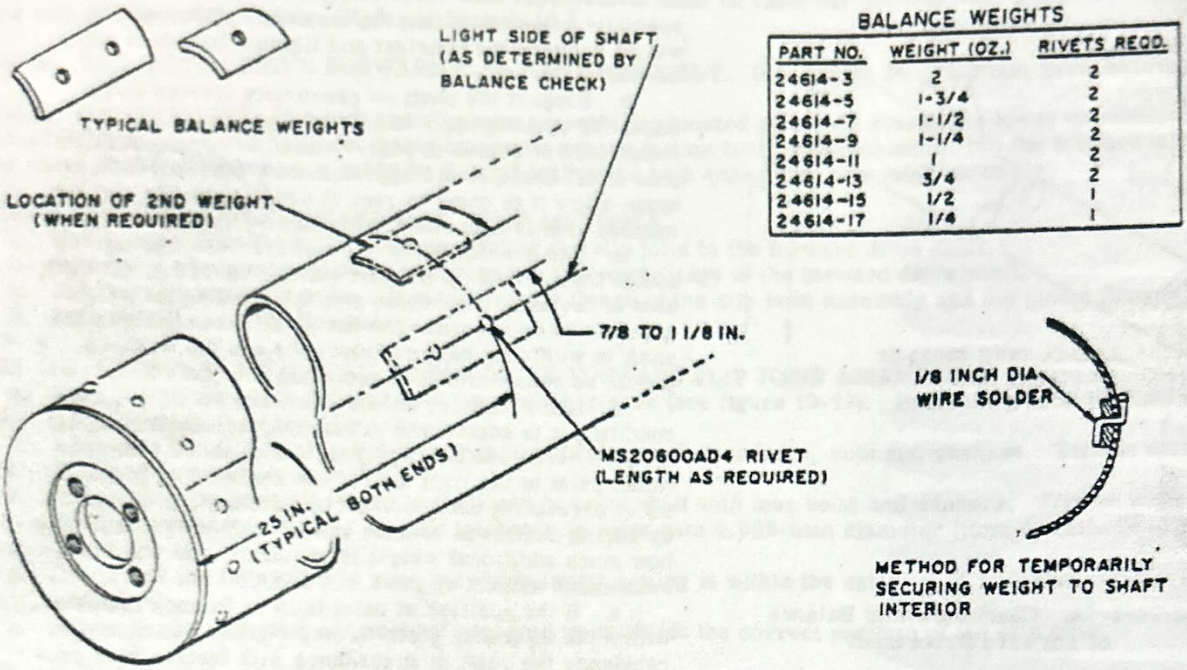


BALANCE WEIGHTS

PART NO.	WEIGHT (OZ.)	RIVETS REQD.
24614-3	2	2
24614-5	1-3/4	2
24614-7	1-1/2	2
24614-9	1-1/4	2
24614-11	1	2
24614-13	3/4	2
24614-15	1/2	1
24614-17	1/4	1

Figure 24-1-1B. Forward Drive Shaft Balance Weights

i. Reinstall the balancing adapter fittings on the ends of the shaft and recheck the shaft balance. The weighted side of the shaft should prove to be the heavy side; if not, replace one of the shaft balance weights with a 1/4-ounce heavier weight.

j. Carefully clip small segments from the exposed length of wire solder until the shaft is within the balance tolerance given in paragraph 24-20-30 step c.

k. When the proper state of balance is achieved, remove the weights and solder from the shaft and determine the total weight. If total weight required is one-half ounce or more, approximately one half of the total must be installed at each end of the shaft. Refer to table of weights contained in figure 24-1-1B for guidance in selecting the final weights. Corners of the balance weights may be clipped away as necessary to obtain a close balance.

l. After selecting the required weights, permanently attach them to opposite ends of the shaft interior as indicated in the illustration, using either one or two blind rivets per weight, as required. When necessary to drill a second rivet hole for securing a single weight, use the individual weight as a layout pattern for drilling the second hole. Note that the second rivet should be located nearer the adjacent end of the shaft.

NOTE: In instances where a large amount of weight is necessary to obtain proper balance it is permissible to install a second weight at either (or both) ends of the shaft; in such cases, locate the second weight as shown in figure 24-1-1B.

24-30-1. UNIVERSAL JOINTS. (See figure 24-1-2.)

24-30-10. REMOVAL AND INSTALLATION OF UNIVERSAL JOINTS. Refer to paragraph 24-30-40, below.

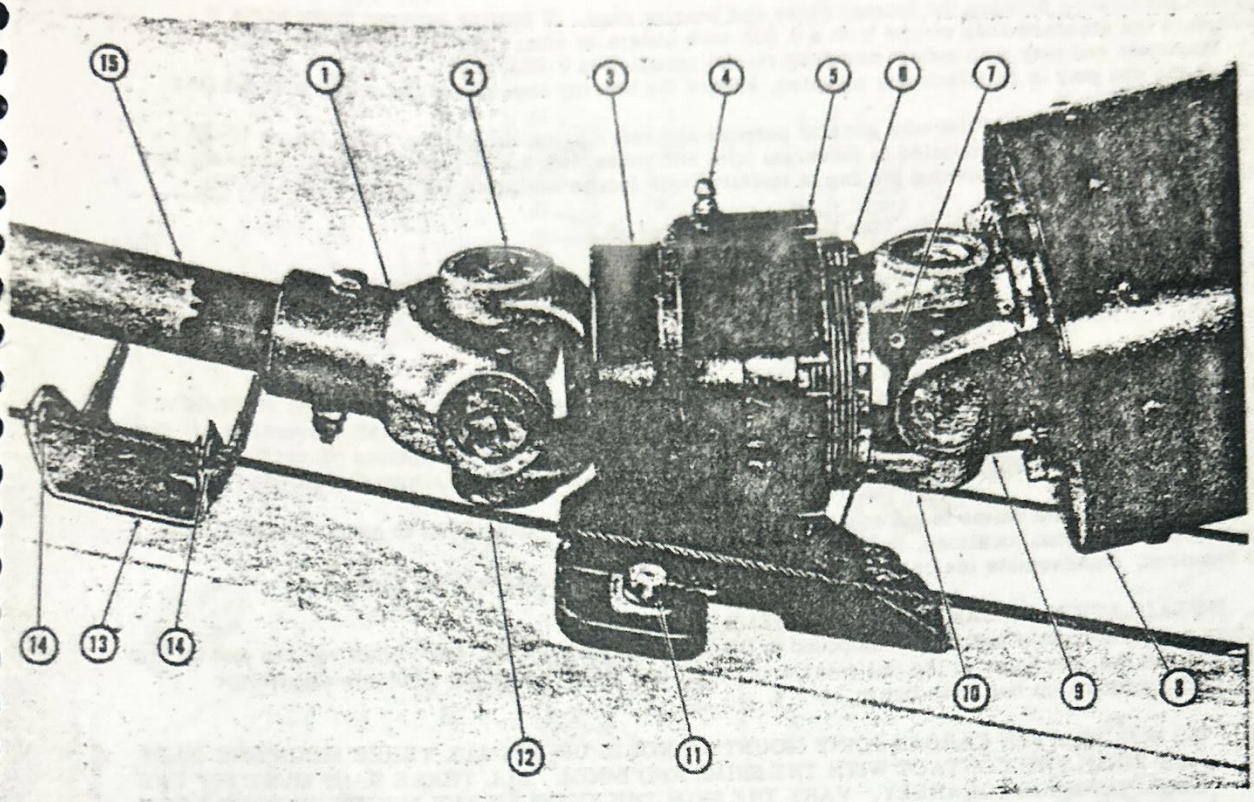
24-30-40. MINOR REPAIR AND PARTS REPLACEMENT OF THE UNIVERSAL JOINTS. (See figure 24-1-3.) Disassemble the universal joint in the following sequence:

a. Remove the four snap rings securing the journal cross (spider) bearing caps in the universal joint end yokes.

b. Use a large C-clamp or an arbor press and suitable fixtures to press against one of the journal cross bearing caps, forcing the opposite cap out of the yoke.

NOTE: The bearing cap farthest from the journal cross grease fitting should be removed first. Take care not to damage the journal cross grease fitting or grease seals located inboard of the bearing caps. Be careful not to lose the needles from the bearing caps.

c. Rotate the universal joint in the C-clamp or arbor press and press out the opposite bearing cap, observing the precautions outlined in the preceding note. Remove the universal joint end yoke from which the bearing caps were removed.



1. Aft Tail Rotor Drive Shaft End Yoke
2. Cardan Joint Aft End Yoke
3. Cardan Joint Housing
4. Lubrication Fitting
5. Cardan Joint Lock Ring
6. Bearing Retainer
7. Lubrication Fitting
8. Forward Tail Rotor Drive Shaft Assembly
9. Universal Joint Forward Yoke
10. Cardan Joint Forward End Yoke
11. Bolt
12. Right-Hand Intermediate Rudder Cable Assembly
13. Rudder Control Cable Guide Bracket
14. Grommet
15. Aft Tail Rotor Drive Shaft

Figure 24-1-2. Cardan Joint Assembly

d. Remove the two remaining bearing caps, following the procedure outlined in steps a and b above. Remove the journal cross from the universal joint end yoke.

e. Clean and inspect the journal cross and bearing cap bearing surfaces for wear or brinelling. Inspect the journal cross seals for damage. If these parts are damaged or worn, replace them by installing a replacement journal cross and bearing kit assembly. This kit includes the journal cross and seals, bearing caps and needles, and a complete set of snap rings. Refer to the illustrated Parts Catalog.

f. Assemble the universal joint as follows:

(1) Apply a coat of general purpose aircraft lubricating grease, to the inside of the bearing caps to retain the needles during installation. (See figure 10-19.)

(2) Install a journal cross and bearing caps in reverse order of removal. (See steps a through d above.)

NOTE: Each journal cross must be installed so that its grease fitting faces the aft end of the helicopter.

g. Check for play between the journal cross and the universal joint end yokes. Play should not exceed 0.005-inch. If end play exceeds this limit, fabricate and install disc shape steel shims between the bearing caps and snap rings. Divide the shims equally at opposite ends of the journal cross. Maximum permissible shimming is limited to 0.046-inch total thickness.

NOTE: Apply a coat of zinc-chromate primer to the shims prior to final installation. Use of laminated shim stock is preferable.

h. Check for binding between the journal cross and bearing caps. If binding between these parts is evident, replace the standard snap ring(s) with a 0.002-inch undersize snap ring. (Refer to UH-12E Parts Catalog.) Maximum end play with undersized snap ring(s) installed is 0.003-inch.

i. When the end play is satisfactorily adjusted, secure the bearing caps in the end yokes with the four snap rings.

j. Lubricate the universal joint with general purpose aircraft lubricating grease. (See figure 10-19.)

k. Bearing caps may be reinstalled in universal joint end yokes with 0.002-inch maximum clearance between cap and yoke assembly, provided the cap is installed with loctite sealant E (Item 24, Table 10-VI).

24-40-1. CARDAN JOINT ASSEMBLY. (See figures 24-1-2 and -3.)

24-40-2. DESCRIPTION. The cardan joint supports the forward and aft drive shafts and is designed so that the forward drive shaft may be adjusted forward or aft to very the length setting of the forward slip joint assembly. (See figure 24-1-2.)

24-40-10. REMOVAL OF CARDAN JOINT ASSEMBLY.

a. Remove the forward tail rotor drive shaft from the helicopter as described in paragraph 24-20-10.

b. Remove the bolt attaching the forward end of the aft tail rotor drive shaft to the aft universal joint end yoke by removing the nut and washer, and withdrawing the bolt passing through the splined connection.

c. Cut the lockwire and remove the four bolts, washers and radius blocks attaching the cardan joint assembly to the tail boom.

d. Note and identify the shims found under the mounting legs of the cardan joint to assure reinstallation of the shims in their original locations.

e. If required, disassemble the cardan joint assembly. (Refer to paragraph 24-40-20.)

24-40-11. INSTALLATION OF CARDAN JOINT ASSEMBLY.

a. Apply a liberal coat of antiseize compound to the universal joint and aft drive shaft splines and engage the splines. Check that the holes in the tail rotor drive shaft and the aft universal yoke are aligned for installation of the attachment bolt; see figure 24-1-4.

CAUTION: DO NOT TIGHTEN CARDAN JOINT MOUNTING BOLTS UNLESS ALL THREE MOUNTING PADS ARE FIRMLY IN CONTACT WITH THE SHIMS AND BOOM. ALL THREE PADS MUST FIT THE BOOM SURFACE SQUARELY. VARY THE SHIM THICKNESS AT ANY MOUNTING BOLT LOCATION AS REQUIRED TO OBTAIN THE PROPER FIT. INSTALL BOLTS OF THE PROPER LENGTH TO COMPENSATE FOR ANY VARIATION IN SHIM THICKNESS. REFER TO THE UH-12E PARTS CATALOG FOR ALTERNATE BOLT LENGTHS.

b. Attach the cardan joint assembly to the tail boom with the four bolts, four washers, three radius blocks and required shims. Determine the number of shims required and install the bolt, washer, and nut securing the tail rotor drive shaft to the aft universal joint.

c. Install the forward drive shaft. (Refer to paragraph 24-20-11.)

d. Align the tail rotor drive shaft. (Refer to paragraph 24-50-30.)

e. Adjust the slip joint position. (See figure 24-1-4.)

24-40-20. DISASSEMBLY OF CARDAN JOINT ASSEMBLY. (See figure 24-1-3.)

CAUTION: DO NOT ATTEMPT TO REMOVE ANY OF THE INTERNAL PARTS OF THE CARDAN JOINT ASSEMBLY WITHOUT FIRST REMOVING THE COMPLETE ASSEMBLY FROM THE TAIL BOOM.

a. Disassemble the universal joint journal crosses from the forward universal joint end yoke and the aft universal joint and yoke. (Refer to paragraph 24-30-10.)

b. Cut the lockwire securing the lock ring. Use an adjustable spanner wrench to loosen the lock ring.

c. Use an adjustable spanner wrench to unscrew the retainer ring from the cardan joint housing.

d. Unscrew the lock ring from the retainer ring.

e. Remove the snap ring from the forward universal joint yoke and press the yoke from the inner race of the front bearing.

f. Remove the snap ring and press the front bearing from the retainer ring.

g. Withdraw the splined shaft from the end yoke assembly.

h. Remove the snap ring from the opposite end yoke and press the yoke from the aft bearing.

i. Remove the snap ring and press the aft bearing out through the forward end of the cardan joint housing.

j. If required, unscrew the grease fitting from the housing.

24-40-21. REASSEMBLY OF CARDAN JOINT. (See figure 24-1-3.)

a. Clean and pack both bearings (41) with specified grease (Section 10).

b. Apply sealing compound, Grade E (Item 24, Table 10-VI) to the cleaned surfaces of bearing OD and bore of cardan joint housing (42). Press bearing into housing so that sealed side of bearing faces aft end of housing. Install retaining ring (40) to secure bearing.

c. Press aft yoke (39) into bearing installed in housing and secure with retaining ring (37).

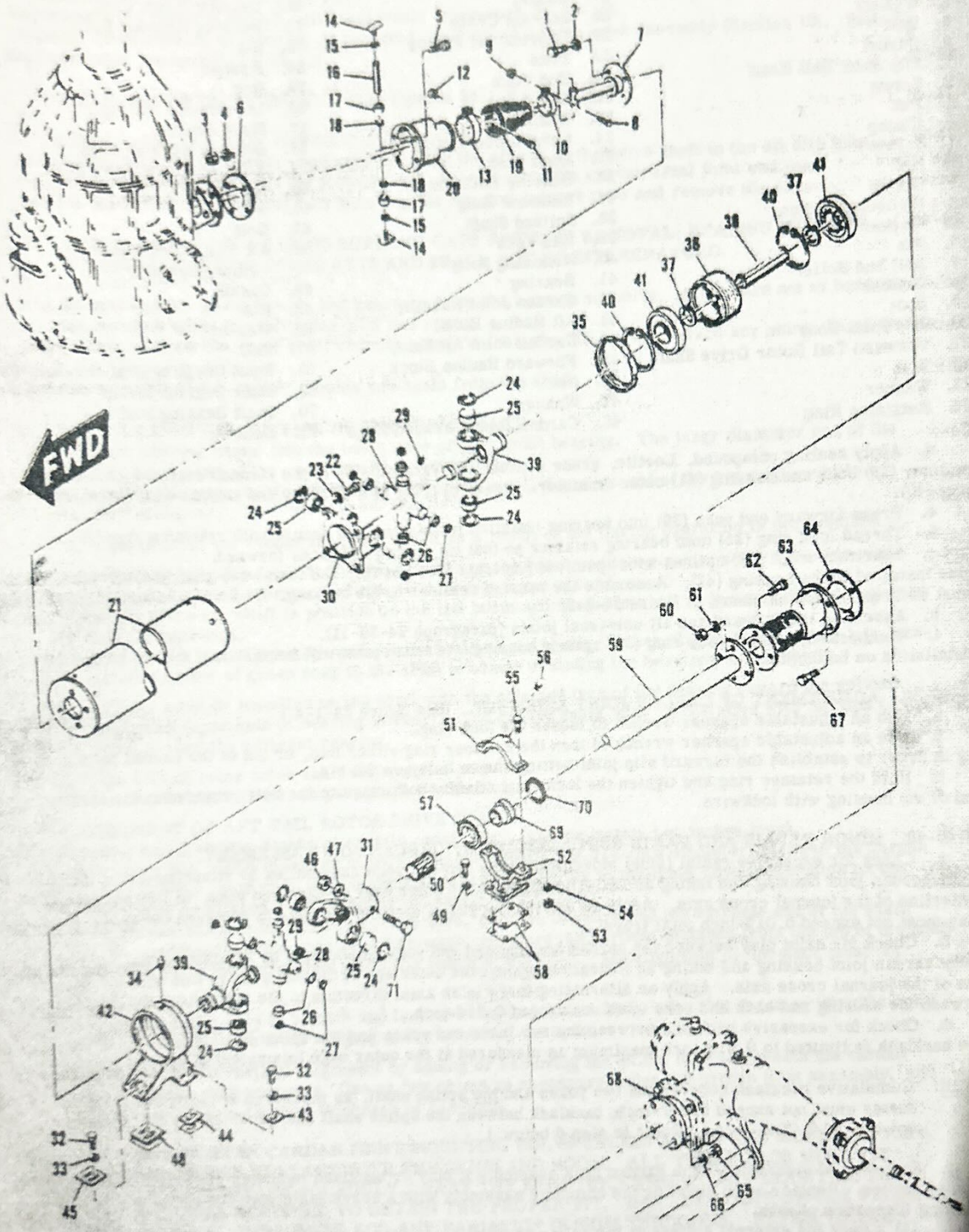


Figure 24-1-3. Tail Rotor Drive System

INDEX TO FIGURE 24-1-3

1. Bolt
2. Washer
3. Nut
4. Washer
5. Bolt
6. Gasket
7. Slip Joint Ball Head
8. Screw
9. Nut
10. Clamp
11. Screw
12. Nut
13. Clamp
14. Centering Button
15. Washer
16. Pin
17. Ball and Roller
18. Washer
19. Boot
20. Slip Joint Body
21. Forward Tail Rotor Drive Shaft
22. Bolt
23. Washer
24. Retaining Ring
25. Bearing
26. Gasket Retainer
27. Gasket
28. Journal Cross
29. Lubrication Fitting
30. Yoke
31. End Yoke
32. Bolt
33. Washer
34. Lubrication Fitting
35. Lock Ring
36. Bearing Retainer
37. Retainer Ring
38. Splined Shaft
39. End Yoke
40. Retaining Ring
41. Bearing
42. Cardan Joint Housing
43. Aft Radius Block
44. Cardan Joint Aft Shim
45. Forward Radius Block
46. Nut
47. Washer
48. Cardan Joint Forward Shim
49. Washer
50. Bolt
51. Bearing Block Cap
52. Bearing Housing Base
53. Nut
54. Washer
55. Bolt
56. Lubrication Fitting
57. Shaft Bearing
58. Bearing Housing Shim
59. Aft Tail Rotor Drive Shaft
60. Nut
61. Washer
62. Bolt
63. Aft Tail Rotor Drive Slip Joint Assembly
64. Gasket
65. Nut
66. Washer
67. Bolt
68. Input Coupling Seal Retainer
69. Shaft Bearing Mount
70. Shaft Bearing Seal
71. Bolt

d. Apply sealing compound, Loctite, grade E (Item 24, Table 10-VI) to the cleaned surfaces of bearing retainer (36) bore and bearing (41) outer diameter. Press bearing into retainer and secure with retaining ring (40).

e. Press forward end yoke (39) into bearing installed in retainer and secure with retaining ring (37).

f. Thread lock ring (35) onto bearing retainer so that its slotted end faces forward.

g. Lubricate shaft (38) splines with specified lubricant (Section 10), and insert the shaft into the aft end yoke installed in the housing (42). Assemble the bearing retainer to the housing. The forward and aft end yokes must be in alignment as shown in figure 24-1-2.

h. Assemble the forward and aft universal joints (paragraph 24-30-11).

i. Temporarily tighten lock ring (35) against housing. (Cardan joint will require adjustment after installation on helicopter.)

24-40-30. ADJUSTMENT OF CARDAN JOINT ASSEMBLY. (See figure 24-1-4.)

a. Use an adjustable spanner wrench to loosen the lock ring.

b. Use an adjustable spanner wrench to turn the retainer ring either into, or out of the cardan joint housing in order to establish the forward slip joint setting shown in figure 24-1-4.

c. Hold the retainer ring and tighten the lock ring. Safety both rings to the hole provided in the forward end of the housing with lockwire.

