United States Army Aviation Logistics School
Fort Eustis, Virginia

APRIL, 1994

THIS DOCUMENT HAS BEEN REVIEWED FOR OPSEC CONSIDERATIONS

STUDENT HANDOUT

FLIGHT CONTROLS AND STABILATOR SYSTEM

071-636-12

The proponent for this SH is USAALS

TERMINAL LEARNING OBJECTIVE:

At the completion of this lesson the student will:

ACTION: Analyze Flight Control Systems Malfunctions.

CONDITIONS: Given an AH-64A helicopter, applicable technical manuals, and a requirement to analyze flight control systems malfunctions.

STANDARDS: Analyze malfunctions of the AH-64A flight control systems, in accordance with the TM 1-1520-238-T series manuals, TM 55-1520-238-CL, TM 55-1520-238-MTF, TM 55-1520-238-10 and TM 55-1520-238-23 series technical manuals.

SAFETY REQUIREMENTS: In addition to specific safety requirements of this lesson plan, aviation shop and flight line safety standards established in the technical manuals will be reinforced.

RISK ASSESSMENT LEVEL: Caution

WARNING

CONTROL MOVEMENT

Maintenance personnel must be warned verbally prior to moving the collective, cyclic sticks, or directional pedals. Any control activated can result in sudden blade movement that can sever or crush fingers or hands.

CAUTION

HYDRAULIC POWER

If controls bind, check problem prior to continuing procedure. Failure to clear controls of binding may result in sheared pins in the control axis.

WARNING

SERVOCYLINDER ROD END ADJUSTMENT

To provide enough thread engagement to maintain safe flight, the distance between center of the rod end and end of the servocylinder piston must not exceed 3.06 inches.

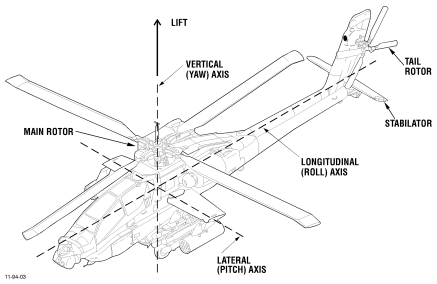
NOTES

CAUTION

SERVOCYLINDER ROD END ADJUSTMENT

Top prevent breakdown of cylinder piston rings, rotation of piston is limited to 90 DEGREES during rigging and installation. Adjustments are made by turning rod end, not piston.

AH-64A FLIGHT CONTROL AXIS



NOTES

A. Flight control system purpose and features

1. Purpose

a. The purpose of the Flight Control System is to input demands to the Main Rotor, Tail Rotor, and Stabilator for flight control of the helicopter.

b. Maintains controlled flight around the pitch, roll, yaw, and vertical axes.

c. Provides crew-initiated mechanical inputs for longitudinal, lateral, directional, and vertical flight of the helicopter.

2. Features

a. All control movements are assisted by hydraulic servoactuators except for the Stabilator. Stabilator movement is provided by two tandem linear electrical actuators mounted back-to-back.

b. Two completely separate control sources are provided in the helicopter.

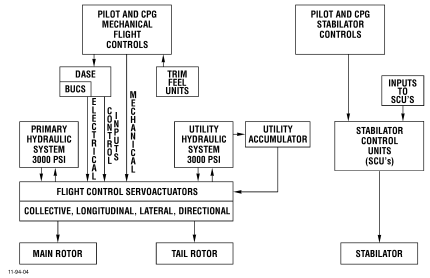
(1) Mechanical flight control rods

(2) Back Up Control System (BUCS), which is fly-by-wire.

c. Stability and Command Augmentation (SCAS) provisions built into the flight control system provide smooth control response and a stable weapons delivery platform.

d. A method to clear control jams and severed controls is incorporated into the flight controls by the use of Shear Pin Actuated Decouplers (SPADs). A controlled shear is provided to bypass a control jam or severence to re-establish flight control. When decoupled, Linear Variable Differential Transducers (LVDTs) in the cockpit controls and flight control servoactuators provide flight control displacement signals for use by the Digital Automatic Stabilization Equipment Computer (DASEC) to control BUCS actuation and control response.

AH-64A FLIGHT CONTROL SYSTEMS BLOCK DIAGRAM



NOTES

e. Redundant mechanical flight controls in pilot and co-pilot gunner (CPG) stations.

f. Mechanical control inputs to the main and tail rotors control the hydraulically powered servoactuators.

g. Hydraulic inputs to the flight control system

(1) The primary hydraulic system provides hydraulic pressure at 3000 PSI to the collective, longitudinal, lateral, and directional control servoactuators.

(2) The utility hydraulic system provides redundant hydraulic pressure at 3000 PSI to the flight control servoactuators.

(3) The primary and utility sides of the servoactuators are independent of each other, if one hydraulic system fails, the remaining system can drive the flight control servoactuators.

(4) The utility accumulator will provide emergency hydraulic power to the servoactuators should the primary and utility hydraulic systems fail. The 200 cubic inch utility accumulator will allow for a minimum control usage landing with one 180 degree heading change and four full collective strokes.

h. The primary side of each flight control servoactuator has two electrohydraulic solenoid valves.

(1) One responds to Digital Automatic Stabilization Equipment (DASE) computer signals for stability augmentation.

(2) The second electrohydraulic solenoid valve responds to DASE computer inputs for the Back Up Control System (BUCS).

i. The Digital Automatic Stabilization Equipment (DASE) system is electrically connected to each servoactuator.

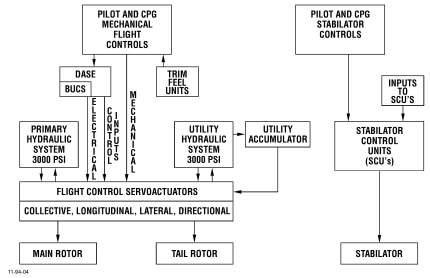
(1) The DASE system utilizes a computer to aid in stabilizing helicopter flight attitudes and reduce pilot's workload.

(2) The DASE controls stability and command augmentation in pitch, roll, yaw, attitude hold, heading hold, hover augmentation, turn coordination, and the Back Up Control System (BUCS).

j. The backup control system (BUCS)

(1) Is a single channel fly-by-wire flight control system which electronically operates all four flight controls if the mechanical flight controls become severed or jammed.

AH-64A FLIGHT CONTROL SYSTEMS BLOCK DIAGRAM



NOTES

(2) Inputs from the pilot or CPG crewstation flight controls provide Linear Variable Differential Transducer (LVDT) signals to the DASE, which electronically controls the BUCS servovalves in the flight control servoactuators.

k. A trim feel magnetic brake and spring assembly is incorporated into the lateral, longitudinal, and directional control system to maintain desired stick and pedal position.

(1) Trim feel is operable through all ranges of cyclic stick or pedal travel. One assembly provides trim for both stations.

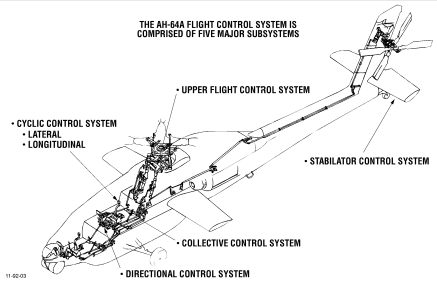
(2) Either crewmember can trim the cyclic and pedal controls.

l. A variable angle of incidence stabilator is installed on the AH-64A.

(1) The stabilator is used to enhance helicopter handling characteristics and improve forward visibility for landing and nap-of-earth (NOE) operations.

(2) Stabilator control units process inputs from the air data system, airspeed transducers, pitch rate gyro, and the collective servoactuator LVDT to automatically position the stabilator.

AH-64A FLIGHT CONTROL SYSTEM



NOTES

B. Flight control system description

1. Flight control system consists of five major subsystems.

a. Collective flight control system provides mechanical input to the main rotor system for vertical flight control of the helicopter.

b. Cyclic flight control system provides mechanical control input to the main rotor system for lateral and longitudinal flight control of the helicopter.

c. Upper flight control system combines control inputs received from the collective, longitudinal, and lateral hydraulic servoactuators for vertical, longitudinal, and lateral flight control of the helicopter.

d. Directional flight control system provides mechanical input to the tail rotor assembly for directional heading and anti-torque control.

e. Stabilator control system is used to vary the longitudinal attitude of the helicopter at various airspeeds.

2. The flight control capability of the helicopter includes Collective, Longitudinal, Lateral, Directional, and Stabilator Control subsystems. These subsystems provide the crewmembers with control of the helicopter around the Vertical, Pitch, Roll, and Yaw Axis.

a. Mechanical flight controls (collective control sticks, cyclic control sticks, and directional control pedals) are provided for the pilot and CPG to control the servoactuators.

b. Crew-initiated control stick(s) and pedal movements control hydraulic at 3000 PSI pressure, to operate the hydraulic servoactuators.

c. The primary hydraulic system provides hydraulic power to the collective, cyclic, and directional control servoactuators.

