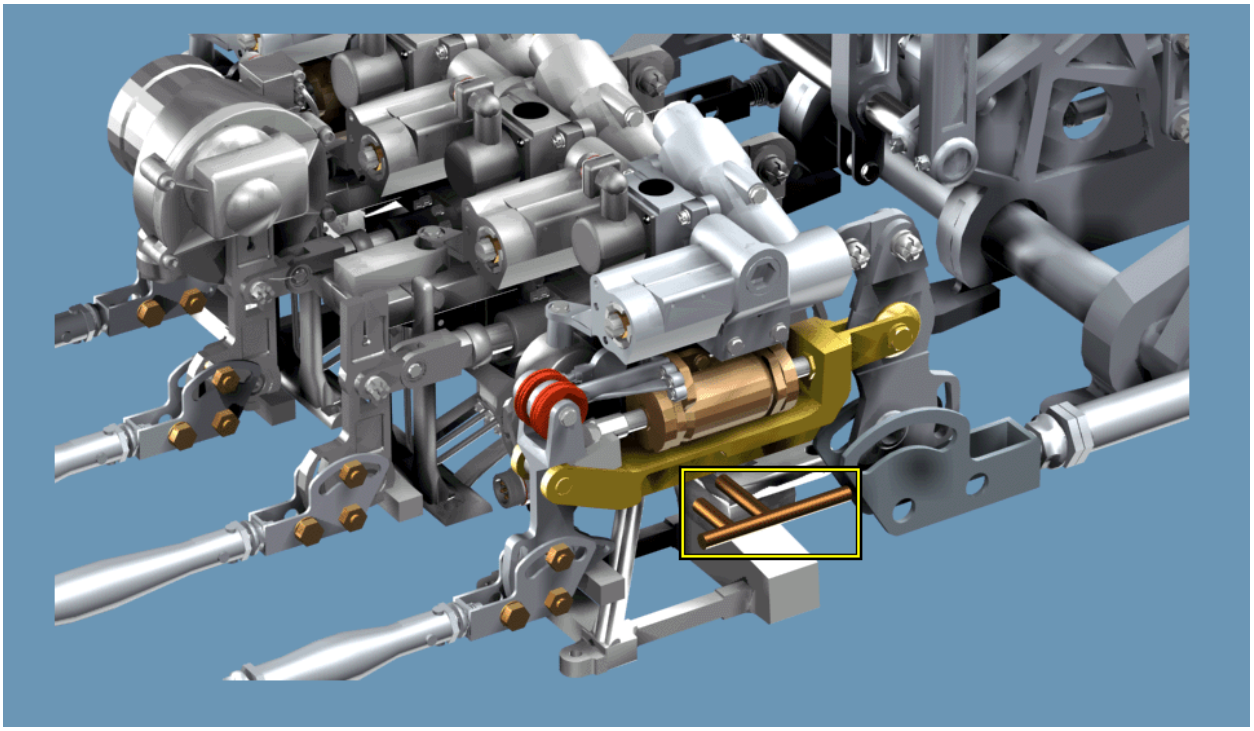


(tttttt) Maintain downward pressure on the collective stick, and push the cyclic stick fully forward.

(uuuuuu) Check to make sure that the roller on the mixer output crank is contacting the forward limiter and that roller cannot be rotated using finger pressure.

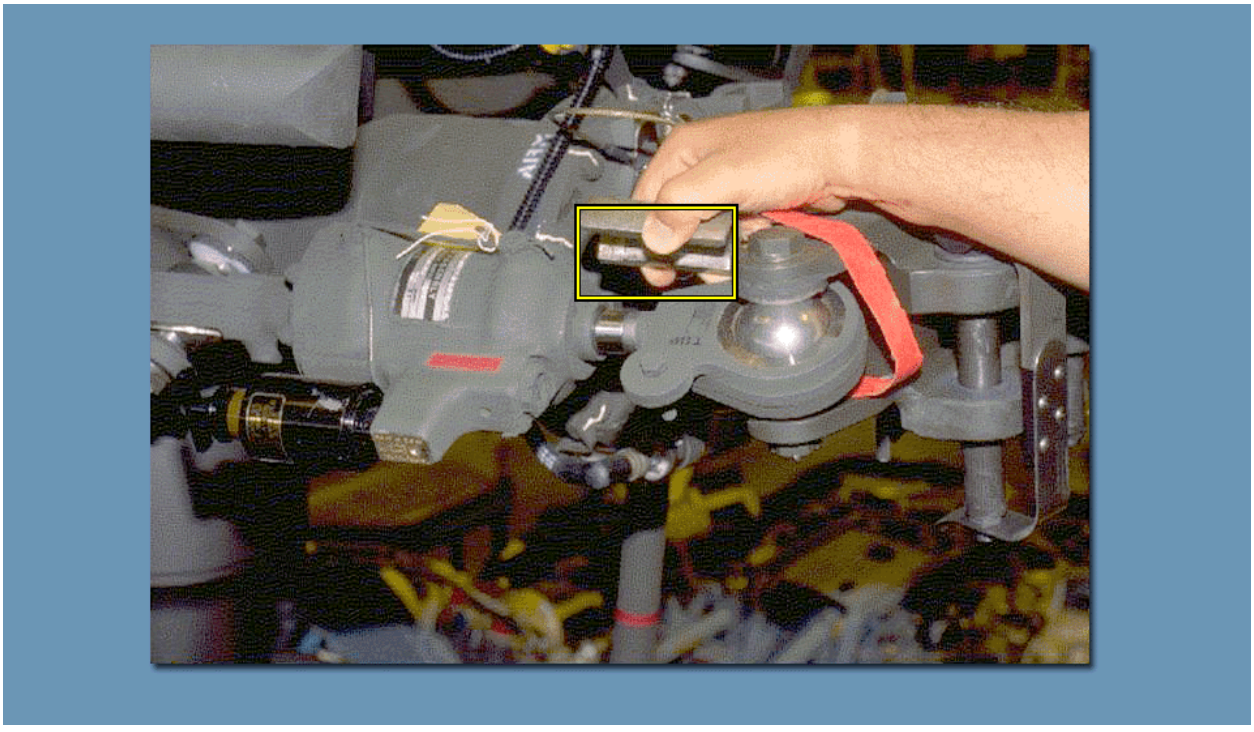
(vvvvvv) Check the forward primary servo for bottoming in the retract direction.

Frame # 0725 (Main Rotor System Complete Rig)



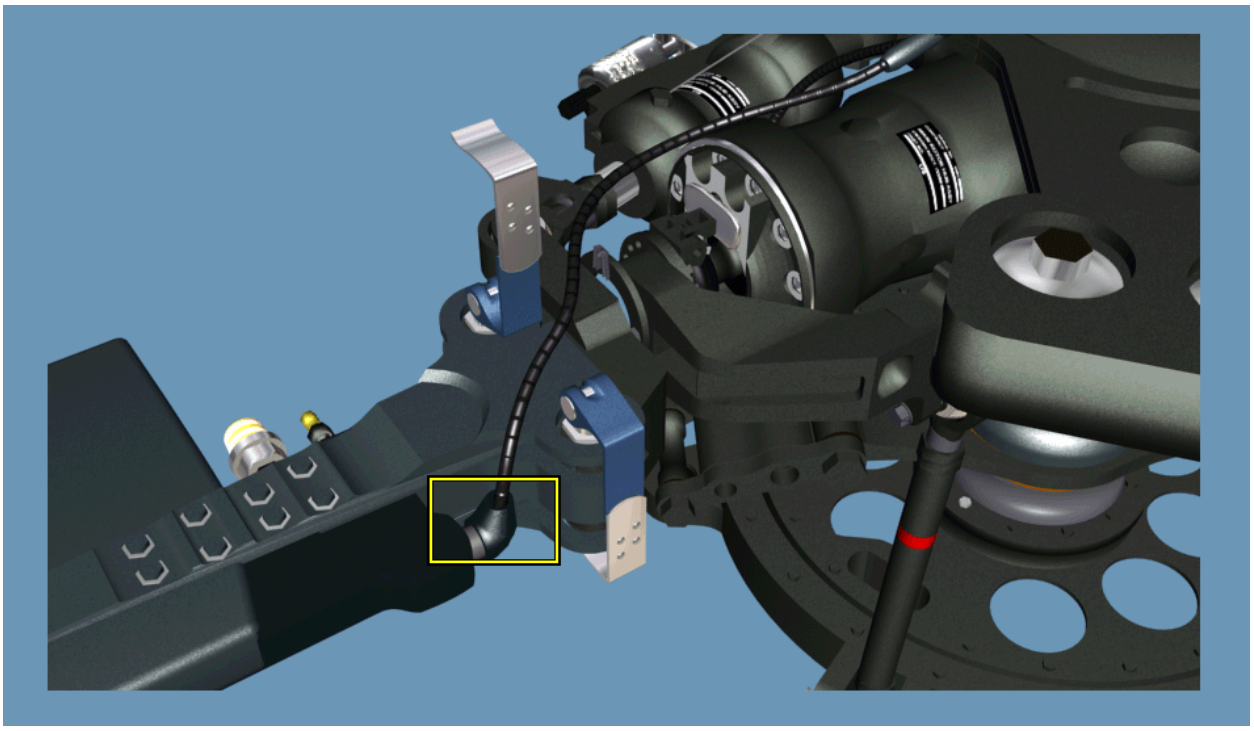
(wwwwww) Remove yaw boost servo rigging pin.

Frame # 0725 (Main Rotor System Complete Rig)



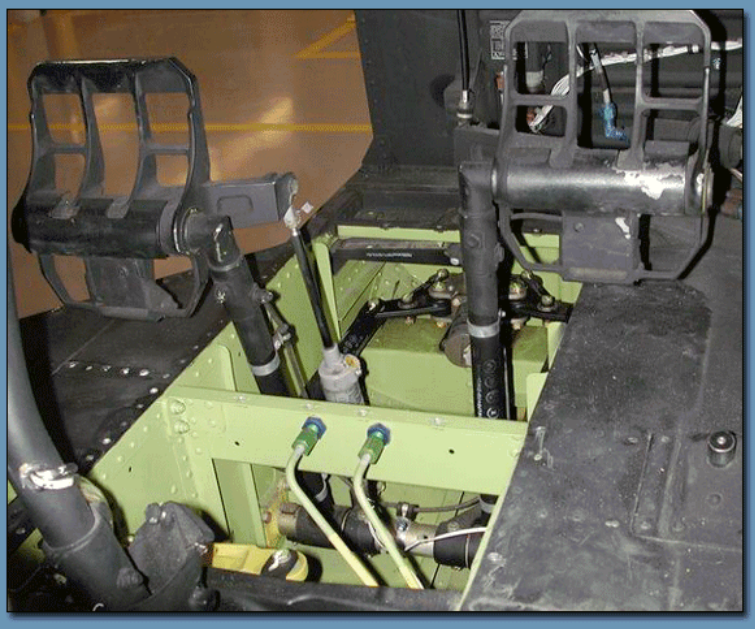
(xxxxxx) Remove damper blocks.

Frame # 0725 (Main Rotor System Complete Rig)



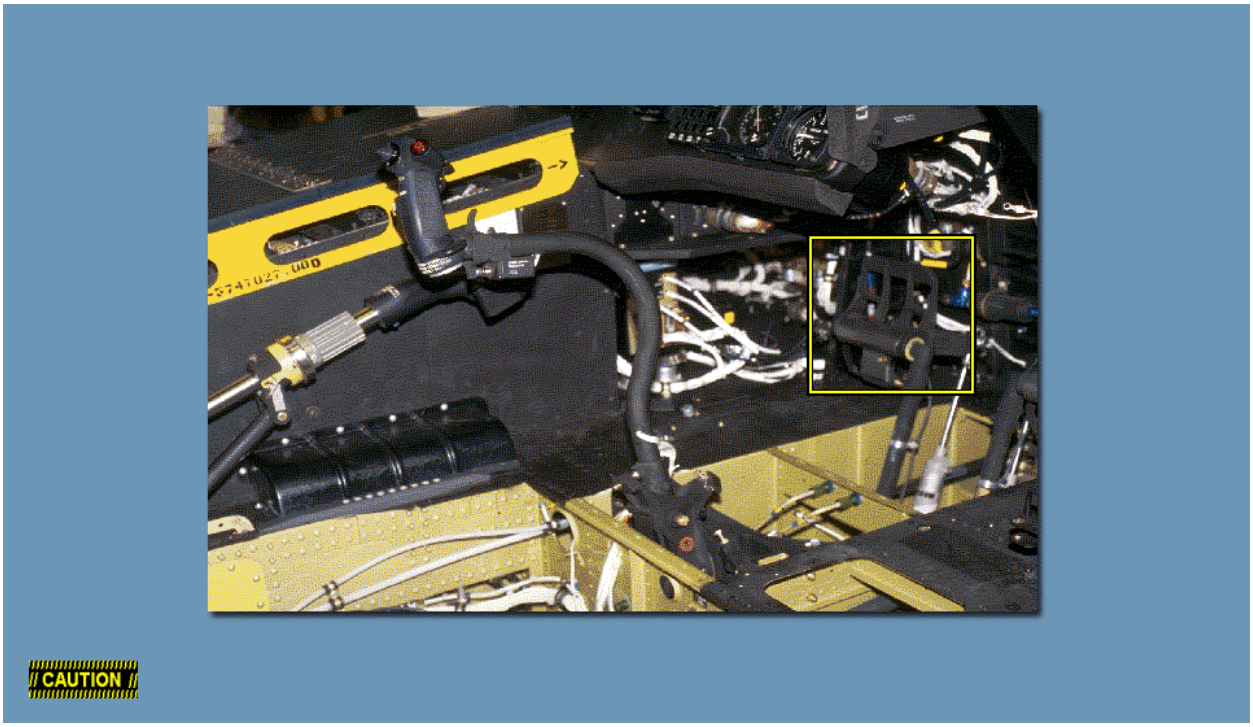
(yyyyyy) Connect blade deice electrical connectors to main rotor blades.

Frame # 0725 (Main Rotor System Complete Rig)



(zzzzzz) Center the cyclic stick and yaw pedals.

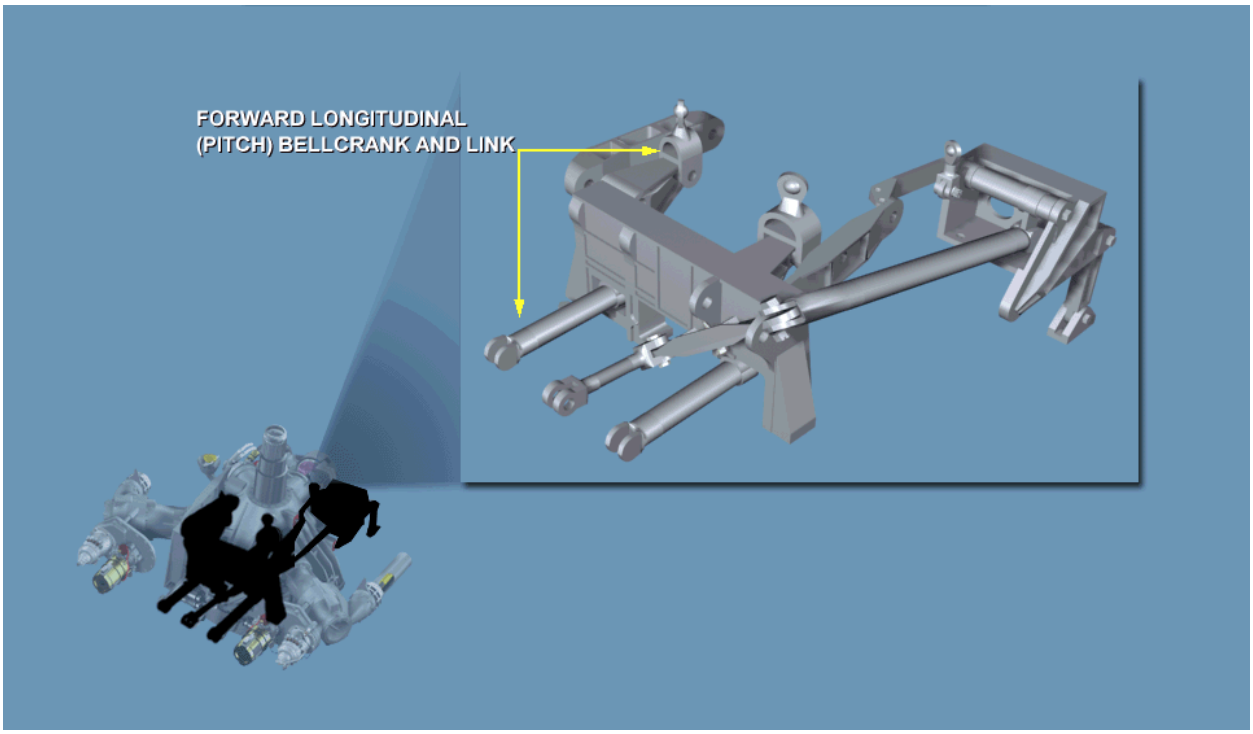
Frame # 0730 (Main Rotor System Complete Rig)



CAUTION: Damage to equipment may result if forward longitudinal (pitch) bellcrank comes into contact with main transmission housing. A minimum clearance of 1/16-inch is required.

(aaaaaaa) Place the collective in the full up position and the cyclic control stick against rear stop.

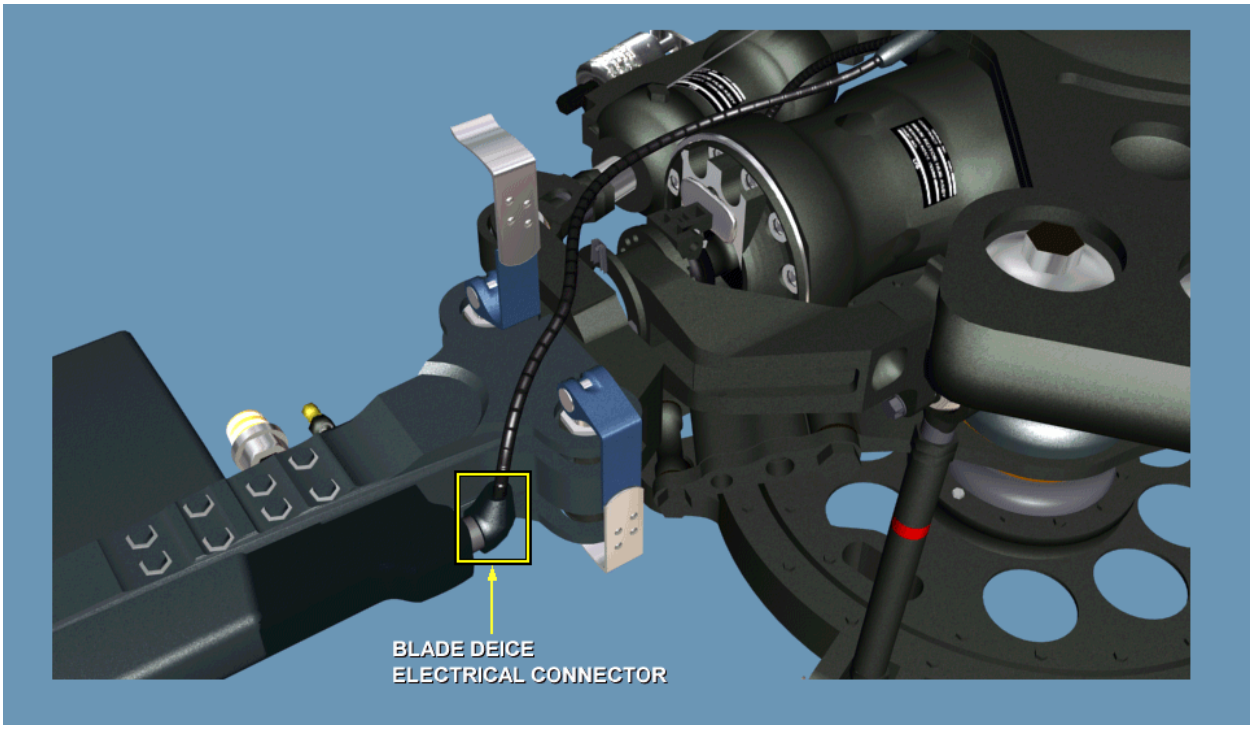
Frame # 0730 (Main Rotor System Complete Rig)



(bbbbbbb) Slowly move the yaw pedals in short increments to full left pedal, making sure that 1/16-inch minimum clearance between bellcrank and housing is maintained throughout entire pedal movement.