24-40-40. MINOR REPAIR AND PARTS REPLACEMENT OF CARDAN JOINT ASSEMBLY.

a. Check for excessive radial (side) movement of the two end yoke assemblies by attaching a dial indicator to the cardan joint housing and taking an indication against the outer edge of each end yoke, in line with the centerline of the journal cross axis. Apply an alternating radial force to the yoke to measure the radial play. Play must not exceed 0.015-inch total travel.

b. Check for axial play between the cardan housing and end yoke assemblies by attaching a dial indicator to the cardan joint housing and taking an indication against the outer end of the end yoke in line with the centerline of the journal cross axis. Apply an alternating force in an axial direction to the end yoke. Axial movement between the housing and each end yoke must not exceed 0.016-inch.

c. Check for excessive backlash between the two inner end yokes and the spline shaft. Allowable cumulative backlash is limited to 0.019-inch maximum as measured at the outer edge (diameter) of the end yokes.

NOTE: Cumulative backlash between the two yokes and the spline shaft, as measured at the spline pitch diameter must not exceed 0.007-inch; backlash between the spline shaft and either one of the yokes must not exceed 0.0045-inch. (Refer to step d below.)

d. Remove and disassemble the cardan joint assembly if play or backlash indicated in steps a or b is found to be excessive. Replace worn parts or the complete assembly with a serviceable unit, as required, after the following inspection checks.

(1) Check the external splines of the spline shaft by measuring the distance over 0.1200-inch diameter pins. Spline dimension is limited to 1.1146 inches minimum.

(2) Check the internal splines of each end yoke by measuring the distance between 0.0900-inch diameter pins. The internal spline dimension is limited to 0.8383-inch maximum.
(3) Check bearings for excessive wear and freedom from binding.
(4) Check each end yoke center cap for looseness and damage. Install a loose or new cap with adhesive, Aerobond PE (Item 34, Table 10-VI).
e. Reassemble the forward and aft universal joints (paragraph 24-30-40).
f. Reinstall grease fitting in housing, if removed. Lubricate cardan joint assembly (Section 10). Install cardan joint assembly (paragraph 24-40-11).

24-50-1. AFT TAIL ROTOR DRIVE SHAFT. (See figures 24-1-2 and -3.)

24-50-10. REMOVAL OF AFT TAIL ROTOR DRIVE SHAFT.
a. Remove the four bolts, washers and nuts securing the aft end of the drive shaft to the aft slip joint.
b. Remove the bolt used to attach the forward end of the shaft to the aft universal joint end yoke.
c. Remove the bolts, washers and nuts securing the bearing support caps and remove the caps.

CAUTION: MATCH-MARK THE BEARING SUPPORT CAPS PRIOR TO REMOVAL; BEARING SUPPORT ASSEMBLIES ARE MATCHED SETS AND SHALL NOT BE INTERCHANGED.

d. Lift the drive shaft, grease seals and bearings from the bearing supports, taking care not to bend the shaft, and slide the shaft from the universal joint end yoke.
e. If required, remove the drive shaft bearing supports from the tail boom. Attach any shims found under the support to facilitate reinstallation.
f. Withdraw the bearings, rubber mounts and seals from the shaft.

24-50-11. INSTALLATION OF AFT TAIL ROTOR DRIVE SHAFT.
a. Press a new bearing mount into the inner race of each shaft bearing. The large diameter end of the bearing mount must be located at the unshielded face of the bearing.
b. Lock the mount in place in the bearing by flaring the small diameter end of the bearing mount to a 0.713 (±0.005)-inch diameter.

NOTE: Slight separation of the rubber from the mount as a result of the flaring operation is permissible.

c. Install the supports and associated shims in place on the boom and temporarily secure them in place with the four bolts and washers; lubrication fitting should face boom aft end.
d. Temporarily place the shaft in position on the tail boom and mark the shaft to indicate the approximate location of each of the bearings.
e. Remove shaft and install bearings and grease seals on the shaft. Before sliding the bearings into location, apply a coat of tincture of green soap to the shaft to assist in sliding the bearings on the shaft.

NOTE: The bearings must be installed on the shaft with the shielded face of the bearing toward the splined end of the shaft (open side of bearing to rear). The grease seals must be installed with the lips of the seal facing toward the adjacent bearing.

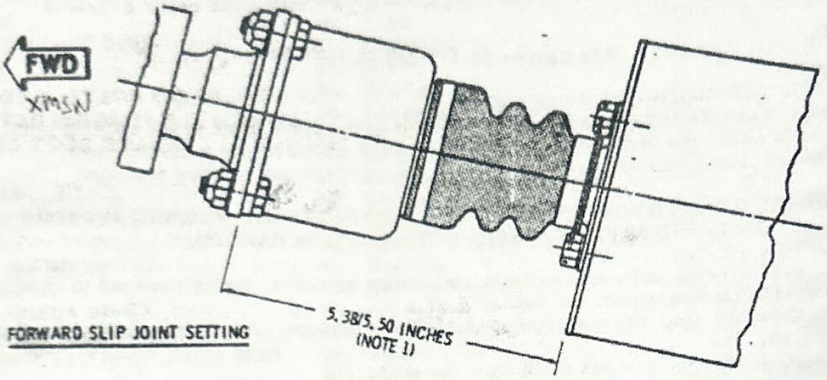
f. Install the aft tail rotor drive shaft and support caps.
g. Align the drive shaft. (Refer to paragraph 24-50-30.)

24-50-30. ALIGNMENT OF AFT TAIL ROTOR DRIVE SHAFT.
a. Obtain two small wooden blocks of exactly equal length (approximately two inches long).
b. Stretch a length of small diameter steel wire (approximately 0.012-inch diameter) between the cardan joint assembly and the tail rotor gear box, using a small tension spring to maintain adequate tension on the wire. The wire should be located directly above the center of the shaft.
c. Place a wooden block under each end of the wire, between the wire and the extreme end of the shaft.
d. Using the fixed height of the wire as a reference, measure the vertical distance from the top of the shaft to the wire. Take similar measurements along the length of the shaft. Misalignment of the shaft must not exceed 3/64-inch.

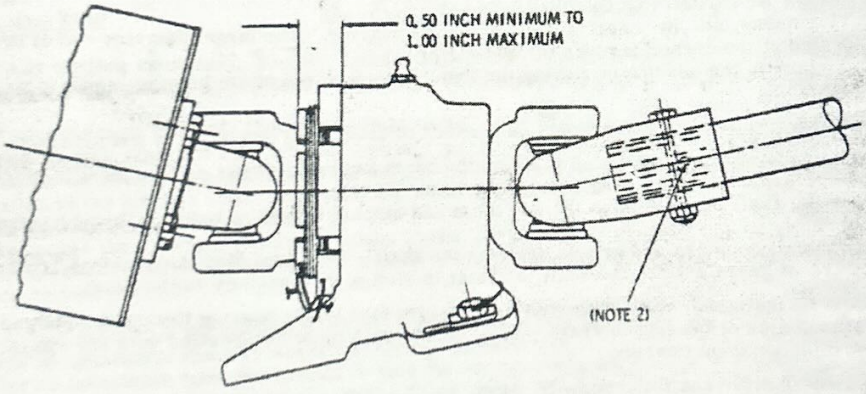
NOTE: Make sure that the wire is smooth and free of kinks or bends. Make sure that the wire is sufficiently taut to prevent the wire from sagging at the center of the span.

e. Bring the shaft into vertical alignment by adding or removing the shims located beneath the cardan joint assembly and drive shaft supports. Use as few shims as necessary under the cardan joint assembly, and under no circumstances exceed a total thickness of 1/4-inch.

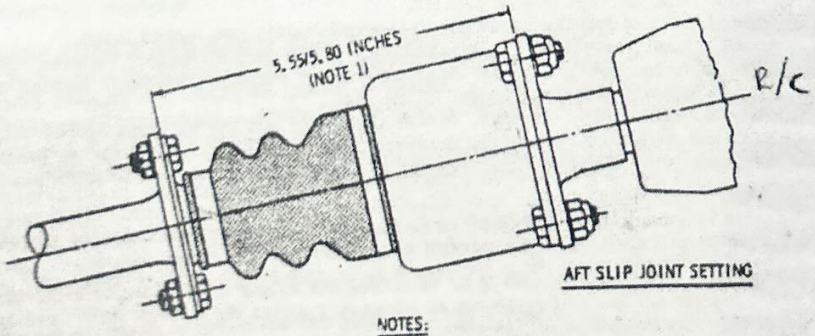
CAUTION: DO NOT TIGHTEN CARDAN JOINT MOUNTING BOLTS UNLESS ALL THREE MOUNTING PADS ARE FIRMLY IN CONTACT WITH THE SHIMS AND BOOM. ALL THREE PADS MUST FIT THE BOOM SURFACE SQUARELY. VARY THE SHIM THICKNESS AT ANY MOUNTING BOLT LOCATION AS REQUIRED TO OBTAIN THE PROPER FIT. INSTALL BOLTS OF THE PROPER LENGTH TO COMPENSATE FOR ANY VARIATION IN SHIM THICKNESS. REFER TO THE UH-12E PARTS CATALOG FOR ALTERNATE BOLT LENGTHS.



FORWARD SLIP JOINT SETTING



CARDAN JOINT ADJUSTMENT



AFT SLIP JOINT SETTING

NOTES:

(1) DIMENSION MAY VARY AROUND SLIP JOINT CIRCUMFERENCE LIMITS APPLY TO ANY POINT OF MEASUREMENT.
(2) INSTALL BOLT IN SHAFT HOLE THAT GIVES MINIMUM VALUE FOR 1.00/0.50-INCH CARDAN JOINT ADJUSTMENT.

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Figure 24-1-4. Cardan Joint Adjustment

f. Move the wire to one side of the shaft and install the two wooden blocks, in the same general manner as used for checking vertical shaft alinement.

g. Using the fixed location of the wire as a horizontal reference, measure the horizontal distance from the side of the shaft to the wire. Take similar measurements along the length of the shaft. Misalinement must not exceed the tolerance specified in step d above.

h. Bring the shaft into horizontal alinement by loosening the cardan joint and/or shaft support attaching bolts, and by moving the cardan joint or supports laterally on the boom, within the range provided by the slotted bolt holes.

i. Recheck to determine that the vertical shaft alinement has not changed.

CAUTION: WHEN INSTALLING CARDAN JOINT OR BEARING SUPPORT ATTACHING BOLTS, CHECK TO MAKE CERTAIN THAT THE BOLT LENGTH IS CORRECT, ESPECIALLY IF SHIMS HAVE BEEN ADDED OR REMOVED. REFER TO THE PARTS CATALOG FOR ALTERNATE BOLT LENGTHS.

24-50-40. MINOR REPAIR AND PARTS REPLACEMENT FOR AFT TAIL ROTOR DRIVE SHAFT. Replace an aft drive shaft (installed or removed from the helicopter) that exceeds the allowable runout dimensions.

a. Check that the I. D. of the counterbore diameter (2.876/ 2.877 inch) on drive shaft flanged end is concentric with adjacent two inches of drive shaft tube (measured aft of the front face of flange) within .010 T.I.R. (difference in T.I.R. readings between the two check points.)

b. Splined end fitting shall be concentric with the shaft tube measured one inch aft of weld within .010 T.I.R. (difference in T.I.R. readings at two check points). Take the indication against splined end fitting adjacent to splined area.

c. The maximum curvature of the drive shaft (not installed) must not exceed 0.010-inch per any one foot of length (0.020-inch TIR).

24-60-1. TAIL ROTOR DRIVE AFT SLIP JOINT ASSEMBLY. (See figures 24-1-3 and -4.)

24-60-2. DESCRIPTION. The aft slip joint assembly transmits rotary motion from the aft tail rotor drive shaft to the tail rotor gear box. This assembly is identical to the forward slip joint assembly.

24-60-10. REMOVAL OF SLIP JOINT ASSEMBLY. Remove the slip joint assembly in accordance with applicable procedures in paragraph 24-10-10.

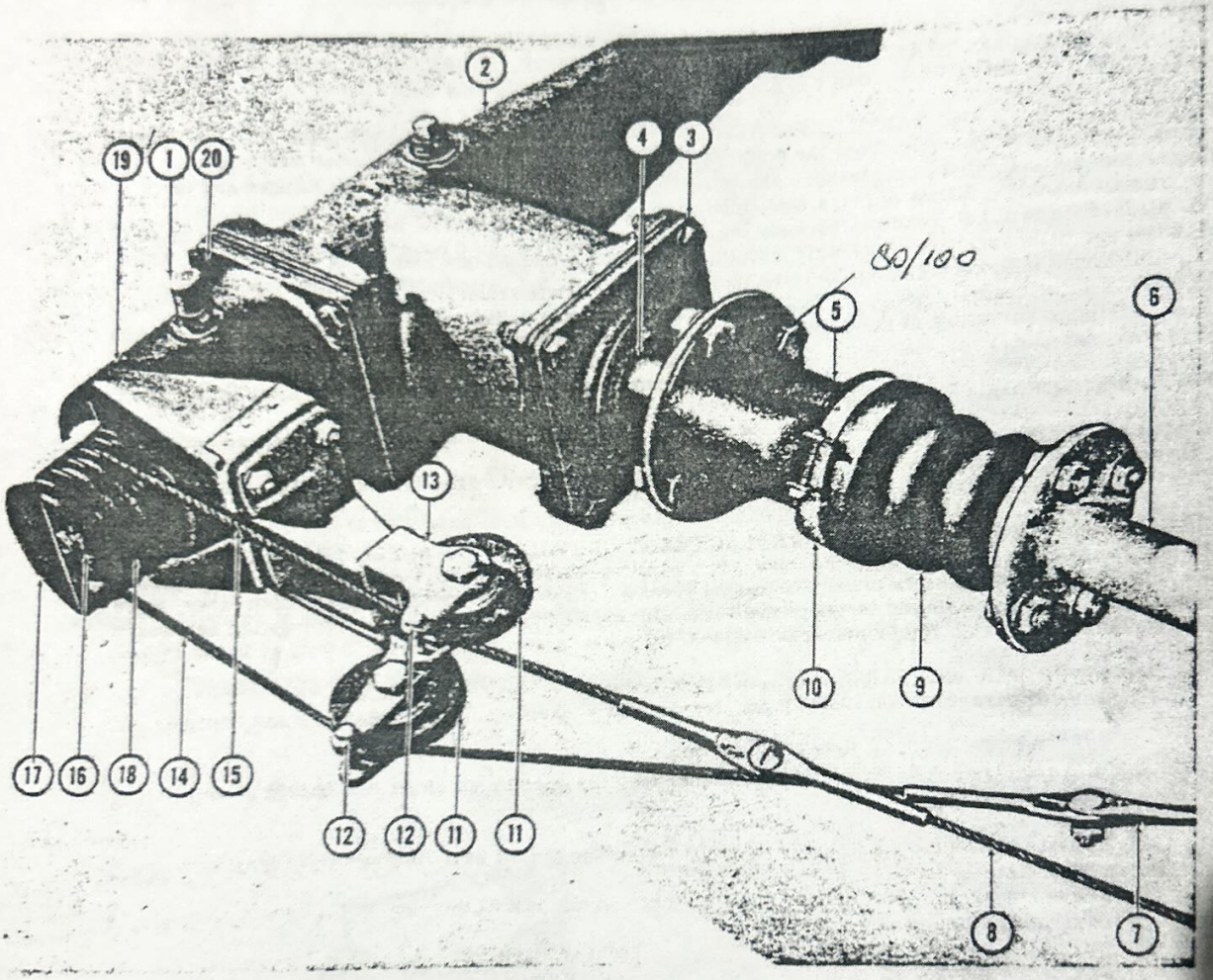
24-60-11. INSTALLATION OF AFT SLIP JOINT ASSEMBLY. Pack the inside of the joint body with lubrication grease specified in figure 10-19 and install the aft slip joint assembly in the reverse order of removal. Tighten the slip joint flange nuts to 80/100 pound-inch torque value.

24-60-40. MINOR REPAIR AND PARTS REPLACEMENT OF TAIL ROTOR DRIVE AFT SLIP JOINT ASSEMBLY. (Refer to paragraph 24-10-40.)

TAIL ROTOR SPEED DECREASER

25-1-1. TAIL ROTOR SPEED DECREASER. (See figures 25-1-1 and -2.)

25-1-2. DESCRIPTION. The tail rotor speed decreaser (also referred to as tail rotor gear box) is located on the aft end of the tail boom. It changes the rotary drive 90 degrees. A tail rotor pitch change mechanism is incorporated internally in the assembly.



1. Tail Rotor Speed Decreaser Main Housing Air Vent
2. Tail Rotor Speed Decreaser Main Housing
3. Bearing Retainer Input End Cap
4. Input Coupling
5. Slip Joint Assembly
6. Tail Rotor Drive Aft Shaft
7. Rudder Control Left-Hand Intermediate Cable Assembly
8. Rudder Control Right-Hand Intermediate Cable Assembly
9. Dust Boot and Moisture Seal
10. Dust Boot and Moisture Seal Attachment Clamp
11. Rudder Control Aft Pulley
12. Rudder Control Aft Pulley Bracket Guard Pin
13. Rudder Control Aft Pulley Bracket
14. Rudder Control Left Aft Cable Assembly
15. Rudder Control Right Aft Cable Assembly
16. Cable Drum Attachment Nut
17. Cable Drum Guard Assembly
18. Cable Drum
19. Cable Drive Housing
20. Cable Drive Housing Attachment Bolt

Figure 25-1-1. Front View of Tail Rotor Speed Decreaser Installation

25-1-3. TROUBLESHOOTING THE TAIL ROTOR SPEED DECREASER. Refer to Table 25-1-I for tail rotor speed decreaser troubleshooting information.

25-1-10. REMOVAL OF TAIL ROTOR SPEED DECREASER.

a. Remove the tail rotor if required. (Refer to Section 65.) It is not necessary to remove the tail rotor in order to remove the speed decreaser from the tail boom.

b. Disconnect the rudder control cables at the cable terminal fittings located immediately forward of the speed decreaser.

c. Remove the four nuts, washers and bolts securing the aft end of the slip joint to the speed decreaser drive flange.

d. Remove the four nuts, washers and close tolerance bolts attaching the gear box to the aft tail boom bulkhead.

25-1-11. INSTALLATION OF TAIL ROTOR SPEED DECREASER. (See figures 25-1-1 and -2.)

a. Clean the dried zinc chromate primer from the gear box mounting flange and the aft end of the tail boom bulkhead.

b. Apply a wet coat of zinc chromate primer to the gear box mounting flange and install the gear box while the primer is still wet.

c. Install the four close tolerance bolts, washers and nuts used to attach the gear box to the tail boom.

d. Use a tail rotor gear box socket wrench (item 11, Table 92-1-I) to hold the boltheads and tighten the nuts in the following sequence:

(1) Tighten the two center nuts to 40/60 pound-inch torque value.
(2) Tighten the two outer nuts to 40/60 pound-inch torque value.
(3) Tighten the two center nuts to 70/90 pound-inch torque value.
(4) Tighten the two outer nuts to 70/90 pound-inch torque value.

e. Pack the body of the aft slip joint with lubricating grease (see figure 10-19) and install the gasket between the slip joint and gear box flanges.

f. Attach the gear box drive flange to the aft slip joint flange with the four bolts, washers and nuts. Tighten the nuts to 80/100 pound-inch torque value.

g. Attach the two short aft rudder cables to the fittings provided on the mating cables. Safety the clevis bolts with cotter pins.

25-1-40. MINOR REPAIR AND PARTS REPLACEMENT OF TAIL ROTOR SPEED DECREASER. Minor repairs are limited to replacement of the input shaft coupling oil seal and the output shaft oil seal; these require removal of external parts only. For major overhaul of the tail rotor drive speed decreaser, refer to the applicable overhaul manual. Refer to the Parts Catalog for nomenclature and information necessary to obtain replacement parts. Replacement of external oil seals is accomplished as described in the following paragraphs.

a. Replace the input shaft coupling oil seal as follows:

(1) Remove the cotter pin, special nut, (or nut and washer), coupling retainers and the input shaft coupling.

NOTE: Replace standard castellated nut and washer with the special nut (Part No. 25232) if not previously accomplished.

(2) Remove the four bolts, washers and nuts securing the oil seal retainer and remove the retainer, taking care not to disturb the bearing shims.

(3) Press out the oil seal and replace with a new seal. Install the new seal with wet zinc chromate primer on the outside diameter of seal shell.

(4) Install the oil seal retainer in the reverse order of removal.

(5) Install the input shaft coupling and the coupling retainers.

(6) Install the special nut (SPL etched on one hex flat) and tighten to 340/390 pound-inch torque value.

(7) Install cotter pin.

b. Replace the output shaft seal as follows:

(1) Remove the four bolts, washers and nuts retaining the output end cover.

(2) Remove the output end cover, taking care not to disturb the cover shim.

(3) Press out the old oil seal and replace with a new seal. Install the new seal with wet zinc chromate primer on the outside diameter of the seal. Also replace the O-ring packing seal on the outside diameter of the output end cover.

(4) Installation of the input end cover is accomplished in the reverse order of removal.

NOTE: Allowable oil leaks on new seals should not exceed 15 countable drops per hour. This limit applies to the first 25 hours of operating. After 25 hours of operation the seal leakage should not exceed 10 countable drops per hour.

25-1-41. CHECKING SPEED DECREASER FOR WORN PARTS.

a. Check the output shaft for excessive radial (side) play as follows:

(1) Attach a dial indicator to the main housing in a manner which will permit the indicator contact point to touch the output shaft approximately 1/2-inch outboard of the oil seal.

(2) Apply an 11-pound load to the output shaft as close to the measuring point as possible and in the direction of the indicator contact arm.