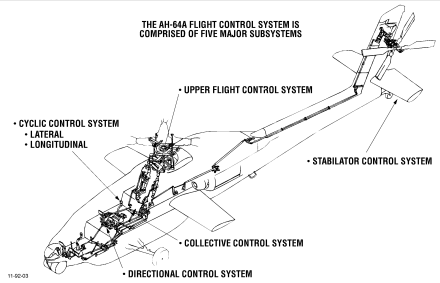
d. The utility hydraulic system provides redundant hydraulic power to the servoactuators and utility hydraulic system components.

e. The utility accumulator will provide emergency hydraulic power to the servoactuators, should both the primary and utility hydraulic systems fail.

f. Emergency hydraulic power, provided by the utility accumulator, will ensure a minimum control usage landing with one 180-degree heading change and four full collective strokes. (A stroke is one full movement from stop to stop in one direction).

g. If a total failure of all hydraulic systems occurs, there is no means to control the helicopter.

AH-64A FLIGHT CONTROL SYSTEM



NOTES

h. Digital Automatic Stabilization Equipment (DASE) is installed to aid in stabilizing helicopter flight attitudes. (DASE Computer stabilizes aircraft for weapons use).

i. Flight control can be maintained by an electrical Back Up Control System (BUCS) if mechanical control is lost and hydraulic power is available.

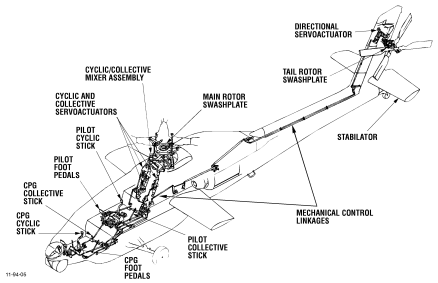
j. The Stabilator system is electrically powered and is automatically or manual-electrically controlled.

k. All mechanical control linkages are routed separately from the "fly-by-wire" Back Up Control System (BUCS) to preclude the loss of both systems from a single projectile impact.

l. A selectable and adjustable trim/feel unit (force trim) for the cyclic control sticks and directional control pedals maintain desired stick and pedal position.

m. Use of a movable horizontal stabilator improves handling characteristics of the helicopter.

AH-64A FLIGHT CONTROL SYSTEM MAJOR COMPONENTS



NOTES

C. Flight control system major components

1. Crew stations controls

a. Co-pilot gunner (CPG) crew station

(1) Collective stick

(2) Cyclic stick

(3) Foot pedals

b. Pilot crewstation

(1) Collective stick

(2) Cyclic stick

(3) Foot pedals

2. Mechanical control linkages between the crewstation controls and the servoactuators

3. Cyclic and collective servoactuators

4. Cyclic and collective mixer assembly

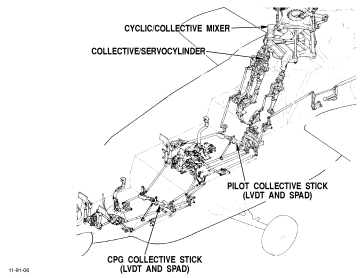
5. Main rotor swashplate

6. Directional servoactuator

7. Tail rotor swashplate

8. Stabilator

COLLECTIVE CONTROL SYSTEM



NOTES

A. Collective control system

1. Purpose

a. The collective control system provides pilot and CPG input for control of the helicopter in the vertical axis.

b. Through movement of the collective control sticks, mechanical control movements and electrical signals are sent to both the collective servoactuator and the DASE. This causes a uniform, simultaneous, pitch change in all four main rotor blades.

2. Location

a. The collective control sticks are mounted to the left of the crew seat in the pilot and CPG stations.

b. Collective controls push-pull rods routing

(1) Along the left fuselage

(2) Behind the pilot's aft canted bulkhead

(3) The controls then cross over to the center fuselage area and are routed out to the collective servoactuator.

3. Collective control system major components

a. Two collective control sticks

b. Two collective Linear Variable Diffential Transducers (LVDTs)

c. Engine Speed droop compensator LVDT (Pilot only)

d. Two 1-g springs

e. Two Shear Pin Actuated Decouplers (SPAD)

f. Mechanical Control linkage

g. Collective servoactuator

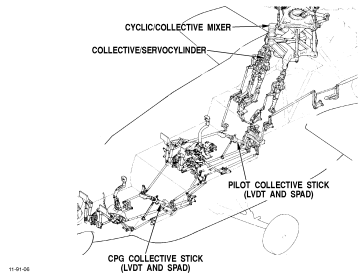
4. Description

a. Inputs to the collective control system can be initiated from either crew station.

(1) Both crewstations have collective control sticks.

(2) An adjustable friction control is provided for the collective control sticks in both crewstations.

COLLECTIVE CONTROL SYSTEM



NOTES

(a) The amount of friction is controlled by a twist grip that adjusts the tension of a friction disk and spring arrangement.

(b) As the collective control stick is moved, the friction disks and spring arrangement moves over a friction bar which is mounted to the floor of the crewstation.

(c) The CPG's Stick has the friction preset to "0" and is shearwired.

(3) Vertical movement of the collective control sticks is transmitted through mechanical linkage to the collective servoactuator. This movement, through the mixer assembly, swashplate assembly, and pitch change links, will simultaneously change the angle of incidence of the main rotor blades.

(4) The control sticks are made of aluminum alloy and employ various switches and controls for aircraft operation.

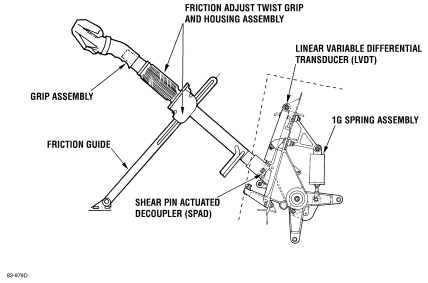
(5) LVDTs are installed on each collective control stick. The CPG's collective control stick has one LVDT, the pilot's has two. These mount to the forward side of the crewstation canted bulkhead and attach to the stick brackets. Two of these LVDT's provide control stick position to the DASEC (one on the CPG's and one on the pilot's). The second LVDT on the pilot stick is the engine droop compensation potentiometer.

(6) The system is power assisted by a hydraulic servoactuator operating at approximately 3000 psi.

(7) A Shear Pin Actuated Decoupler (SPAD) is installed in each collective stick housing assembly. The shear pin can be sheared in the event of a control system jam.

(8) Rigging Pin Holes are located behind the canted bulkhead at the collective bellcrank for each crewstation. The CPG's stick is rigged to the pilot's, and the pilot's is rigged to the collective input bellcrank at the servoactuator. The third (3rd) rigging pin goes into the servoactuator input bellcrank.

COLLECTIVE CONTROL STICK INSTALLATION



NOTES

5. Collective control system major components purpose, location, and description

a. Collective Control Sticks

(1) Allow the pilot and CPG to make mechanical control inputs to the collective mechanical control linkage.

(2) The collective control sticks are located to the left of the crew seat in the pilot and CPG station.

(3) Description

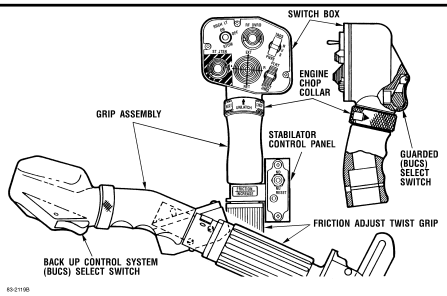
(a) The collective control sticks contain various switches and controls for aircraft/systems operation. Flight control operations that can be controlled from the collective assemblies are

1) Stabilator

2) BUCS

(b) The control sticks are manufactured of tubular aluminum alloy.

COLLECTIVE GRIP ASSEMBLY



NOTES

b. Collective control stick switch box and grip assembly

(1) Stick switch box

(a) Provides selected grouping of switches for quick system operation.

(b) Mounted in the upper forward portion of the grip assembly.

(c) Collective control stick switch box and grip switches and controls

1) Searchlight (SRCH LT) power/stow switch

2) Emergency stores jettison (ST JTSN)

3) Searchlight extend/retract, directional control switch (EXT/RET/L/R)

4) Radio frequency override (RF OVRD)

5) Night vision system (NVS) [Target Acquisition Designation System (TADS), or Pilot Night Vision System (PNVS)]

6) Boresight helmet mounted display/polarity switch (BRSIT HMD or PLRT)

7) Guarded (BUCS) select switch

a) Allows control transfer of BUCS from pilot to CPG's LVDTs.

b) Mounted in the lower forward portion of the grip assembly.

c) Description

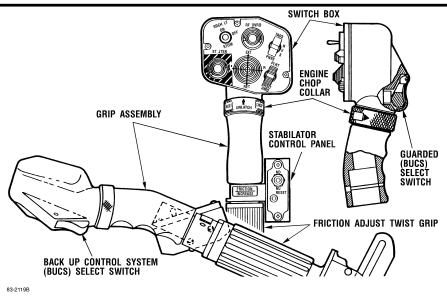
(1) The guard must be raised and the trigger squeezed to actuate the BUCS select switch (CPG ONLY).