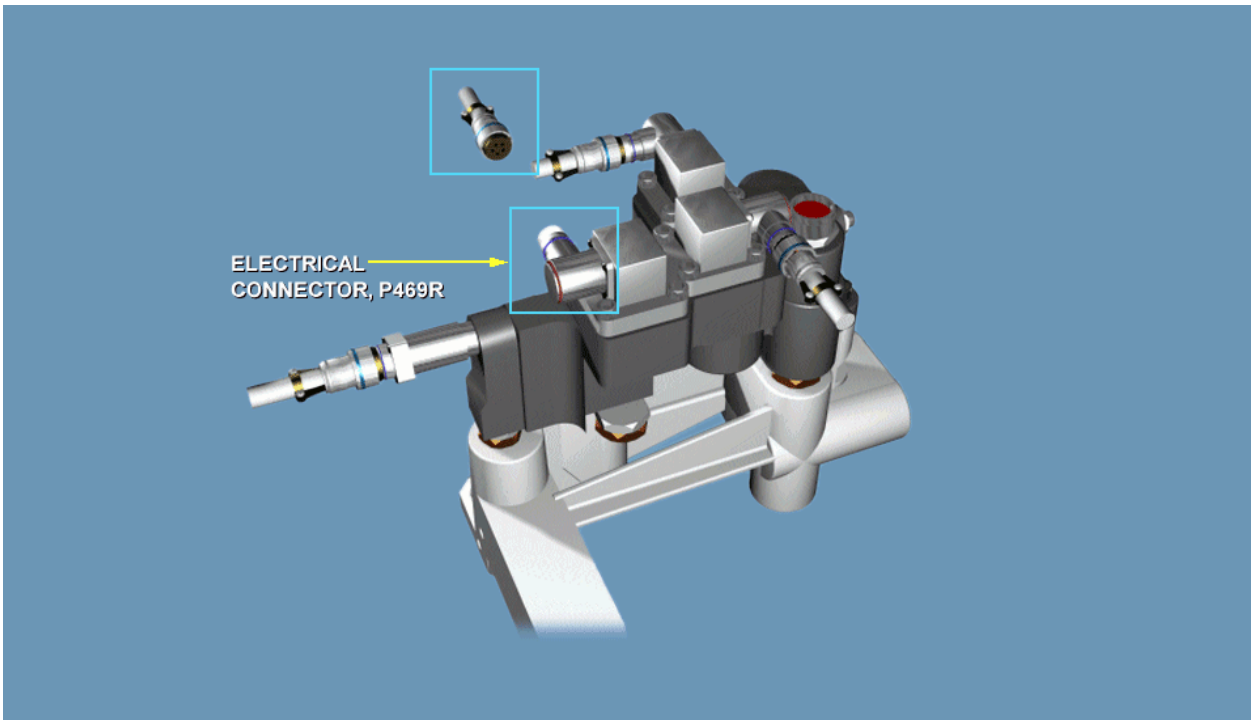
(ccccccc) When full left pedal is achieved, verify the roller is contacting the aft limiter in the mixer and that the forward primary servo is not bottomed.

Frame # 0735 (Main Rotor System Complete Rig)



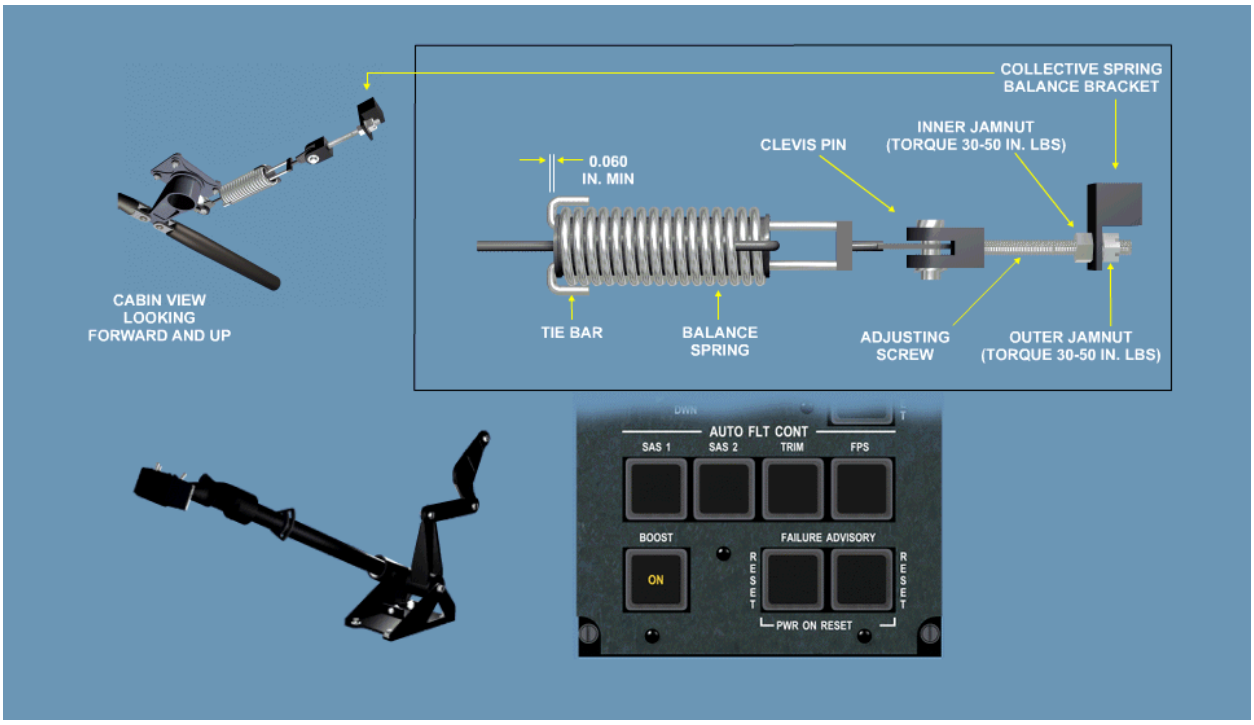
(ddddddd) Turn off all electrical and hydraulic power and inspect and treat blade deice electrical connector.

Frame # 0735 (Main Rotor System Complete Rig)



(eeeeeee) Remove the caps and connect the electrical connector to the boost shutoff valve on the top of pilot-assist module.

Frame # 0740 (Main Rotor System Complete Rig)



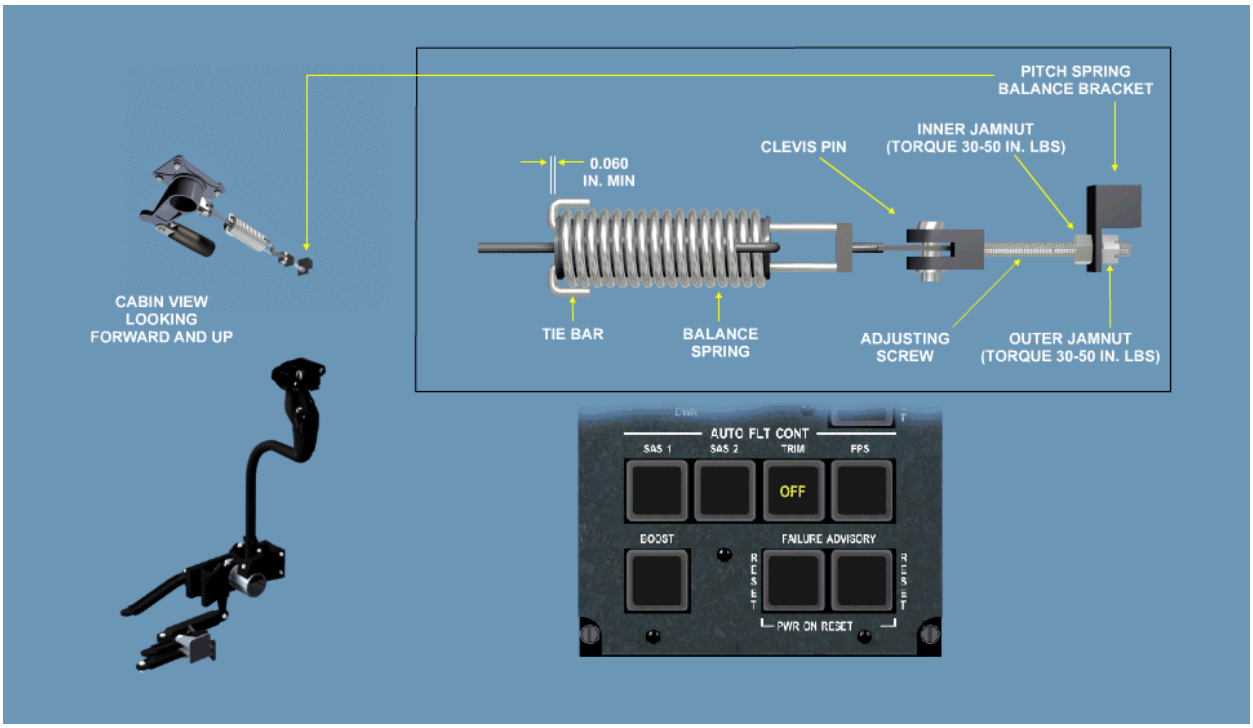
(fffffff) To check the collective balance springs, apply electrical and hydraulic power.

(ggggggg) Engage the BOOST switch on the AUTO FLIGHT CONTROL panel and position the collective stick up to high collective.

(hhhhhhh) The collective stick should stay up and not move. Push the collective stick down to low collective.

(iiiiiii) Upward movement must not exceed 1/2-inch. If collective sticks move when they are let go, adjust balance springs.

Frame # 0745 (Main Rotor System Complete Rig)



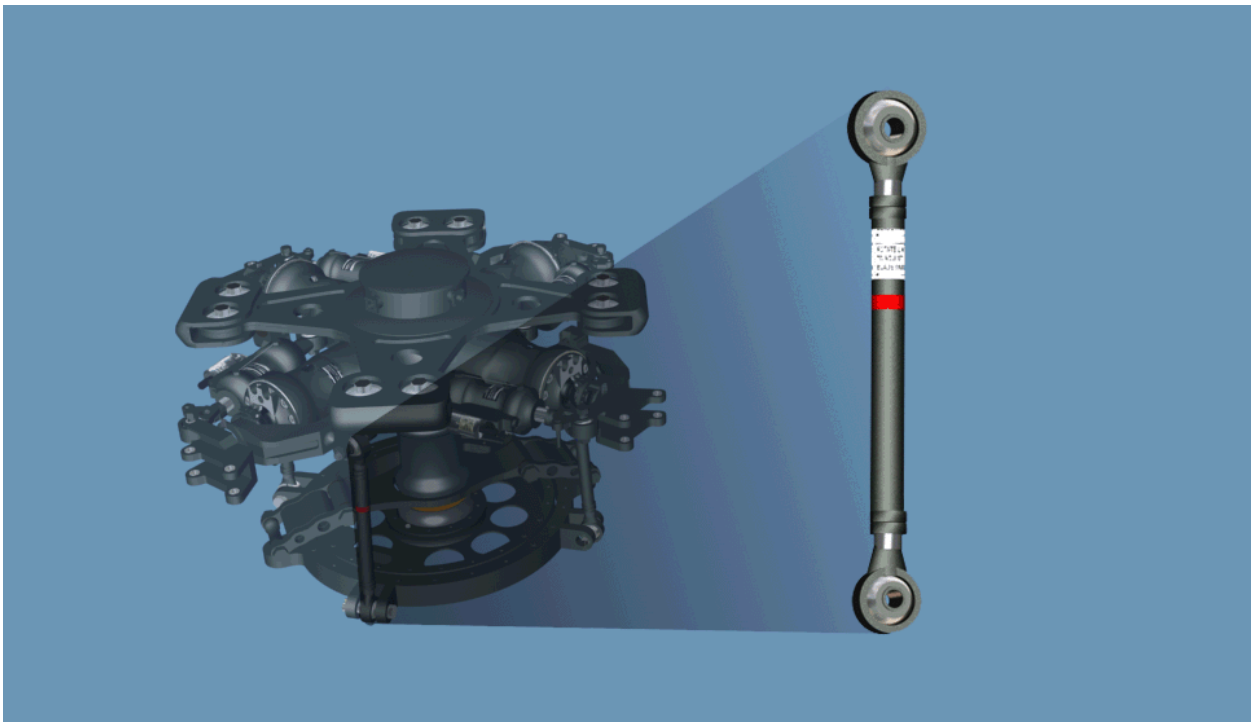
(jjjjjjj) On the AUTO FLIGHT CONTROL panel, disengage the TRIM switch and move the cyclic stick to the neutral position.

(kkkkkkk) Push the control stick forward about 6 inches and let go, the stick should not move forward.

(lllllll) Move the control stick forward again until it is almost fully forward let go and again, it should not move forward.

(mmmmmmm) If the cyclic sticks move when they are let go, adjust balance springs.

Frame # 0750 (Main Rotor System Complete Rig)

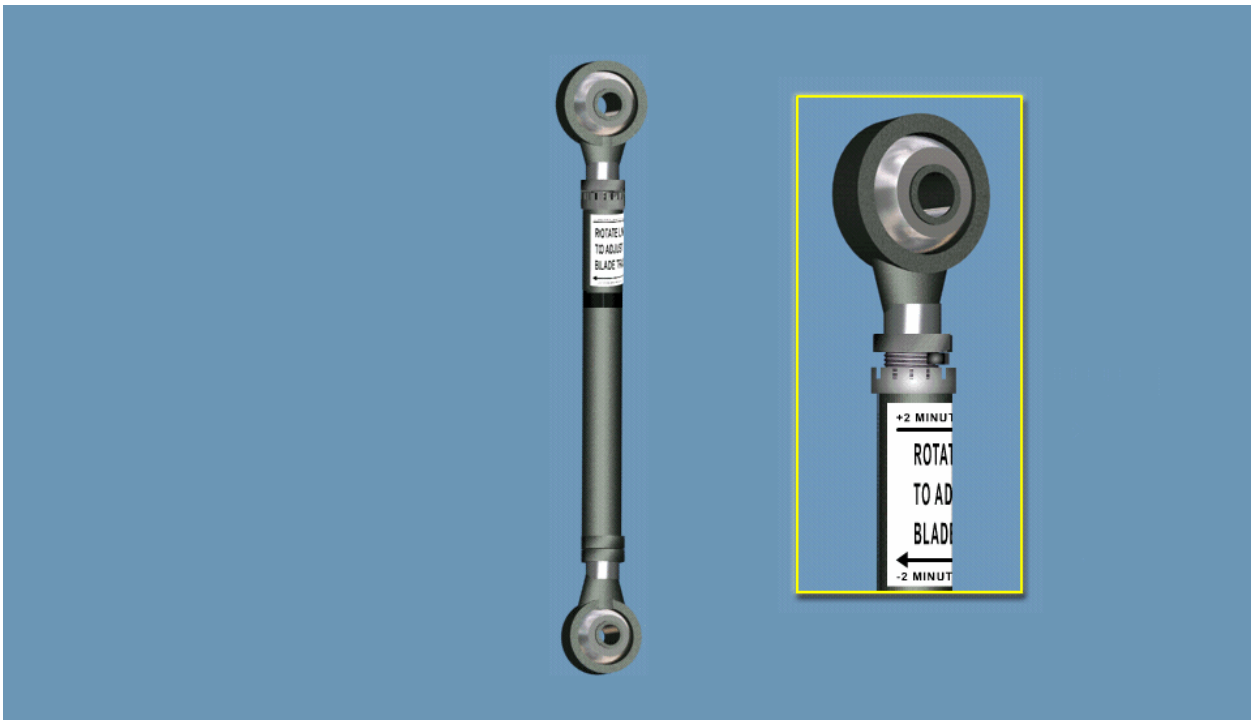


(nnnnnnn) If the main rotor pitch control rods have been adjusted for collective angles, adjust them for pretrack by doing this.

(ooooooo) Divide the number stenciled on bottom of the blade by 2. This number is the number of notches to turn the rod.

(ppppppp) This number is the number of notches to turn the rod.

Frame # 0755 (Main Rotor System Complete Rig FLASH)

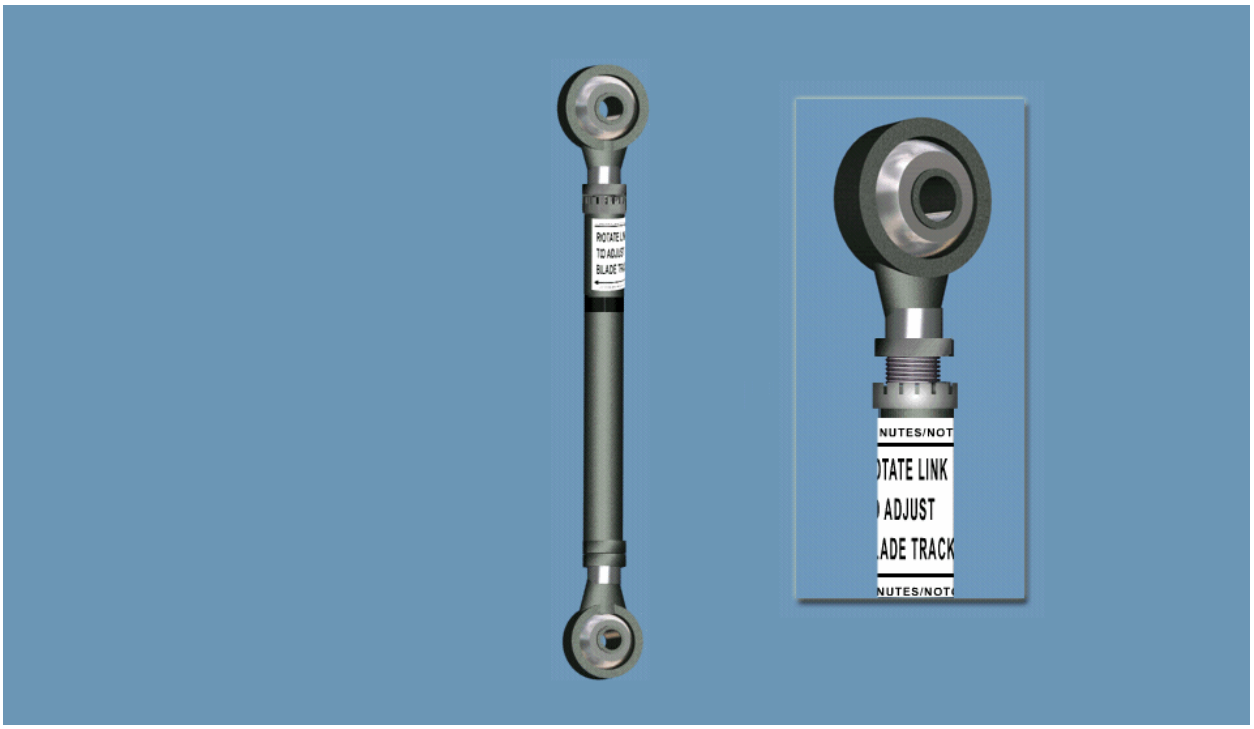


(qqqqqqq) Loosen the locknuts on rod end and turn rod in +2 minutes/notch direction if number on blade is positive, or - 2 minutes/notch direction if number on blade is negative.

(rrrrrrr) Ensure the exposed threads on each of the pitch control(s) are not more than 0.75-inch.

(sssssss) Lock tang in notch by tightening upper locknut and torque IAW TM.

Frame # 0755 (Main Rotor System Complete Rig FLASH)



h. Quality Control Checks

Frame # 0760 (Quality Control Checks)

(1) Perform these quality control checks on the main rotor flight control system, after all procedures have been followed IAW applicable TM.

(a) No passage of 0.020-inch lockwire through control rod inspection holes.

(b) Main rotor pitch control rods above rotating swashplate for no more than 0.75-inch thread showing.

(c) Swashplate ball extends no more than 0.250-inch above swashplate guide with collective in full up position.

(d) Primary servo input control rods for lockwire.

(e) Control rods for lockwire.

(f) Cotter pins installed in nuts, where required.

(g) All flight control system attaching hardware installed and safetied.

(h) All control system tri-pivot hardware is properly installed and safetied.