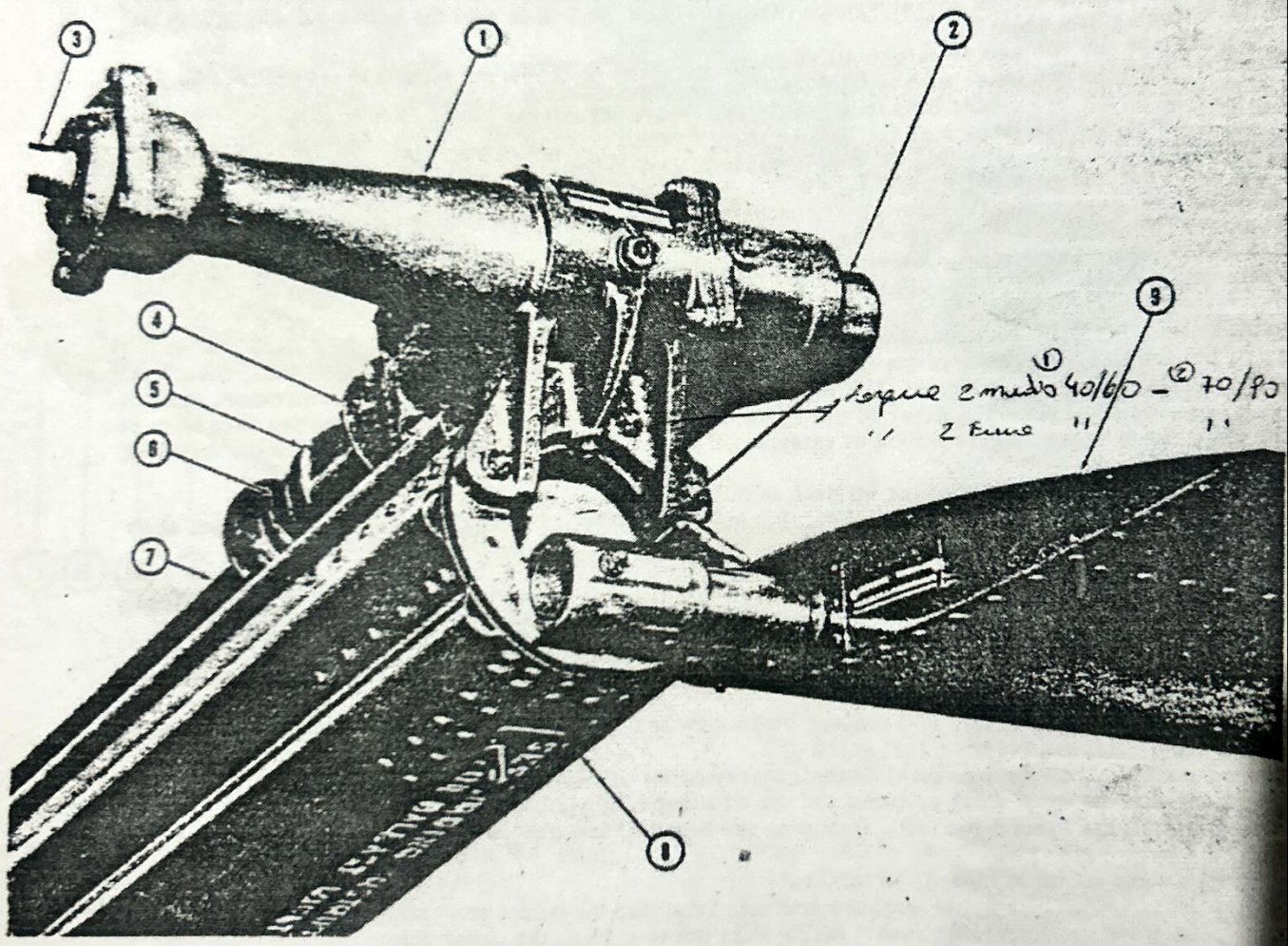
(3) Check the amount of play indicated. Maximum allowable side play is limited to 0.003-inch.

NOTE: Play in excess of the amount specified usually indicates a worn bearing in the output end of the main housing.

(4) If maximum allowable side play is exceeded, replace the speed decreaser, or repair the assembly in accordance with overhaul manual instructions.

b. Check the output shaft for excessive axial (end) play as follows:

(1) Clamp a dial indicator to the output shaft between the main housing and the tail rotor assembly,



1. Tail Rotor Speed Decreaser Main Housing
2. Cable Drum
3. Pinion Shaft
4. Aft Slip Joint Assembly
5. Boot Clamp
6. Boot
7. Aft Tail Rotor Drive Shaft
8. Tail Boom Assembly
9. Horizontal Stabilizer

Figure 25-1-2. Rear View of Tail Rotor Speed Decreaser Installation

Table 25-1-I. Troubleshooting the Tail Rotor Speed Decreaser

TROUBLE	PROBABLE CAUSE	REMEDY
Stiffness in system	Bent pitch change rod at tail rotor speed decreaser	Replace with serviceable speed decreaser.
	Binding control mechanism inside tail rotor speed decreaser	Same as above.
High frequency vibration	Rough bearings in tail rotor speed decreaser	Remove speed decreaser from tail boom. Rotate tail rotor to check bearings. If roughness is detected, replace bearings.

with the indicator contact point touching the oil seal retainer.

(2) With rudder pedal control placed in either full throw position, move the control to the opposite full throw position and check the output shaft play indicated. Maximum allowable play is limited to 0.002-inch.

NOTE: Play in excess of the amount specified usually indicates a worn output shaft bevel gear bearing, or a loose output shaft hexagon nut.

(3) If the maximum allowable play is exceeded, replace the speed decreaser, or repair the assembly in accordance with overhaul manual instructions.

FLIGHT CONTROLS SYSTEMS

30-1-1. FLIGHT CONTROL SYSTEMS. (See figures 30-1-1 and -2.)

30-1-2. DESCRIPTION. There are three separate mechanical flight control systems: The collective control system, the cyclic control system and the directional control system. The pitch of the main rotor blades, which is varied by operation of the collective control system, governs the rate of ascent or descent of the helicopter. The pitch of the control rotor blades, which is controlled by operation of the cyclic control system, produces an aerodynamic effect causing the entire main rotor assembly to tilt. Tilting of the main rotor disc establishes longitudinal and lateral flight attitudes. The pitch of the tail rotor controls the helicopter's heading. Refer to sections 31, 32 and 33 for maintenance instructions for the flight control systems.

30-1-3. TROUBLESHOOTING THE FLIGHT CONTROL SYSTEM. Refer to table 30-1-II for troubleshooting vibration difficulties related to the flight control system.

30-1-30. TRACKING MAIN ROTOR BLADES. (See figure 30-1-3.) In order to avoid vibration and undesirable flight control characteristics, it is important that under certain specified conditions, both blades of the main rotor assembly move through the same plane of rotation. The main rotor blades may be tracked by the light reflector method as follows:

a. The reflector tracking method employs the principle of "persistency of vision" which occurs during observation of a beam of light which is being intercepted by two light reflectors. One reflector is installed at the tip of each main rotor blade. The surface of one reflector is plain white, and the surface of the other is white with a horizontal black stripe painted across the center of the face. A perfect in-track pattern may be observed as in step (1) and an out-of-track condition is indicated as described in step (2) below.

(1) As the blades rotate and the light beam is intercepted by the reflectors, the observer will see two white bands and one black band. One white band will be above, and the other white band will be below the black band. A perfect in-track pattern is indicated by a superimposition of both reflector images, in which the white bands are the same width.

(2) If one reflector image becomes displaced vertically, relative to the other, one white band will be perceptibly wider than the other white band. This occurrence indicates an out-of-track condition. Should the vertical displacement exceed the diameter of the reflectors, two separate images will be seen. The white band will be all white, and the black band running across the white surface of the other reflector will be visible.

b. Track the main rotor blades as follows:

NOTE: Coordinate any adjustment of the trim tabs and/or incidence pushrods to establish blade track with blade autorotation rpm requirements as outlined in paragraph 30-1-31.

(1) Remove the second screw from the bottom side of each main rotor blade tip fairing.

(2) Install the reflectors finger-tight in the nut of the blade tips so that both reflectors are in line with the tip fairing parting surface, and are facing toward the cabin. Install the reflector with the black stripe in the tip of the blue blade.

NOTE: In the event that a reflector does not aline with the tip fairing parting surface after being finger tightened, loosen the reflector by the amount required to produce parallel alinement. Exercise care in handling the reflectors as the mirror surfaces are made of plastic and are easily scratched or damaged. Use a clean, soft cloth and a cleaning solution suitable for plastic materials to clean the mirror faces.

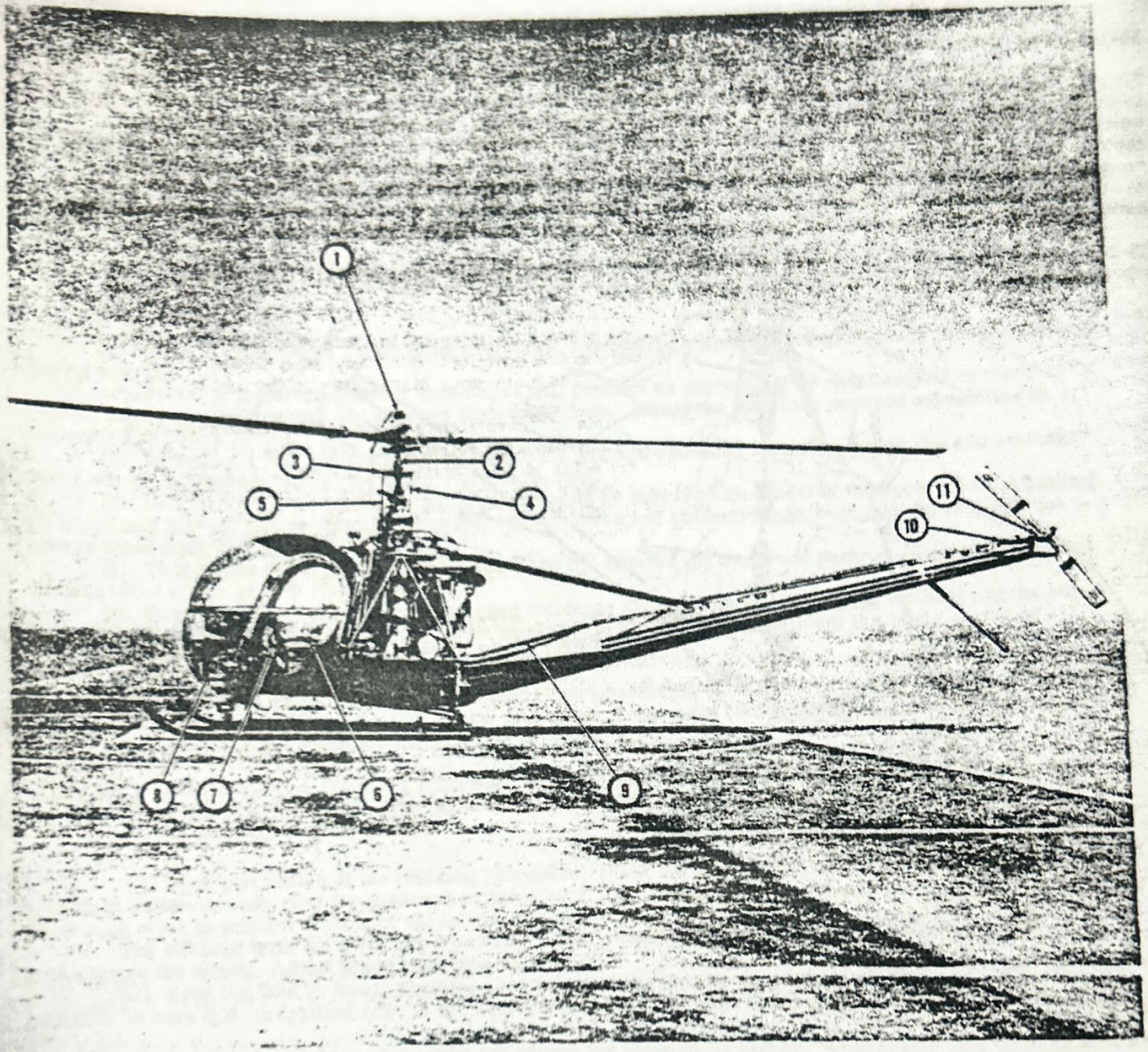
(3) Plug a tracking light (item 46, table 92-1-I) or a signal light (Specification MIL-L-7569, Type MA-1, or equivalent) into the cabin receptacle. If the tracking or signal light is not available, a satisfactory substitute can be made from a landing light lamp.

(4) Fly the helicopter in a hovering attitude at 3200 engine rpm, and observe the track of the blades by directing the light from the cockpit forward toward the reflectors. The light source must be held as close as possible to the eye of the observer. Slowly "washing" the light beam up and down through the tip path plane of the rotor will aid in "picking up" the reflectors.

NOTE: Whenever possible, hover tracking should be accomplished during still wind conditions since even moderate surface winds can cause erroneous out-of-track indications.

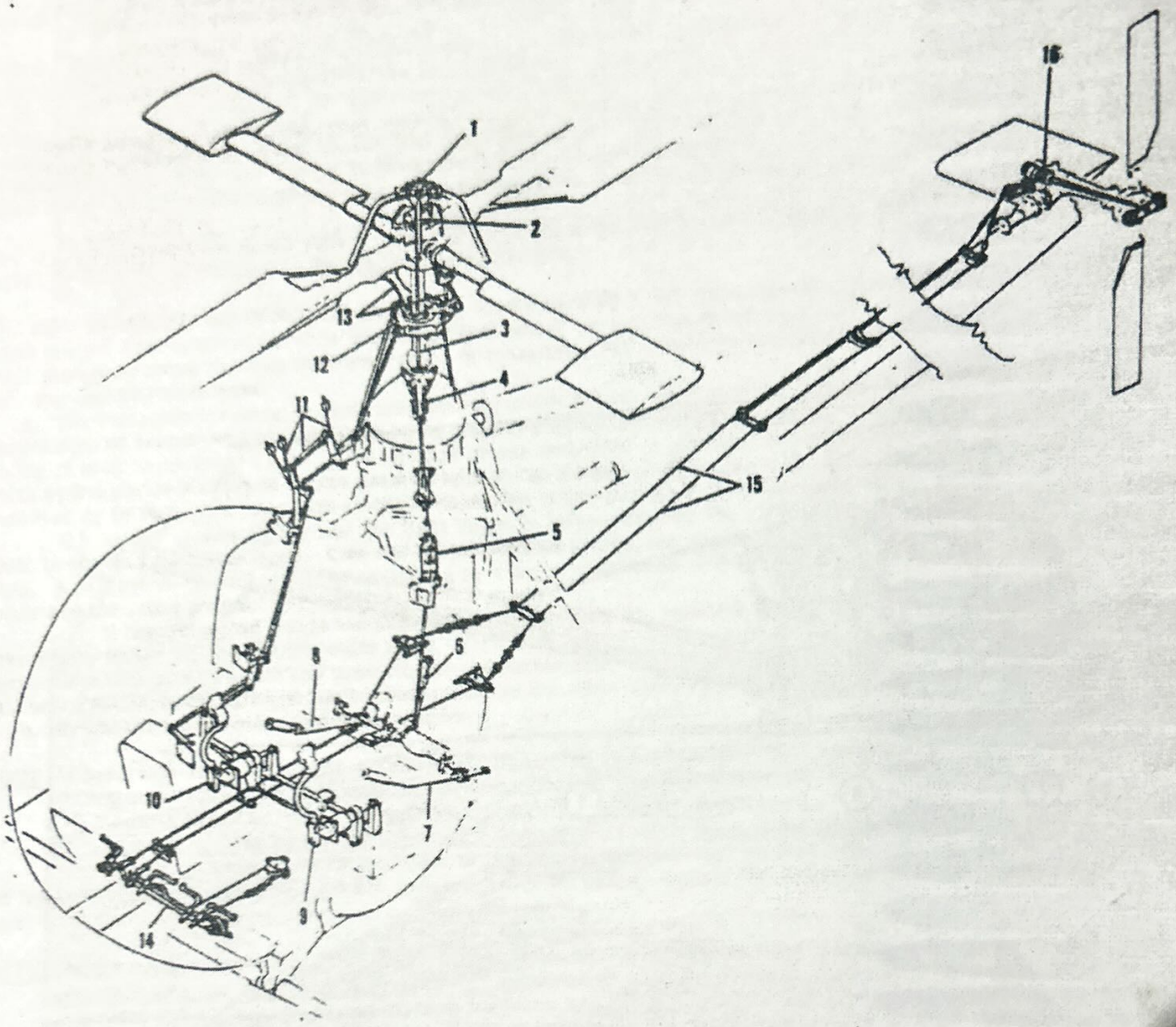
(5) Check the relative widths of the white bands in the reflected light pattern. If one white band is wider by 1/4-inch or more than the other white band, objectionable vibration may occur. Use the known diameter of the reflector as a reference in estimating the amount of out-of-track condition that exists at the rotor tips.

(6) With the blade tabs set in neutral position, use the incidence arm adjustment at the main rotor hub to bring the blades into track in the hover condition. Refer to step c, below for detailed instructions on adjustment of the incidence pushrod assemblies.



1. Collective Ballast Assembly
2. Scissors Assembly
3. Wobble Plate Assembly
4. Cyclic Pylon Assembly
5. Cyclic External Push Rod Assembly
6. Collective Control Stick Installation
7. Cyclic Control Stick Installation
8. Rudder Control Pedals
9. Rudder Cable Assemblies
10. Tail Rotor Speed Decreaser
11. Tail Rotor Pitch Change Mechanism

Figure 30-1-1. Location of Flight Control Major Components



1. Collective Ballast Assembly
2. Collective Incidence Push Rod Assembly
3. Collective Internal Push Rod Assembly
4. Collective Yoke Assembly
5. Collective Bellcrank-Bracket Assembly
6. Bungee Assembly
7. Dual Collective Outboard Stick Assembly
8. Collective Stick Assembly
9. Dual Cyclic Outboard Stick Assembly
10. Cyclic Stick Assembly
11. Vibration Damper and Bellcrank-Bracket Assembly
12. Wobble Plate Assembly
13. Scissors Assembly
14. Rudder Controls Installation
15. Rudder Cable Assemblies
16. Tail Rotor Pitch Change Mechanism

Figure 30-1-2. Flight Control Systems

(7) If it is necessary, recheck the hover track, and repeat the procedure until the blades are precisely in track.

(8) After the hover track has been satisfactorily adjusted, check the track in the forward (270° to 90°) azimuth position and at an airspeed of 60 knots and 3200 engine rpm. If an out-of-track condition exists, correct by adjusting the blade tabs. Refer to step d below for detailed instructions on tab adjustments.

(9) After each tab adjustment, recheck the hover track. If necessary, repeat steps (5), (6) and (7) above, using a combination of incidence arm adjustments and tab adjustments to achieve proper tracking in both hovering and forward flight conditions.

(10) If a satisfactory track is obtained in hover and at 60 knots, check the track at the maximum allowable airspeed (Vne) and 3200 engine rpm. If an out-of-track condition is evident, correct as directed in steps (8) and (9) above.

NOTE: Under normal conditions, the main rotor hub incidence arm should be adjusted to track the blades in the hovering attitude. Blade tab adjustments should be used to correct out-of-track conditions under forward flight conditions.

(11) Upon completion of the tracking procedure, remove the reflectors from the blade tips and reinstall the tip screws.

c. Adjustment of incidence pushrod assemblies will produce an approximately equal amount of track correction in both the hovering and forward flight conditions. Adjust the incidence pushrod assemblies as follows: (See figure 30-1-4.)

(1) To secure a fine adjustment of the incidence pushrod assembly adjust the lower rod end bearing. For a coarse adjustment, adjust the upper rod end bearing.

(2) Lengthening of the incidence pushrod assembly by outward adjustment of the upper rod end bearing (7/16-20 inch thread) and/or outward adjustment of the lower rod end bearing (3/8-24 inch thread) will decrease blade pitch and lower the blade tip.

(3) To increase blade pitch and raise the blade tip, shorten the incidence pushrod assembly by inward adjustment of either or both rod end bearings.

(4) Combinations of adjustment (increased incidence at one blade and decreased incidence at the other) at both incidence pushrod assemblies should be employed to equalize the adjustment if a large degree of correction (two inches or more out-of-track) is required.

NOTE: Due to possible variation in individual blade characteristics, the amount of incidence pushrod adjustment required to raise or lower the tip path plane of one rotor blade may not apply when adjusting the opposite blade incidence for the same tip path correction.

WARNING: MAIN ROTOR AUTOROTATION RPM IS AFFECTED BY THE INCIDENCE PUSHROD ADJUSTMENT AND MUST BE CHECKED BY FLIGHT TEST FOLLOWING SUCH ADJUSTMENT. (REFER TO PARAGRAPH 30-1-31.)

(5) Upon completion of the tracking procedure, check the pushrod assemblies for adequate engagement length of hidden threads, and for tightness of check nuts. Make sure that the rod end bearings are locked in line with each other to prevent binding of the incidence arm.

d. The effect of trim tab adjustment on blade track is dependent upon air speed. The higher the air speed, the greater the effect. Adjust blade trim tabs as follows:

(1) Bend the tabs by hand, applying pressure with the thumbs or with a forming block. When bending the tab, be sure that its trailing edge is straight and lies parallel to the trailing edge of the blade. (See figure 30-1-3.)

(2) Raising the trailing edge of the tab causes the blade to fly higher. Conversely, the blade flies lower when the trailing edge of the tab is lowered.

(3) Do not bend tabs more than 35 degrees maximum with respect to the rotor blade chord line. Adjustment beyond 35 degrees results in a "two-per-revolution" roughness.