(2) The guard is to prevent inadvertently actuating the BUCS select switch.

(2) Grip assembly

(a) Mounted on forward end of stick below the switch box and used as a handle for control of the stick.

COLLECTIVE GRIP ASSEMBLY



NOTES

(b) The grip assembly incorporates an engine chop and reset collar used to reduce engine rpm to flight idle in the event of an emergency by removing the ground from the turbine speed control unit (i.e. tail rotor control failure).

1) Located just aft of the collective stick switch box.

2) The collar is actuated by pushing forward (to unlock) and then rotating 45 degrees right for chop and left 45 degrees for reset.

3) The collar is spring-loaded to ensure return to mid-position when released.

4) The chop collar is safetied with .020 breakaway lockwire to prevent inadvertent activation.

(3) Stabilator control panel

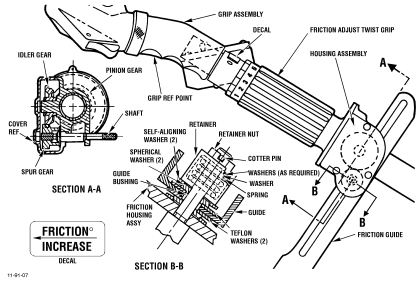
(a) Houses manual stabilator control switch.

(b) Located between the grip assembly and the friction adjust twist grip on the collective sticks.

(c) The 3-position switch, nose-up, nose-down, spring loaded to off (NU-OFF-ND) position allows the crew to disengage the automatic mode and manually position the stabilator.

(d) Houses stabilator RESET control switch that allows the crewmembers to reset the automatic stabilator system by depressing and releasing the spring-loaded, momentary, push button switch.

COLLECTIVE FRICTION ADJUST
TWIST GRIP AND HOUSING ASSEMBLY



NOTES

c. Collective friction adjust twist grip and housing assembly

(1) Holds the collective control stick in a desired position and prevents the collective stick from creeping during flight.

(2) Mounted below the grip assembly and forward of the friction guide.

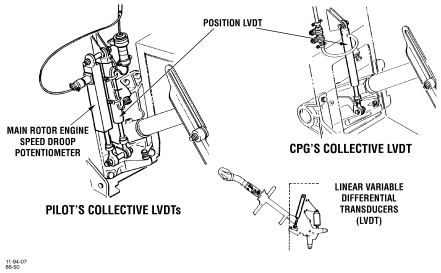
(3) Description

(a) A twist type friction adjustment is installed on the collective stick assembly.

(b) Friction housing assembly consists of a guide, guide bushing, spring, selected washers, and is shaft driven by idler, pinion, and spur gears.

(4) Rotation of the grip (counterclockwise) applies (pressure) friction through the housing assembly to the slotted friction guide.

COLLECTIVE (LVDTs)
AND ENGINE DROOP POTENTIOMETER
(A/C S/N 88-0199 AND BELOW)



NOTES

d. Collective LVDT's (BUCS deactivated) and engine droop potentiometer

(1) Collective LVDT's (A/C S/N 88-0199 and below)

(a) Collective position LVDT's generate electrical signals that are proportional to the amount of collective stick movement. In aircraft with BUCS deactivated the collective LVDTs perform no operational function.

(b) Location

1) The collective position LVDT is installed at the canted bulkhead and to the base of the collective control stick assembly in the pilot's station.

2) The CPG collective position LVDT is installed at the same point in the CPG's station.

(c) Description

1) The pilot's and CPG's collective flight control LVDTs are a 1-3/4 inch (1.9 centimeters) diameter tube, 7-1/2 inches (19 centimeters) long, containing a plunger with approximately a " 1 inch (2.5 centimeters) stroke.

2) In aircraft with BUCS deactivated, the LVDT's are painted black and have a female (receptacle) electrical connector on a shielded harness.

3) The BUCS LVDT originally provided signals for the Back-Up Control System. This system was deactivated by ECPs 757 and 312. This collective LVDT (black in color) remains installed in all A/C prior to S/N 88-0200, but performs no operational function.

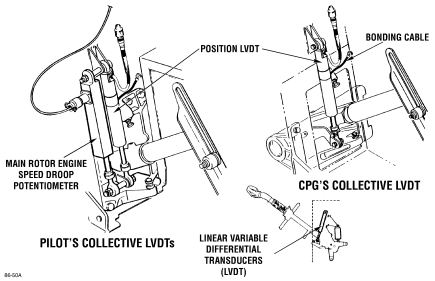
(2) Engine droop potentiometer

(a) The engine droop potentiometer provides signals to the electronic control units (GE-T700-701 engines) or the digital electronic control units (GE-T700-701C engines) to supplement the load demand spindle (LDS) in maintaining 100% NP during load demand changes.

(b) The engine droop potentiometer is installed at the canted bulkhead and to the base of the collective control stick alongside and inboard of the collective LVDT, in the pilots station.

(c) It is a square tube similar in size to the LVDT, painted black, with an electrical receptacle on it.

COLLECTIVE LINEAR VARIABLE DIFFERENTIAL TRANSDUCERS (LVDT)
(A/C S/N 88-0200 AND SUBSEQUENT)



NOTES

e. Collective LVDT's BUCS activated (A/C S/N 88-0200 and subsequent)

(1) BUCS reactivated utilizes the position signals from the LVDTs for BUCS operation. The LVDT's generate electrical signals, proportional to stick movement, that are sent to the DASE computer for BUCS operation.

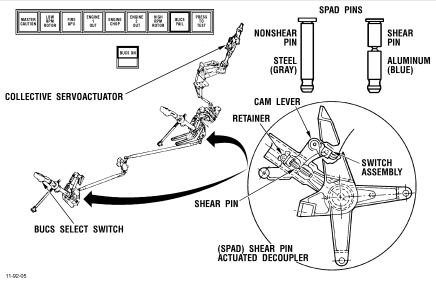
(2) The collective BUCS LVDTs have been modified to prevent external electromagnetic interference (EMI) from affecting the position signals going to the DASE computer.

(a) EMI shield grounded to the airframe via bonding jumpers

(b) Shielded twisted harness with EMI backshells and a male plug adapter

(c) Finished with olive drab cadmium plating

COLLECTIVE SPAD ASSEMBLY



NOTES

f. Shear Pin Actuated Decoupler (SPAD) assembly

(1) The SPAD connects each collective control stick to the collective system mechanical linkage.

(2) On aircraft prior to S/N 88-0200, the SPAD assembly cannot shear.

(3) On aircraft S/N 88-0200 and subsequent, the SPAD assembly (when sheared) activates the fly-by-wire BUCS system if the mechanical flight controls are jammed or severed.

(4) Description

(a) The SPAD, during normal operation, is part of the mechanical linkage.

(b) The SPAD incorporates a mechanical cam lock, switch, and shear pin that fits into a slot on one of the bellcranks and locks the input and output bellcranks together as a single unit.

1) A/C prior to S/N 88-0200 have a solid corrosion resistant gray steel pin installed in the SPAD.

2) A/C S/N 88-0200 and subsequent have a titanium shear pin installed in the SPAD. When jamming prevents normal control movement, a 27- to 56-foot-pound force on the pilot's collective control stick and a 32- to 66-pound force on the CPG control stick will cause the SPAD shear pin to snap, severing mechanical linkage.

(5) Operation

(a) NON-BUCS A/C (prior to S/N 88-0200)

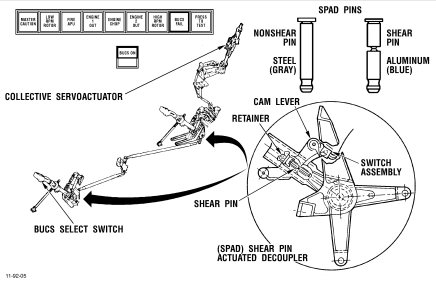
1) Normal operation

a) A/C prior to S/N 88-0200 have a solid corrosion resistant gray steel pin installed in the SPAD.

b) The SPAD, during normal operation, is part of the mechanical linkage and connects each collective control stick to the collective system mechanical linkage for control of the collective servoactuator.

2) BUCS operation is not available.

COLLECTIVE SPAD ASSEMBLY



NOTES

(b) BUCS A/C (88-0200 and subsequent)

1) Normal operation

a) A/C S/N 88-0200 and subsequent have a titanium shear pin installed in the SPAD.

b) The SPAD, during normal operation, is part of the mechanical linkage and the titanium shear pin connects each collective control stick to the collective system mechanical linkage for control of the collective servoactuator.

2) BUCS operation

a) The SPAD incorporates a mechanical cam lock, switch, and shear pin that fits into a hole on one of the bellcranks and the titanium shear pin locks the input and output bellcranks together as a single unit.

b) When jamming prevents normal control movement, a 27-56 foot-pounds (pilot's) or 32-66 foot-pound force (CPG's) on the collective control stick will cause the SPAD shear pin to snap, severing mechanical linkage.