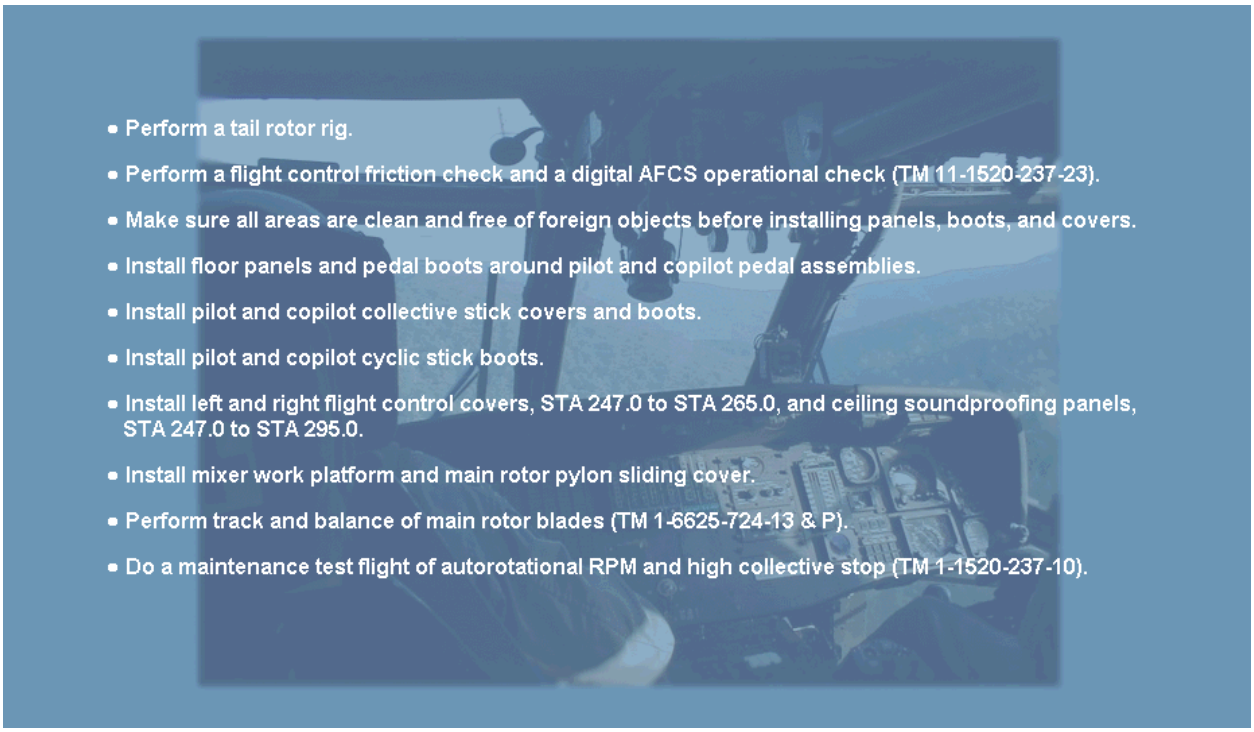
(i) Cyclic and collective stick stopbolts, and high pitch collective mixer stopbolt for lockwire.

(j) All rigging pins and damper blocks removed.

(k) Cycle controls through full range.

(l) Other than previously adjusted stops, no interference with any component is allowable except cyclic stick grip may touch glare shield padding or instrument knobs with forward stop on cyclic stick properly set.

Frame # 0765 (Quality Control Checks)



(2) Perform these quality control checks on the main rotor flight control system, after all procedures have been followed IAW applicable TM.

(a) Perform a tail rotor rig.

(b) Perform a flight control friction check and a digital AFCS operational check (TM 11-1520-237-23).

(c) Make sure all areas are clean and free of foreign objects before installing panels, boots, and covers.

(d) Install floor panels and pedal boots around pilot and copilot pedal assemblies.

(e) Install pilot and copilot collective stick covers and boots.

(f) Install pilot and copilot cyclic stick boots.

(g) Install left and right flight control covers, STA 247.0 to STA 265.0, and ceiling soundproofing panels, STA 247.0 to STA 295.0.

(h) Install mixer work platform and main rotor pylon sliding cover.

(i) Perform track and balance of main rotor blades (TM 1-6625-724-13 & P).

(j) Do a maintenance test flight of autorotational RPM and high collective stop (TM 1-1520-237-10).

CHECK ON LEARNING

1. What type protractor is used when rigging the UH-60 helicopter?

2. When is a Main Rotor Complete rig is required?

3. Adjustable length rods may be changed without a rigging check, provided_____.

4. When is the Primary Servo four point rig check required?

5. A tail rotor complete rig is required whenever any major changes in tail rotor flight controls are made, or when_____.

6. The main rotor must be in proper rig before any_____.

SECTION XI. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Main Rotor Complete rigging lesson for the UH-60 helicopter. The key points to remember are:

- Rigging of the flight control system consists of coordinating cyclic, collective stick, and yaw pedal movements, with correct blade angles at the main and tail rotors.
- Rigging procedures shall be done by qualified technicians who are familiar with the helicopter and flight control system. It is essential to keep the helicopter perfectly still while zeroing and taking blade angle readings.
- The digital vernier protractor or the universal vernier propeller protractor is the preferred tool to accomplish this.
- A limit of three technicians are recommended on the helicopter at a time, one to take readings, one to assist in rotating blades, and one in the cockpit to position and cycle the controls.
- All calculations should be documented on a rigging worksheet and filed away. The rigging worksheet is used to record all alignment readings.
- A Main Rotor Complete rig and rig check is required whenever a main gear box, rotor head, bellcrank support, or when Flight Safety Critical component is replaced or adjusted.
- Fixed length pushrods, bellcranks, and idlers are interchangeable without a rigging check.
- There are five different rigging procedures for flight controls on the UH-60 helicopter: a Main Rotor Complete rig, Main Rotor rig check, Primary Servo Four-point rig check, Tail Rotor Complete rig, and Tail Rotor rig check.
- A Main Rotor Complete rig is required if the Main Rotor rig check fails, or by direction of the maintenance officer.
- To properly accomplish a rig, utilize rig kit, 70700-20389-042, which consists of all rigging pins, and rigging blocks required to complete the rig.
- A Main Rotor rig check is required whenever a main gear box, rotor head, bellcrank support, or when any flight control component is replaced.
- Fixed length pushrods, bellcranks, and idlers are interchangeable without a rigging check. Adjustable length rods may be changed without a rigging check, provided replacement is trammeled to exact length.
- The main rotor must be in proper rig before any rigging is to be completed on the tail rotor section.
- A tail rotor complete rig is required whenever any major changes in tail rotor flight controls are made, or adjustments are made to flight controls not covered in the tail rotor rig check.
- To begin a Main Rotor system complete rig, remove the main rotor pylon sliding cover and mixer work platform.
- There are separate parts to a main rotor complete rig.
- These are commonly referred to as a dry rig (blade angles).
- The dry rig, centers the flight controls, allows for full range of motion (as required) for flight, and ensures the flight control rods have adequate clearance. This procedure is accomplished with the hydraulics off.

J. ENABLING LEARNING OBJECTIVE No. 10

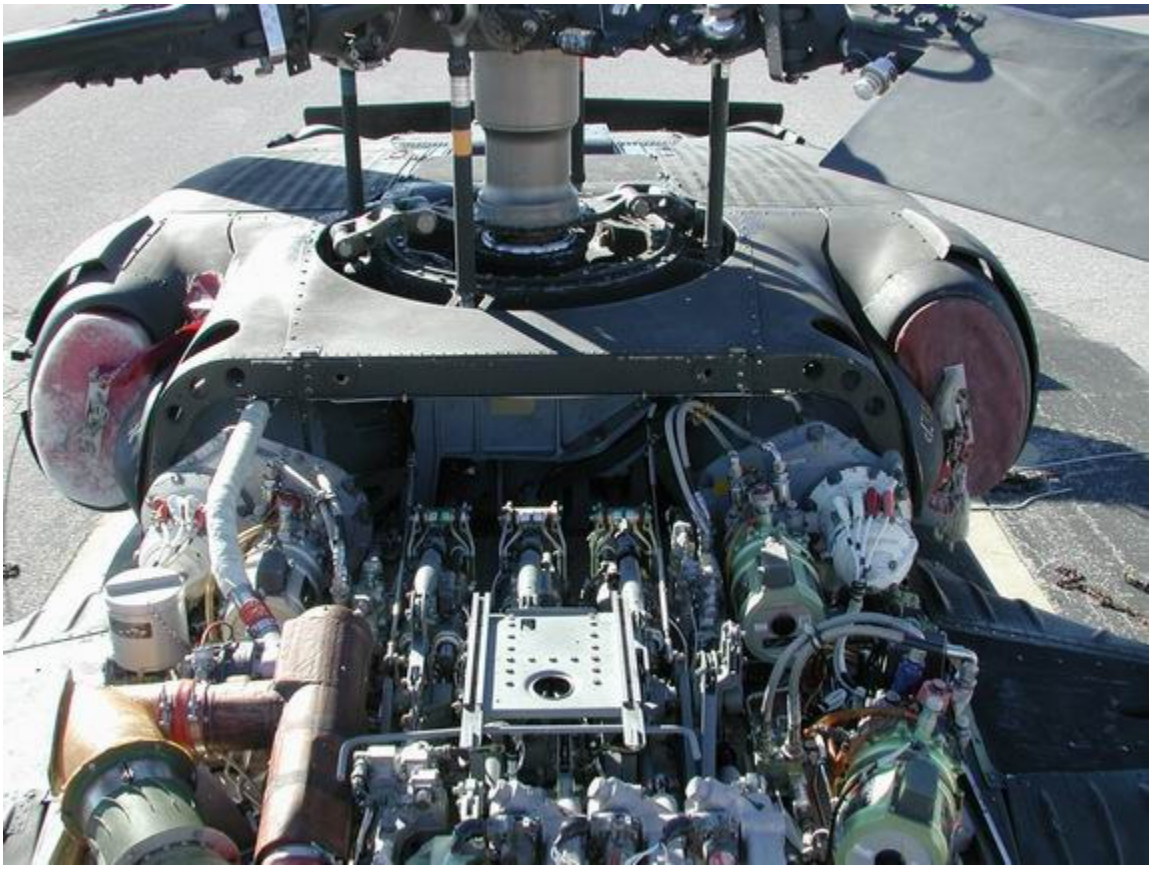
ACTION: Identify the procedures to complete a Tail Rotor complete Rigging.

CONDITION: Given a description and related technical manuals.

STANDARD: IAW UH-60 Technical Manuals.

a. Tail Rotor Complete Rig

Frame # 0825 (Tail Rotor Complete Rig)



CAUTION: Put a sign in the cockpit to notify personnel that flight controls should not be moved during rigging, as damage to components could result.

To prevent damage to the antiflap cam and antiflap stop attaching bolts, the antiflap cam must be held in flight position when cycling flight controls with main rotor blades not installed.

NOTE: Main rotor must be in proper rig before rigging tail rotor.

A tail rotor complete rig is required whenever major changes in tail rotor flight controls are made or when adjustments must be done to system that are not covered in tail rotor rig check.

(1) A complete tail rotor rig is required whenever major changes have been made to tail rotor flight controls or when adjustments must be made to the system not covered in the rig check.

(2) The main rotor must be in proper rig before rigging the tail rotor.

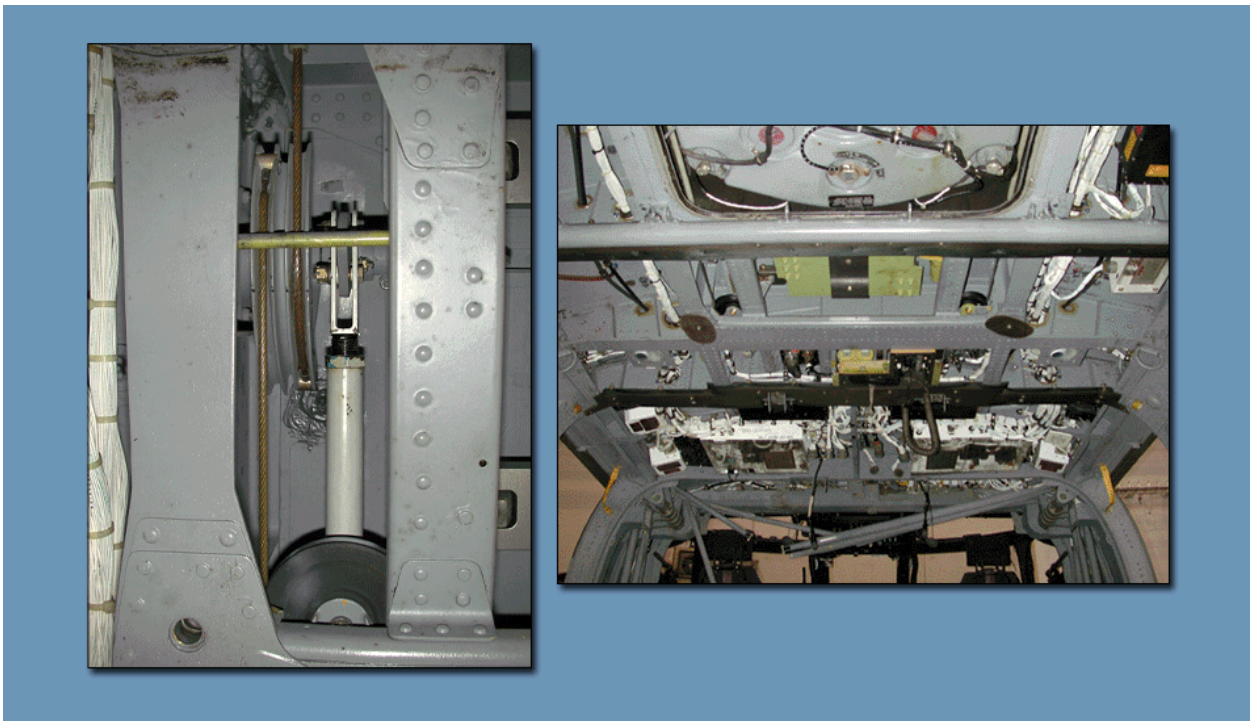
(3) To begin, open the main rotor pylon sliding cover.

Frame # 0830 (Tail Rotor Complete Rig)

(4) Remove tail gear box forward fairing.

(5) Use external hydraulic power if possible or the back-up hydraulic system.

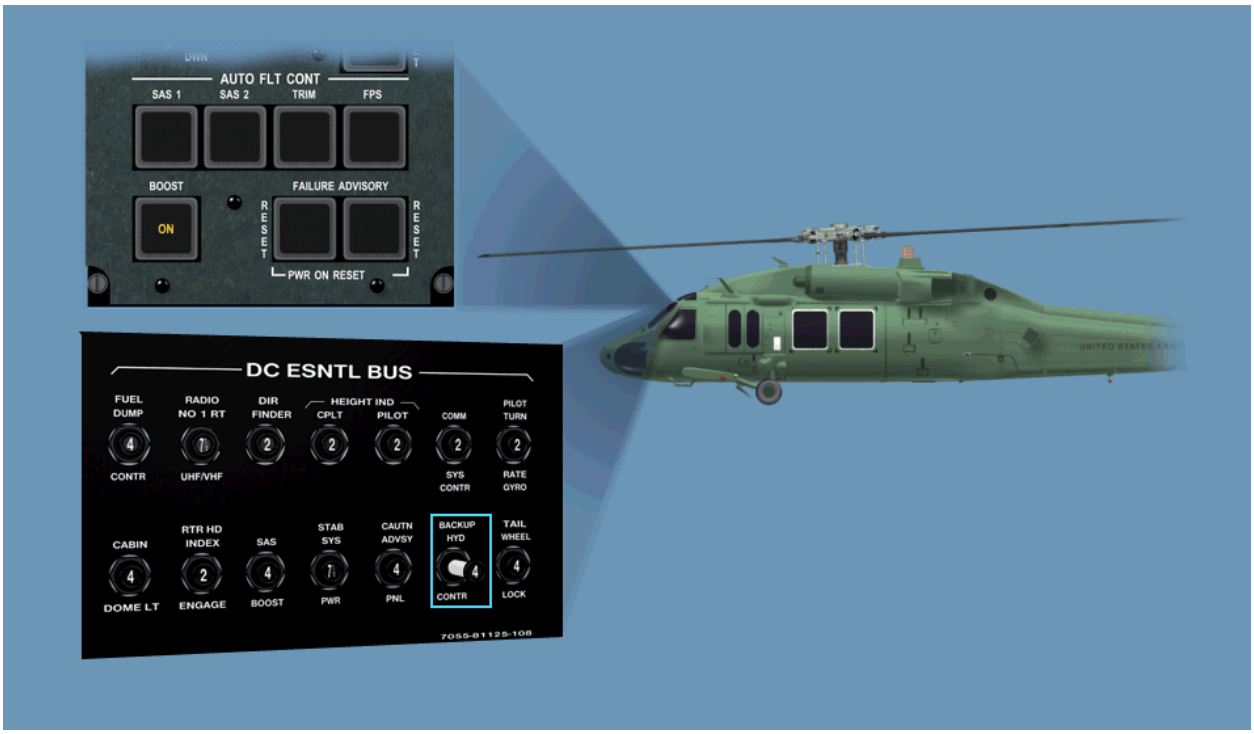
Frame #0835 (Tail Rotor Complete Rig)



(6) Remove soundproofing from cabin ceiling at STA. 311.0 and from storage compartment.

(7) Remove troop seats from rear cabin.

Frame # 0840 (Tail Rotor Complete Rig)

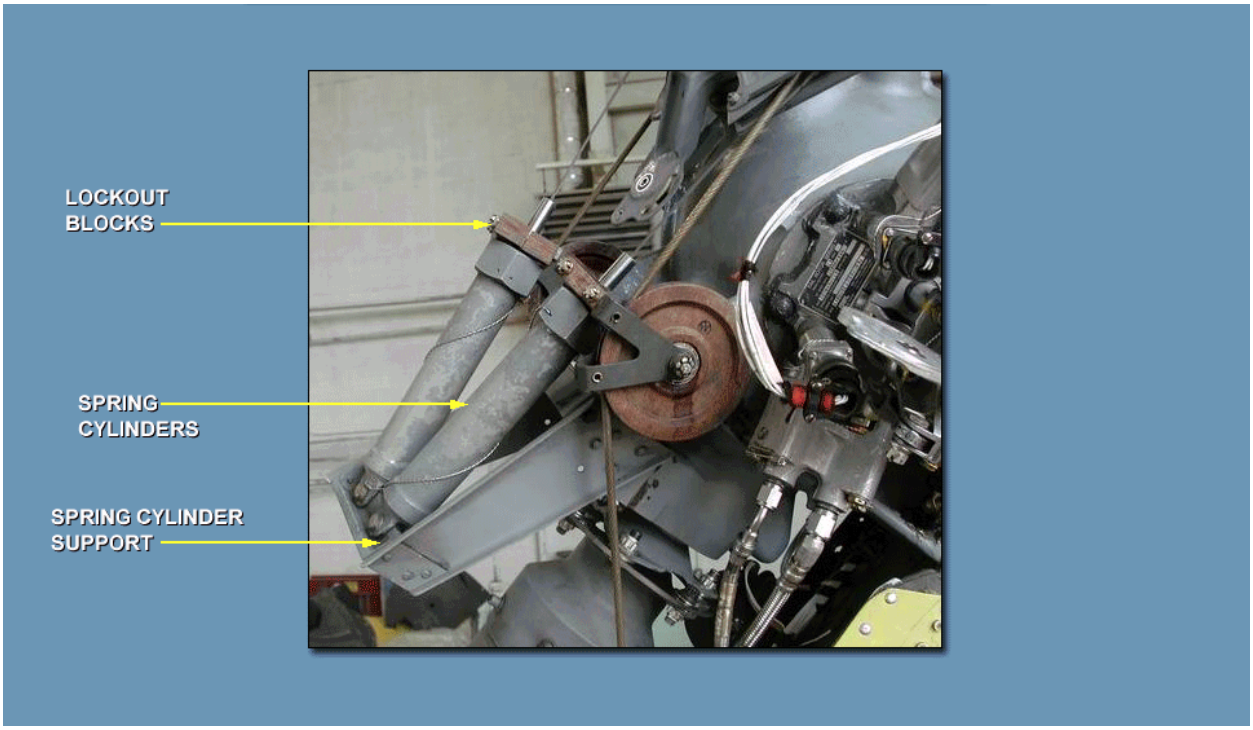


(8) When using external hydraulic power to perform, pull the BACKUP HYD CONTR circuit breaker in DC ESNTL BUS on overhead upper console.