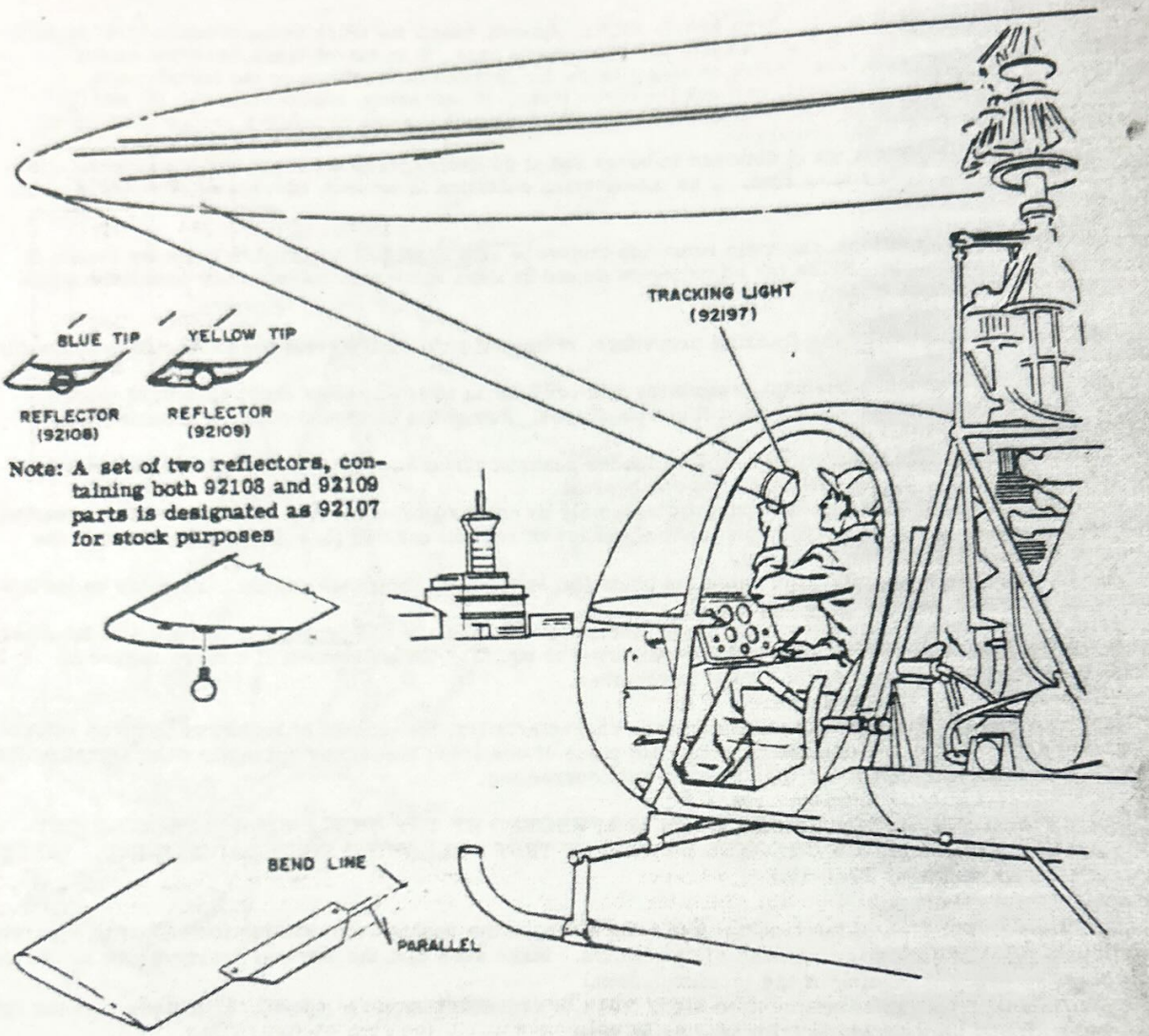
30-1-31. ADJUSTMENT OF MAIN ROTOR SPEED IN AUTOROTATION. It is essential for safe autorotational flight that the main rotor speed stabilize between the limits indicated on the tachometer. Correct main rotor speed in autorotation is obtained by equalized adjustment of the incidence pushrods on both main rotor blades. Adjust the main rotor speed as follows:

a. After loading the helicopter, determine actual gross weight.

b. Fly to a safe altitude to execute autorotational descents at 43 knots indicated airspeed.

c. After reaching the desired altitude, note the altimeter reading and the outside air temperature. Climb several hundred feet above this test altitude, and make an autorotational descent, holding the ship at a "steady" indicated airspeed, maintaining a straight directional heading, and holding the collective pitch stick full "down". Allow the rpm to stabilize before taking the autorotation rpm reading.

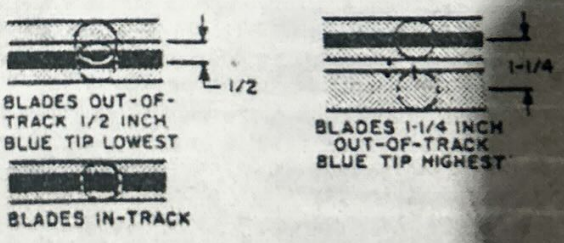
WARNING: DO NOT PERMIT ROTOR RPM TO FALL OUTSIDE THE RED LINES ON THE TACHOMETER.



Note: A set of two reflectors, containing both 92108 and 92109 parts is designated as 92107 for stock purposes

TRACKING CORRECTIONS

TRACKING IMAGES



Note: All dimensions are in inches.

Figure 30-1-3. Tracking Main Rotor Blades

Table 30-1-I. Main Rotor Autorotation Rpm Chart

Altitude vs Temperature at 43 Knots IAS
2250 Pounds Gross Weight*
(Allowable Variation, ±3 Rpm)

PRESSURE ALTITUDE**	0°F	10°F	20°F	30°F	40°F	50°F	60°F	70°F	80°F	90°F	100°F
0 ft	333	335	338	340	342	345	348	350	352	356	357
500 ft	335	337	340	342	344	347	350	352	355	357	359
1000 ft	337	340	342	344	347	349	354	356	358	360	362
1500 ft	339	342	345	347	349	352	356	358	360	362	364
2000 ft	342	344	347	349	352	355	358	360	362	364	366
3000 ft	347	349	352	355	357	360	363	365	367	369	372

* Approximate weight of helicopter plus 170 pound pilot plus full fuel tank.

** Altimeter set at 29.92 in.

NOTE: Deduct 7 rpm for each 100 lbs under 2250 pounds gross weight.
Add 7 rpm for each 100 pounds over 2250 pounds gross weight.

d. If the rotor rpm shows signs of exceeding the red line limits, correct the rigging as described in steps g through k, below.

e. If the rotor rpm falls within the red line limits on the tachometer, note the rotor rpm after the ship stabilizes in a glide. The rpm during this operation should fall between the limits specified in table 30-1-I for that particular pressure altitude and outside air temperature. If these specifications are met, the rigging is correct. For example:

(1) Climb until the altimeter reads 2000 feet.
(2) The outside air temperature at this altitude reads 15.6°C (60 °F).
(3) Climb to 2300 feet and make an autorotational descent at 43 knots indicated airspeed.
(4) Gross weight is 2250 pounds; observed rotor speed is 360 rpm. Determine from table 30-1-I if this rotor speed is satisfactory as follows: Read the rpm (corrected for observed altitude and outside air temperature) equal to 358 rpm from table 30-1-I. Since the allowable variation of the true rpm is ±3 rpm, the observed rpm of 360 is satisfactory.

NOTE: Rpm figures shown in table 30-1-I apply when the collective pitch stick is held against the low pitch stop. When the hand is removed from the collective stick, the rpm should remain between the red line limit markings on the rotor tachometer scale.

f. If the rotor rpm is not within the limits shown in table 30-1-I, note the actual rpm and correct as described in steps g through k, below.

g. If the rotor rpm lies below the minimum limit specified in table 30-1-I, lower the low pitch setting slightly by lengthening the adjustable incidence pushrod assemblies equally on each rotor blade. (See figure 30-1-4.)

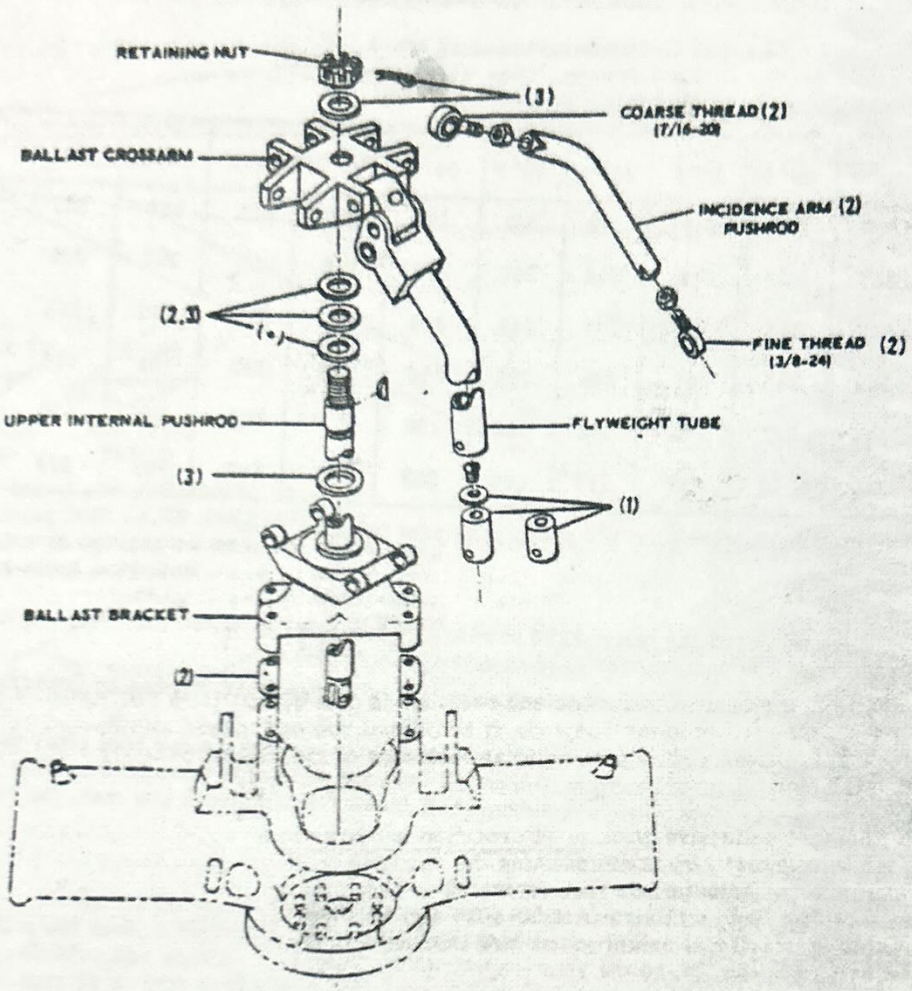
h. If the rotor rpm is above the maximum limit, raise the low pitch setting slightly by equally shortening the two pushrod assemblies.

i. To change the length of these pushrod assemblies, adjust the rod end bearing in the lower end of the pushrod to make fine adjustments. If considerable change in blade pitch is required, turn the upper rod end bearing of the pushrod. Extremely fine adjustment can be obtained by turning both rod ends in opposite directions.

j. One-half turn of the lower (fine adjustment) rod end bearing will change autorotative rpm by approximately 5 to 15 rpm.

k. Double check the safetying of nuts, bolts and check nuts which were loosened or removed to adjust the rpm.

30-1-32. ADJUSTMENT OF COLLECTIVE STICK FORCES. (See figure 30-1-4.) The collective pitch ballast assembly is designed to counteract the aerodynamic forces produced by main rotor blades in their basic form. Adjust the collective pitch ballast assembly as necessary to obtain the desired collective static equilibrium—that is, to establish satisfactory collective stick forces for all flight conditions (including autorotation). Adjustment methods are: (1) the increase or decrease of ballast weight; (2) the raising or lowering of the ballast downstop limit (with corresponding adjustment of incidence arm length); (3) bending of main rotor blade tabs;



COLLECTIVE FORCE	BALLAST CORRECTION	ADJUSTMENT
Stick "light" in cruise	Remove washers and/or substitute short weight for long weight	(1)
Stick "heavy" in cruise	Add washers (35 max) and/or substitute long weight for short weight	(1)
Collective stick "light" in autorotation and low power settings	Remove shims and/or washers to lower the downstop limit (this may produce a slightly heavier stick in cruise and climb power settings)	(2)
	One thin washer must remain	
	Shorten incidence push rods equally	(2)
	Insert one shim (each side) as shown to provide additional rod end thread adjustment	(2)
Collective stick "heavy" in autorotation and low power settings	Add shim and/or washers to raise the downstop limit (total shimstack height must not exceed 19/64-inch maximum)	(3)
	Add one washer as shown to supplement shimstack height (this may permit removal of part of shimstack and eliminate need for cotter pin or washer substitution) -- requires check for main rotor blade total travel (para. 31-1-31)	(3)
	Substitute smaller dia cotter pin and/or thin washer if required to allow shimstack buildup to maximum	(3)

Collective Force	Supplementary Correction (used as last resort)
Stick "light" (or creeps upward) in cruise and autorotation	Bend both tabs downward by an equal amount (refer to paragraph 30-1-32)
Stick "heavy" (or creeps downward) in cruise - - stable in autorotation	Bend both tabs upward by an equal amount

Figure 30-1-4. Correction of Collective Stick Forces

and (4) adjustment of the collective bungee assembly.

NOTE: Excessive amounts of up-tab can cause the collective stick to feel "light" in all flight conditions (see step g, below). Each adjustment method is additive to another; therefore a combination of several adjustments may be necessary to obtain the desired collective force correction.

a. To correct a "light" collective stick in cruise, increase the manual effort required (make the stick "heavier") by removing washers and/or replacing the standard (long) weights with the light (short) weights in both flyweight tubes of the ballast assembly.

b. To correct a "heavy" collective stick in cruise, reduce the manual effort required (make the stick "lighter") by accomplishing the opposite of step a, above.

CAUTION: DO NOT INSTALL MORE THAN 35 WASHERS IN EACH FLYWEIGHT TUBE WITH STANDARD (LONG) WEIGHTS INSTALLED. THE WASHER ATTACHMENT SCREWS MUST BE LONG ENOUGH TO THREAD INTO THE WEIGHTS AT LEAST 5/16-INCH, REGARDLESS OF THE NUMBER OF WASHERS USED OR THE LENGTH OF THE WEIGHTS.

c. To correct a "light" collective stick in autorotation and low power settings, increase the manual effort required (make the stick "heavier") by lowering the collective ballast downstop limit. Reducing the thickness of the downstop shim will also tend to make the collective stick somewhat heavier in cruise and climb power settings.

NOTE: A minimum of one thin steel washer (AN960-1016L) must remain between the ballast crossarm and the upper internal pushrod shoulder at all times.

d. After lowering the ballast downstop limit, adjust the lengths of the incidence arm pushrods (shorten each in an equal amount) to maintain satisfactory autorotation rpm. (Refer to paragraph 30-1-31.) Lowering the downstop limit by 1/16-inch would require shortening of the pushrods by 1-1/2 inward turns of the coarse-threaded (upper) rod end (exposed threads permitting), or 1-1/2 to 2 turns of the fine-threaded (lower) rod end bearings.

NOTE: The coarse-to-fine turns ratio of the rod end bearings is 5 to 6; that is, 5 full turns of the upper rod end is equal to 6 full turns of the lower rod end. If additional rod end thread adjustment is required at the incidence pushrods, insert a shim (one only) at each side of the ballast assembly bracket, between the bracket and rotor hub.

e. To correct a "heavy" collective stick in autorotation and low power settings, reduce the manual effort required (make the stick "lighter") by accomplishing the opposite of steps c and d, above. Raise the downstop limit by making downstop shim adjustments (see figure 30-1-4) within the following limitations:

(1) Add thick and thin steel washers (AN960-1016 and AN960-1016L) in any combination required to supplement the downstop shim. Total height (combined thickness of washers and shim) must not exceed 19/64-inch maximum. (See steps (2) and (3), below.)

(2) If additional downstop limit height is required to provide a satisfactorily adjusted collective control system, install one thick steel washer (AN960-1216) over the shank of the upper internal pushrod so that it is located on the shank between the bottom of the downstop shim stack and the ballast bracket.

CAUTION: INSTALLATION OF A THICK WASHER BETWEEN THE BOTTOM OF THE DOWNSTOP SHIM STACK AND THE BALLAST BRACKET WILL REQUIRE A CHECK FOR CONFORMITY WITH MAIN ROTOR BLADE TOTAL PITCH TRAVEL REQUIREMENTS. (REFER TO SECTION 31 FOR A RIGGING CHECK OR FOR COMPLETE COLLECTIVE SYSTEM RIGGING, IF REQUIRED.)

NOTE: If addition of this washer provides a downstop limit height greater than the amount necessary to make the required collective control correction, remove that amount of shims from the shim stack which will eliminate the need for the cotter pin and washer substitution permitted by step (3), below.

(3) After the maximum allowable thickness of shims has been installed (step (1), above), it may not be possible to reinstall the standard size (1/8-inch diameter) cotter pin which secures the castellated nut on the upper internal pushrod. If this condition exists, replace the standard size cotter pin (AN381-4-16) with a smaller diameter cotter pin (AN381-3-16) and/or the dural washer (AN960PD816) with a thin steel washer (AN960-816L).

NOTE: When a single thick steel washer (AN960-1216) has been installed on the pushrod (step (2), above), this substitution should not be necessary.

(4) Check that the ballast crossarm retaining nut is tightened to 160-250 pound-inch torque value.

f. To correct a "light" collective stick in autorotation when it cannot be corrected by adjustment of the ballast downstop limit (step c, above), bend both main rotor blade tabs DOWN by the same amount.

Table 30-1-II. Troubleshooting Vibration Difficulties

TROUBLE	PROBABLE CAUSE	REMEDY
One-to-one lateral vibration	Main rotor out of alinement or balance	Refer to Section 50.
	Incorrect main rotor gimbal ring clearance	Refer to Section 51.
One-to-one vertical vibration	Damaged main rotor blades	Refer to Section 53.
	Rotor out of track	Retrack blades.
Two-to-one vibration	Main rotor blade tabs bent excessively	Reposition blade tabs.
	Engine Lord mounts and snubbers deteriorated or separated beyond permissible limits	Replace mounts.
	Lost motion in cyclic controls	Replace worn rod end bearings, tighten or replace bellcrank pivot bearings and wobble plate scissor bearings. Readjust cyclic torque shaft bearings.
	Damaged or maladjusted dampers	Adjust dampers (Section 33)
	Rough or notchy control rotor cuff and trunnion bearings	Replace bearings.
	Wobble plate bearings rough or notchy	Replace wobble plate bearings.
	Control rotor blades out of rig	Refer to Section 36.
High frequency vibration (too fast to count) or high frequency vibration (108 cycles per minute)	Binding or frozen pitch change links at tail rotor	Replace links.
	Tail rotor damaged or out of track and, or rig	Replace tail rotor or retrack tail rotor blades.
	Tail rotor out of balance	Rebalance tail rotor.
	Worn tail rotor blade root bushings	Replace bushings.
	Loose tail rotor stop nut	Retighten stop nut.
	Worn or rough tail rotor flapping hinge bearing	Replace bearings.
	Incorrect rudder control cable tension	Readjust cable tension.
	Loose or worn universal joints	Shim as required to eliminate end play. Replace worn journal cross and bearings.
	Aft tail rotor drive shaft out of alinement	Realine drive shaft.
	Rough or worn aft tail rotor drive shaft bearing	Replace defective bearing.
	Defective engine Lord mounts and snubbers	Replace as necessary.
	Rough bearings in tail rotor speed decreaser	Replace bearings.
	Engine outer gimbal ring bearings worn or improperly adjusted	Replace bearings.

NOTE: Tab correction should be kept to a minimum and used only as a last resort. Unequal bending of the tabs can cause the blades to go out-of-track, making it necessary to retrack the rotor blades.

g. Adjust the collective bungee after satisfactory collective stick forces are obtained. The bungee should be adjusted upward or downward so that it just begins to apply tension at the climb-power collective stick setting. If the collective stick is a little "light" when raised above the cruise-power stick setting, adjust the bungee to apply tension sooner.

NOTE: It should not be necessary to adjust the bungee for other stick settings.

h. If absolutely necessary, it is permissible to sweep both main rotor blades in an AFT direction (by adjustment of blade drag struts) to correct for undesirable collective stick forces or track conditions. DO NOT sweep the blades forward of their neutral alinement position. (Use the painted drag strut neutral alinement marks as reference.) Limit the amount of sweep so that it does not exceed 1/3-turn of the blade drag strut from the neutral setting.

30-1-33. TROUBLESHOOTING VIBRATION. Investigate vibrations by grouping them according to vibration frequency. Read paragraphs a through d following, prior to consulting table 30-1-II.

a. What is commonly known as a one-to-one lateral vibration is a one per revolution beat of the main rotor. It can be felt by leaning firmly against the cockpit backrest. This condition normally remains constant from hover condition through the full airspeed range, neither increasing nor diminishing in severity. Check for this condition while hovering to avoid confusing it with the one-to-one vertical vibration normally experienced during forward flight. It is often possible to have a combination of one-to-one lateral and one-to-one vertical vibration.

b. What is known as a one-to-one vertical vibration is also a one per revolution beat of the main rotor. It is distinguished by a vertical bounce or "hump" in the ship, readily detected through the seat deck of the cockpit. A one-to-one vertical vibration is distinguished from a one-to-one lateral vibration by determining through normal tracking procedures that the rotor is in track in the hover condition. If the main rotor is known to be in track and the one-to-one vibration is still felt, then the vibration can usually be diagnosed as one-to-one lateral.

NOTE: To avoid confusing the one-to-one vertical and lateral vibrations, do not lean against the backrest when checking for vertical vibration. The one-to-one vertical may be present at any or all flight conditions. It is commonly light or nonexistent at hovering attitude, but usually increases in severity as airspeed increases.

c. A two-to-one vibration of the main rotor can best be described as a rapid "choppy" vibration of a frequency too fast to count. This condition may exist during any or all flight attitudes or conditions but is more common in the higher airspeed ranges. It is common for a two-to-one vibration to appear in conjunction with, or be aggravated by a one-to-one vibration.