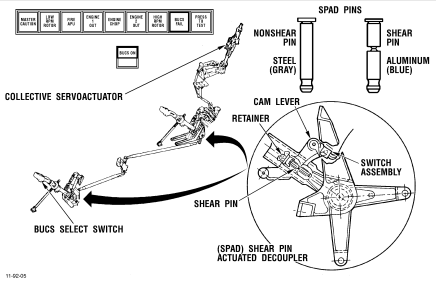
c) When the collective control stick side of the SPAD breaks free from the jammed linkage, the cam actuator is moved from its mid-position by the severed bellcrank in the SPAD assembly and continues to be rotated by spring pressure, causing the cam portion of the assembly to contact and close the dual switch assembly circuit.

d) The mechanical controls are disconnected and switch contact is made.

e) Once the mechanical controls are disconnected and switch contact is made, it enables the fly-by-wire (BUCS) flight control system to operate.

f) Severing of only the CPG's controls will not automatically engage BUCS since the pilot retains mechanical control.

COLLECTIVE SPAD ASSEMBLY



NOTES

g) Manually closing the CPG's BUCS select switch causes the BUCS solenoid to lock out the mechanical controls to the actuator, and forces the actuator to follow CPG LVDT signals.

h) The BUCS ON advisory light illuminates amber when the BUCS is engaged.

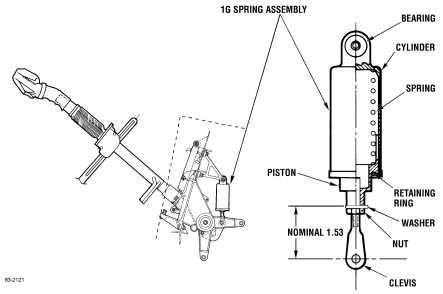
i) The BUCS FAIL master caution light illuminates red when BUCS fails.

WARNING

AVOID EXCESSIVE FORCE

Jammed or severed mechanical flight controls prevent normal control movement, a 27 - 56 foot pound (12.2 - 25.4 kilogram) force on the pilot's collective control stick, or a 32 - 66 pound (14.5 - 30.0 kilogram) force on the CPG's collective control stick will cause the SPAD shear pin to snap, severing mechanical linkage

COLLECTIVE 1G SPRING ASSEMBLY



NOTES

g. One (1) G spring assembly

(1) The collective 1G spring provides the means of counterbalancing the weight of the collective control stick.

(2) A 1G spring is connected to the lower portion of the collective control stick assembly in each crewstation

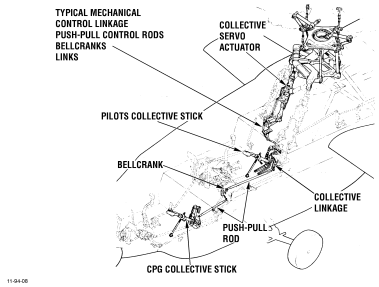
(a) Upper bearing end of spring attaches to canted bulkhead

(b) Clevis portion of spring is attached to SPAD bellcrank

(3) The 1G spring assembly is a cylinder which contains a spring that, when compressed, will exert a force of approximately 54 pounds (24.5 kilograms).

(4) Incorporates an adjustable clevis at the lower end for periodic adjustments of a heavy or light collective load during flight.

COLLECTIVE MECHANICAL CONTROL LINKAGE



NOTES

h. Collective mechanical control linkage

(1) Movement of the collective control stick is transmitted through mechanical control linkage, collective servoactuator, mixer, torque link, lateral link, swashplate assembly, pitch links, and pitch housing to the main rotor blade and will change the angle of incidence of the main rotor blades simultaneously.

(2) The mechanical linkage is routed through the left side of the fuselage to the aft side of the canted bulkhead, then routed up to the collective servoactuator.

(3) Description

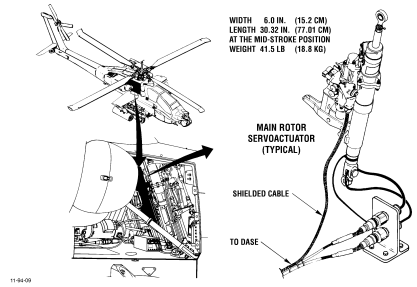
(a) The mechanical linkage incorporates various support brackets, bellcranks and push-pull tubes made primarily of aluminum alloy.

(b) The push-pull tubes vary in diameter proportionately with the length of the tube.

(c) The push-pull tubes have steel self-centering rod end bearings containing Teflon.

(d) Selected push-pull tubes have adjustable rod end bearings for system rigging.

COLLECTIVE SERVOACTUATOR



NOTES

i. Collective servoactuator

(1) The collective servoactuator utilizes hydraulic power to transfer collective inputs from the mechanical linkage to the upper controls.

(2) Collective servoactuator on A/C S/N 88-0200 and subsequent also use hydraulic power to transfer collective inputs from the Back Up Control System (BUCS) to the upper controls.

(3) Mounted on the transmission deck just left of the center line and forward of the transmission.

(4) Description

(a) Receives inputs from either the mechanical controls or electrical components (BUCS and DASE) which cause hydraulic pressure to move the actuator piston.

(b) The collective servoactuator is 6 inches (15.2 centimeters) wide, 30.32 inches (77.01 centimeters) long at the mid-stroke position, and weighs 41.5 pounds (18.8 kilograms).

(c) The collective servoactuator connects the upper and lower controls.

(d) The output piston of the collective servoactuator connects directly to the collective bellcrank on the mixer assembly.

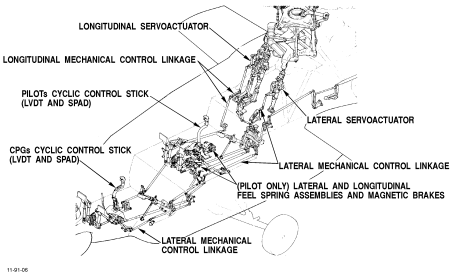
(e) The collective servoactuator has an adapter for the mounting of a push-pull rod to the manual servo valve input arm. The push pull rod connects to the bellcrank assembly which controls the cables leading to the hydromechanical units (HMUs) on the engines.

WARNING

BUCS ACTIVE

THIS ACTUATOR IS EQUIPPED WITH A SHEAR PIN. DO NOT INSTALL IN AIRCRAFT NOT MODIFIED FOR BACKUP CONTROL SYSTEMS. FAILURE TO COMPLY CAN RESULT IN DEATH OR SERIOUS INJURY AND LOSS OF AIRCRAFT.

CYCLIC CONTROL SYSTEM



NOTES

A. Cyclic control system

1. The Cyclic Control System is used to provide pilot and CPG inputs in the lateral (roll) and longitudinal (pitch) axes. Inputs are provided through a mixture of mechanical bellcranks, push-pull rods, and electrical signals, to control the lateral and longitudinal servoactuators. These, in turn, cause the upper flight controls, mixer assembly, pitch links, and pitch housings to position the main rotor blades in an infinite combination of blade angles.

2. Location

   a. Both crew stations have cyclic controls that are mounted on the floor centerline in each crewstation. The CPG cyclic control stick is stowable, while remaining functional.

   b. The cyclic control system is installed from the CPGs crewstation aft to the mixer assembly.

   c. The lateral mechanical control linkage is located on the left side of the aircraft fuselage along side of the collective mechanical control linkage.

   d. The longitudinal mechanical control linkage is located on the right side of the aircraft fuselage.

3. Description

   a. The cyclic control system provides mechanical inputs to the main rotor for longitudinal and lateral control of the helicopter.

   b. Provides control input to the lateral and longitudinal servoactuators through all phases of lateral and longitudinal flight.

      (1) Provides longitudinal control of the helicopter around the pitch axis by the forward and aft movement of the cyclic control stick.

      (2) Provides lateral control of the helicopter around the roll axis by the left or right movement of the cyclic control stick.

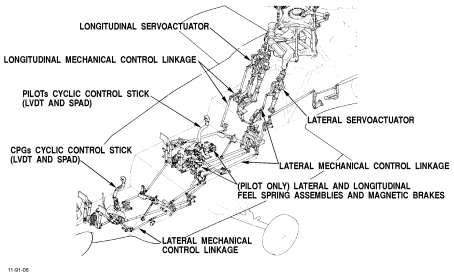
   c. The cyclic sub-system mechanically and/or electrically controls the hydraulically powered lateral and longitudinal servoactuators, operating at approximately 3000 psi.

   d. The cyclic control stick mechanical control linkage incorporates two SPAD units in each stick housing assembly, one for lateral and one for longitudinal.

   e. Cyclic mechanical control linkages are routed separately from the Back Up Control System (BUCS) wire harnesses for ballistic survivability.

   f. Lateral and longitudinal control can be maintained by the Back Up Control System (BUCS) on (A/C S/N 88-0200 and subsequent), if the mechanical flight controls are severed or jammed.