(9) Disengage SAS 1, SAS 2, and TRIM buttons, on AUTO FLIGHT CONTROL panel in lower console.

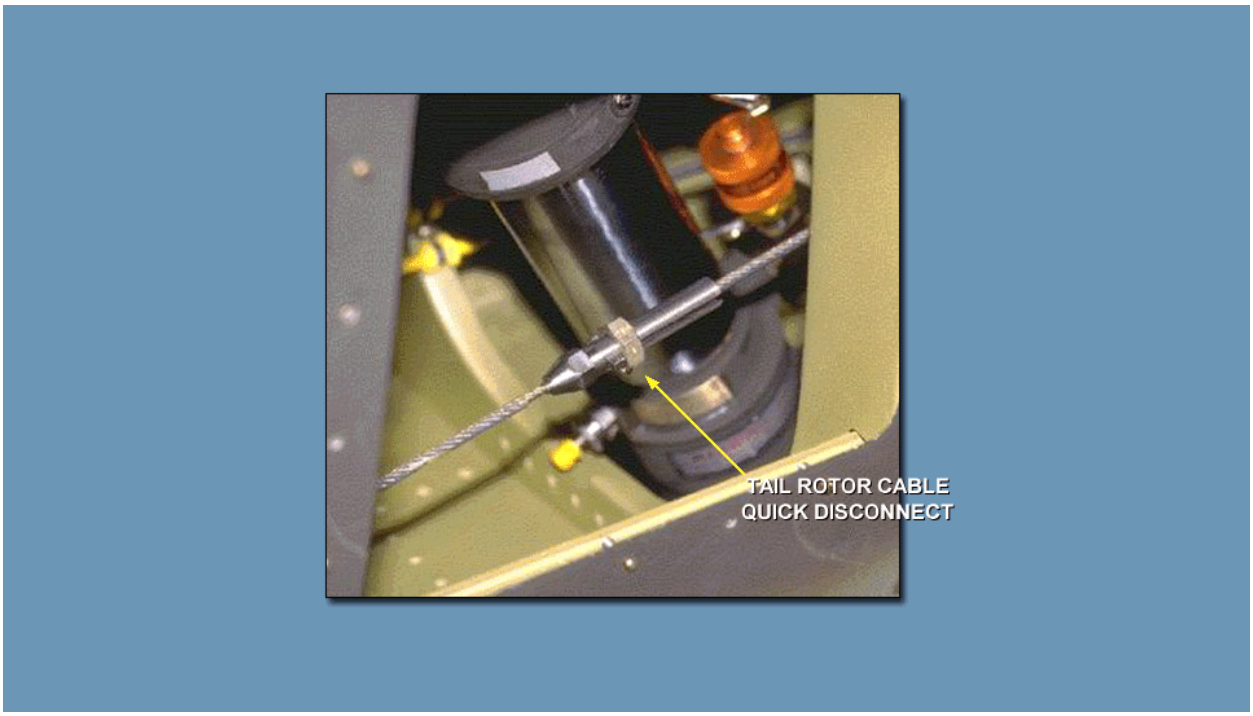
(10) Engage the boost switch.

Frame # 0845 (Tail Rotor Complete Rig)



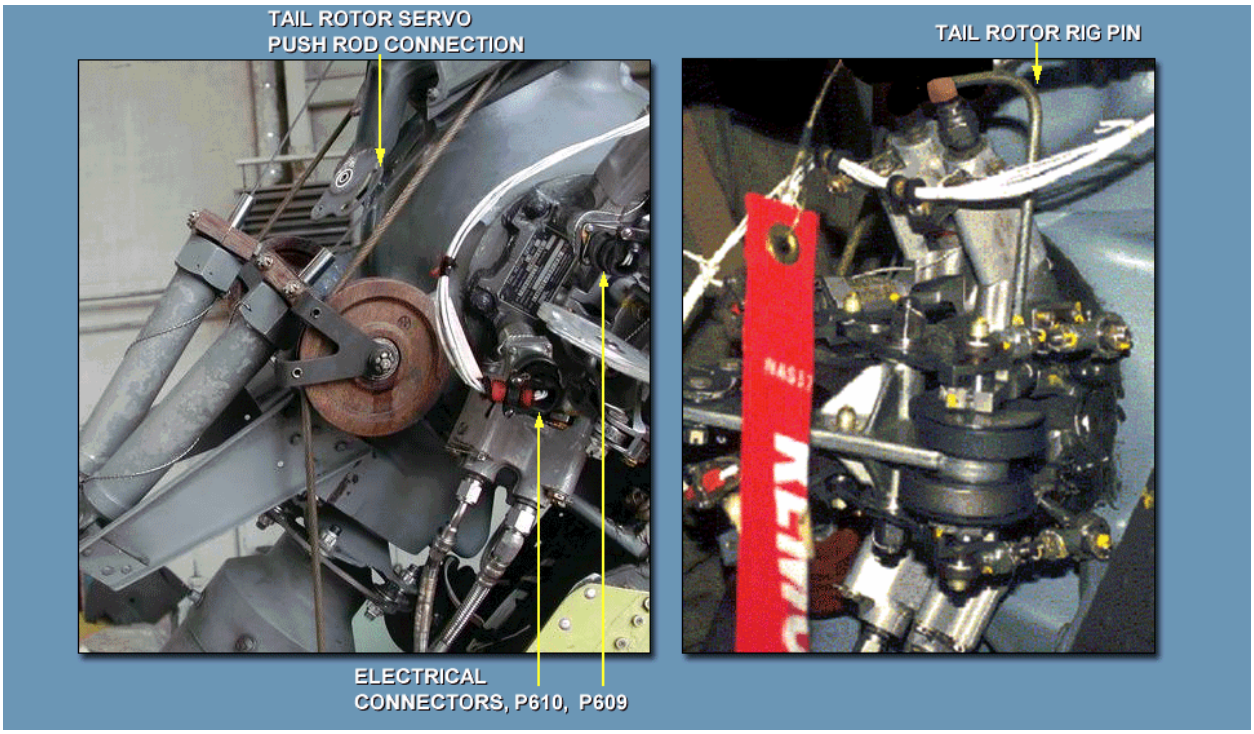
(11) Install lockout blocks on the aft quadrant and disconnect the spring cylinders from support at tail rotor quadrant.

Frame # 0847 (Tail Rotor Complete Rig)



(12) Disconnect the tail rotor cables at the quick disconnects, located behind the upper tail strut inspection panels.

Frame # 0850 (Tail Rotor Complete Rig)

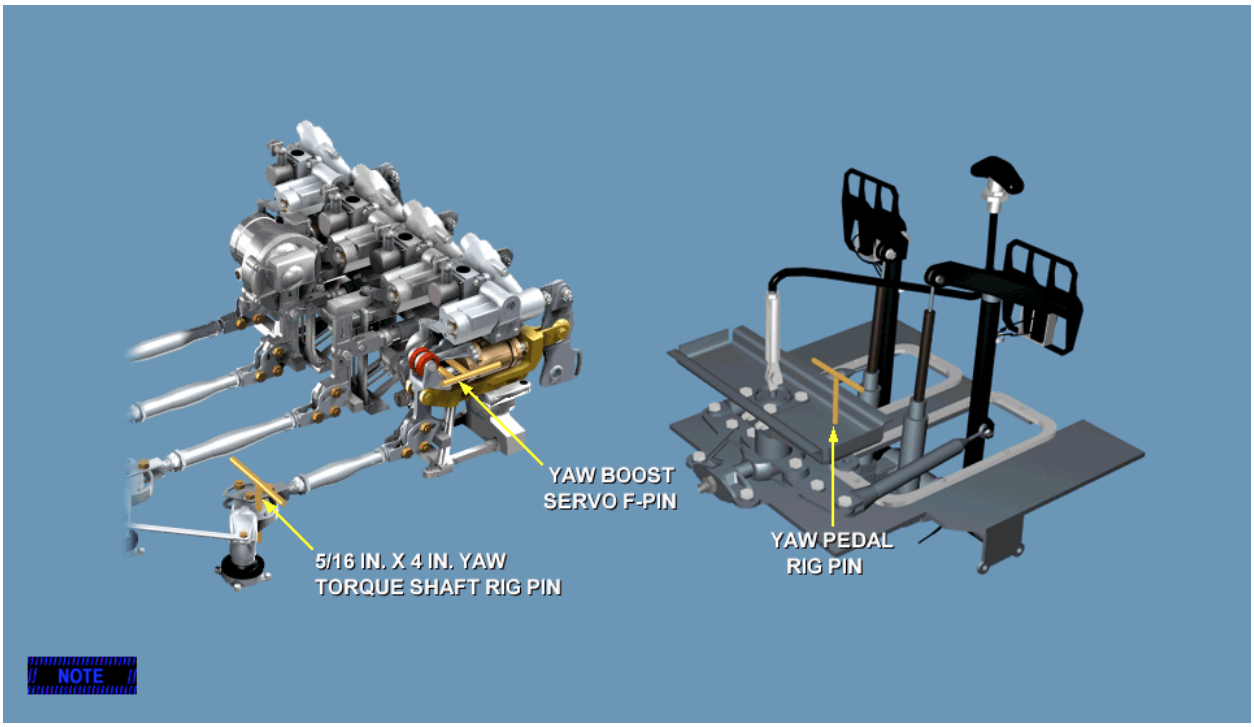


(13) Disconnect electrical connectors, P609 and P610, on the tail rotor servo pressure switches.

(14) Remove the pushrod from the tail rotor servo and install rigging pin (1/4 x 6 in.) in the tail rotor servo.

(15) Prior to reinstalling the electrical connectors inspect and treat the connectors.

Frame # 0855 (Tail Rotor Complete Rig)



NOTE: Control rod is adjusted to correct length when notch in forward quadrant outside diameter is lined up with hole in airframe which holds cable guard. It may be necessary to screw the right pedal stop all the way in to perform rod adjustment.

(16) Move the pilot collective stick to mid-position, install rig pin 70700-20380-062, (F-pin) on yaw boost servo, and rig pin (5/16 in. x 4 in.) in yaw torque shaft.

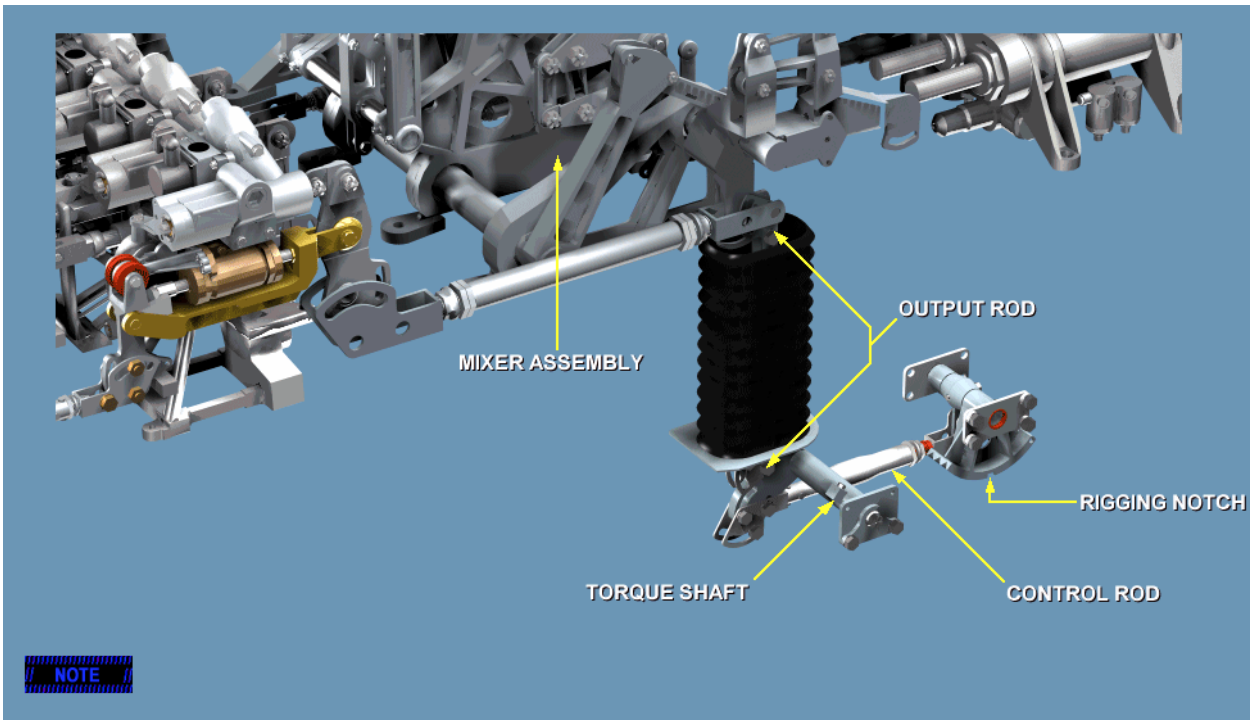
(17) Adjust the yaw input control rod if necessary and install two rigging pins (5/16 in. x 6 in.) in both pilot and copilot yaw pedal adjustors.

(18) If the rigging pins will not go in easily, adjust torque shaft input rods in cabin as required.

(19) At this time, be sure all control rods are adjusted and connected from cockpit to mixer.

(20) Check that the output rod from the mixer to torque shaft is properly connected.

Frame # 0857 (Tail Rotor Complete Rig)



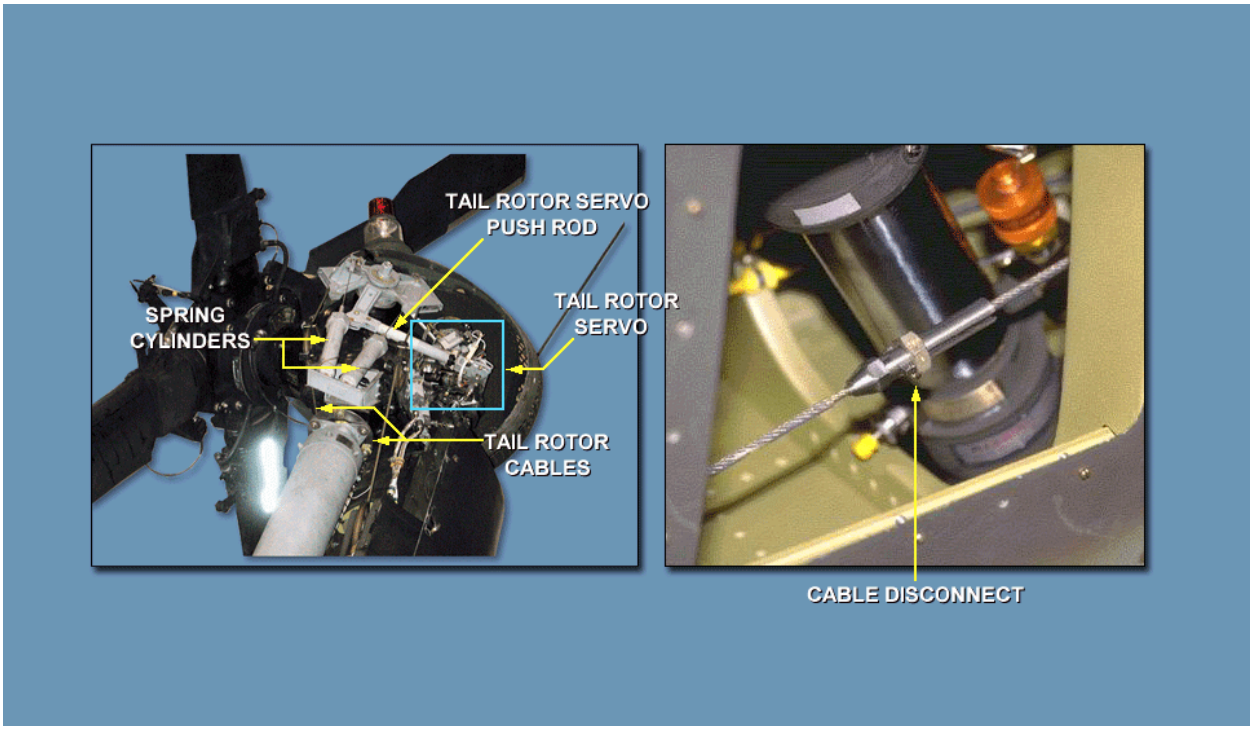
NOTE: Control rod is adjusted to correct length when notch in forward quadrant outside diameter is lined up with hole in airframe which holds cable guard. It may be necessary to screw right pedal stop all the way in to perform rod adjustment.

(21) Check that the output rod from the mixer to the torque shaft is properly connected.

(22) Adjust and connect the control rod from the torque shaft to the forward quadrant.

(23) Tighten jam nuts.

Frame # 0860 (Tail Rotor Complete Rig)



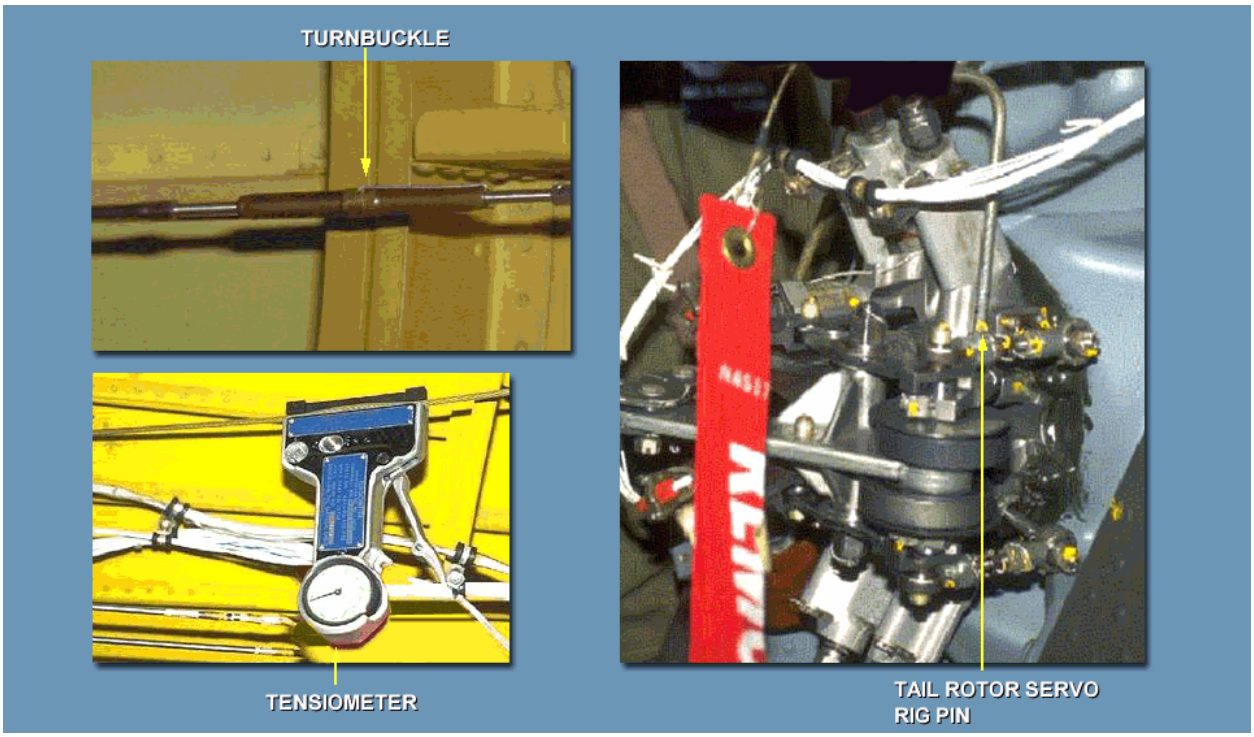
(24) Adjust the tail rotor quadrant to the tail rotor servo pushrod to a length of between 12.56 to 12.68 inches and connect the cable disconnects.

(25) Torque the bottom forward cable retainer jamnut in the aft cable slot 40 - 60 inch-pounds and lockwire.

(26) Do not use these connections as an adjustment for cable tension.

(27) Connect the tail rotor pushrod between the tail rotor servo and quadrant, spring cylinders and remove the lockout blocks.

Frame # 0865 (Tail Rotor Complete Rig)



(28) Utilizing a cable tensiometer, adjust the cable tension at the forward end of tail cone.

(29) Ensure the rigging pins in the mixer and tail rotor servo remain free at all times.

(30) Install all new locking clips in the turnbuckles after the cable tension(s) have been set.