NOTE: Elimination of one-to-one vibrations by tracking and balancing procedures will often eliminate or minimize the two-to-one vibration. For this reason, it is necessary to first make certain the rotor is properly tracked and balanced before attempting to isolate two-to-one vibration sources.

d. High frequency vibrations that are felt throughout the helicopter and the controls, as distinguished from the localized vibration described above, may originate from a number of different sources and must be isolated by process of elimination. Refer to table 30-1-II, Troubleshooting Vibration Difficulties, for the procedural sequence for elimination of undesirable vibration.

NOTE: A certain amount of high frequency vibration (approximately four-to-one) is normal in the helicopter, appearing in the cyclic control system at high airspeed.

30-1-34. TRACKING THE TAIL ROTOR BLADES. (See figure 30-1-5.) The procedure for tracking the tail rotor blades is similar to that used in tracking the main rotor blades except that the tail rotor blades pass through the same point measured horizontally and parallel to the axis of rotation of the tail rotor.

a. Stand in a convenient position on the right-hand side of the tail boom as shown in figure 30-1-5. Do not lean against the tail boom. Use a grease pencil marking device attached to any convenient length of tubing or dowelling.

b. Track the tail rotor blades with the engine running at 3200 rpm and with the rudder pedals in neutral position. Mark the blades in two or three different chord planes in order to establish whether or not an average adjustment will be required as the result of slight variations which may exist between the airfoil contours of the blades.

CAUTION: ADVANCE THE TIP OF THE GREASE PENCIL VERY SLOWLY TOWARD THE ROTATING BLADES UNTIL THE GREASE PENCIL FIRST CONTACTS THE ROTOR BLADES.

c. Adjust the tail rotor blade track by decreasing the pitch of the more heavily marked, or only marked

blade, until the marks appear to have uniform width on each blade. (Mark length may not appear exactly uniform due to slight blade contour variations.) To decrease the pitch of a given blade and move its plane of rotation farther from the tail boom, shorten the turnbarrel adjustment of the blade. If it is apparent that more than one-half turn of the turnbarrel is needed for acceptable tracking, lengthen the opposite turnbarrel by the same amount the first turnbarrel was shortened in order to divide the adjustment more equally between the blades. Repeat the operation until the blade paths coincide (indicated by the markings) during rotation.

d. Tighten the turnbarrel check nuts after each adjustment, taking care to keep the rod end bearings properly alined to prevent binding when the blades are at the limits of pitch travel.

30-1-60. FLIGHT TEST PROCEDURE FOLLOWING FLIGHT CONTROL RIGGING OPERATIONS. Upon completion of any flight control rigging operation, make a flight test as a final check of the rigging operation. Prior to, and during flight test, test the following operational characteristics of the helicopter.

a. Perform the normal prescribed preflight inspection.

b. During ground run, check the following for freedom of operation and range of travel:
(1) Collective pitch control.
(2) Cyclic pitch control.
(3) Rudder control.
(4) Engine controls.
(5) Cyclic stick trim control.

c. During hovering flight, check:
(1) Hovering attitude of helicopter (refer to loading instructions).
(2) Main rotor track.
(3) Main rotor balance.
(4) Collective pitch stick forces (light or heavy collective stick).
(5) Directional control (adequate rudder control).
(6) Cyclic stick for roughness or feedback.
(7) Tail rotor track and balance (as evidenced by high frequency vibration in rudder pedals and aft section of tail boom and stabilizer).

d. After takeoff, check the following:
(1) Track of main rotor with increasing airspeed.
(2) Cyclic stick position in relation to airspeed and center of gravity location.
(3) Autorotation rpm (climb to safe altitude and determine that autorotation rpm is within specified limits before proceeding further with flight tests).

e. At cruising speed, check the following:
(1) Cyclic stick for level flight with trim.
(2) Stability of the collective pitch stick with hand removed.
(3) Neutral position of rudder controls with feet removed.
(4) Observe vibration level of helicopter, and vibration in the controls.

30-1-61. FLIGHT CHECKING COLLECTIVE CONTROL SYSTEM. Flight testing is necessary to check the general performance of the main rotor and collective pitch control system, and the correct main rotor speed during autorotation. (Refer to paragraph 30-1-31.)

30-1-62. FLIGHT CHECKING CYCLIC CONTROL SYSTEM.

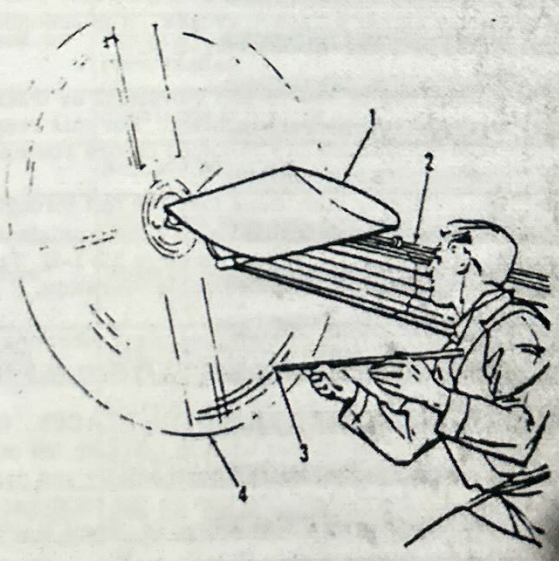
a. During ground operations only, the main rotor hub may strike the rotor drive tube rather severely when the limits of cyclic control stick travel are reached. With the engine speed between 2400 and 2600 rpm, check the stick travel limits by momentarily moving the stick to the limit stops and immediately returning the stick to neutral.

CAUTION: AVOID PROLONGED GROUND OPERATION WITH THE CYCLIC CONTROL STICK AGAINST THE LIMIT STOPS.

b. During flight testing, check for proper trim actuator operation, cyclic control response, and excessive vibration of the cyclic system vibration dampers.

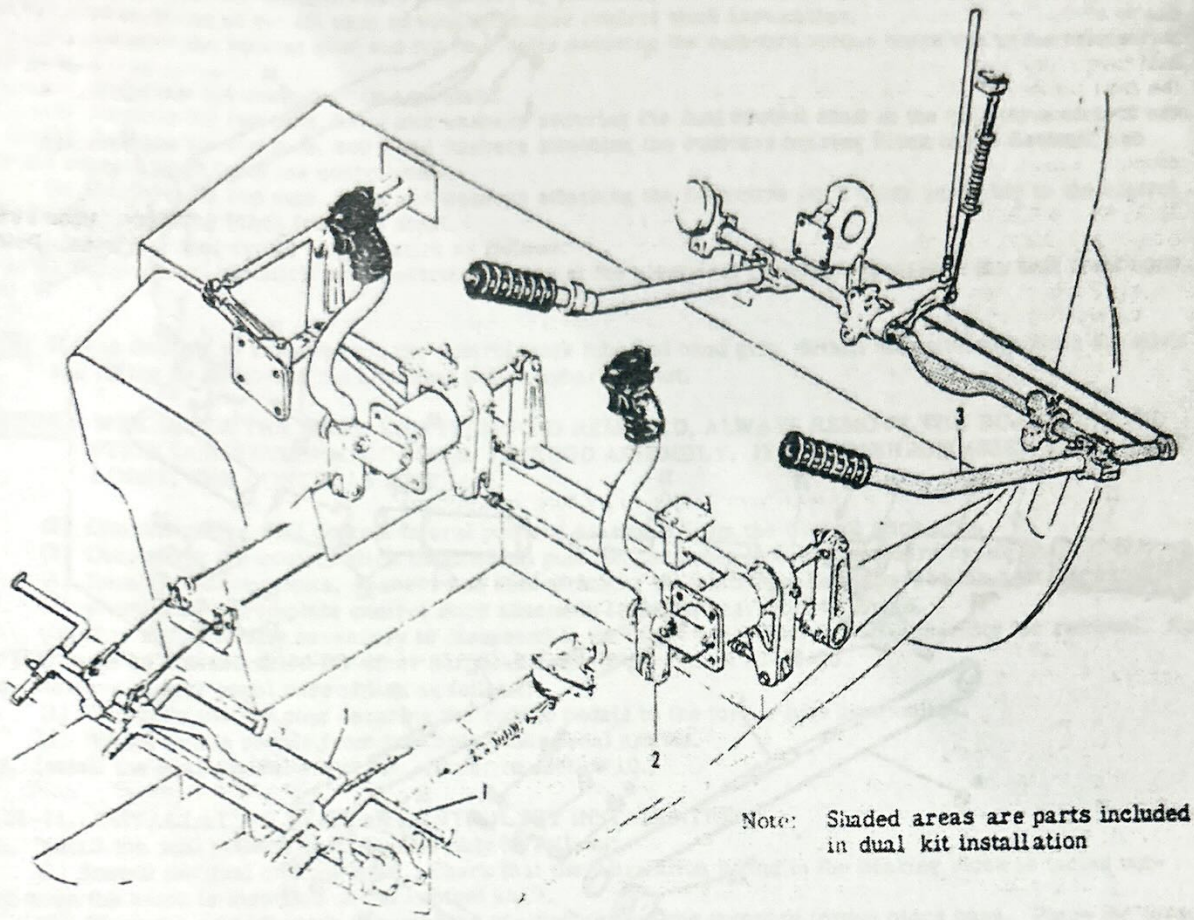
30-1-63. CHECKING DIRECTIONAL CONTROL SYSTEM.

a. Flight test the helicopter to determine if there is



1. Horizontal Stabilizer
2. Aft Tail Rotor Drive Shaft
3. Chalk or Crayon
4. Tail Rotor Blades

Figure 30-1-5. Tracking the Tail Rotor Blades



Note: Shaded areas are parts included in dual kit installation

1. Rudder Pedals
2. Cyclic Control
3. Collective Control

Figure 30-101-1. Dual Control Kit Installation

sufficient left rudder control available to produce a turn against the main rotor torque while hovering the helicopter in a crosswind with the wind from the right.

b. Move the rudder pedals full left and full right to check the travel of the cable drum, tail rotor gear box pitch change rod, and the rotor blades. If the pitch change rod travel is insufficient to produce an adequate pitch range, check for interference in the gear box by disconnecting the aft rudder cables and pitch change turnbarrels and operating the cable drum on the gear box. If internal interference is felt, the gear box should be replaced or repaired.

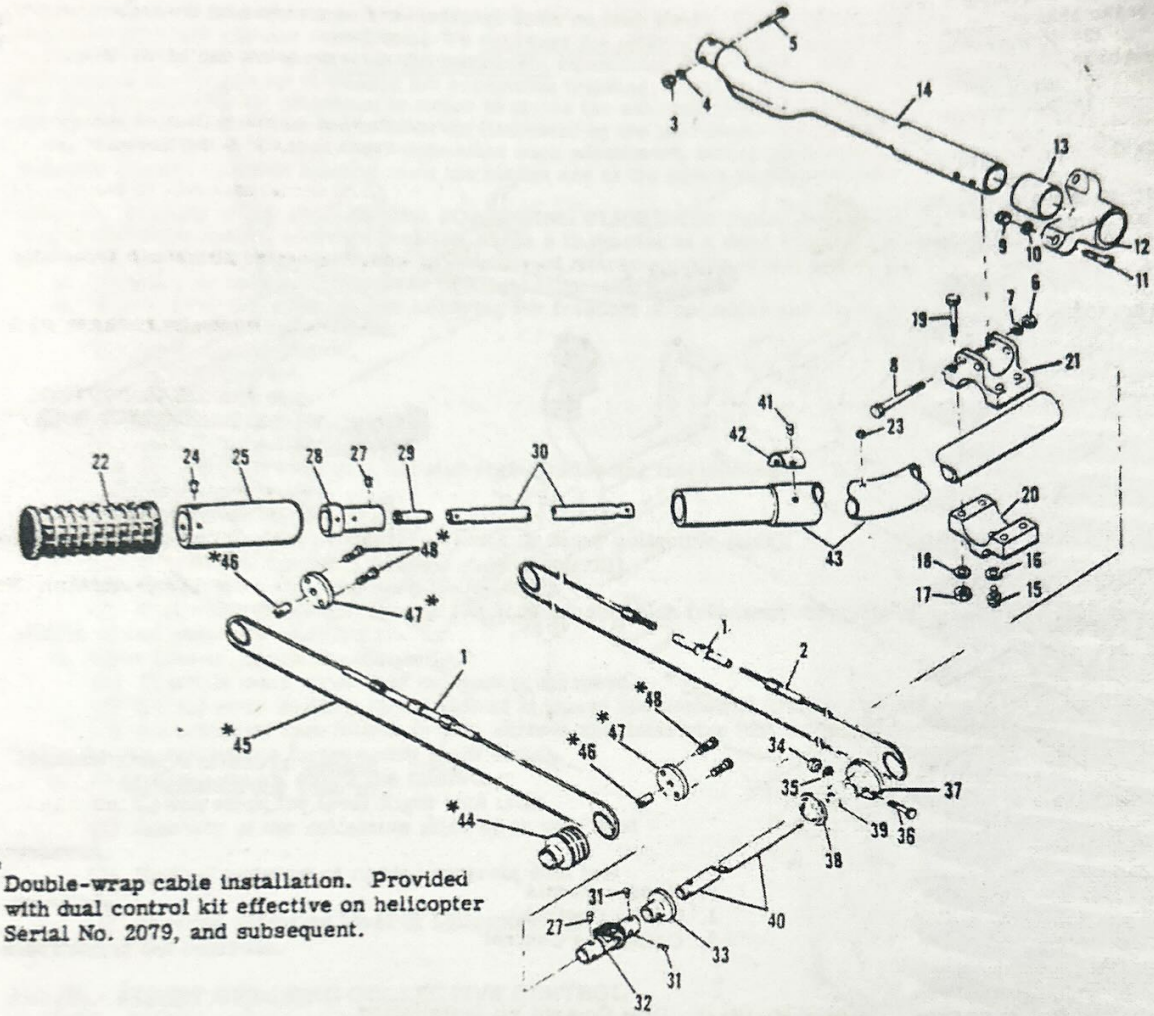
30-101-1. DUAL CONTROL KIT INSTALLATION: COLLECTIVE, CYCLIC AND RUDDER. (See figure 30-1-1.)

30-101-2. DESCRIPTION. The dual control kit installation consists of a collective stick, cyclic stick, rudder pedals and related attaching parts. When installed, these components are located within the cabin enclosure and aft of the firewall seatback, at the left-hand side of the helicopter. Upon installation, and after completion of the required rigging, the dual control installation provides a separate, auxiliary flight control station from which the pilot or a trainee can operate the helicopter.

30-101-3. TROUBLESHOOTING THE DUAL CONTROL KIT INSTALLATION. Refer to appropriate tables in Sections 31 and 33.

30-101-10. REMOVAL OF DUAL CONTROL KIT INSTALLATION. (See figures 30-101-1, -2 and -3.)

a. Remove the dual collective stick assembly as follows:



* Double-wrap cable installation. Provided with dual control kit effective on helicopter Serial No. 2079, and subsequent.

1. Turnbarrel
2. Dual Throttle Control Cable Assy
3. Nut
4. Washer
5. Bolt
6. Nut
7. Washer
8. Bolt
9. Nut
10. Washer
11. Bolt
12. Outboard Bearing Block
13. Bearing
14. Dual Control Shaft
15. Locking Stud
16. Washer
17. Nut
18. Washer
19. Bolt
20. Torque Block Cap
21. Torque Block Base
22. Control Stick Grip
23. Grommet
24. Rivet
25. Stick Grip Sleeve
26. Rivet
27. Rivet
28. Sleeve Fitting
29. Plug
30. Forward Torque Tube
31. Rivet
32. Universal Joint
33. Bushing
34. Nut
35. Washer
36. Bolt
37. Sheave Fitting
38. Bearing
39. Bearing
40. Aft Torque Tube
41. Drive Screw
42. Nameplate
43. Dual Control Stick
*44. Control Stick End Fitting
*45. Dual Throttle Control Cable Assy
*46. Sleeve
*47. Washer
*48. Screws

Figure 30-101-2. Dual Collective Control Stick Assembly

(1) Disconnect the throttle cable assembly by loosening the turnbarrel and removing the cable assembly from the sheave fitting at the aft ends of both collective control stick assemblies.
(2) Remove the locking stud and the four bolts securing the outboard torque block cap to the torque block base.
(3) Withdraw the control stick assembly.
(4) Remove the two nuts, bolts and washers securing the dual control shaft in the collective control tube.
(5) Remove the two nuts, bolts and washers attaching the outboard bearing block to the firewall, and slide the control shaft from the control tube.
(6) Remove the two nuts, bolts and washers attaching the collective stick block assembly to the control shaft; slide the bearing block from the shaft.

b. Remove the dual cyclic control stick as follows:
(1) Disconnect the stick grip electrical wiring at the electrical connector located at the seat front bulkhead.

NOTE: If it is desired to remove only the control stick tube and hand grip, detach the stick tube from the stick end fitting by removing the attaching bolt, washer and nut.

WARNING: WHENEVER THE STICK END FITTING IS REMOVED, ALWAYS REMOVE THE DUAL CONTROL STICK LONGITUDINAL CONTROL PUSHROD ASSEMBLY. IF THE PUSHROD ASSEMBLY IS LEFT LOOSE, THE CONTROLS MAY JAM.

(2) Disconnect the dual control lateral pushrod assembly from the control stick arm.
(3) Disconnect the control stick longitudinal pushrod assembly from the outboard cyclic shaft arm.
(4) Remove the four bolts, washers and nuts attaching the control stick support to the seat front bulkhead.
(5) Withdraw the complete control stick assembly from the seat front bulkhead.
(6) It is not generally necessary to disassemble the dual cyclic control stick assembly for removal. However if it must be disassembled for other purposes refer to paragraph 33-10-20.

c. Remove rudder pedal assemblies as follows:
(1) Withdraw the pip pins securing the rudder pedals to the torque tube assemblies.
(2) Withdraw the pedals from the torque tube pedal cranks.

d. Install the dual control cover kit. (Refer to section 10.)

30-101-11. INSTALLATION OF DUAL CONTROL KIT INSTALLATION.

a. Install the dual collective stick assembly as follows:
(1) Install the dual control shaft. Check that the lubrication fitting in the bearing block is facing outboard when the block is installed on the control shaft.
(2) Place the control stick assembly in position against the outboard torque block base. Place the torque block cap over the stick assembly and install the four attaching bolts.
(3) Install the locking stud and tighten the four attaching bolts to 10-15 pound-inch torque value.
(4) Safety the head of the locking stud to the adjacent bolt head with lockwire.
(5) Install the dual control throttle cable assembly in the outboard control stick sheave fitting and secure the cable fitting to the sheave fitting with two turns of lockwire.
(6) Connect the dual throttle cable assembly and adjust the turnbarrel to provide a cable tension of 25 to 30 pounds. Safety the turnbarrel with lockwire.

NOTE: On helicopters Serial Number 2079 and subsequent, install cable ball fittings in slots of control stick fittings. Insert sleeve, washer and screws. Connect dual throttle cable assembly and adjust turnbarrel to provide a cable tension of 25 to 30 pounds. Turnbarrel must be located on top strand as shown in figure 30-101-2. Safety turnbarrel and screws with lockwire.

b. Install the dual cyclic control stick in the reverse order of removal. Accomplish the additional step:
(1) If the control stick assembly has been disassembled, check that the end play between torque tube spacer and the control stick arm does not exceed 0.002-inch. If there is too much gap, add more shims (index 54, figure 30-101-3) between the aft support bearing and the torque tube spacer.

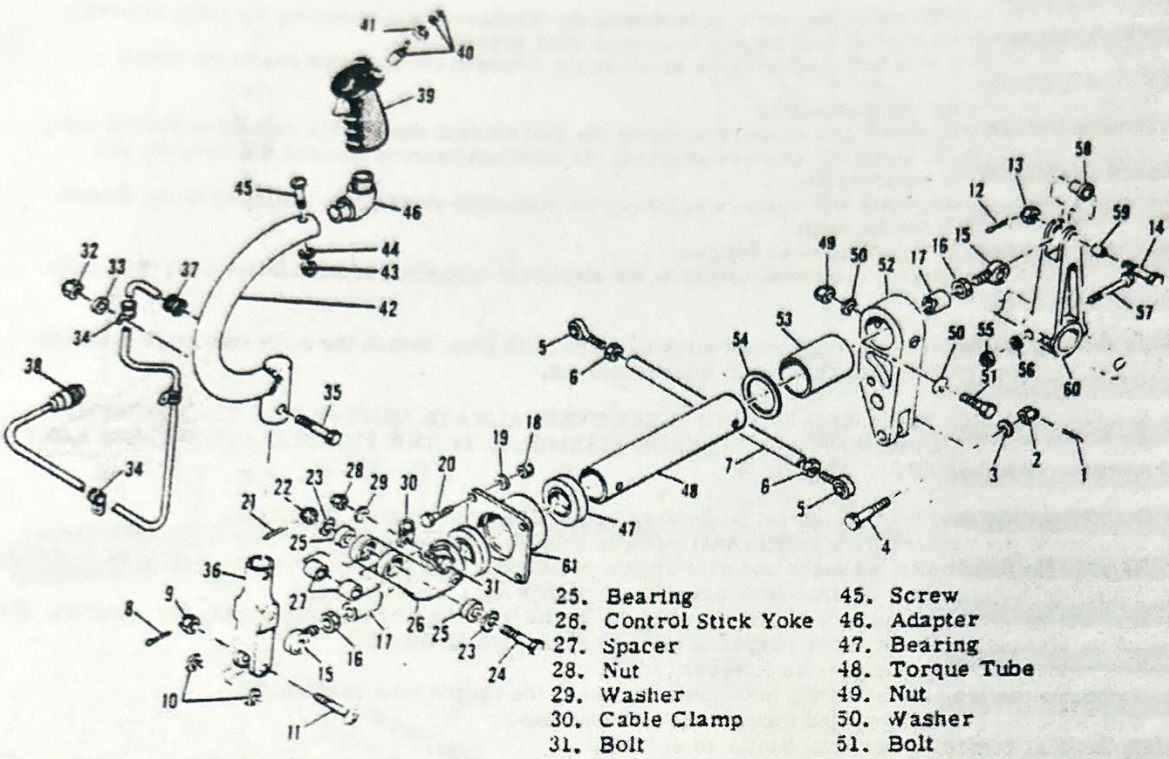
NOTE: If the length of any of the pushrod assemblies was disturbed or if parts are being replaced, rerig the cyclic control stick as described in paragraph 30-101-30.

c. Install rudder pedal assemblies in the torque tube pedal cranks.