CYCLIC CONTROL SYSTEM



NOTES

g. The CPG cyclic stick is manually foldable, which provides more room when operating the Optical Relay Tube (ORT) and for egress.

(1) A Stick-Release Cable causes the stick to unlatch and fold down. The stick still has all of its control functions operational even when folded.

h. Cyclic stick travel, full forward to full aft, is 10 inches.

i. Cyclic stick lateral travel, full left to full right, is 9 inches.

j. Two hydraulic servoactuators, located in the transmission bay, just forward of the main transmission operating at 3000 psi.

(1) Lateral

(2) Longitudinal

4. Cyclic control system major components

a. Cyclic Control Stick Assembly (2) (Pilot's and CPG's)

b. Cyclic Control Stick Support Assembly (2) (Pilot's and CPG's)

c. Cyclic Control Stick Housing Assembly (2) (Pilot's and CPG's)

d. Four Linear Variable Diffential Transducers (LVDTs).

e. Four Shear Pin Actuated Decouplers (SPADs)

f. Two feel spring assemblies and magnetic brake assemblies

(1) Connected to the pilot's cyclic control assembly only

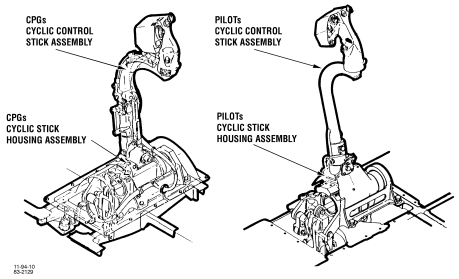
(2) Controllable from the pilot and CPG cyclic grips

g. Mechanical control linkages

h. Lateral servoactuator

i. Longitudinal servoactuator

CYCLIC CONTROL STICK INSTALLATION I



NOTES

5. Cyclic control system major components purpose, location and description

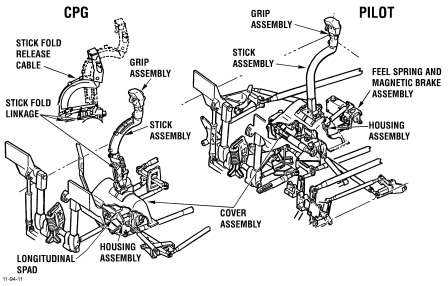
a. Cyclic control sticks

(1) Allow the pilot and CPG to make mechanical inputs to the cyclic mechanical control linkage.

(2) Mounted to the floor centerline in each crew station.

(3) The pilot's and CPG's cyclic control sticks consists of the cyclic control stick and cyclic stick housing assemblies.

CYCLIC CONTROL STICK INSTALLATION II



NOTES

(4) The pilot and CPG crewstation cyclic control sticks differ from one another two ways.

(a) The CPG cyclic control stick can be manually folded down and locked.

1) Allows for greater maneuverability in the use of the optical relay tube (ORT).

2) Easier to enter and exit the CPG crewstation.

(b) The CPG cyclic stick housing assembly has a built in longitudinal SPAD while the pilots longitudinal SPAD is a separate component.

1) The pilot cyclic stick installation incorporates two feel spring and magnetic brake assemblies, the CPG housing assembly has none.

(5) Description

(a) The pilot's and CPG's cyclic consists of two major assemblies

1) Cyclic control STICK assembly

2) Cyclic stick HOUSING assembly

(b) An aluminum tubing stick assembly that is contoured for greater clearance in the crewstation and pilot comfort during use.

(c) The cyclic grip assemblies contain various switches and controls for aircraft/systems operation. Flight control operations that can be controlled from the cyclic grip assemblies are

1) Force Trim operation (pilot and copilot)

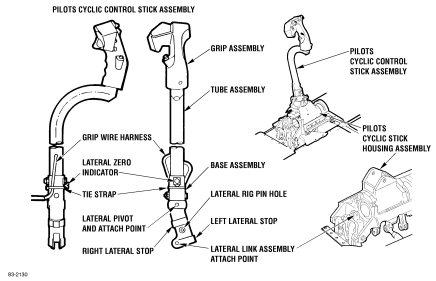
2) ASE release

(d)) A longitudinal and lateral stick "zero" or centering pointers are mounted at the base of the cyclic. These assist in centering the controls while on the ground.

(e) Rigging Pin Holes can be found under the Control Mount and are used to center the control during rigging.

(f) The CPG cyclic stick is mechanically linked to the pilot's cyclic stick.

PILOT CYCLIC CONTROL STICK ASSEMBLY



NOTES

B. Pilots cyclic control stick assembly

1. Pilots cyclic control stick assembly allows for pilot control of the main rotor assembly for controlled longitudinal and lateral flight.

2. Pilots cyclic control stick assembly consists of

a. Tube Assembly

b. Base Assembly

c. Grip Assembly

3. Tube assembly

a. Supports the cyclic grip, controls, and switches.

b. Houses the wiring for the cyclic grip controls.

c. Mounted to the base assembly

d. Description

(1) The tube assembly is a three-piece welded assembly consisting of a tube, fitting, and cover.

(2) Formed 5 degrees forward at the base and 102.5 degrees aft at the upper station with 3.75 inch radius for pilot's normal reach and comfort in the sitting position.

(3) The mid-section has mounting holes for attachment of the base assembly to the cyclic stick housing assembly, and also is the lateral pivot point reference.

(4) The lower section has a clevis arm with mounting holes for attachment of the lateral link assembly.

(5) The lower portion of the tube assembly has provisions for mounting the base assembly and exiting slots for the grip assembly wire harness.

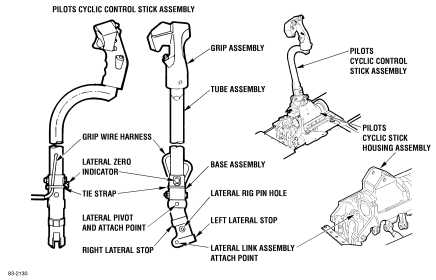
(6) The upper portion of the tube assembly has provisions for mounting the grip assembly.

4. Base assembly

a. Provides support for the tube and grip assembly and attaches to the cyclic stick housing assembly.

b. Attaches to the cyclic housing and the lateral SPAD at the lateral pivot and lateral link attachment points.

PILOT CYCLIC CONTROL STICK ASSEMBLY



NOTES

c. Incorporated into the base assembly

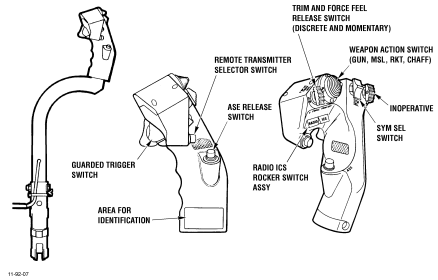
(1) Right and left lateral stops

(2) Lateral zero indicator matches up to lateral zero indicator on the housing cover. Indicators are used by the pilot to center the cyclic.

(3) A lateral rig pin hole

d. The base assembly upper portion has a socket and mounting holes for attachment of the tube assembly.

PILOT CYCLIC GRIP ASSEMBLY



NOTES

5. Grip assembly

   a. Provides the pilot a point of cyclic control and operation of selected switches and controls.

   b. Mounted at the upper end of the cyclic control stick assembly.

   c. Grip assembly switches and controls

      (1) RADIO/ICS rocker switch

      (2) RTSS (Remote Transmitter Selector Switch)

      (3) Automatic Stabilization Equipment (ASE) release switch

      (4) Trim and force feel release switch

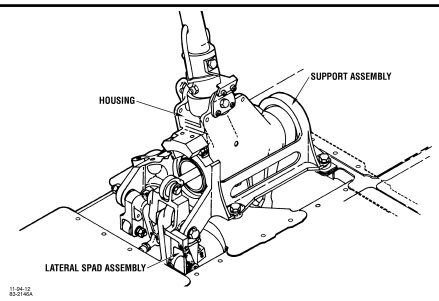
      (5) Symbology select switch

      (6) Inoperative switch (for system growth)

      (7) Weapon action switch

      (8) Guarded trigger switch

PILOT CYCLIC STICK
HOUSING ASSEMBLY



NOTES

C. Pilot cyclic stick housing assembly

1. Provides the axis for lateral and longitudinal control movement of the cyclic control stick assembly.

2. Pilot's cyclic stick housing assembly components

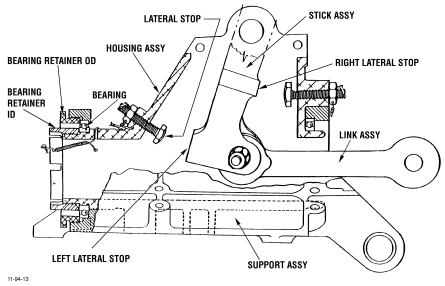
a. Housing

b. Support assembly

c. Lateral SPAD assembly

3. Mounted to the support assembly at the floor centerline in the pilot's crewstation.

CYCLIC CONTROL STICK HOUSING ASSEMBLY



NOTES

4. Cyclic control stick housing assembly

   a. Provides attachment points for the cyclic stick assembly to the link assembly.