(31) Check that the rigging pin in the tail rotor servo can be removed and reinstalled easily without pulling or pushing on the servo input linkage if not, readjust the cable tension.

(32) Safety the turnbuckles with locking clips.

Frame # 0875 (Tail Rotor Complete Rig)

(33) Check the cable tension only after the helicopter has been at an even temperature for 1 hour.

(34) Do not check the cable tension with the helicopter parked in the hot sun.

(35) Tolerance on specified tension values is ± 2% difference between two cables.

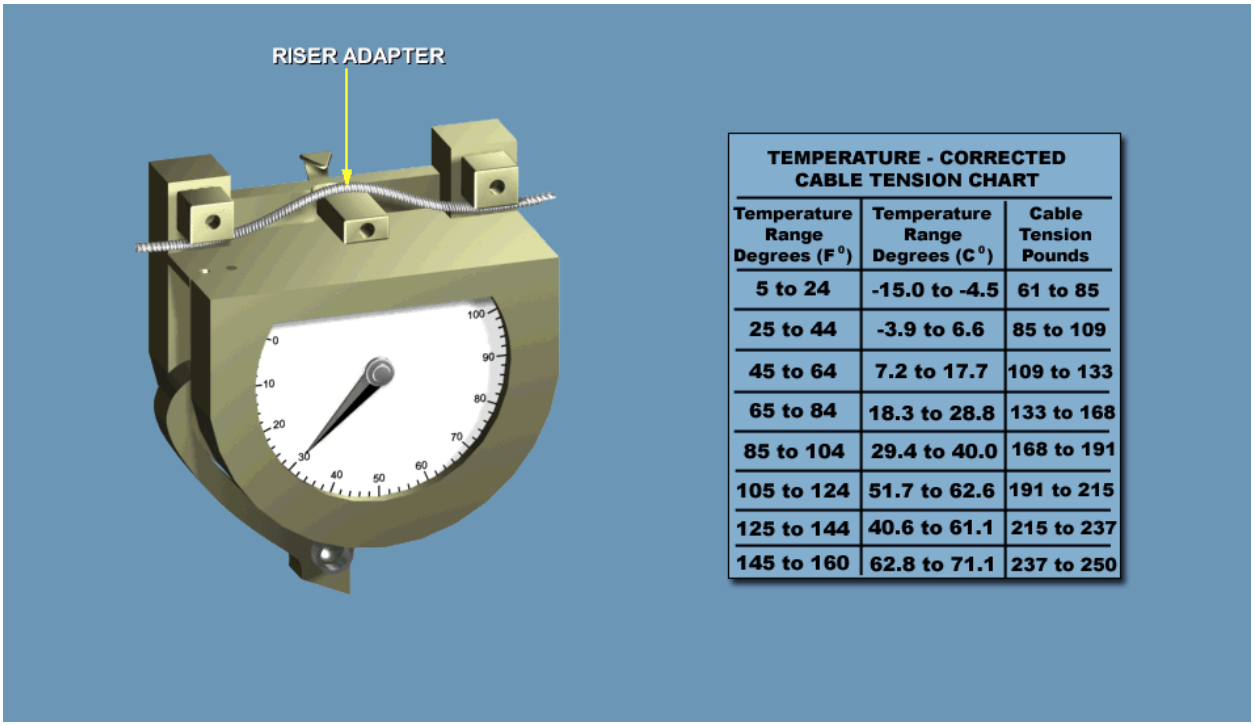
(36) If temperatures below +5 °F are anticipated, set tension to 75 pounds.

(37) Reset tension to chart before helicopter is operated at temperatures above 40 °F.

(38) Flight control cables are 5/32-inch diameter, and with a plastic coating, total diameter is 7/32-inch.

(39) Measure cable tension with proper tensiometer setting.

Frame # 0875 (Tail Rotor Complete Rig)



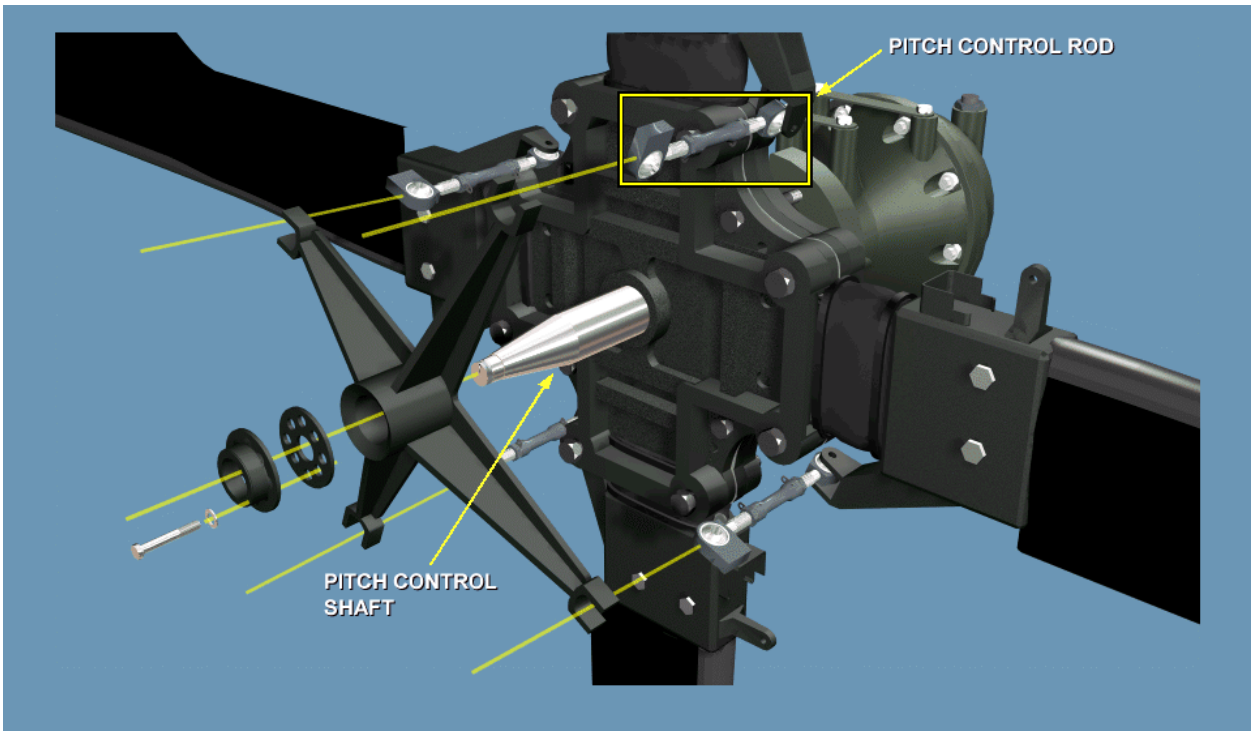
(40) When using adjustable risers, the No. 3 riser adapts to 7/32-inch total-diameter cable.

(41) When the tensiometer does not have adjustable risers, use the 5/32-inch diameter tension scale.

(42) Record temperature and cable tension on DA Form 2408-13-1 for use when performing future tension check.

(43) Check DA Form 2408-13-1 to make sure tail rotor cable tension check is shown as due at 9 to 11 flight hours

Frame # 0870 (Tail Rotor Complete Rig)



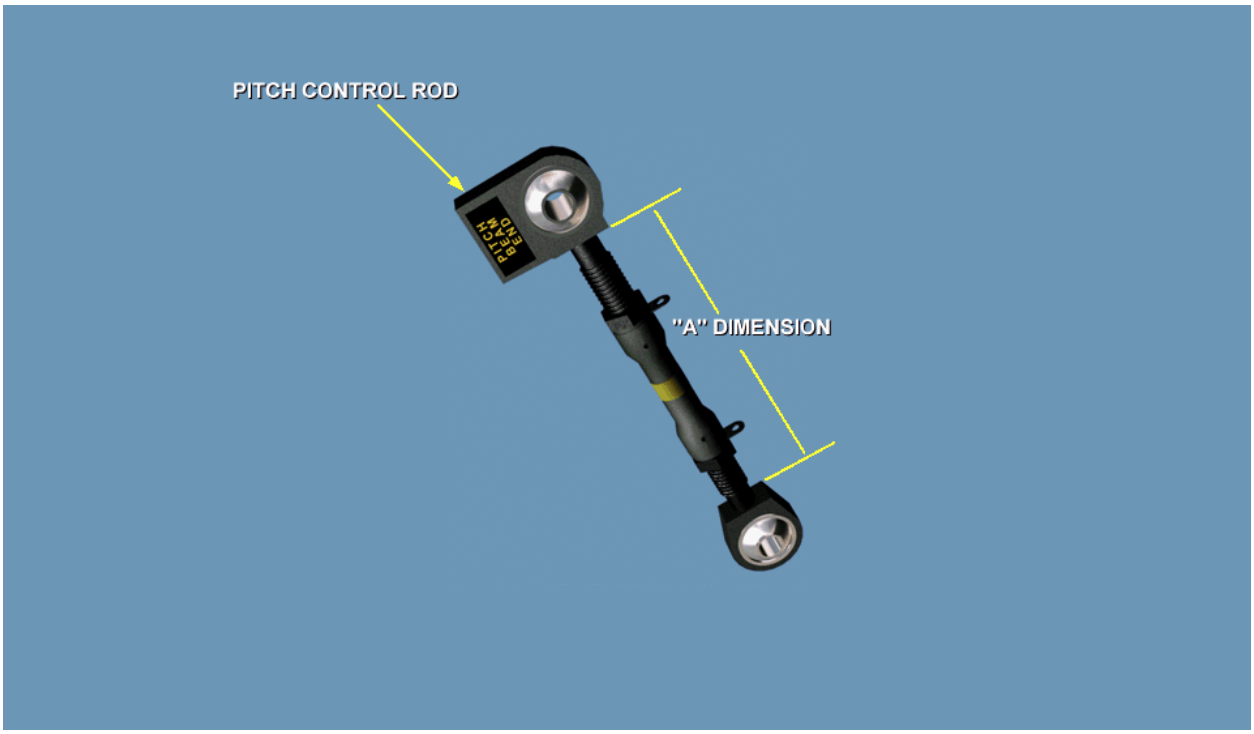
(44) Position each blade, in turn (one blade at a time), in a horizontal position pointing forward, and remove the bolt, washer, and nut securing the pitch control rod to the pitch change beam.

(45) Adjust the pitch control rod, as required, until attaching bolts drop freely into holes on pitch change beam.

(46) Do not apply any pressure on the blades to line up attaching bolt holes.

(47) Install the pitch control rods to the pitch change beam and hand tighten the jam nut and position each blade, in turn, in horizontal position pointing forward.

Frame # 0870 (Tail Rotor Complete Rig)

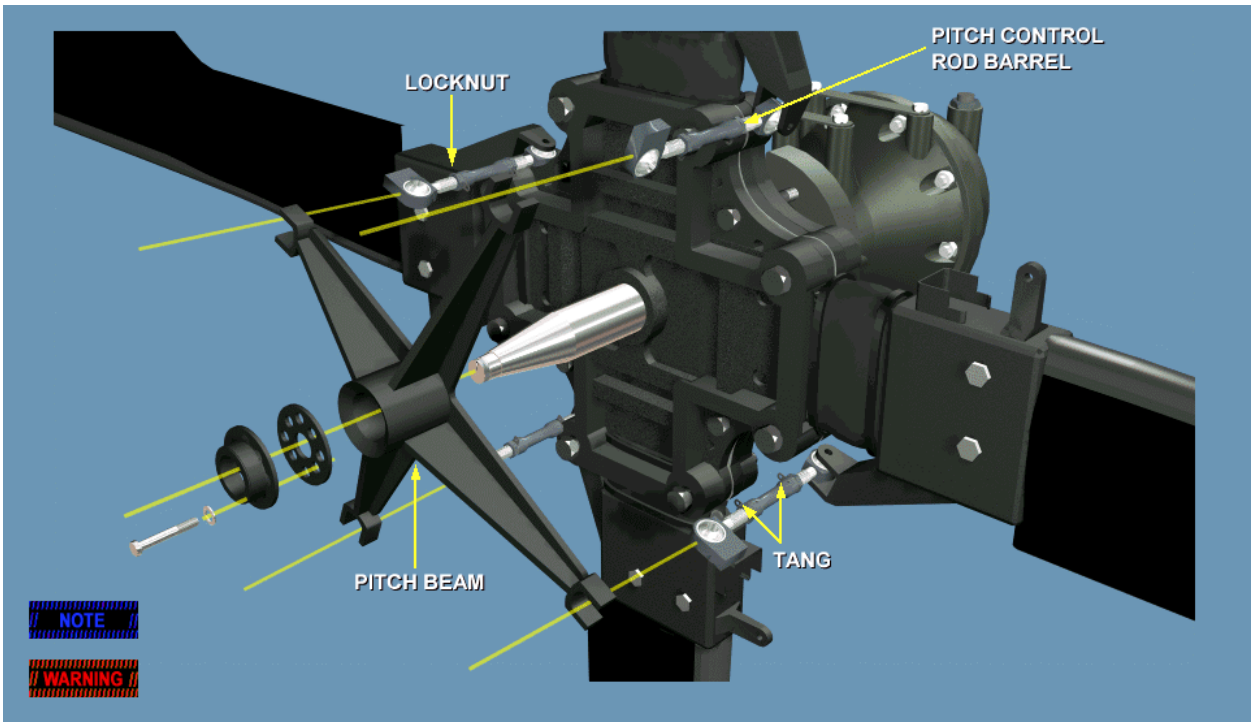


(48) Back off the jam nut on both ends of pitch control rods, approximately 0.050-inch.

(49) Measure each pitch control rod to the nearest ± 0.050-inch.

(50) Record dimension "A" and corresponding blade color on DA Form 2408-13-1.

Frame # 0880 (Tail Rotor Complete Rig)



WARNING: To prevent damage to helicopter, do not use safety cable in this application. Use only lockwire that is specified in this step.

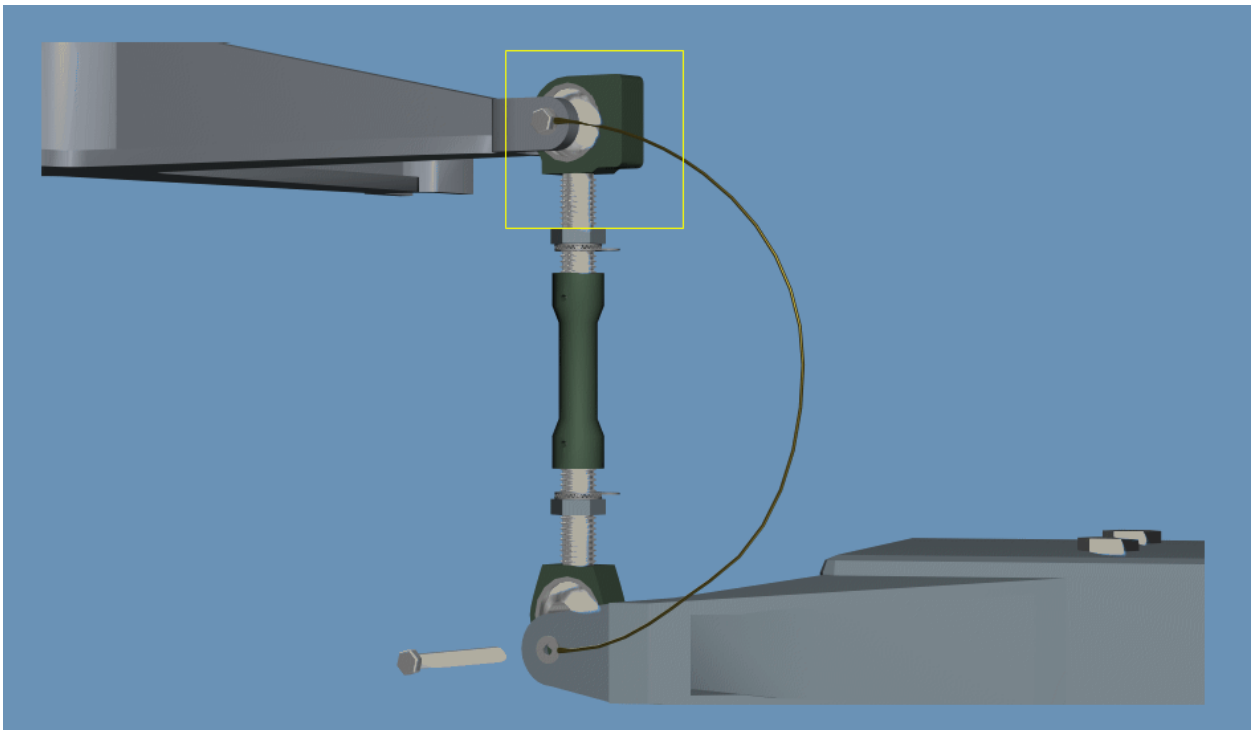
NOTE: Metal to metal contact between rod end and pitch horn may be present while in the static position.

(51) Ensure that rod ends are aligned and parallel to each other within the pitch beam ears and pitch horn.

(52) Torque the jamnut and all locknuts to the proper torque IAW TM and ensure the locking devices are engaged.

(53) Install lockwire from locknut to tang and then back to opposite side of locknut.

Frame # 0883 (Tail Rotor Complete Rig FLASH)



(54) Lengthen each pitch control rod 4 complete barrel turns and record this dimension.

(55) Record the Dimension "A" and corresponding blade color on DA Form 2408-16-1 block seven.

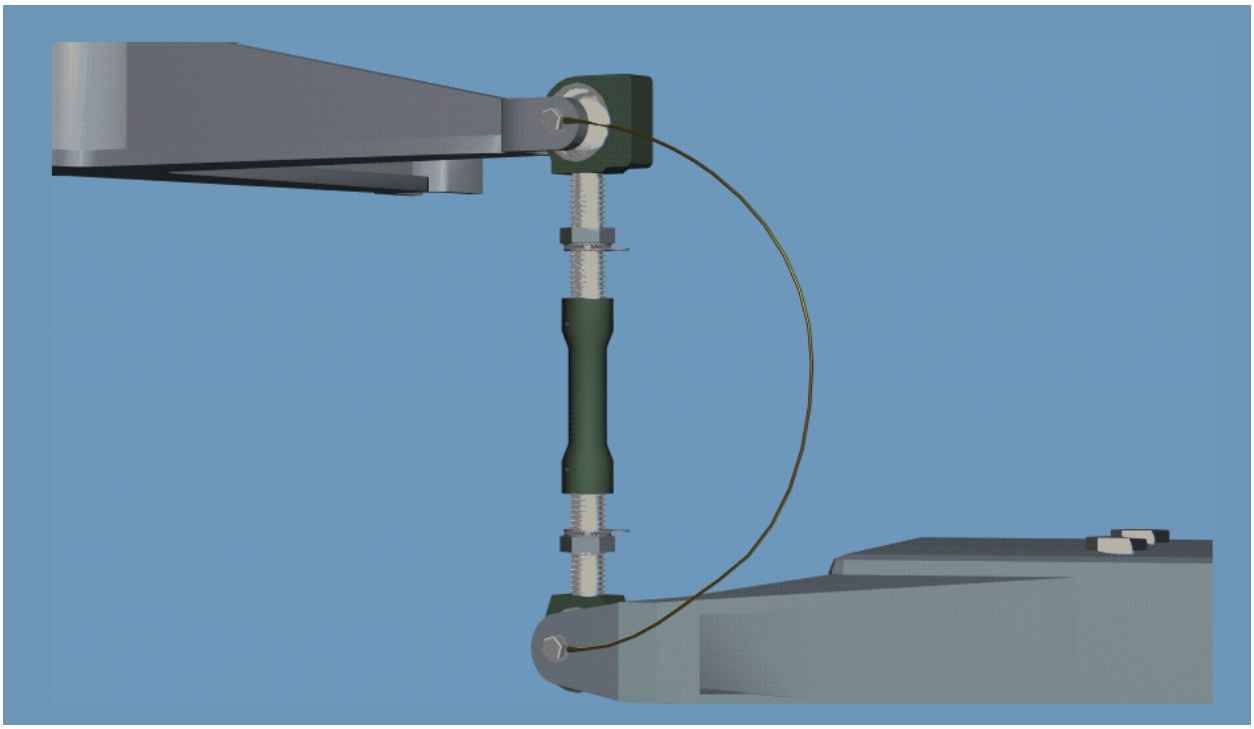
(56) Subtract the first measurement from the second for each blade.