30-101-20. DISASSEMBLY OF DUAL COLLECTIVE CONTROL STICK ASSEMBLY. (See figure 30-101-2.)

a. Remove the bolt securing the sheave fitting to the torque tube assembly.
b. Remove the two rubber grommets at the bend in the control stick assembly.
c. Drill out the two rivets connecting the forward throttle torque tube to the universal joint.

CAUTION: BE CAREFUL NOT TO ENLARGE THE RIVET HOLES IN THE TORQUE TUBE AND THE UNIVERSAL JOINT.



1. Cotter Pin
2. Nut
3. Washer
4. Bolt
5. Rod End Bearing
6. Nut
7. Control Stick Lateral Rod
8. Cotter Pin
9. Nut
10. Washer
11. Bolt
12. Cotter Pin
13. Nut
14. Bolt
15. Rod End Bearing
16. Nut
17. Control Stick Longitudinal Rod
18. Nut
19. Washer
20. Bolt
21. Cotter Pin
22. Nut
23. Washer
24. Bolt
25. Bearing
26. Control Stick Yoke
27. Spacer
28. Nut
29. Washer
30. Cable Clamp
31. Bolt
32. Nut
33. Washer
34. Cable Clamp
35. Bolt
36. Stick End Fitting
37. Grommet
38. Connector Plug
39. Grip
40. Switch
41. Adapter
42. Control Stick Tube
43. Nut
44. Washer
45. Screw
46. Adapter
47. Bearing
48. Torque Tube
49. Nut
50. Washer
51. Bolt
52. Torque Tube Arm
53. Spacer
54. Shim
55. Nut
56. Washer
57. Bolt
58. Bushing
59. Bushing
60. Outboard Cyclic Shaft Arm
61. Stick Support

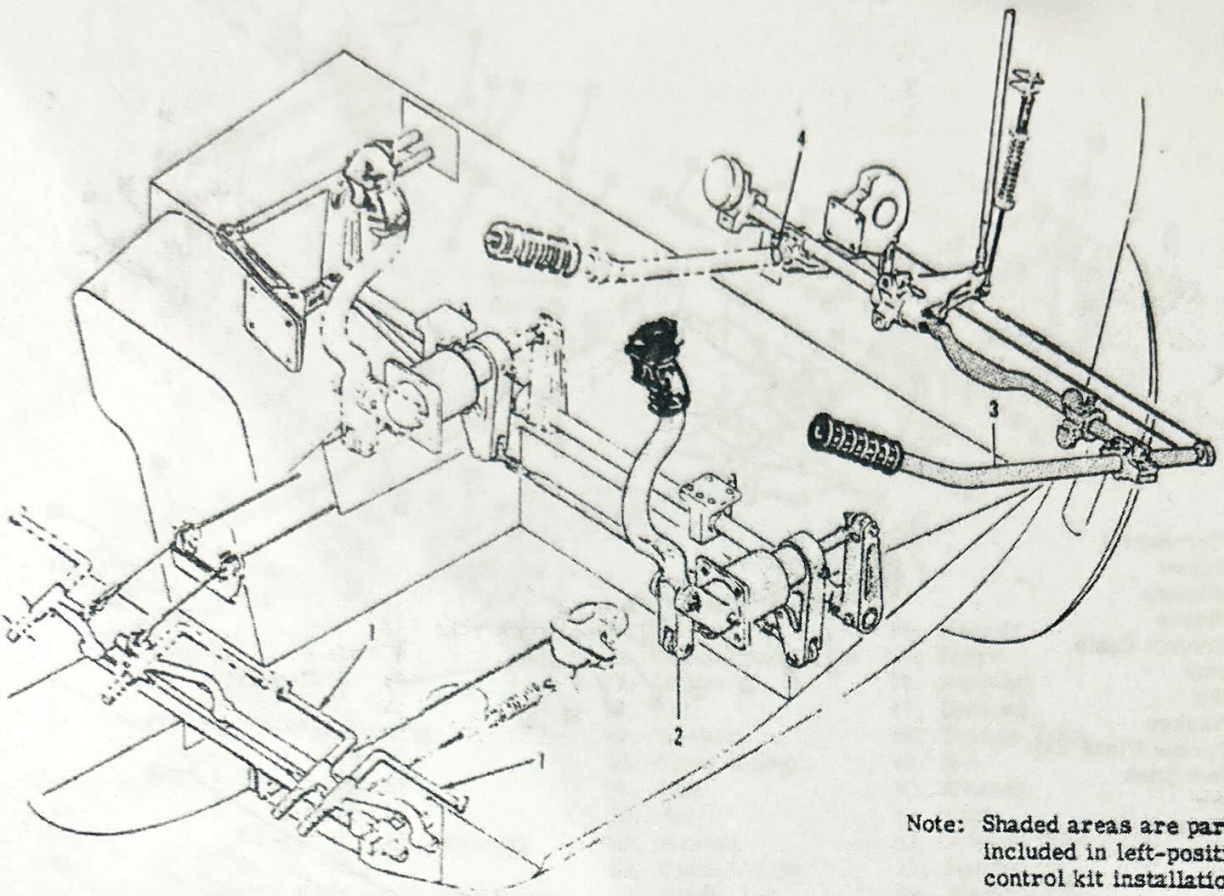
Figure 30-101-3. Dual Cyclic Control Stick Assembly

d. Pull the sleeve assembly and the forward torque tube out of the front end of the control stick assembly.
e. Pull the aft torque tube and the universal joint out of the aft end of the control stick assembly.
f. Remove the bearing retainer and bearing from the aft end of the control stick assembly.

30-101-21. ASSEMBLY OF DUAL COLLECTIVE CONTROL STICK ASSEMBLY.

a. Insert the aft torque tube and universal joint through the aft end of the control stick assembly.
b. Install the forward torque tube and the sleeve assembly through the front end of the control stick assembly.
c. Insert the forward torque tube assembly in the universal joint.
d. Rotate the universal joint until the rivet holes are alined. Secure the torque tube and the universal joint with two AN470-AD3 rivets of the appropriate length.
e. Install the two rubber grommets in the control stick assembly.
f. Install the bearing retainer and bearing in the aft end of the control stick assembly.
g. Install the sheave fitting on the aft end of the torque tube assembly and secure it with the bolt, washer and nut.

30-101-30. RIGGING OF DUAL CONTROL KIT INSTALLATION. No rigging is required for the collective stick. Rig the cyclic stick as follows:



Note: Shaded areas are parts included in left-position control kit installation

1. Rudder Pedals
2. Cyclic Control
3. Collective Control
4. Collective Stub Stick

Figure 30-201-1. Left-Position Control Kit Installation

a. Refer to section 33, paragraph 33-1-30, step b. Lock the cyclic stick in neutral position as outlined in sub steps (1), (2) and (3), of paragraph 33-1-30.

b. Adjust the length of the lateral interconnect dual control pushrod assembly so that the dual control stick is laterally parallel to the inboard stick (±0.5 degree).

c. Adjust the length of the longitudinal pushrod assembly of dual cyclic control stick so that the control stick is longitudinally parallel to the inboard stick (±0.5 degree).

d. After rigging, remove the rigging braces from inboard cyclic stick. Check that all bolts are properly safetied and that checknuts are tight on pushrods.

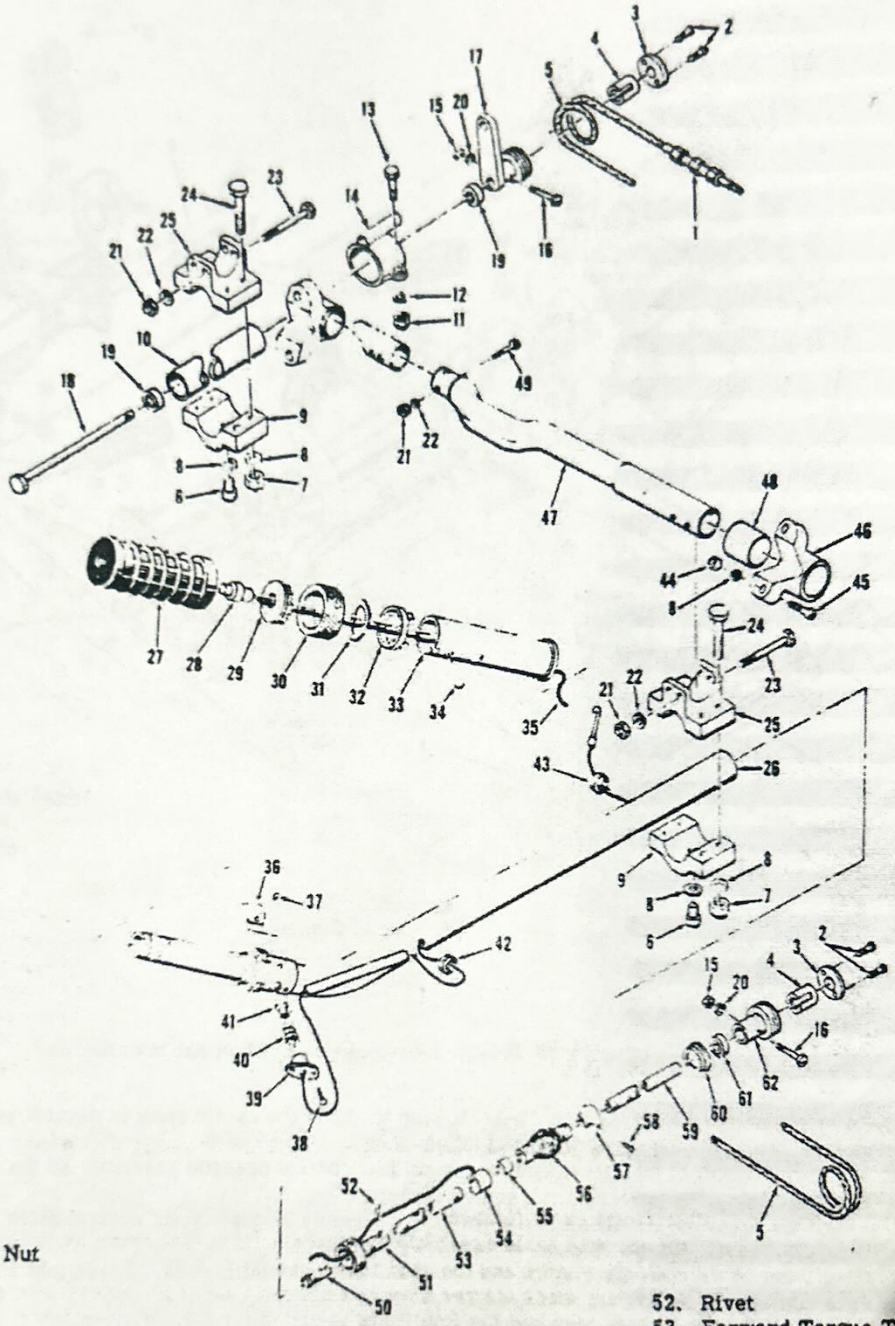
e. Check controls for freedom of operation.

30-201-1. LEFT-POSITION CONTROL KIT INSTALLATION. (See figure 30-201-1.)

30-201-2. DESCRIPTION. The left-position control installation consists of a collective stick, cyclic stick, rudder pedals and attaching parts. When installed, these components are located within the cabin enclosure, and aft of the firewall seatback, at the left-hand side of the helicopter. Upon installation, and after completion of the required rigging, the left-position control installation allows the helicopter to be flown exclusively from the left seat.

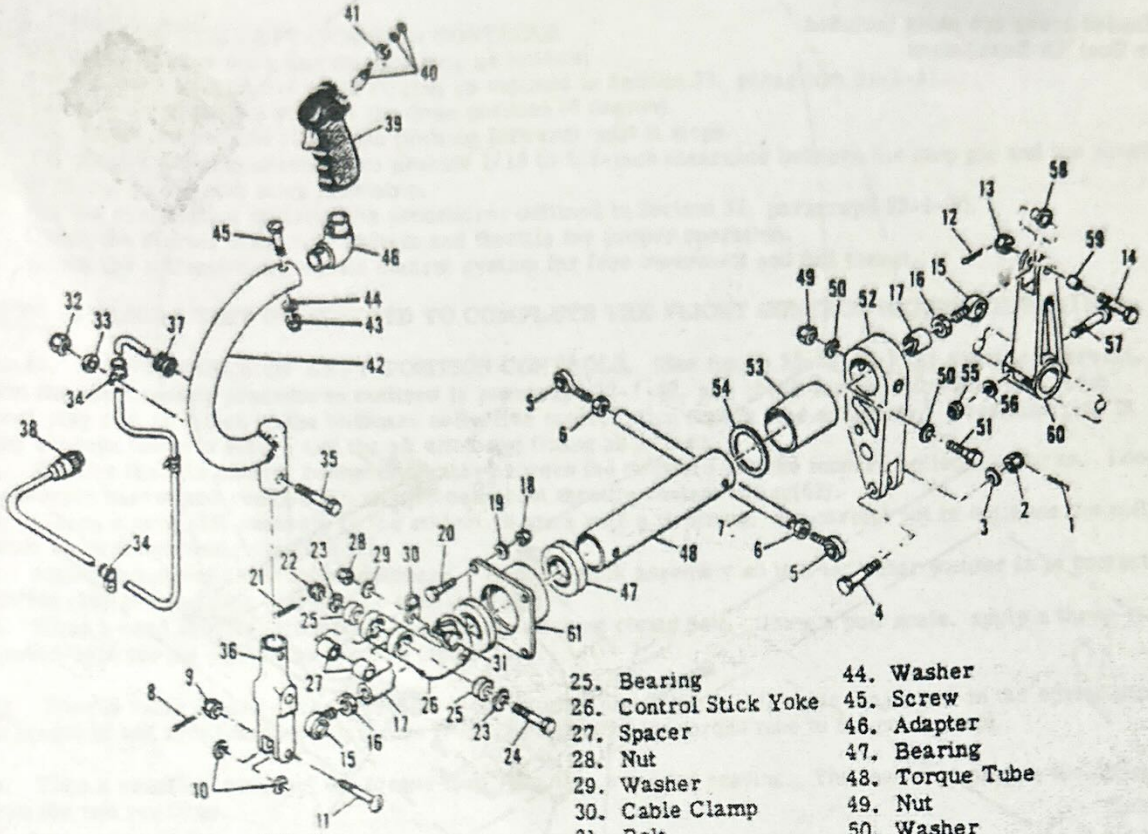
30-201-3. TROUBLESHOOTING THE LEFT-POSITION CONTROL KIT INSTALLATION. Refer to appropriate tables in Sections 31 and 33.

30-201-10. REMOVAL OF LEFT-POSITION CONTROL KIT INSTALLATION.



1. Turnbarrel
2. Screw
3. Washer
4. Sleeve
5. Control Cable
6. Stud
7. Nut
8. Washer
9. Torque Block Cap
10. Stub Stick
11. Nut
12. Washer
13. Bolt
14. Stick Fitting Stop
15. Nut
16. Bolt
17. Sheave Fitting
18. Stub Stick Tube
19. Bearing
20. Washer
21. Nut
22. Nut
23. Bolt
24. Bolt
25. Torque Block Base
26. Control Stick
27. Grip
28. Switch Button
29. Switch Plug
30. Friction Adjustment Nut
31. Grip Spring Washer
32. Grip Sleeve Fitting
33. Grip Sleeve
34. Rivet
35. Wire
36. Name Plate
37. Rivet
38. Rivet
39. Insulation Plug
40. Spring
41. Starter Lead Plunger
42. Grommet
43. Grommet
44. Nut
45. Bolt
46. Outboard Bearing Block
47. Control Shaft
48. Bearing
49. Bolt
50. Torque Tube Plug
51. Fitting
52. Rivet
53. Forward Torque Tube
54. Torque Tube Terminal
55. Insulator
56. Universal Joint
57. Bushing
58. Rivet
59. Aft Torque Tube
60. Bearing Retainer
61. Bearing
62. Control Stick Sheave Fitting

Figure 30-201-2. Left-Position Collective Control and Stub Stick Assemblies



1. Cotter Pin
2. Nut
3. Washer
4. Bolt
5. Rod End Bearing
6. Nut
7. Control Stick Lateral Rod
8. Cotter Pin
9. Nut
10. Washer
11. Bolt
12. Cotter Pin
13. Nut
14. Bolt
15. Rod End Bearing
16. Nut
17. Control Stick Longitudinal Rod
18. Nut
19. Washer
20. Bolt
21. Cotter Pin
22. Nut
23. Washer
24. Bolt
25. Bearing
26. Control Stick Yoke
27. Spacer
28. Nut
29. Washer
30. Cable Clamp
31. Bolt
32. Nut
33. Washer
34. Cable Clamp
35. Bolt
36. Stick End Fitting
37. Grommet
38. Connector Plug
39. Grip
40. Switch
41. Adapter
42. Control Stick Tube
43. Nut
44. Washer
45. Screw
46. Adapter
47. Bearing
48. Torque Tube
49. Nut
50. Washer
51. Bolt
52. Torque Tube Arm
53. Spacer
54. Shim
55. Nut
56. Washer
57. Bolt
58. Bushing
59. Bushing
60. Outboard Cyclic Shaft Arm
61. Stick Support

this is right here is open

Figure 30-201-3. Left-Position Cyclic Control Stick Assembly

a. Remove the collective stick as follows:

(1) Disconnect the throttle cable assembly by loosening the turnbarrel and removing the cable assembly from the aft end of the collective stick and the stub stick assembly.

(2) Disconnect collective stick starter wire at knife disconnect located aft of firewall.

(3) Remove the locking stud and the four bolts securing the torque tube block cap to torque block base.

(4) Withdraw collective stick assembly.

b. Remove stub stick assembly as follows:

(1) Disconnect rod end bearing attached to sheave lever arm of stub stick assembly. Take care not to lose the small spacer. (See figure 75-1-2.)

(2) Remove locking stud and four bolts securing the torque tube block cap to torque block base.

(3) Withdraw stub stick assembly.

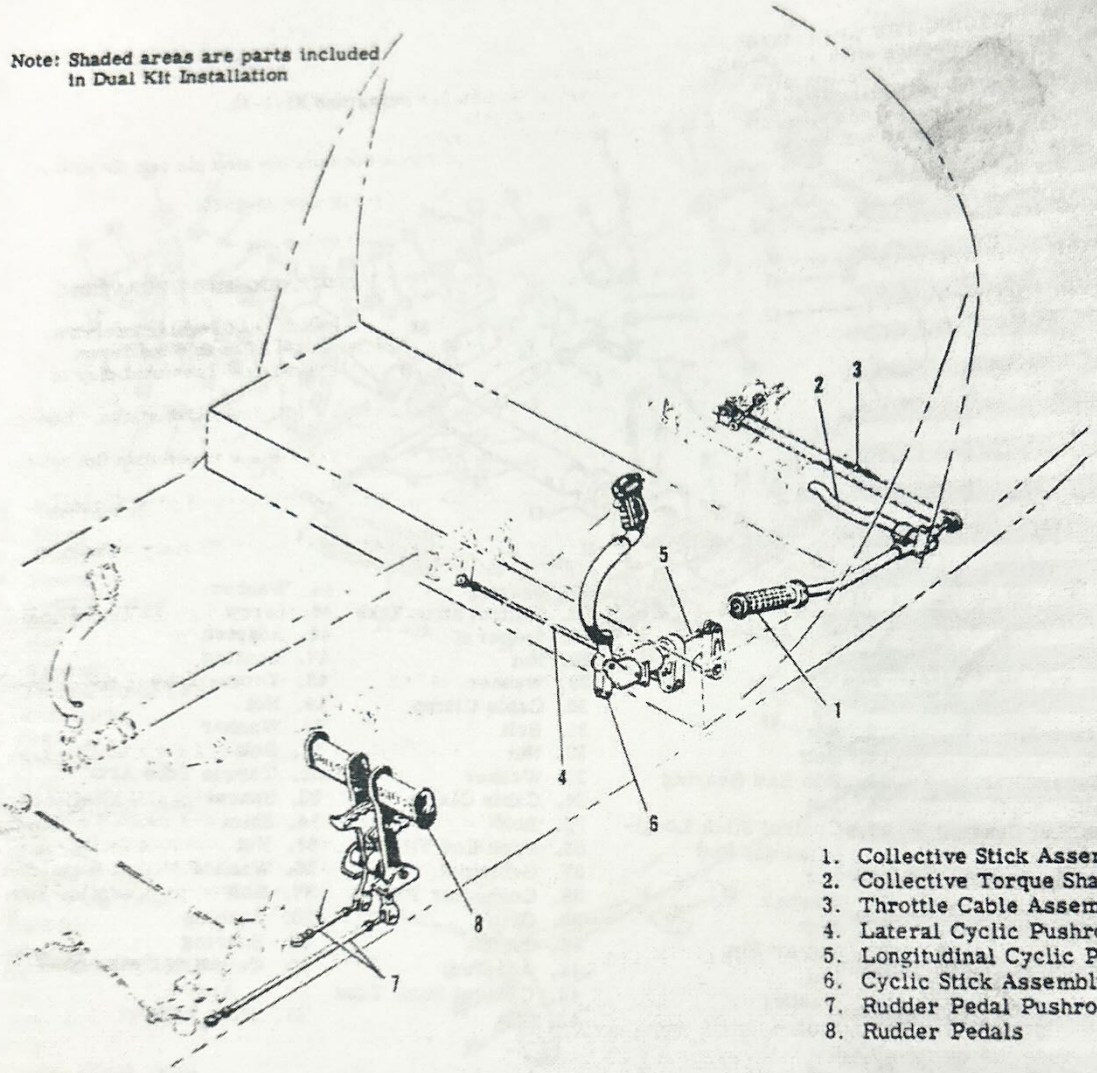
c. Remove the cyclic stick as follows:

(1) Disconnect the stick grip electrical wiring at the connector at seat front bulkhead.