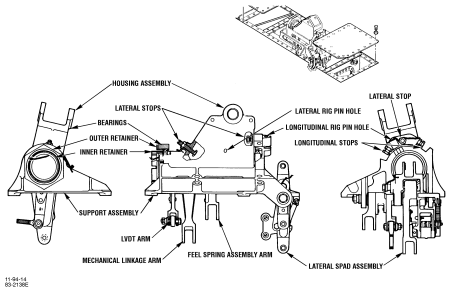
   b. Equipped with right and left lateral adjustable stop bolts.

   c. The lateral stops on the cyclic control stick assembly make contact with the lateral adjustable stop bolts which limits the lateral travel of the cyclic control stick assembly.

   d. The lateral stop bolts are adjusted from the outside of the housing assembly.

   e. Attached to the support housing by the longitudinal pivot bearings.

PILOT CYCLIC CONTROL STICK HOUSING ASSEMBLY DESCRIPTION



NOTES

5. Pilot cyclic control stick housing assembly description

a. Longitudinal axis

(1) The housing assembly is supported within the support assembly by two outboard bearings.

(a) The two outboard bearings allow the housing assembly to rotate forward and aft in the longitudinal axis.

(b) The housing assembly and bearings are secured to the support assembly by two threaded retainers.

(2) Along the left side of the clevis is an integral boss for the longitudinal center rig pin hole and the adjustable stops for the lateral movement of the cyclic control stick assembly.

(a) The longitudinal adjustable stops make contact with the support assembly.

(b) Limits the longitudinal travel of the cyclic control stick assembly.

(c) The rig pin hole is the longitudinal mid-travel position of the cyclic control stick assembly.

b. Lateral axis

(1) The upper (support) section of the housing assembly has a clevis with two bearings.

(2) The web-like clevis bearings are for the mounting and form the pivot point for lateral movement of the cyclic control stick assembly.

(3) Inside the clevis are two adjustable stops for the lateral movement of the cyclic control stick assembly.

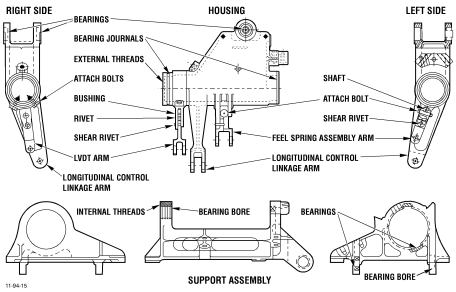
(a) The base assembly of the cyclic control stick assembly makes contact with the lateral, adjustable stops.

(b) Limits the lateral travel of the cyclic control stick assembly.

(c) The left and right adjustable stops are adjusted from the outside of the housing assembly.

(4) At the center section of the clevis is a rig pin slot for the lateral mid-travel position of the cyclic control stick assembly.

CYCLIC STICK HOUSING AND SUPPORT ASSEMBLIES



NOTES

D. Cyclic stick housing and support assemblies

1. The lower section of the housing assembly provides attachment for the longitudinal control linkage, longitudinal LVDT, and the longitudinal control feel spring.

2. The lower section of the housing assembly incorporates three extended clevis arms.

a. The longitudinal control linkage clevis arm

(1) Provides for the attachment of the longitudinal mechanical control linkage.

(2) Integral part of the housing assembly.

b. The LVDT clevis arm assembly

(1) Provides for the attachment of the longitudinal LVDT.

(2) Secured to the housing assembly by two attaching bolts.

(3) Incorporates a bushing, a securing rivet, and a shear rivet.

c. The feel spring assembly arm

(1) Provides for the attachment of the feel spring assembly

(2) Secured to the housing by a shaft and bolt combination.

(3) Incorporates a shear rivet.

E. Support assembly

1. Provides mounting and support for the housing and the lateral SPAD assembly.

2. Mounted to the floor centerline in the pilot's station.

3. The upper section of the support assembly supports and secures the housing assembly by two bearings and two threaded retainers.

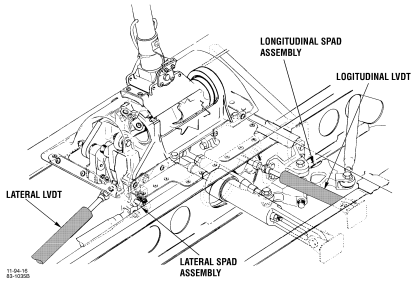
a. The inner threaded retainer secures the bearing inner race to the housing assembly.

b. The outer threaded retainer secures the bearing outer race to the support assembly.

4. The lower left side of the support assembly has two extended clevis arms with bearings facing down approximately 45 degrees.

5. The arms support the lateral SPAD assembly and are secured by a through bolt.

PILOTS CYCLIC LVDT AND SPAD ASSEMBLIES



NOTES

F. Pilots Cyclic LVDT And SPAD assemblies provide the means to connect the pilot control inputs for mechanical and electrical (CAS/BUCS) control of the helicopter.

G. Linear Variable Differential Transducers (LVDTs)

1. Cyclic Linear Variable Differential Transducers (LVDTs) generate electrical signals for use by the DASE that are proportional to the amount of cyclic stick movement.

a. Non BUCS active helicopters

(1) Cyclic lateral and longitudinal LVDTs give position signals to the DASE for CAS.

(2) Unlike the collective signals, these position signals are used on all S/N aircraft for operation of the Command Augmentation System (CAS).

(3) The position signals are used by the DASE computer to signal the longitudinal and lateral servoactuators to operate by electrical inputs to their electro-hydraulic valves.

(4) The LVDTs used for non-BUCS aircraft are black in color.

b. BUCS active helicopters

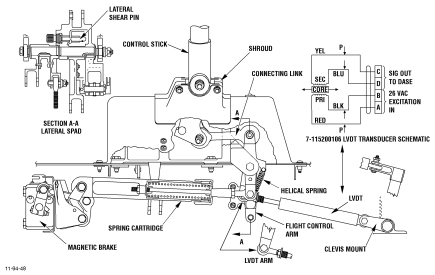
(1) Cyclic lateral and longitudinal LVDTs give position signals to the DASE for

(a) Command augmentation system (CAS)

(b) BUCS. These signals are also used for operation of the BUCS system on A/C S/N 88-0200 and subsequent, as are the collective signals.

(c) The LVDTs used for the operational BUCS aircraft are olive drab and have bonding cables and shielding installed on the harness.

PILOT LATERAL SPAD AND LDVT ASSEMBLIES



NOTES

H. Shear Pin Actuated Decouplers (SPAD)

1. SPADs used in the pilot's and CPG's cyclic control mechanisms serve the same purpose as that discussed for the Collective. The difference is that the cyclic controls two axis; lateral and longitudinal.

2. Two SPADs are installed under each of the two cyclic control sticks; one for lateral and one for longitudinal control. The lateral and longitudinal SPADs are attached to the respective cyclic output bellcrank assembly at each crew station.

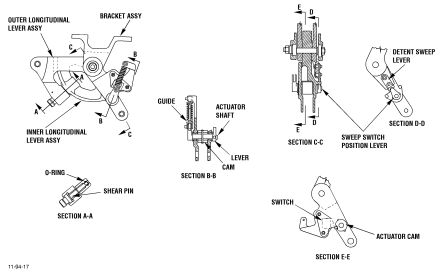
3. The SPADs have the same functional characteristics and aircraft S/N applicability as discussed in the collective control system with the exception of

   a. The pilot's lateral SPAD requires a force of 18 - 32 pounds (7.1 - 14.5 kilograms) and the CPG's lateral SPAD requires a force of 22 - 38 pounds (10 - 17.2 kilograms) to sever the mechanical controls.

      (1) The aft end of the shear pin has an O-ring packing over the pin to prevent that end from slipping out and jamming the movable side of the SPAD once it has sheared.

      (2) The forward end of the pin is retained by a cap that is lockwired to the SPAD.

PILOT LONGITUDINAL SPAD ASSEMBLY



NOTES

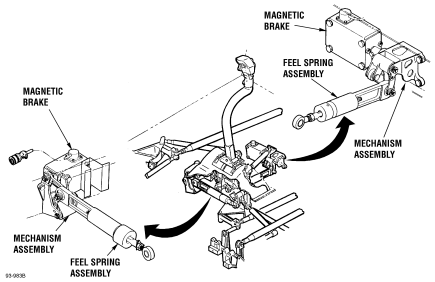
b. The pilot's longitudinal SPAD requires a force of 30 - 52 pounds (13.6 - 23.5 kilograms) and the CPG's longitudinal SPAD requires a force of 35 - 85 pounds (15.9 - 36.3 kilograms) to sever the mechanical controls.

(1) The aft end of the pin is retained by a cap that is lockwired to the SPAD.

(2) The forward end of the shear pin has an O-ring packing over the pin to prevent that end from slipping out and jamming the movable side of the SPAD once it has sheared.