(57) The value should be 0.280 TO 0.380-inch (this is the 3 degrees of bias required).

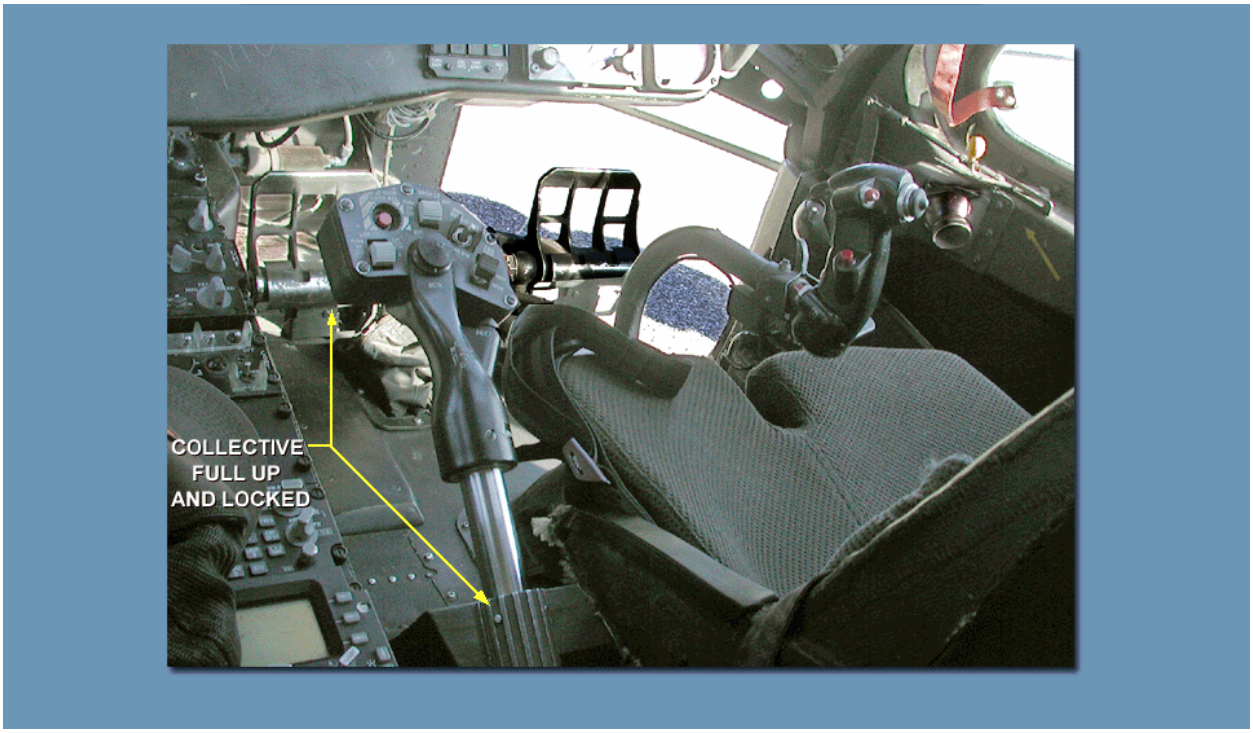
(58) If the value is not within this range, disconnect the pitch control rod from that blade and repeat the adjustment steps for that blade only.

(59) Safety and reconnect pitch control rods to pitch change beam and remove all rig pins previously installed.

Frame # 0883 (Tail Rotor Complete Rig)

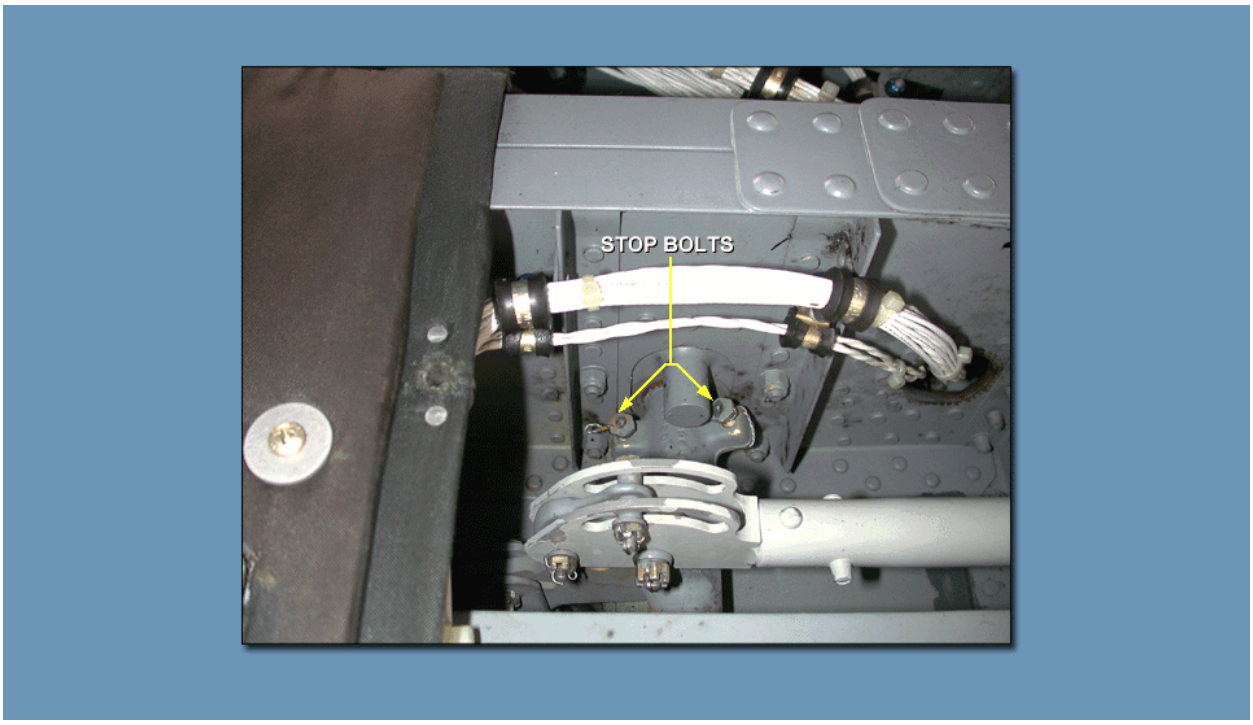


Frame # 0885 (Tail Rotor Complete Rig)



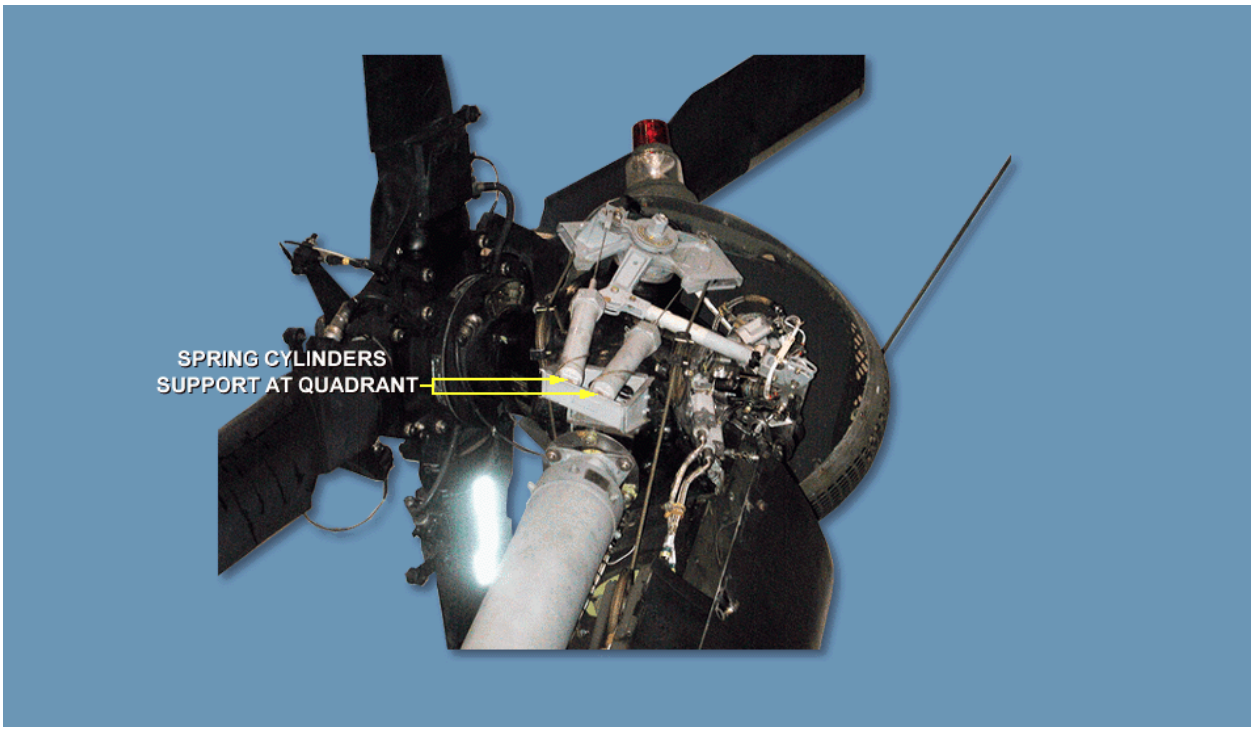
(60) Raise collective stick to full up position and lock in place.

Frame # 0890 (Tail Rotor Complete Rig)



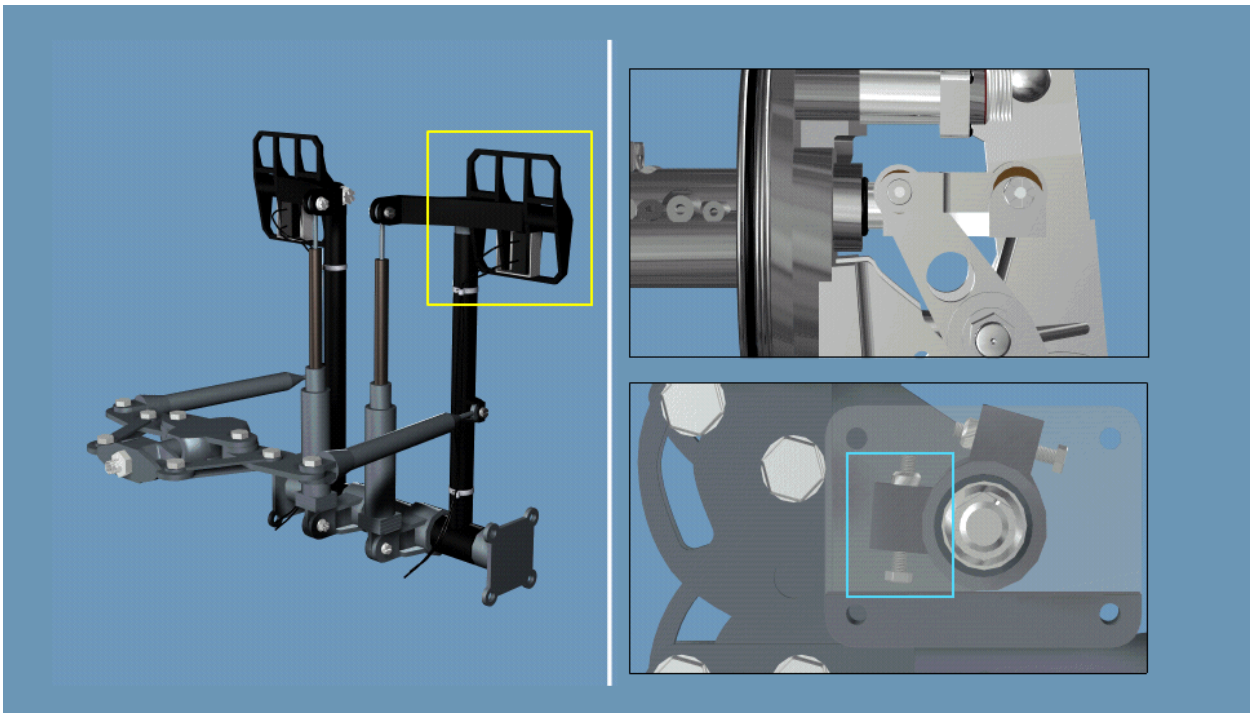
(61) Thread in left and right pedal stop bolts at front torque shaft lever installation just below mixer.

Frame # 0895 (Tail Rotor Complete Rig)



(62) Disconnect spring cylinders from support at tail rotor quadrant.

Frame #0900 (Tail Rotor Complete Rig FLASH)

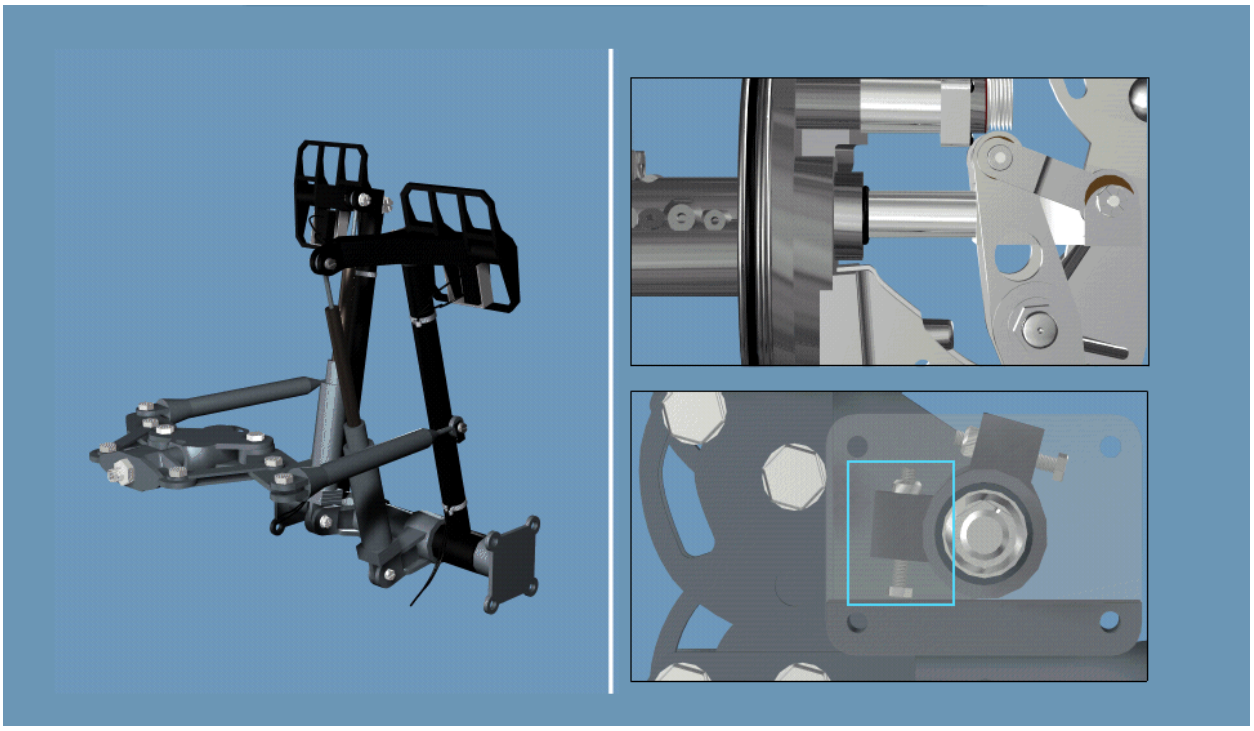


(63) Push the left pedal until the tail rotor servo fully extends.

(64) While the left pedal is fully pressed, note the length of the exposed piston rod between the servo housing and the piston rod yoke.

(65) The length of the exposed piston must be greater than 3.50 inches.

Frame #0900 (Tail Rotor Complete Rig FLASH)



(66) With the left pedal fully pressed, adjust the left pedal stop bolt at the front torque shaft lever installation, just below the mixer, until the stop is contacted.

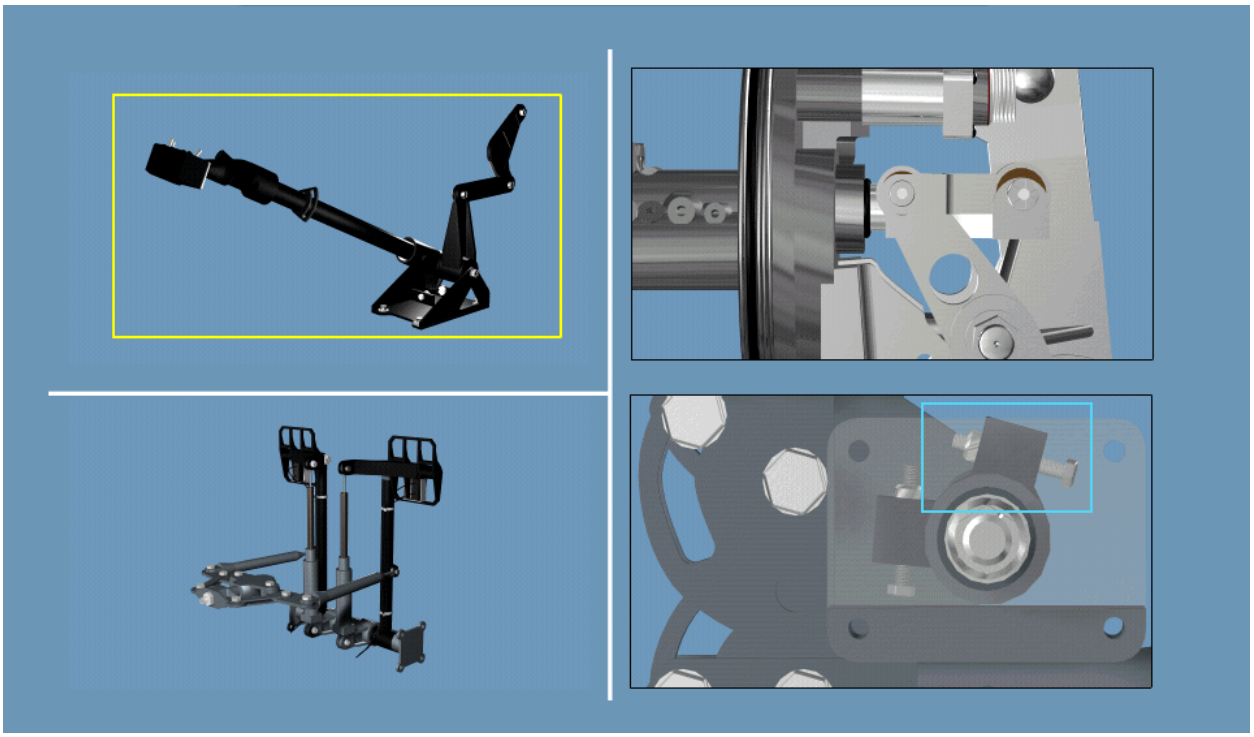
(67) Turn the stop bolt out in 1/2-turn increments while cycling pedals.

(68) Recheck the extended dimension between adjustments until noted dimension is decreased by 0.010 to 0.060-inch.

(69) The exposed piston rod between the servo housing and piston rod yoke will read 3.44 inches or greater at full left pedal after the above adjustments are performed.

(70) Once completed, lockwire the bolt.