(2) Remove nut, washer and bolt securing the stick to stick and fitting.

(3) Withdraw cyclic stick.

d. Remove the rudder pedals from rudder torque tubes by withdrawing pip pins.



1. Collective Stick Assembly
2. Collective Torque Shaft
3. Throttle Cable Assembly
4. Lateral Cyclic Pushrod
5. Longitudinal Cyclic Pushrod
6. Cyclic Stick Assembly
7. Rudder Pedal Pushrods
8. Rudder Pedals

Figure 30-301-1. Dual Control Kit, Four-Place Configuration

30-201-11. INSTALLATION OF LEFT-POSITION CONTROL KIT INSTALLATION. Installation of the collective, cyclic and stub stick assemblies is essentially the reverse order of removal. Accomplish the following additional steps:

a. Tighten the bolts securing the torque block caps of the collective and stub stick assemblies to 10-15 pound-inch torque value. Safety stud located in each torque block cap to the head of one hex head torque block bolt with lockwire.

b. Install the throttle cable on the stub stick and collective stick sheaves, taking care to locate the turnbarrel on the top strand. Adjust the turnbarrel to provide a cable tension of 12-15 pounds.

c. Safety the cable turnbarrel and the screws located on sheave fittings with lockwire.

d. Take care to install the small spacer between the rod end bearing and lever arm of stub stick assembly. (See figure 75-1-2.)

30-201-20. DISASSEMBLY AND ASSEMBLY OF LEFT-POSITION COLLECTIVE CONTROL STICK ASSEMBLY. Follow procedures outlined in section 31, paragraphs 31-10-20 and 31-10-21.

30-201-30. RIGGING THE LEFT-POSITION CONTROLS.

a. Rig the collective stick and throttle stop as follows:
(1) Check the collective stick rigging as outlined in Section 31, paragraph 31-1-31.
(2) Set the collective stick at the down position (0 degree).
(3) Twist the throttle clockwise (looking forward) until it stops.
(4) Adjust the stop assembly to provide 1/16 to 1/8-inch clearance between the stop pin and the sheave lever arm fitting on the stub stick assembly.

b. Rig the cyclic stick utilizing the procedures outlined in Section 33, paragraph 33-1-30.

c. Check the starter electrical system and throttle for proper operation.

d. Check the collective and cyclic control system for free movement and full travel.

CAUTION: A FLIGHT TEST IS REQUIRED TO COMPLETE THE FLIGHT CONTROL RIGGING OPERATION.

30-201-40. MAINTENANCE OF LEFT-POSITION CONTROLS. (See figure 30-201-2.) At regular intervals, perform the maintenance procedures outlined in paragraph 33-1-40, and check for the allowable maximum torsional play of 0.017-inch in the outboard collective control stick torque tube assembly. Torsional play is checked between the grip sleeve and the aft stick end fitting as follows.

a. Remove throttle control connecting cable between the outboard and the inboard collective sticks. Loosen the turnbuckle barrel and remove the swaged ball from throttle control fitting(62).

b. Clamp sleeve (33) securely to the collective stick with a C-clamp. Be careful not to collapse the collective stick by overtightening the clamp.

c. Attach a dial indicator to the outboard collective stick assembly so that indicator pointer is in contact with fitting (62) at the fitting slot (0.694-inch radius).

d. Wrap a cord around fitting (62) adjacent to attaching clevis bolt. Using a pull scale, apply a three-to four-pound-inch torque pull to the throttle torque tube.

NOTE: Torque value (pound-inches) is calculated by multiplying the pull (pounds measured on the spring scale) by the length of the arm (distance in inches from the center of the torque tube to the cord wrap).

e. Take a reading, reverse the torque load, and take a second reading. The torsional play is the difference between the two readings.

30-301-1. DUAL CONTROL KIT INSTALLATION, FOUR-PLACE CONFIGURATION. (See figure 30-301-1.)

30-301-2. DESCRIPTION. The dual control kit installation, four-place configuration, consists of a collective stick, cyclic stick, rudder pedals and attaching parts. When installed, these components are located within the cabin enclosure and aft of the firewall seatback at the left-hand side of the helicopter. Upon installation, and after completion of the required rigging, the dual control installation provides a separate, auxiliary flight control station from which the pilot or a trainee can operate the helicopter. The forward seat must be occupied, however, when the helicopter is flown from the rear seat.

30-301-3. TROUBLESHOOTING THE DUAL CONTROL KIT INSTALLATION. Refer to appropriate tables in Sections 31 and 33.

30-301-10. REMOVAL OF DUAL CONTROL KIT INSTALLATION. (See figure 30-301-1.)

a. Remove the dual collective stick assembly as follows:
(1) Disconnect the throttle cable assembly by loosening the turnbarrel and removing the cable assembly from the sheave fitting at the aft ends of the control stick assembly and throttle fitting assembly.
(2) Remove the locking stud and the four bolts securing the collective stick torque block cap to the torque block base. Remove lockwire and mounting screws securing boot assembly to stick and firewall.
(3) Withdraw the control stick assembly.
(4) Remove the two nuts, bolts and washers securing the dual control shaft in the collective control tube.
(5) Remove the two nuts, bolts and washers attaching the outboard bearing block to the firewall, and slide the control shaft from the control tube.
(6) Remove the two nuts, bolts and washers attaching the collective stick torque block assembly to the control shaft.

b. Remove the dual cyclic stick as follows:

NOTE: If it is desired to remove only the control stick tube and hand grip, detach the stick tube from the stick end fitting by removing the attaching bolt, washer and nut.

(1) Disconnect the stick grip electrical wiring at the electrical connector at the seat front bulkhead.

WARNING: IF THE STICK END FITTING IS REMOVED, ALWAYS REMOVE THE DUAL CONTROL STICK LONGITUDINAL CONTROL PUSHROD ASSEMBLY. IF THE PUSHROD ASSEMBLY IS LEFT LOOSE, THE CONTROLS MAY JAM.

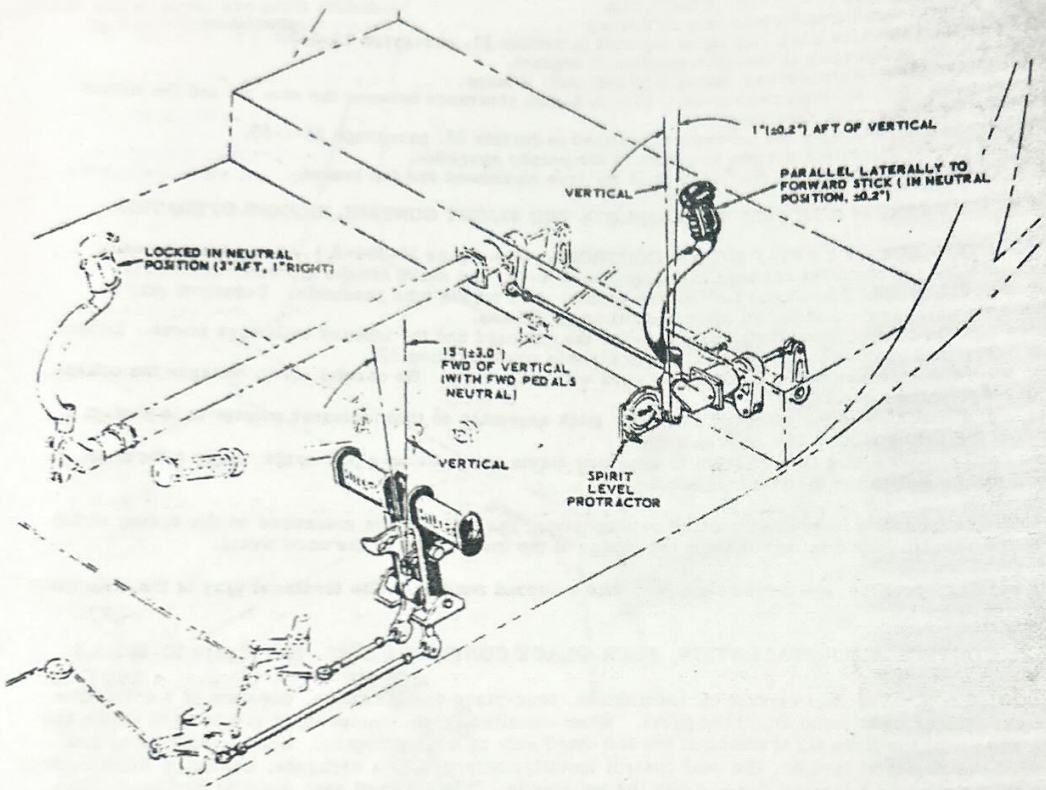


Figure 30-301-2. Rigging Rudder and Cyclic Controls, Four-Place Configuration

(2) Disconnect the dual control lateral pushrod assembly from the control stick arm.
(3) Disconnect the control stick longitudinal pushrod assembly from the outboard cyclic shaft arm.
(4) Remove the four bolts, washers and nuts that attach the control stick support to the seat front bulkhead.
(5) Withdraw the control stick assembly carefully from the seat front bulkhead.
(6) Normally it is unnecessary to disassemble the dual cyclic control stick assembly for removal. If it must be disassembled for other purposes, refer to Section 33, paragraph 33-10-20.

c. Remove rudder pedal assemblies as follows:
(1) Disconnect pushrods at rudder balance cable bellcranks and rudder pedal arms. Remove pushrods.
(2) Remove screws attaching the rubber shields to rudder pedals. Remove shields.
(3) Remove bolts securing rudder pedals to cabin floor. Withdraw rudder pedals.

30-301-11. INSTALLATION OF DUAL CONTROL KIT INSTALLATION.

a. Install the dual collective stick assembly as follows:
(1) Install the dual control shaft. Check that the lubrication fitting in the bearing block is facing outward when the block is installed on the control shaft.
(2) Install torque block base. Secure with bolts, washers and nuts. Install boot assembly on stick and place the control stick assembly in position against the torque block base. Place the torque block cap over the stick assembly and install the four attaching bolts.
(3) Install the locking stud and tighten the four attaching bolts to 10-15 pound-inch torque value.
(4) Safety the head of the locking stud to the adjacent bolt head with lockwire.

(5) Install the cable ball fittings in slot of control stick fitting, and throttle fitting assembly. Insert sleeve, washer and screws.

(6) Connect dual throttle cable assembly and adjust turnbarrel to provide a cable tension of 25 to 30 pounds. Turnbarrel must be located on top strand as shown in figure 30-301-1. Safety turnbarrel and screws with lockwire.

(7) Secure boot assembly to stick with lockwire. Secure boot assembly to firewall with plate and attach screws.

b. Install the dual cyclic control stick in the reverse order of removal. Accomplish the following additional step:

(1) If the control stick assembly has been disassembled, check that the end play between torque tube spacer and the control stick arm does not exceed 0.002-inch. If there is too much gap, add more shims between the aft support bearing and the torque tube spacer.

c. Install rudder pedals in reverse order of removal.

NOTE: If the length of any of the pushrod assemblies was disturbed, or if parts are being replaced, rerig the controls as described in paragraph 30-301-30.

30-301-20. DISASSEMBLY AND ASSEMBLY OF DUAL COLLECTIVE CONTROL STICK ASSEMBLY, FOUR-PLACE CONFIGURATION. Refer to paragraph 30-101-20.

30-301-30. RIGGING OF DUAL CONTROL KIT INSTALLATION. No rigging is required for the collective stick.

a. Rig the cyclic stick as follows:

(1) Refer to section 33, paragraph 33-101-30, steps a and b. Lock the cyclic stick in neutral position as outlined in step b, sub steps (1), (2) and (3).

(2) Adjust the length of the lateral interconnect dual control pushrod assembly so that the dual control stick is laterally parallel to the inboard stick (± 0.2 degree).

(3) Adjust the length of the longitudinal pushrod assembly of dual cyclic control stick that the control stick is located 1.0 degree (± 0.2 degree) aft of the vertical position.

b. Rig rudder pedals as follows:

(1) Position rudder pedals in center hole of index arms.

(2) With forward rudder pedals rigged and located in the neutral position, adjust pushrods between balance cable bellcranks and rudder pedal arms so that rudder pedals are located 15 degrees (± 3.0 degrees) forward of vertical position.

NOTE: After rigging, check controls for freedom of operation. Make sure all bolts are properly safetied and that checknuts are tight on pushrods.

COLLECTIVE PITCH CONTROLS

31-1-1. COLLECTIVE CONTROL SYSTEM. (See figure 31-1-1.)

31-1-2. DESCRIPTION. The collective control system consists of the following operational units: a control stick; the pushrod which connects the stick (or sticks) to the upper firewall bracket-link-bellcrank assembly; the pushrods extending to the transmission bellcrank-bracket assembly; the pushrod connecting the transmission bellcrank-bracket assembly to the yoke assembly; the yoke assembly which is mounted at the top of the transmission; and the internal pushrod located inside the drive tube and extending to the ballast assembly which is mounted on top of the main rotor hub.

a. Movement of the incidence pushrods of the ballast assembly is transferred to the curved incidence arms of the main rotor blades, resulting in a change of the blade incidence angle. A bungee assembly is incorporated in the system to reduce the tendency of the blade to increase its angle of attack when entering a nose-up "flare" or during gusty flight conditions.

b. Rotation of the collective friction knob located in the center seat back increases or decreases friction on the control tube at the inboard support block, and tends to hold the stick in a given position.

31-1-3. TROUBLESHOOTING THE COLLECTIVE CONTROL SYSTEM. Table 31-1-I lists in the order of likely occurrence the most frequent collective control system troubles, their probable causes and suggested remedies.

31-1-10. REMOVAL OF COLLECTIVE CONTROL SYSTEM.

a. Remove the ballast assembly. (Refer to paragraph 31-60-10.)
b. Remove the bellcrank-bracket and pushrod assemblies. (Refer to paragraph 31-50-10.)
c. Remove the yoke assembly. (Refer to paragraph 31-40-10.)
d. Remove the internal push rod assembly. (Refer to paragraph 31-30-10.)
e. Remove the collective control stick assembly. (Refer to paragraph 31-10-10.)
f. Remove the collective control tube and adjustable friction installation. (Refer to paragraph 31-20-10.)

31-1-11. INSTALLATION OF COLLECTIVE CONTROL SYSTEM.

a. Install the collective control tube and adjustable friction unit. (Refer to paragraph 31-20-11.)
b. Install the collective control stick assembly. (Refer to paragraph 31-10-11.)
c. Install the bellcrank-bracket and pushrod assemblies. (Refer to paragraph 31-50-10.)
d. Install the internal pushrod. (Refer to paragraph 31-30-11.)
e. Install the yoke assembly. (Refer to paragraph 31-40-11.)
f. Install the ballast assembly. (Refer to paragraph 31-60-11.)

31-1-30. RIGGING CHECK OF COLLECTIVE CONTROL SYSTEM. (See figures 31-1-8 and 31-1-9.)

a. Make sure that the total main rotor blade travel from low pitch to high pitch is plus (+) 10.5 degrees (+0.5, -0.2 degree). Check the clearance of both blade incidence arms at the main rotor hub, in both high and low pitch positions, paying particular attention to the spacer and nut attaching the arm to the main rotor fork. Make certain that there is no play or binding in the system and that there is no excessive friction in the system.

b. Full high pitch, normally an approximate plus (+) 11.5 degrees, is adequate for all permissible flight attitudes.

NOTE: The final low pitch setting is variable and is dependent upon autorotation rpm requirements, blade pitch travel is the total available pitch range, and must be measured by comparing the low pitch and high pitch readings.

c. Make sure that at full low pitch, normally an approximate plus (+) 1.0 degree, the main rotor speed falls within the proper limits during autorotation under the specified conditions. (Refer to table 30-1-I, Rotor Autorotation rpm.) Make certain that the ballast assembly crossarm is in contact with the downstop shim.

d. Make sure that there is sufficient engagement length for hidden threads on all parts in the system. Inspect all jam nuts or check nuts for tightness. Check the security of all safetied parts.

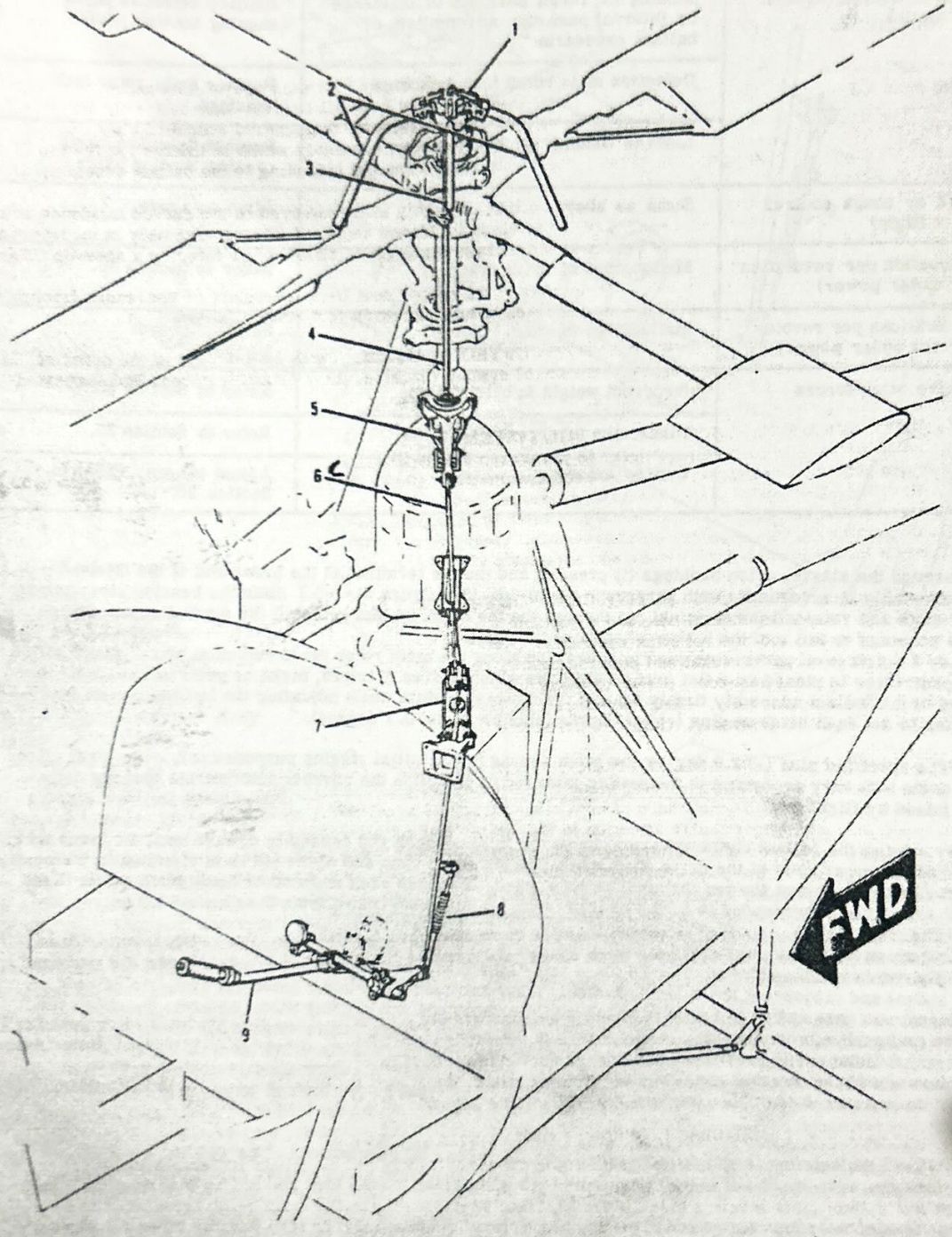
31-1-31. RIGGING COLLECTIVE PITCH. (See figures 31-1-8 and 31-1-9.)

a. Jack-up the helicopter so that the main rotor drive shaft is vertical. (Refer to Section 10.)

b. Block the main rotor assembly, positioning the main rotor blades fore and aft, by inserting the main rotor hub and wobble plate leveling block (item 28, table 92-1-I) between the main rotor drive shaft and the bottom surface of the hub. While using leveling block, level the hub, making sure that the three adjustment screws in the block are backed out and do not make contact with the hub. (The adjustment screws are not used for rotor hub leveling.)

c. Disconnect the external push rod assembly from the yoke arm, and the yoke link from the support bracket on the top of the transmission.

d. Disconnect the collective yoke assembly and slide it up the drive shaft. Remove the terminal pin which



1. Ballast Cross Arm
2. Ballast Fly-weight Tube
3. Incidence Pushrod Assembly
4. Internal Pushrod Assembly
5. Yoke Assembly
6. External Pushrod
7. Bellcrank-Bracket Assembly
8. Bungee Assembly
9. Collective Control Stick

Figure 31-1-1. Collective Control System

Table 31-1-I. Troubleshooting the Collective Control System

TROUBLE	PROBABLE CAUSE	REMEDY
Stiffness in control system (rotor static)	Binding or rough bearings in incidence or internal pushrod assemblies, or ballast crossarm	Replace defective parts causing binding joints.
	Defective main rotor fork bearings	Replace main rotor fork bearings.
	Linkage binding aft of firewall	Replace defective parts causing binding joints.
Sluggish or rough control stick (in flight)	Same as above	Same as above.
One vibration per revolution (rotor under power)	Malfunction of main rotor	Refer to Section 50.
Two vibrations per revolution (rotor under power)	Malfunction of main rotor	Same as above.
Excessive stick forces	Incorrect weight in ballast arms	Refer to Section 30.
	Blade tabs incorrectly adjusted	Refer to Section 30.
	Bungee incorrectly adjusted	Adjust bungee. Refer to Section 30.

passes through the sleeve, nylon bushings (if present) and the tee terminal at the lower end of the internal pushrod assembly in accordance with paragraph 31-30-10. (See figure 31-1-5.) Slide the bearing sleeve above the shaft slots and reinstall the terminal pin through the tee terminal and reinstall the pin bushings. Do not allow the bushings to fall into the hollow interior of the shaft.

e. Lay a spirit level protractor exactly chordwise along the main rotor blade retention plate. Make sure that the protractor is placed on a flat area of the plate which is free of burrs, nicks or protrusions. Hold the crossarm of the ballast assembly firmly against the down-stop shim while adjusting the incidence pushrod assemblies to set each blade at plus (+) 1.0 degree (plus or minus 0.1 degree).