4. Operation - the SPADs in the cyclic control mechanisms operate in the same manner as the collective SPAD discussed earlier.

CYCLIC FEEL SPRING AND MAGNETIC BRAKE ASSEMBLIES



NOTES

I. Feel spring and magnetic brake assemblies

1. Provide longitudinal and lateral flight trim.

2. Installed beneath the pilot's cyclic housing assembly (one set provides trim for both stations).

3. The magnetic brake assembly components

a. Magnetic brake - is a 28 VDC electromechanical unit.

(1) Disengage to enable the magnetic brake assembly to track the cyclic control stick position.

(2) Re-engage to lock the magnetic brake assembly to the new trim position.

b. Feel-spring assembly is a spring-loaded device which, when the magnetic brake is locked, can override the magnetic brake by moving the cyclic control stick against the spring.

(1) There are three different feel-spring assemblies on the AH-64A, each exerting a specific amount of spring force.

(2) Each spring assembly has a different internal spring compression cup (-3, -5, -7), but identical housing assemblies.

(3) Therefore, if they are not properly marked prior to removal, they can very easily be installed in the wrong position.

c. The mechanism assembly provides interfacing between the magnetic brake and the feel spring assembly.

4. Magnetic brake operation

a. Pilot's Cyclic Stick Force Trim Switch Aft - OFF position

(1) The Force Trim Brakes will have 28 VDC from the emergency DC bus applied to the TRIM BRAKE RELAY, energizing the relay, and routing 28 VDC to the magnetic brake unit solenoids.

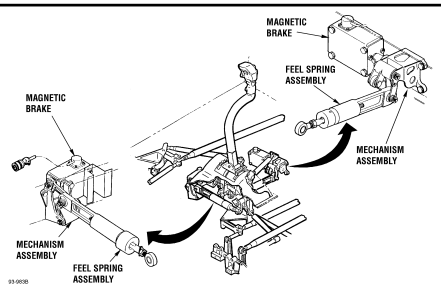
(2) When energized, the mag brakes release, permitting the controls to move without any restraint.

b. Pilot's cyclic stick force trim switch forward - ON position

(1) 28 VDC is removed from the brakes and the solenoids deenergize.

(2) When deenergized, the brakes lock and the spring assemblies that are used with the mag brakes must be overridden in order to move the controls.

CYCLIC FEEL SPRING AND MAGNETIC BRAKE ASSEMBLIES



NOTES

(3) It takes about 4 pounds force to override the spring assembly.

(4) When the pilot's switch is in the On or Temporary position, a 28 VDC signal is applied to the DASEC. This discrete signal prevents ASE switches from unlatching.

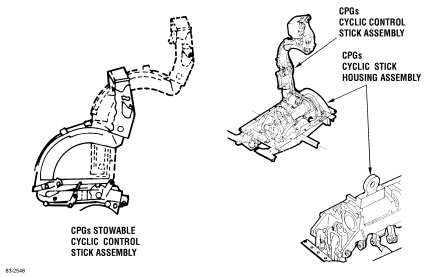
c. CPG's cyclic stick button

(1) The button is wired as a momentary ON button.

(2) This switch is wired in such a way that power is applied to the TRIM BRAKE RELAY and to the DASEC.

(3) The relay will energize, but the discrete signal will not permit pilot ASE Panel Switches to unlatch.

CPGs CYCLIC CONTROL STICK ASSEMBLY



NOTES

J. CPGs cyclic control stick assembly

1. CPGs cyclic control stick assembly allows for CPG control of the main rotor assembly for controlled longitudinal and lateral flight.

2. CPGs cyclic control stick assembly components

a. Cyclic control stick assembly

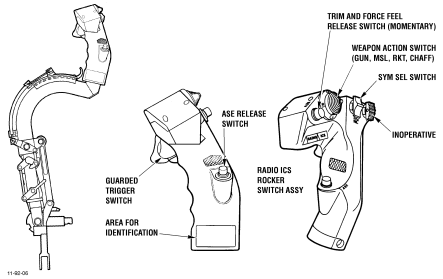
b. Cyclic stick housing and support assemblies

3. Basically identical to the cyclic control stick assembly and has the same functional characteristics as the pilots assembly, except for:

a. A folding feature is incorporated into the CPG stick.

b. The CPG has a momentary TRIM push button switch on the grip assembly instead of the force TRIM release switch.

CPGs CYCLIC GRIP ASSEMBLY



NOTES

4. The CPG's cyclic control stick assembly components

   a. Grip assembly

      (1) A handle for controlling the cyclic control stick assembly.

      (2) Mounted at the upper end of the cyclic control stick assembly.

      (3) Grip assembly switches and controls

         (a) RADIO/ICS rocker switch

         (b) RTSS (Remote Transmitter Selector Switch)

         (c) Automatic Stabilization Equipment (ASE) release switch

         (d) Trim switch

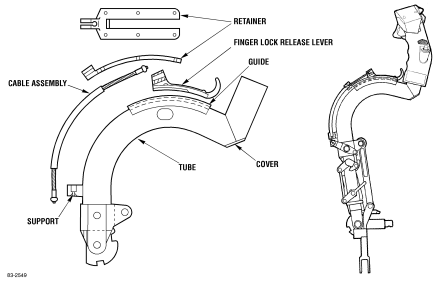
         (e) Symbology select switch

         (f) Inoperative switch (for system growth)

         (g) Weapon action switch

         (h) Guarded trigger switch

CPGs CYCLIC FINGER LOCK RELEASE, CABLE AND TUBE ASSEMBLY



NOTES

b. Tube assembly

(1) Controller for the cyclic control system.

(2) Mounted to a fitting assembly, which is supported by the lock and base assemblies.

(3) Description

(a) The tube assembly is a five-piece welded assembly consisting of a tube, fitting, cover, guide, and support.

(b) The lower portion of the tube assembly has provisions for mounting the fitting assembly.

(c) The upper portion of the tube assembly has provisions for mounting the grip assembly and an exiting slot for the wire harness.

c. Cable assembly

(1) Releases the lock assembly in the retracted position.

(2) Mounted to the upper portion of the tube assembly.

(3) Description

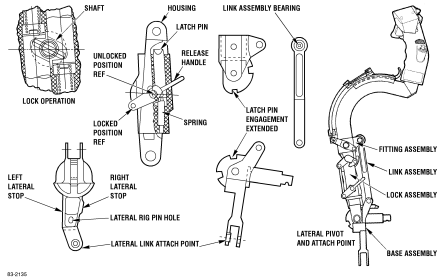
(a) The cable assembly consists of a cable, tube, and two crimped ball ends.

(b) The cable assembly is secured to the tube assembly by a fitting, lever, and support at the lower end; and a finger lock release lever, guide, and retainer at the upper end.

(c) Finger lock release retainer is secured by six screws.

(d) The cable has no adjustments and will stretch with use.

CPGs CYCLIC STICK
FITTING, LOCK, AND BASE ASSEMBLY



NOTES

d. Fitting assembly

(1) Provides mounting for the tube assembly and attachment of the lock assembly.

(2) Lower portion of the tube assembly

(3) The upper portion of the fitting assembly has a socket for attachment of the tube assembly, and a clevis facing aft for attachment of the support link. The lower portion of the fitting assembly has outboard mounting clevises for the pivot point and attachment of the lock assembly, with a tongue-like lug extending between the clevises with two detent notches for engagement of the lock assembly.

e. Base assembly

(1) Provides mounting of the lock assembly and the lateral pivot point.

(2) Lower portion of the cyclic control stick assembly.

(3) The base assembly upper section has a clevis facing aft for attachment of the support link.

(4) The support link assembly connects the fitting assembly and base assembly and provides a pivot point.

(5) The midsection has an integral stud facing aft for attachment of the base assembly to the housing assembly, and is the lateral pivot point.

(6) Facing forward is an integral tongue-like lug with two detent notches for engagement of the lock assembly.

(7) The center through hole is for the attachment of the lock assembly.

(8) The extended clevis arm in the lower section is for the attachment of the lateral link assembly.

(9) The clevis arm also incorporates the lateral rig pin hole and the contact surfaces for right and left lateral stops.

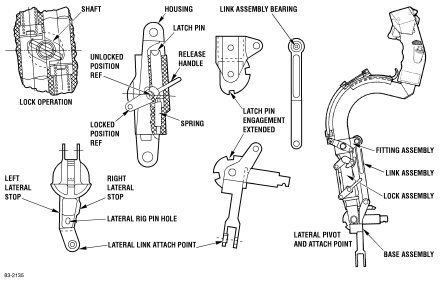
f. Lock assembly

(1) Allows the cyclic control stick assembly to be locked in the extended or retracted position, facilitating use and operation of the Optical Relay Tube (ORT)

(2) Mounted between the fitting assembly and the base assembly.

(3) The lock assembly incorporates upper and lower clevises for attachment to the fitting assembly and the base assembly.

CPGs CYCLIC STICK
FITTING, LOCK, AND BASE ASSEMBLY



NOTES

(4) Both the upper and lower clevises are also the pivot points when the cyclic control stick assembly is retracted or extended.