Frame # 0905 (Tail Rotor Complete Rig FLASH)

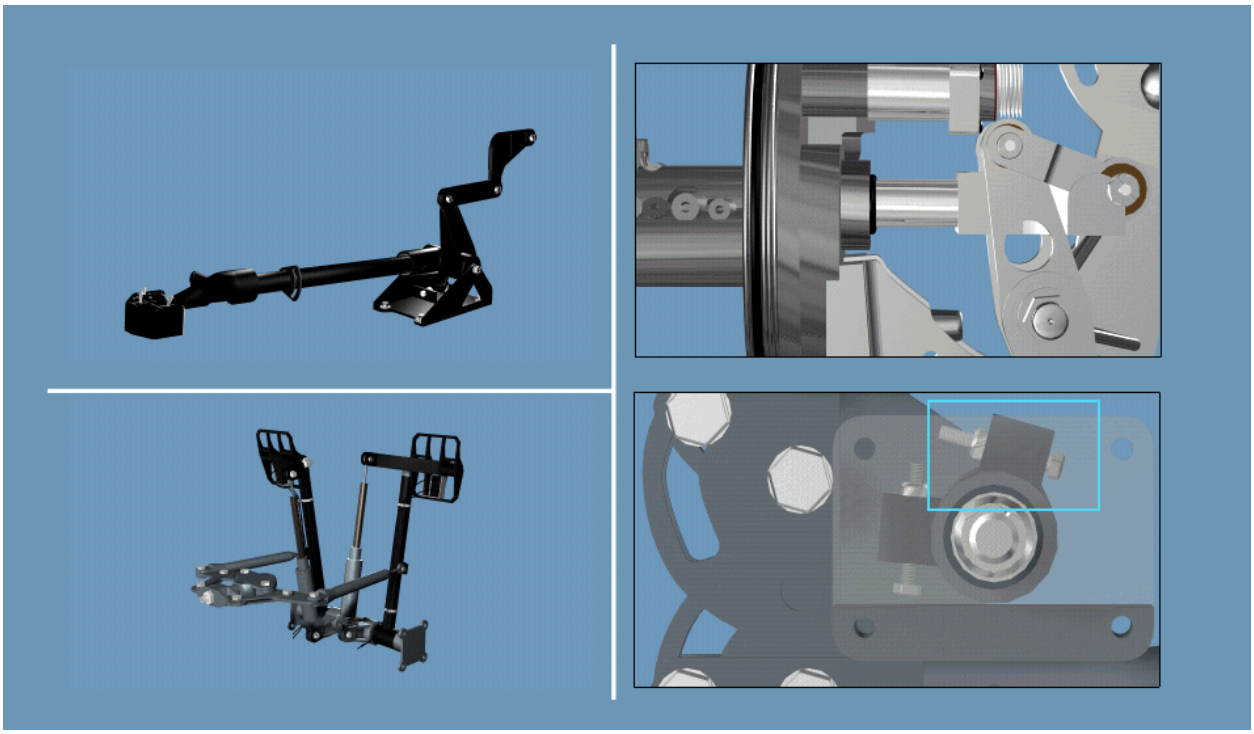


(71) Unlock and move the collective stick to full down position and lock in place.

(72) Push the right pedal until the tail rotor servo bottoms (less than 0.030-inch gap between servo housing and piston rod yoke).

(73) Note this dimension.

Frame # 0905 (Tail Rotor Complete Rig FLASH)



(74) With the right pedal fully pressed, adjust the right pedal stop bolt at the front torque shaft lever installation until the stop is contacted.

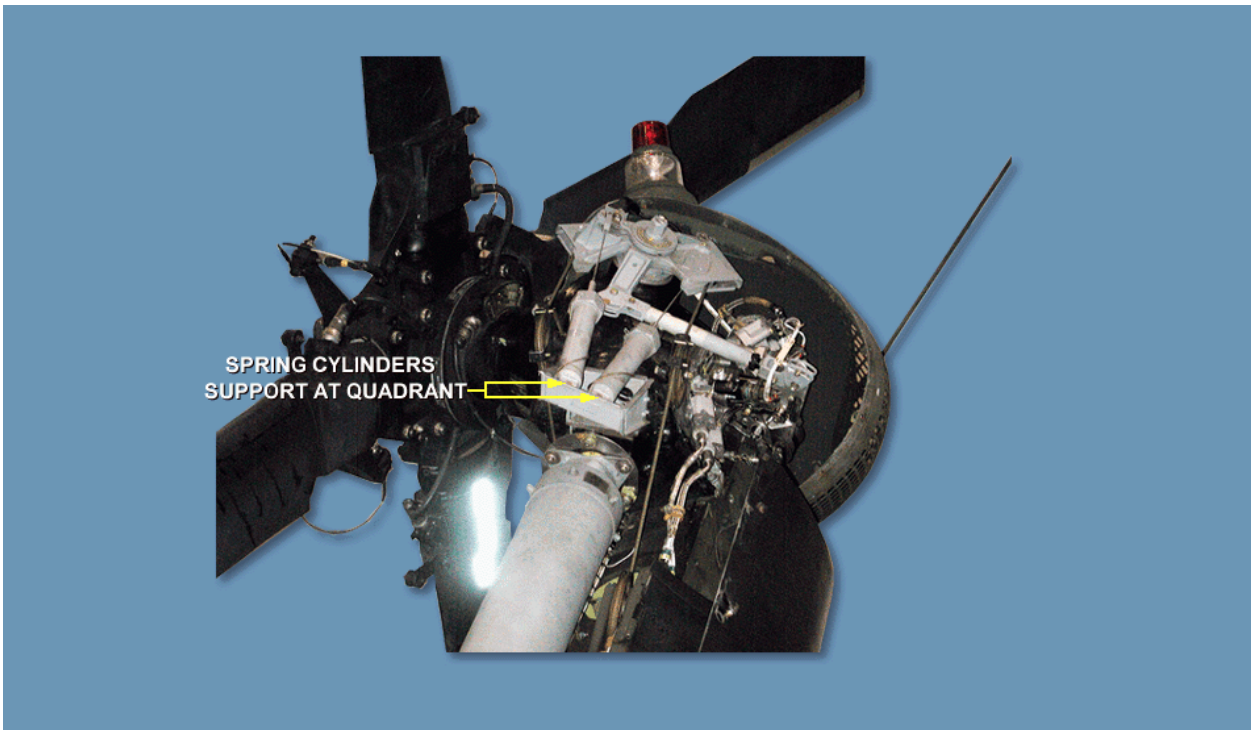
(75) Turn the stop out in 1/2-turn increments while cycling pedals.

(76) Recheck the dimension between adjustments until noted dimension is increased by 0.010 to 0.060-inch and the tail rotor servo no longer bottoms.

(77) The gap between the servo housing and the piston rod yoke will be less than 0.090-inch at the full right pedal after above adjustments are performed.

(78) Once completed, lockwire the bolt.

Frame # 0910 (Tail Rotor Complete Rig)



(79) Connect spring cylinders to the support at tail rotor quadrant.

b. Quality Control Checks

Frame # 0915 (Quality Control Checks)

(1) Perform these quality control checks on the tail rotor flight control system, after all procedures have been followed IAW applicable TM.

(a) Yaw pedals stopbolts lockwired.

(b) No passage of 0.020-inch lockwire through control rod inspection holes.

(c) Turnbuckles safetied with locking clips.

(d) Cables, pulleys, and fair-leads for condition and proper routing.

(e) Pitch control rod measurement calculation between a value of 0.280 to 0.380-inch.

(f) Make sure all rigging pins are removed and all flight control system attaching hardware installed and safetied.

(g) All control system tri-pivot hardware is properly installed and safetied.

(h) Do an operational check on tail rotor flight control system.

(i) Turn off all electrical and hydraulic power.

(j) Check area for cleanness and foreign material.

(k) Install soundproofing panels in ceiling, STA 295.0 through STA 311.0.

(l) Install tail gear box forward fairing.

(m) Close main rotor pylon sliding cover.

(n) Do a maintenance test flight IAW with TM 1-1520-237-MTF.

(o) Check DA Form 2408-13-1 to make sure tail rotor cable tension check is shown as due at 9 to 11 flight hours.

c. Flight Control Limit Check

Frame # 0916 (Flight Control Limit Check)

(1) The pilots ground flight control check limit check is designed to verify that the controls hit the proper control stops or limiters.

(2) It does not replace the rigging procedures in the TM's.

(3) Each aircraft may be slightly different but the movement of the flight controls as indicated by these procedures is a good indication that the control stops are set properly, there are no unwanted restrictions to the flight controls, and the pilot has full range.

(4) This does not mean that the aircraft has been properly rigged however.

(a) 3 Physical Control Stops

Frame # 0917 (3 Physical Control Stops)

1) BOLT STOPS-Maximum range of Flight Controls.

   a) COLLECTIVE-Metal to metal contact at the base of the pilot and copilot collective sticks.

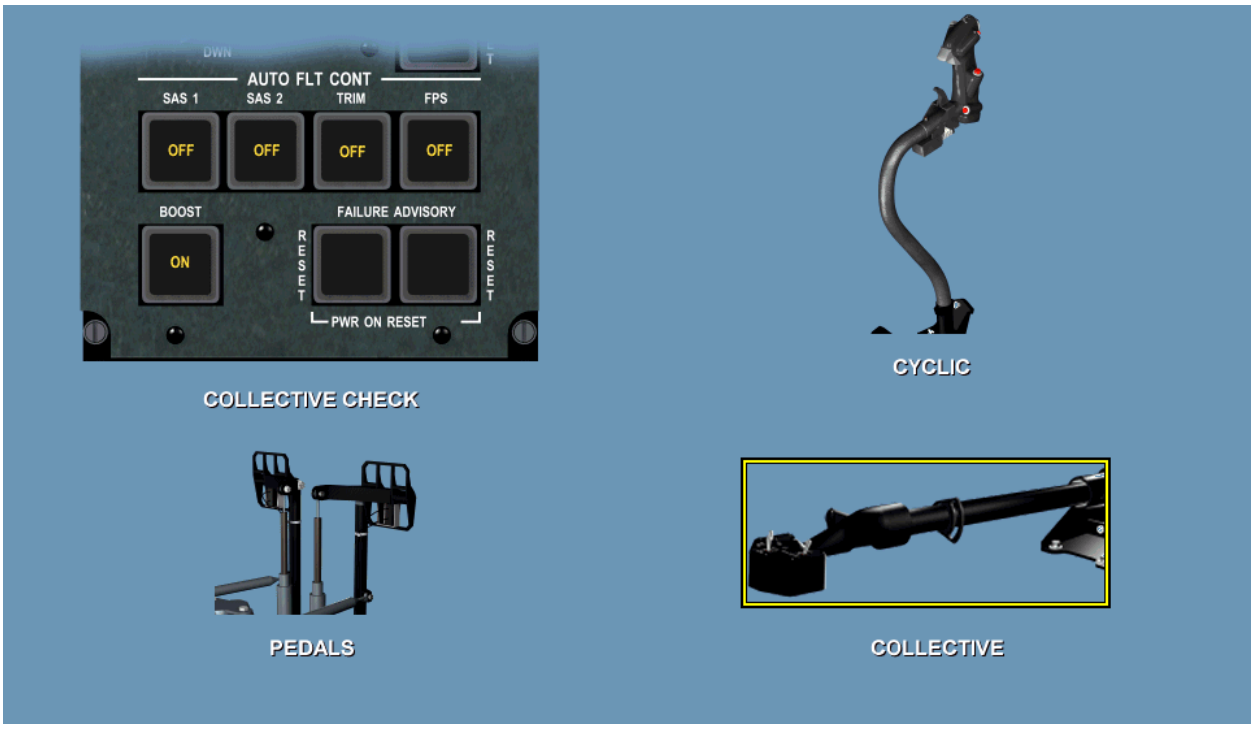
   b) CYCLIC-Metal to metal contact at the base of the pilot and copilot cyclic sticks.

   c) PEDALS-Metal to metal contact located on the cabin overhead at Station 300.

2) MIXING UNIT ROLLER LIMITERS-A spongy contact because the pilot feels the flexing of the flight controls between the cyclic or collective sticks and the mixing unit.

3) 3. SERVO PISTON BOTTOMING OUT-For high collective and right pedal, or low collective and left pedal, the yaw boost servo may contact the cylinder wall before the yaw bolt stops.

Frame # 0918 (Flight Control Limit Check)



(5) BOOST - ON

(6) SAS 1, SAS 2, TRIM, FPS - OFF

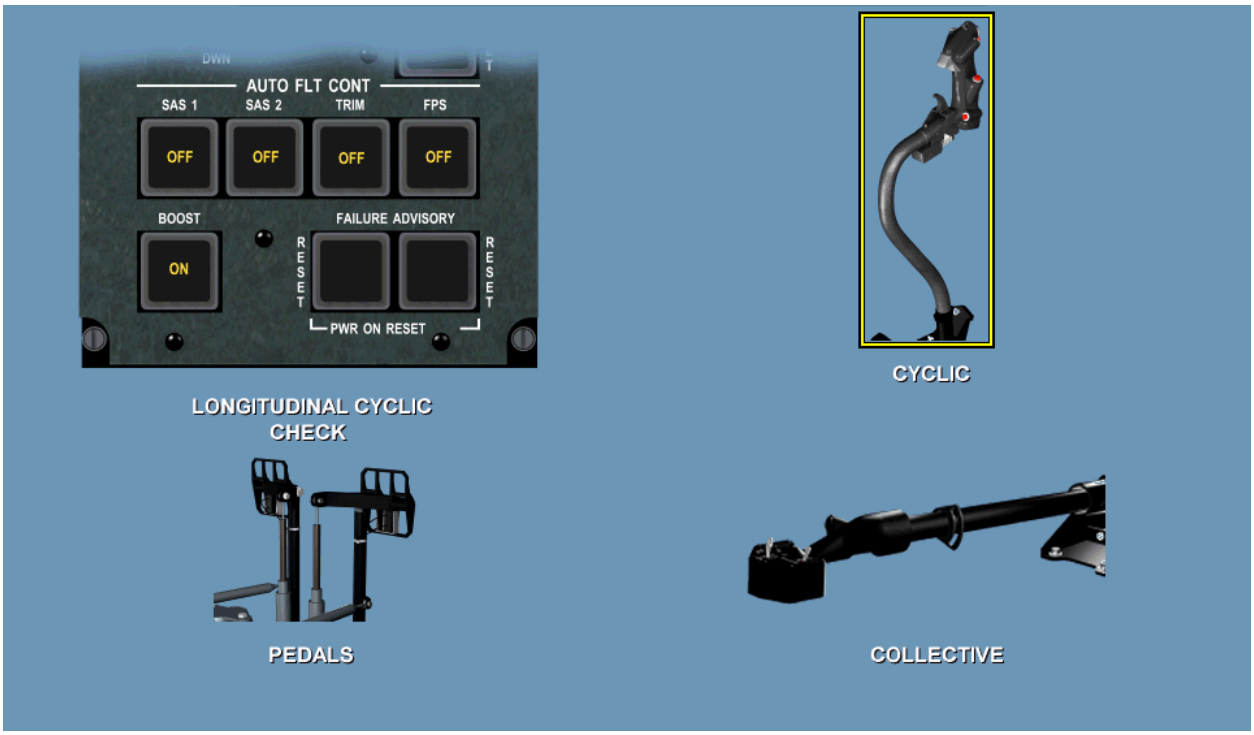
(7) Pedals - Centered

(8) Cyclic - Centered

(9) Collective - Full Down. Collective should contact the lower bolt stop

(10) Collective - Full Up. Collective should contact the upper bolt stop

Frame # 0918 (Flight Control Limit Check)



(11) BOOST - ON

(12) SAS 1, SAS 2, TRIM, FPS - OFF

(13) Pedals - Centered

(14) Collective - Full Down. Collective should contact the lower bolt stop

(15) Cyclic - Full Forward

(16) Maintain slight forward pressure on the cyclic

(17) Slowly raise collective.

(18) Cyclic will move forward (unless the forward stop bolt is contacted) as the collective goes from bottom to mid position then the cyclic should move aft slightly from mid to high collective (Verifies cyclic is on the Mixer roller limiter).

(19) Lack of cyclic movement must be due to contact with the forward bolt stop.

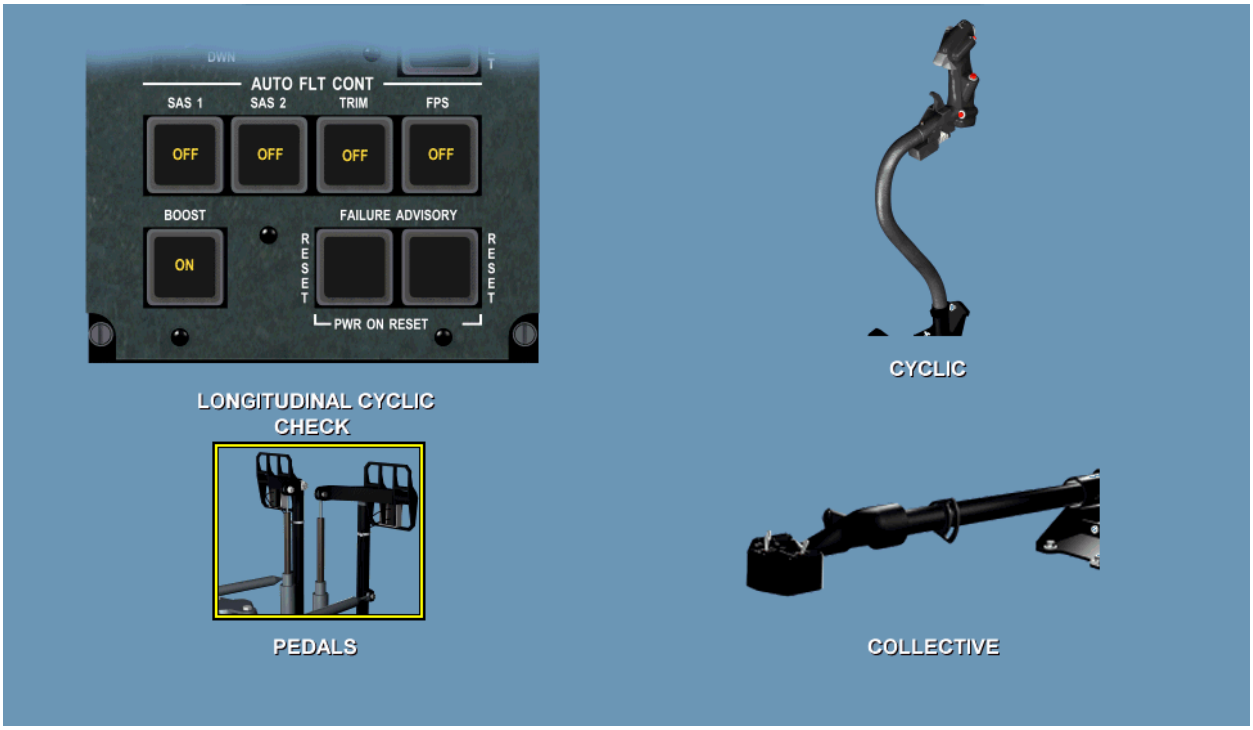
(20) The transition from forward to aft movement of the cyclic during this check should be smooth unless the forward bolt stop is contacted.

(21) In the mid collective range, either pilots cyclic may contact the forward bolt stop at extreme forward cyclic.

(22) The forward bolt stops are set to assure clearance with the instrument panel of 0.76 inches plus or minus 0.03.

(23) If forward bolt contact is suspected, verify the cyclic is on the forward bolt stop (pilot or copilot) by unzipping the cyclic boot and observing bolt to cyclic contact.

Frame # 0918 (Flight Control Limit Check)



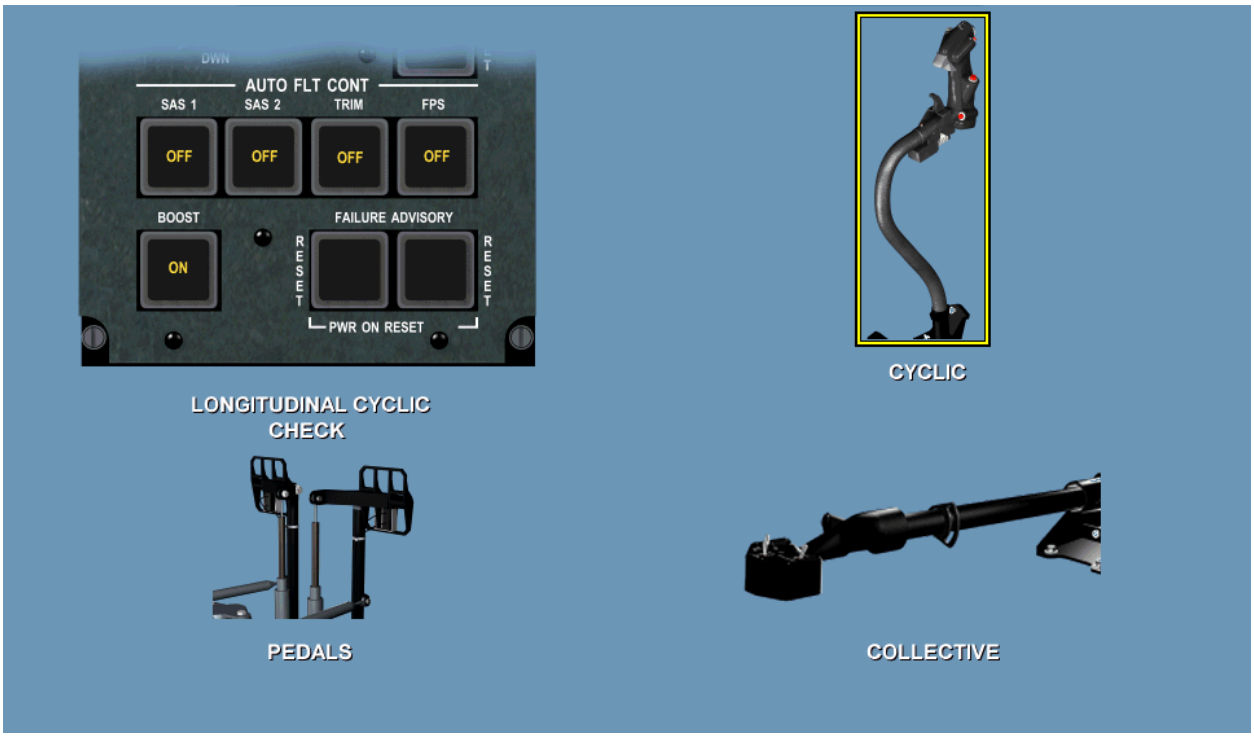
(24) Collective - Full Up

(25) Pedals - Centered

(26) Cyclic - Full Aft

(27) Apply full Right Pedal - Cyclic should not move (verifies cyclic is on the aft cyclic bolt stop)

Frame # 0918 (Flight Control Limit Check)



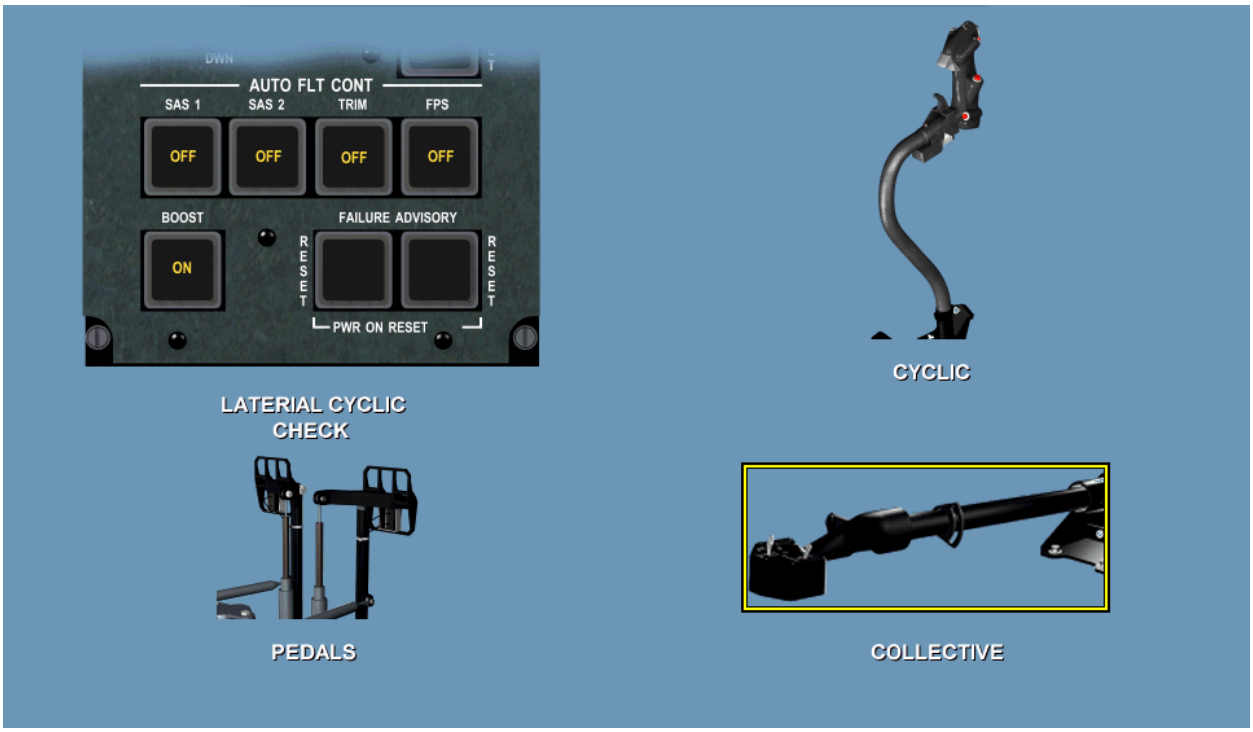
(28) Pedals - Centered

(29) Cyclic - Full Aft, maintain slight aft pressure on the cyclic

(30) Slowly lower collective

(31) Cyclic should move forward from mid collective to low collective (verifies cyclic is NOT on a cyclic bolt stop)

Frame # 0918 (Flight Control Limit Check)



(32) BOOST - ON

(33) SAS 1, SAS 2, TRIM, FPS - OFF

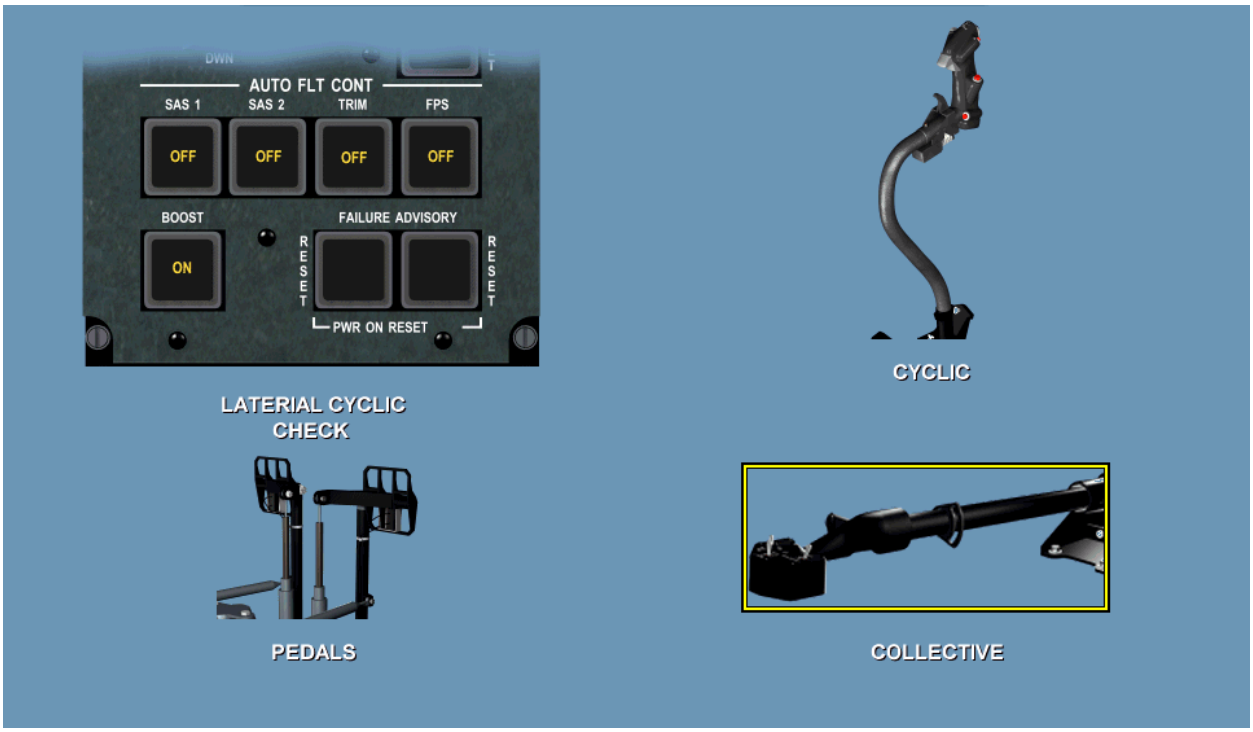
(34) Pedals - Centered

(35) Collective - Full Down

(36) Cyclic - Full Left. Maintain slight forward pressure on the cyclic

(37) Slowly raise collective. Cyclic should move slightly right throughout full collective range (verifies cyclic is on the roller limiter)

Frame # 0918 (Flight Control Limit Check)



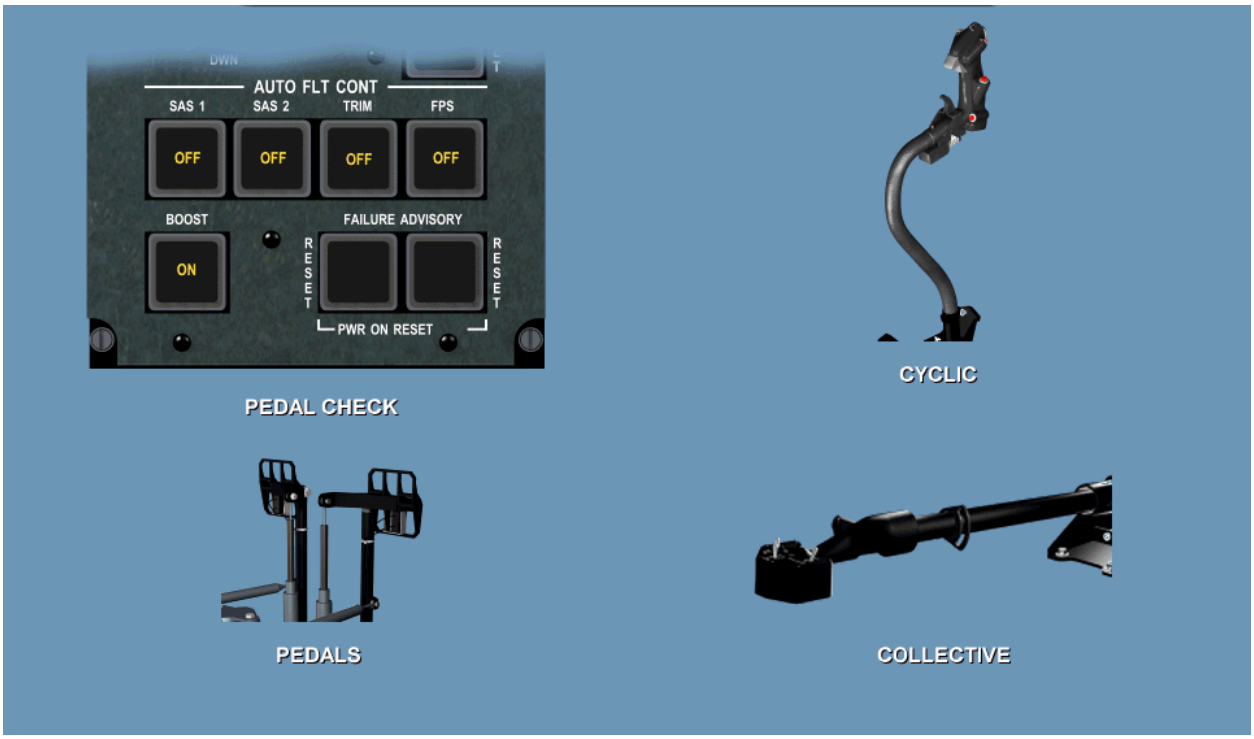
(38) At full up collective, cyclic full right

(39) Maintain slight right pressure on the cyclic

(40) Slowly lower collective - Cyclic should not move (verifies cyclic is on the right cyclic stop bolt) until near low collective and then should move left a small amount (roller limiter).

(41) If there is no left movement, verify clearance .010 - .030 at stop bolt.

Frame # 0918 (Flight Control Limit Check)



(42) BOOST - ON

(43) SAS 1, SAS 2, TRIM, FPS - OFF

(44) Collective - Mid position

(45) Cyclic - Centered

(46) Pedals - Full right to full left. Left and right travel should be equal and full pedal travel should be attained at mid collective.

CHECK ON LEARNING

1. What is rigged before the Tail Rotor can be rigged?

2. How many hours must pass before cable tension is verified?

3. What form is used to document Dimension “A” and corresponding blade color?

4. When performing the quality control checks, check the cables, pulleys, and fair-leads for_____.

SECTION XII. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the correct procedures to accomplish the Tail Rotor Complete rigging lesson for the UH-60 helicopter.
The key points to remember are:

- A complete tail rotor rig is required whenever major changes have been made to the tail rotor flight controls, or when adjustments must be made to the system not covered in the rig check.
- The main rotor must be in proper rig before rigging the tail rotor.
- Use external hydraulic power if possible or the back-up hydraulic system to perform the rig procedure.
- Remove soundproofing from cabin ceiling at STA. 311.0 and from storage compartment. Remove troop seats from rear cabin.
- If using external hydraulic power, pull the BACKUP HYD CONTR circuit breaker in DC ESNTL BUS on overhead upper console. Disengage SAS 1, SAS 2, and TRIM buttons, on AUTO FLIGHT CONTROL panel in lower console.
- Install lockout blocks on the aft quadrant and disconnect the spring cylinders from support at tail rotor quadrant.
- Disconnect electrical connectors, P609 and P610, on tail rotor servo pressure switches.
- Make sure the rigging pins in the mixer and tail rotor servo remain free at all times.
- Install all new locking clips in the turnbuckles after the cable tension(s) have been set, check that rigging pin in tail rotor servo can be removed and reinstalled easily without pulling or pushing on servo input linkage.
- If the rigging pins will not go in easily, adjust torque shaft input rods in cabin as required.
- Be sure all control rods are adjusted and connected from cockpit to mixer. Check that output rod from mixer to torque shaft is properly connected.
- If the control rod is adjusted to correct length, the notch in the forward quadrant outside diameter is lined up with hole in airframe. Adjust the tail rotor quadrant to tail rotor servo pushrod to a length between 12.56 to 12.68-inches.
- Connect the cable disconnects, and ensure the bottom forward cable retainer jam nut in the aft cable slot is torqued to 40 - 60 inch-pounds, and lockwire.
- Do not use these connections as an adjustment for cable tension.
- Connect tail rotor pushrod between tail rotor servo and quadrant. In the forward end of tail cone, adjust the cable tension using the tensiometer.
- With each blade, in turn (one blade at a time), in horizontal position pointing forward, remove bolt, washer, and nut securing pitch control rod to pitch change beam.
- Adjust pitch control rod as required until attaching bolts drop freely into holes on pitch change beam. Do not put any pressure on blades to line up attaching boltholes.
- Back off the jam nuts on both ends of pitch control rods approximately 0.050-inch. Measure each pitch control rod to the nearest ± 0.050-inch. Record dimension "A" and corresponding blade color on DA Form 2408-16-1.

- Check cable tension only after the helicopter has been at an even temperature for 1 hour. Do not check tension with helicopter parked in hot sun. If temperatures below +5 °F are anticipated, set tension to 75 pounds. Tolerance on specified tension values is ± 2% difference between two cables.
- Reset tension to chart before helicopter is operated at temperatures above 40 °F. Flight control cables are 5/32-inch diameter, and with a plastic coating, total diameter is 7/32-inch.
- Make sure that rod ends are aligned, and parallel to each other within the pitch beam ears and pitch horn.
- Tighten the jam nut and all locknuts to 119 - 131 inch pounds against the barrel and ensure the locking devices are engaged. Lengthen each pitch control rod 4 complete barrel turns and again record this dimension.

APPENDIX A

ILLUSTRATION LISTING

FRAME #	FRAME TITLE
0040	Flight Control System Components
0055	Flight Control Routing
0056	Flight Control Routing
0076	Collective Flight Control Routing
0077	Pitch Flight Control Routing
0078	Roll Flight Control Routing
0079	Yaw Flight Control Routing
0067	Cabin Center Section Controls
0068	Trim Servos
0070	Mixing Unit
0060	Directional Controls FLASH
0061	Collective Operation FLASH
0062	Cyclic Operation FLASH
0065	Collective Assembly
0072	Directional Torque Shaft
0075	Control Cable Routing
0075A	Control Cable
0075A2	Locking Pins Operation FLASH
0075C	Tail Rotor Servo and Pitch Change Shaft
0075C	Tail Rotor Servo and Pitch Change Shaft
0075D	AFT Quadrant FLASH
0075E	Tail Rotor
0120	Flight Critical Safety Aircraft Parts
0130	Critical Characteristics
0150	Critical Characteristics Connections
0160	Self Retaining Bolts
0170	Self-Retaining Bolts
0171	Self-Retaining Bolts
0175	Impedance Bolts FLASH
0208	Flight Control Stops
0210	Mixer Limiters
0215	Adjustable Collective Bolt Stop
0220	Adjustable Directional Bolt Stop
0226	Adjustable Cyclic Bolt Stop
0275	Directional Routing Flight Controls
0285	MTF Checks and Pedals FLASH
0310	Cyclic Controls
0315	Cyclic Controls Rods
0325	Cyclic Controls Routing
0355	Collective Controls
0360	Collective Friction Lock FLASH
0400	Torque Shafts
0405	Torque Lever
0415	Balance Spring Operation FLASH
0445	Mixer Assembly
0450	Mixer Assembly
0455	Mixer Assembly Limiters
0481	Main Rotor System Complete Rig
0485	Complete Rig Pin Set
0490	Main Rotor Rig Check Requirements

0495	Primary Servo Four Point Rig Check Requirements
0500	Tail Rotor Complete Rig Check Requirements
0508	Main Rotor System Complete Rig
0510	Main Rotor System Complete Rig
0515	Main Rotor System Complete Rig
0517	Flight Control Access Panel
0520	Main Rotor System Complete Rig
0525	Main Rotor System Complete Rig
0530	Main Rotor System Complete Rig
0535	Main Rotor System Complete Rig FLASH
0540	Main Rotor System Complete Rig
0545	Main Rotor System Complete Rig
0545	Main Rotor System Complete Rig
0550	Main Rotor System Complete Rig
0555	Main Rotor System Complete Rig
0560	Main Rotor System Complete Rig
0563	Main Rotor System Complete Rig
0565	Main Rotor System Complete Rig
0570	Main Rotor System Complete Rig
0572	Main Rotor System Complete Rig
0575	Main Rotor System Complete Rig FLASH
0580	Main Rotor System Complete Rig
0585	Main Rotor System Complete Rig
0590	Main Rotor System Complete Rig
0595	Main Rotor System Complete Rig
0600	Main Rotor System Complete Rig
0605	Main Rotor System Complete Rig
0610	Main Rotor System Complete Rig
0615	Main Rotor System Complete Rig
0620	Main Rotor System Complete Rig
0625	Main Rotor System Complete Rig
0630	Main Rotor System Complete Rig
0635	Main Rotor System Complete Rig
0637	Main Rotor System Complete Rig
0640	Main Rotor System Complete Rig
0645	Main Rotor System Complete Rig
0650	Main Rotor System Complete Rig
0655	Main Rotor System Complete Rig
0660	Main Rotor System Complete Rig
0665	Main Rotor System Complete Rig
0670	Main Rotor System Complete Rig
0675	Main Rotor System Complete Rig
0678	Main Rotor System Complete Rig
0680	Main Rotor System Complete Rig
0685	Main Rotor System Complete Rig
0686	Main Rotor System Complete Rig
0690	Main Rotor System Complete Rig
0695	Main Rotor System Complete Rig
0700	Main Rotor System Complete Rig
0705	Main Rotor System Complete Rig
0710	Main Rotor System Complete Rig
0715	Main Rotor System Complete Rig
0720	Main Rotor System Complete Rig
0725	Main Rotor System Complete Rig
0730	Main Rotor System Complete Rig
0735	Main Rotor System Complete Rig

0740	Main Rotor System Complete Rig
0745	Main Rotor System Complete Rig
0750	Main Rotor System Complete Rig
0755	Main Rotor System Complete Rig FLASH
0760	Quality Control Checks
0825	Tail Rotor Complete Rig
0830	Tail Rotor Complete Rig
0835	Tail Rotor Complete Rig
0840	Tail Rotor Complete Rig
0845	Tail Rotor Complete Rig
0847	Tail Rotor Complete Rig
0850	Tail Rotor Complete Rig
0855	Tail Rotor Complete Rig
0857	Tail Rotor Complete Rig
0860	Tail Rotor Complete Rig
0865	Tail Rotor Complete Rig
0870	Tail Rotor Complete Rig
0875	Tail Rotor Complete Rig
0880	Tail Rotor Complete Rig
0883	Tail Rotor Complete Rig
0885	Tail Rotor Complete Rig
0890	Tail Rotor Complete Rig
0895	Tail Rotor Complete Rig
0900	Tail Rotor Complete Rig FLASH
0905	Tail Rotor Complete Rig FLASH
0910	Tail Rotor Complete Rig
0915	Quality Control Checks
0916	Flight Control Limit Check
0917	3 Physical Control Stops
0918	Flight Control Limit Check

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.