(5) The lock assembly consists of the housing, two latch lock pins and springs, shoulder shaft, and a release handle.

(a) The two latch lock pins and shoulder shaft are spring loaded to the locked position within the lock assembly housing.

(b) The two latch lock pins engage and lock into the detent notches of the fitting assembly and the base assembly.

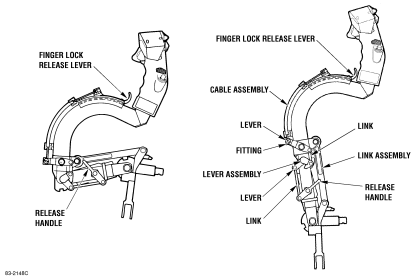
(6) Pushing down on the release handle, on the left side, will release the latch lock pins allowing the cyclic control stick assembly to extend or retract.

(7) The finger lock release lever, through a cable assembly, levers, and links

(a) Will release the lock assembly in the retracted position.

(b) Will not release the lock assembly in the extended position.

CPGs CYCLIC FINGER LOCK RELEASE LINKS AND LEVERS



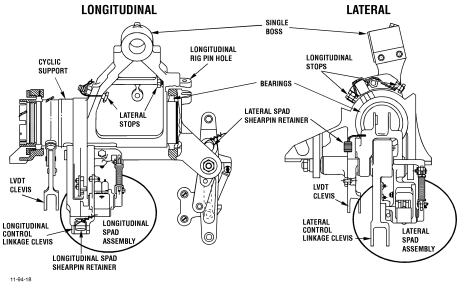
NOTES

K. Links and levers

1. Provides the interconnection between the finger lock release lever and cable assembly, to actuate the lock assembly.

2. The linkage and levers are located and mounted to the fitting, lock assembly, and the base assembly.

CPG CYCLIC STICK HOUSING ASSEMBLY



NOTES

L. CPG's cyclic stick housing assembly

1. Provides longitudinal and lateral control movements of the cyclic control stick assembly.

2. Mounted in the support assembly at the floor centerline in the CPG's station.

3. Description

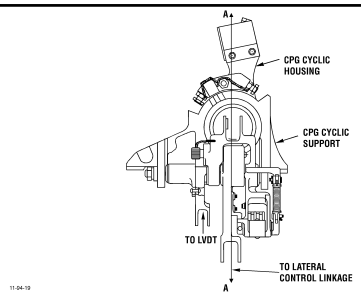
a. Basically identical to and has the same functional characteristics as the pilots housing assembly, except for:

(1) The housing assembly has a single bossed area with sleeve bearings for the attachment of the cyclic control stick assembly.

(2) The extended clevis arm for the mechanical control linkage incorporates the longitudinal SPAD assembly.

(3) Does not have extended clevis arm for the longitudinal feel spring assembly.

CPG CYCLIC STICK SUPPORT ASSEMBLY



NOTES

M. Support assembly

1. Provides mounting and support for the housing assembly and the lateral SPAD assembly.

a. Mounted on the floor centerline in the CPG's station.

b. Identical to the pilot's support assembly.

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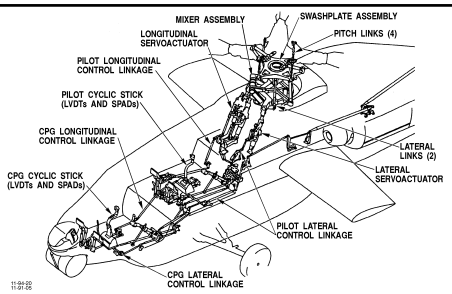
CYCLIC MECHANICAL CONTROL LINKAGE



NOTES

N. Cyclic mechanical control linkages

1. Lateral control linkage

a. Lateral movement of the cyclic control sticks is transmitted through mechanical control linkage, lateral servoactuator, mixer, lateral links, swashplate assembly, and pitch links to the main rotor blades.

b. The lateral mechanical control linkage is routed through the lower left side of the fuselage to the aft side of the canted bulkhead, then up to the lateral servoactuator.

c. Lateral movement of the cyclic control stick

(1) Moving the cyclic stick left causes the lateral servoactuator to retract and pivot the lateral bellcrank down on the left end and up on the right end. The lateral links connect this motion to the rotating swashplate assembly to tilt the rotor disk to the left to roll the helicopter to the left.

(2) Moving the cyclic stick right causes the lateral servoactuator to extend and pivot the lateral bellcrank up on the left end and down on the right end. The lateral links connect this motion to the rotating swashplate assembly to tilt the rotor disk to the right to roll the helicopter to the right.

2. Longitudinal control linkage

a. Longitudinal movement of the cyclic control stick is transmitted through mechanical control linkage, longitudinal servoactuator, mixer, torque link, swashplate assembly, and pitch links to the main rotor blades.

b. The longitudinal mechanical control linkage is routed through the right side of the fuselage to aft of the canted bulkhead, then up to the longitudinal servoactuator.

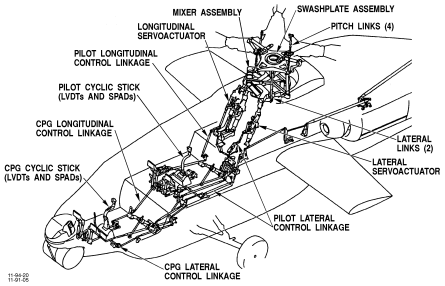
c. Longitudinal movement of the cyclic control stick

(1) Moving the cyclic stick forward causes the longitudinal servoactuator to retract and pivots the forward longitudinal bellcrank down, moving the two longitudinal links forward which pivot the aft longitudinal bellcrank up. The torque link moves up and connects this motion to the rotating swashplate assembly to tilt the rotor disk forward and pitch the helicopter forward.

(2) Moving the cyclic stick aft causes the longitudinal servoactuator to extend and pivots the forward longitudinal bellcrank up, moving the two longitudinal links aft which pivot the aft longitudinal bellcrank down. The torque link moves down and connects this motion to the rotating swashplate assembly to tilt the rotor disk aft and pitch the helicopter aft.

O. Lateral and longitudinal servoactuators

CYCLIC MECHANICAL CONTROL LINKAGE



NOTES

WARNING

BUCS ACTIVE

THIS ACTUATOR IS EQUIPPED WITH A SHEAR PIN. DO NOT INSTALL IN AIRCRAFT NOT MODIFIED FOR BACKUP CONTROL SYSTEMS. FAILURE TO COMPLY CAN RESULT IN DEATH OR SERIOUS INJURY AND LOSS OF AIRCRAFT.

1. Lateral servoactuator

    a. Allows hydraulic power to assist the lateral movements of the mechanical control linkage.

    b. The lateral servoactuator is mounted on the transmission deck on the left hand side forward of the transmission.

    c. Performs the same function as the collective servoactuator.

    d. Description

        (1) Receives inputs either mechanically or electrically like the collective servoactuator. Its physical size is 6 inches (15.2 centimeters) wide and 31-3/4 inches (80.6 centimeters) long at the mid-stroke portion, and it weight 36.4 pounds (16.5 kilograms).

        (2) The output piston of the lateral servoactuator connects directly to the lateral bellcrank on the mixer assembly.

2. Longitudinal servoactuator

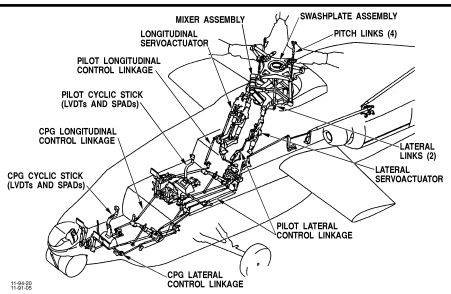
    a. Allows hydraulic power to assist the longitudinal movements of the mechanical control linkage.

    b. The longitudinal servoactuator differs slightly from the collective and lateral servoactuators at the attachment points.

    c. The longitudinal servoactuator is mounted on the transmission deck on the right hand side and forward of the transmission.

    d. Serves same functions as the collective servoactuator.

CYCLIC MECHANICAL CONTROL LINKAGE



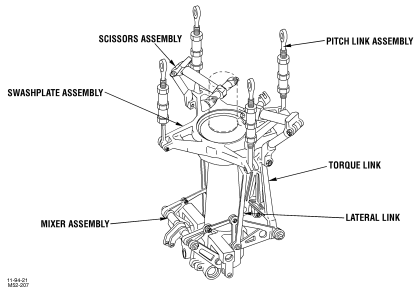
NOTES

e. Description

(1) Receives inputs either mechanically or electrically like the collective servoactuator. Its physical size is 8 inches (20.3 centimeters) wide, 37-3/4 inches (95.9 centimeters) long at the mid-stroke position, and it weighs 47.1 pounds (21.9 kilograms).

(2) The output rod end of the longitudinal servoactuator connects directly to the longitudinal bellcrank on the mixer assembly.

UPPER FLIGHT CONTROLS



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