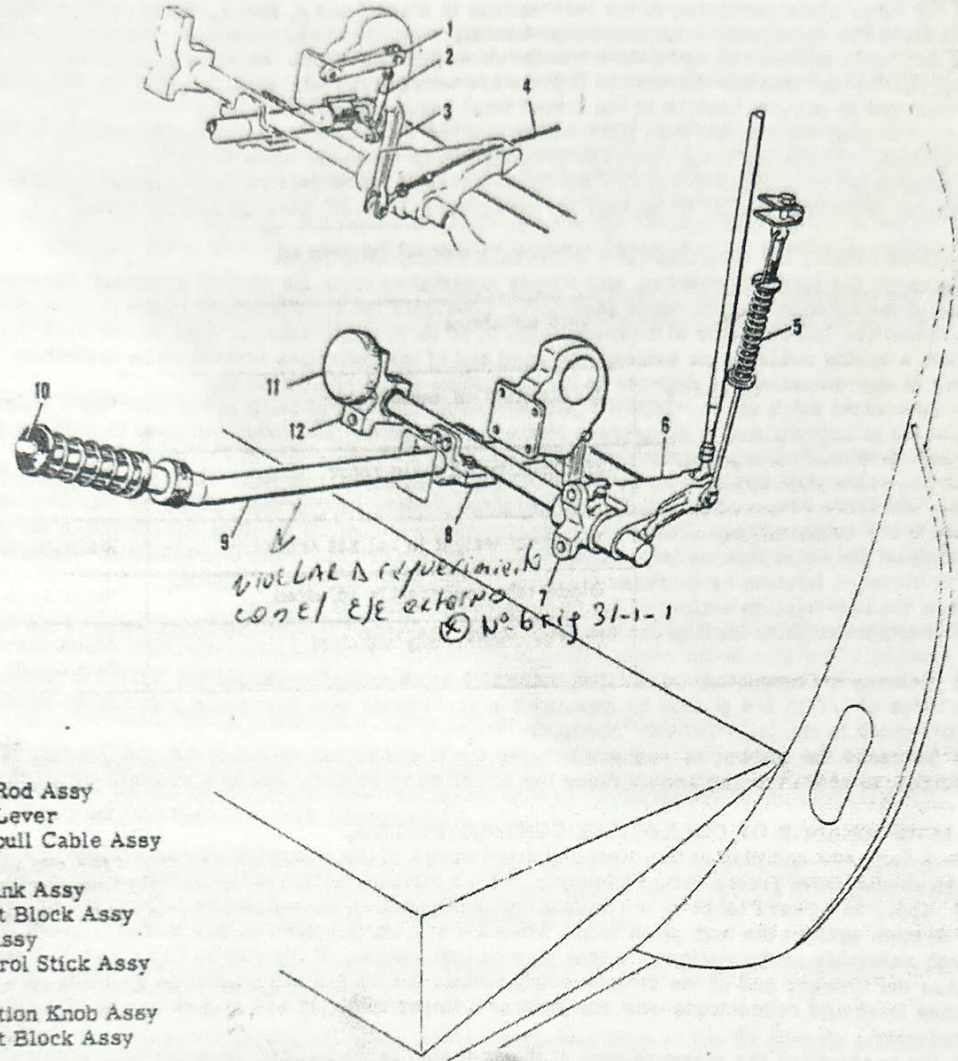
NOTE: The specified plus (+) 1.0 degree low pitch setting is for initial rigging purposes only. The final pitch angle will vary according to the setting required to establish the correct autorotation rpm, as determined by flight test.

f. By raising the ballast flyweight arms, move the internal push rod assembly upward until the terminal pin is seated at the upper ends of the drive shaft slots. Be sure that each end of the pin is in simultaneous contact with both slot ends, so that the tee terminal is not cocked. Measure each main rotor blade pitch angle. Each measurement should correspond to a 10.5 degree (+0.5, -0.2 degree) travel from the plus (+) 1.0 degree low pitch setting.

g. If the high pitch angles do not lie within the limits specified in step f above, adjust the length of the internal push rod assembly as required. To make this adjustment, remove the terminal pin from the tee terminal (step d, above) and disconnect the ballast assembly from the main rotor hub. Raise the complete ballast and internal push rod assemblies in order to reach the adjustable rod end bearing which connects the upper and lower internal push rod assemblies. After adjusting the pushrod length, make certain the checknut on the rod end is tight, and that the tee terminal is properly alined with the slots in the drive tube. If the rod end bearing at the upper end of the internal pushrod shows any evidence of binding, roughness or notchiness, replace the bearing. Do not exceed the specified torque value (5/20 pound-inches) for the rod end special bolt and nut.

NOTE: When adjusting the length of any pushrod, make certain that the shanks of the rod end bearings are threaded into the rod at least as far as the 1/16-inch witness holes located near the ends of the rod.

h. Reinstall the ballast assembly and internal pushrod assembly. Check that the ballast assembly cross arm contacts the down-stop shim in the minimum pitch position and install the terminal pin in the tee terminal. Check that a minimum of 0.050-inch exists between the terminal pin ends and the bottom of the drive shaft slots; if nylon bushings are installed on the tee terminal pin ends, the minimum clearance required between the



1. Cam Lever
2. Cam Follower Rod Assy
3. Cam Follower Lever
4. Throttle Push-pull Cable Assy
5. Bungee Assy
6. Control Bellcrank Assy
7. Bearing Support Block Assy
8. Torque Block Assy
9. Collective Control Stick Assy
10. Starter Button
11. Collective Friction Knob Assy
12. Bearing Support Block Assy

Figure 31-1-2. Collective Control Stick Installation

nylon bushings and the bottom of the slot is 0.010-inch. Remove the terminal pin (if unbushed) and then replace the sleeve, terminal pin, bearing, yoke, snapring, boots, clamps and lockwire. Connect the yoke link to the support bracket and the yoke arm to the external pushrod. Check the position of the collective control stick in its lowest position, with no pressure applied. The control stick aft portion should be parallel to the longitudinal level marks on seat deck. To obtain this low pitch stick position, adjust the pushrod ends of the external pushrod assembly as required. Tighten all locknuts.

i. The rigging of the bellcrank-bracket and pushrod assemblies is accomplished as follows:

(1) Check the length of the inboard firewall-to-transmission pushrod assembly. The distance between the rod end bearing centerlines must be 8.38-inches (± 0.030-inch).

(2) Adjust the length of the outboard pushrod so that the centerline of the long arm of the firewall bracket bellcrank is parallel to the centerline of the long arm of the transmission bracket bellcrank.

(3) Raise the collective stick to the full "UP" position. Adjust the upper external pushrod assembly so that the centerline of the long arm of either bellcrank is projected 22.0 degrees (± 1.0 degree) downward from the horizontal.

(4) Lower collective stick to full "DOWN" position. Adjust lower external push rod assembly so that collective stick aft portion is parallel to the longitudinal level marks.

j. Move the collective pitch control stick through its full range of travel, and recheck the low and high pitch

settings of the rotor blade according to the instructions in steps f and g, above. Make certain that all locknuts are tightened and that the required cotter pins and safety wire have been installed. Inspect the adjustable rod ends of the incidence pushrod to make sure that the threaded ends reach the witness holes in each end of the pushrod assemblies and that the lubrication fittings are accessible. Make certain that the rod ends are correctly centered to prevent binding at the travel limit positions.

k. After obtaining the low and high pitch settings of the collective pitch system according to the instructions in this paragraph, remove the main rotor hub leveling block, (item 28, table 92-1-1).

l. Flight test the helicopter to verify final correctness of the collective pitch system rigging. Adjust auto-rotation rpm as required. (Refer to section 30, paragraphs 30-1-31, 30-1-32 and 30-1-61.)

31-1-32. ADJUSTMENT OF COLLECTIVE CONTROL STICK FRICTION.

a. Disconnect the external pushrod and bungee assemblies from the control bellcrank assembly. Detach the forward end of the throttle control cable assembly. Lubricate the split bushings in the friction block assembly. Adjust the collective friction knob to a torque value of 50 to 70 pound-inches. (See figure 31-1-2.)

b. Attach a spring scale at the extreme forward end of the collective control stick assembly. Place the scale with its axis at approximately 90 degrees to the centerline of the control stick.

c. Set the control stick at the "DOWN" position. Pull the control stick to the full "UP" position, keeping the spring scale at approximately 90 degrees to the control stick. The force required to pull the control stick into this position should be approximately 10 to 20 pounds.

d. With the scale still attached as in step b, and the control stick at full "UP" position, pull the control stick down. The force required to pull the control stick down should be approximately 5 to 10 pounds.

e. If the force required to pull the control stick into the two positions does not lie within the limits just described, adjust the shim located in the slot of the friction block aft of the friction knob. Reduce the shim thickness to increase friction or increase the shim thickness to decrease friction.

f. Check the low-friction setting of the friction control knob as follows:

(1) Turn the friction knob to the low friction setting and raise the collective stick to the full "up" position.

(2) Release the collective stick. The collective stick assembly should not fall as a result of its own weight. A force of 1/2 to 3/4 pounds as measured in accordance with paragraph b should be required to return the collective stick to the full "DOWN" position.

(3) Increase the number of washers between the friction knob retaining nut and the support block assembly, if required, to close the gap and increase the low friction setting. Remove washers to decrease the friction.

31-1-40. MAINTENANCE OF COLLECTIVE CONTROL SYSTEM.

a. Check for wear and play at the pivot and hinge points of the control stick assemblies and the linkage. These parts should move freely, without binding. Check for lost motion in the system by the following method:

(1) Apply an upward force to the ballast flyweight arms of the collective ballast assembly to hold the collective system against the high pitch stop. When the system is locked in this manner, check the collective control stick assembly in the cockpit for free play or lost motion. If the play is in excess of 3/4-inch (measured at the forward end of the throttle grip), isolate the source of lost motion by bridging across the various hinge lines and connections with one hand or a finger to detect any play in the parts. Replace worn parts as required.

(2) To accomplish the measurement of the free play in the ballast flyweight arm assembly, apply an upward force on the external pushrod so that the ballast crossarm will be locked against the downstop shim in the low pitch position. Lift one ballast flyweight arm to its extreme position, upward and to the right or left. Holding the arm lightly but firmly in this position, measure the opposite ballast weight arm free play at the ballast weight end of the ballast flyweight arm. Release the arm and repeat the procedure on the opposite side. Total permissible free play is 3/4-inch. Replace worn parts as required.

b. Lubricate the pivot points at the intervals specified in the Lubrication Chart, figure 10-19.

NOTE: Do not pack the collective pitch sleeve boots completely full of grease. Stiffness in the collective system may result from over-lubrication in this area.

c. At regular intervals check the following:

(1) Remove and inspect the nylon terminal pin bushings, and/or the terminal pin which passes through the tee terminal for wear resulting from the pin rubbing against the sides of the drive tube slots and the holes in the sleeve. Replace the pin if there is noticeable wear. Replace the sleeve in the event the pin holes are worn. (Refer to paragraph 31-30-10 for nylon bushing removal instructions.) Instructions for sleeve hole repair are provided in paragraph 31-41-50.

(2) Inspect the collective yoke and ring assemblies for cracks, especially in the area around the yoke end of ears. Replace any worn bushings in these castings.

(3) Keep the checknuts on the adjustable rod ends tight.

(4) Inspect the collective pitch bearing by removing the snap rings and sliding the bearing out of the yoke ring. (See figure 31-1-5.)

(5) Whenever the internal push rod assembly is removed, inspect the condition of the welds, and for any evidence of bending of the threaded shanks on the adjustable rod end bearing or adapter. Inspect the rod end bearing for roughness, notchiness or binding. Replace the rod end bearing if defective.

(6) Inspect for cracks or bending in push rods and bellcranks, paying special attention to bellcrank forks Replace or straighten defective pushrods and replace defective bellcranks (paragraph 31-50-40).

(7) Check the wear between the upper collective pushrod assembly and the bushings in the ballast assembly bracket. (Refer to paragraph 31-60-40.)

(8) Check for play at the collective control tube and torque tube assembly aft of the firewall. Shim laminations may be removed to eliminate radial play at the friction support block bearing provided the required friction adjustment is maintained. (Refer to paragraph 31-1-30.) Replace the bushing when all of the laminations have been removed. A maximum diametral clearance of 0.010-inch is permitted between the collective torque shaft and the outboard support block bearing. Allowable end play between the inboard bearing block and the control bellcrank assembly is limited to 0.050-inch. Replace the bushings in the block assembly to reduce the play.

(9) Check the throttle torque tube assemblies for roughness and squeaking. It is permissible to remove the rubber boot and the retaining rings from a universal joint causing this condition. (Refer to paragraph 31-10-20.)

CAUTION: DO NOT WIPE THE GREASE FROM THE UNIVERSAL JOINT.

(10) Check for side (axial) play in the isolation pushrod assembly rod end bearings (Part No. HE-5S series). Side play measured parallel to the attaching bolt axis is limited to 0.005-inch maximum.

(11) Check for side (axial) play in the control link assembly bearings by moving the link axially on the hinge line bolts of the firewall bracket. All movement of the link must be a result of bearing play only. Maximum allowable movement is limited to 0.008-inch. No play is permissible between the bearing outer races and the link ends.

31-1-41. EXTREME WEATHER MAINTENANCE OF COLLECTIVE CONTROL SLEEVE BOOTS. If ambient temperatures as low as -30°C (-22°F) are anticipated, replace the standard sleeve boots with boots of local manufacture. Make the boots from materials with good low temperature flexibility characteristics.

31-10-1. COLLECTIVE CONTROL STICK ASSEMBLY. (See figures 31-1-2 and -3.)

31-10-10. REMOVAL OF COLLECTIVE CONTROL STICK ASSEMBLY.

a. Disconnect the starter switch wiring at the knife disconnect located at the aft end of the control stick assembly. Disconnect the adjacent starter switch ground wire.

CAUTION: PRIOR TO DISCONNECTING OR REMOVING ANY COMPONENT WHICH INVOLVES THE ELECTRICAL SYSTEM, TURN THE MASTER SWITCH AND IGNITION SWITCH TO THE OFF POSITION. DISCONNECT THE BATTERY FROM THE ELECTRICAL SYSTEM.

b. Remove the nut, washer, spacer and clevis bolt which connect the cam lever turnbarrel assembly to the control stick fitting. Take care not to lose the spacer.

NOTE: Before proceeding with further disassembly steps, apply match-markings to the aft throttle torque tube and the control stick fitting and to the stick fitting stop and the control stick.

c. Remove the bolt, washer and nut securing the control stick fitting to the aft end of the throttle torque tube assembly and remove the fitting.

d. Remove the control stick fitting stop from the control stick assembly.

e. Remove the locking stud and four bolts securing the inboard torque block cap to the torque block base. Remove the torque block cap.

f. Remove the six screws that attach the control stick boot to the firewall.

g. Pull the control stick assembly forward out of the firewall.

h. Remove the throttle grip and throttle torque tube assembly as described in paragraph 31-10-20.

CAUTION: BE CAREFUL NOT TO ROTATE THE THROTTLE GRIP AFTER THE CONTROL STICK FITTING AND STOP HAVE BEEN REMOVED AS THE STARTER SWITCH WIRE LOCATED INSIDE THE CONTROL STICK ASSEMBLY MAY BE DAMAGED.

31-10-11. INSTALLATION OF COLLECTIVE CONTROL STICK ASSEMBLY.

a. Install the throttle grip and throttle torque tube assembly as described in paragraph 31-10-21.

b. Insert the control stick assembly, with the boot in place, through the firewall.

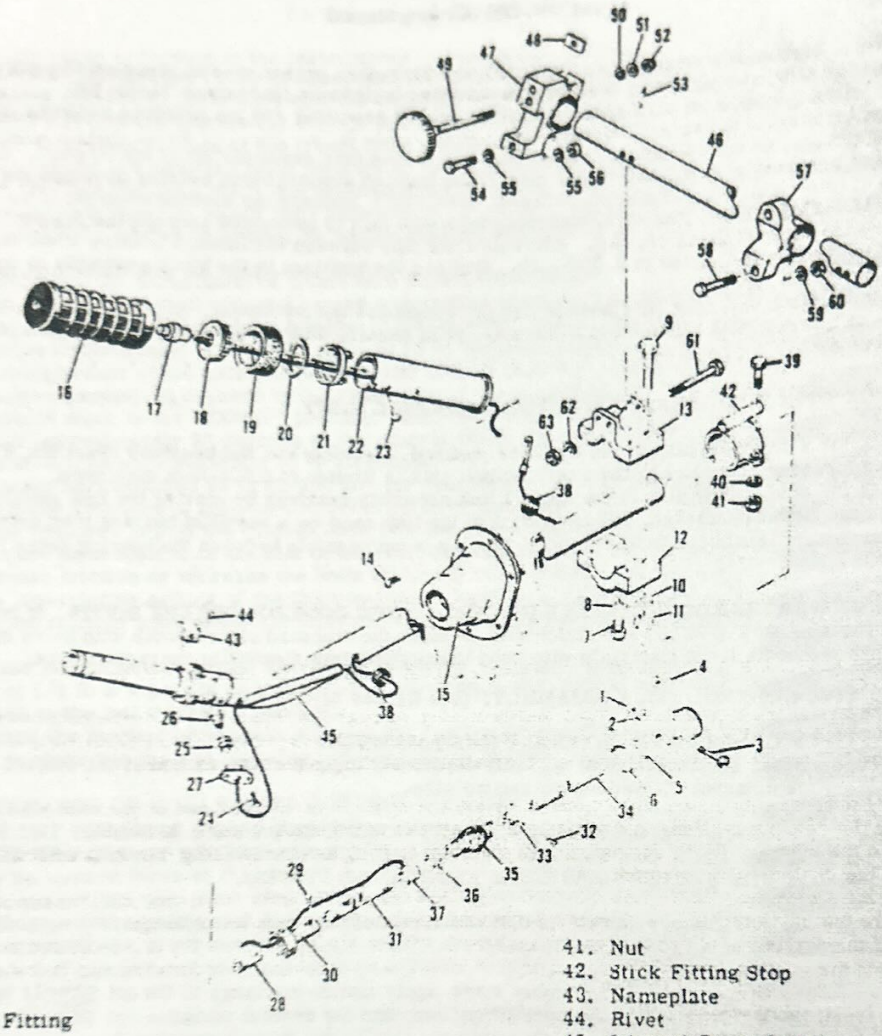
c. Place the control stick assembly in position against the torque block base. Place the torque block cap over the stick assembly and install the four attaching bolts.

d. Install the locking stud and tighten the four attaching bolts to 10/15 pound-inch torque value.

e. Tighten the locking stud and safety the head of the locking stud to the adjacent bolt head with lockwire.

f. Install the control stick fitting stop on the aft end of the control stick assembly. Line up the match-marks made during removal.

g. Install the control stick fitting on the throttle torque tube assembly aft end, lining up matchmarks made



1. Nut
2. Washer
3. Bolt
4. Control Stick Fitting
5. Bearing
6. Bearing Retainer
7. Locking Stud
8. Washer
9. Bolt
10. Washer
11. Nut
12. Torque Block Cap
13. Torque Block Base
14. Screw
15. Boot
16. Control Stick Grip
17. Starter Switch
18. Starter Switch Plug
19. Friction Adjustment Nut
20. Grip Spring Washer
21. Grip Sleeve Fitting
22. Grip Sleeve
23. Rivet
24. Rivet
25. Plunger Spring
26. Starter Lead Plunger
27. Insulation Plug
28. Torque Tube Plug
29. Rivet
30. Fitting
31. Forward Torque Tube
32. Rivet
33. Bushing
34. Aft Torque Tube
35. Universal Joint
36. Insulator
37. Torque Tube Terminal
38. Grommet
39. Bolt
40. Washer
41. Nut
42. Stick Fitting Stop
43. Nameplate
44. Rivet
45. Inboard Control Stick
46. Collective Control Tube
47. Friction Bearing Support Block
48. Friction Shim
49. Friction Knob Assembly
50. Washer
51. Washer
52. Nut
53. Cotter Pin
54. Bolt
55. Washer
56. Nut
57. Inboard Bearing Block
58. Bolt
59. Washer
60. Nut
61. Bolt
62. Washer
63. Nut

Figure 31-1-3. Collective Control Stick Assembly

during removal. Tighten bolt securing fitting (4, figure 31-1-3) to aft torque tube assembly to 4/5 pound-inches.

h. Install the clevis bolt spacer, washer and nut which connect the cam lever turnbarrel assembly to the control stick fitting. Make certain that the spacer is installed between the lower rod end and the control stick fitting. (If the turnbarrel assembly rod ends have been disturbed, the throttle control system must be checked for proper rigging.) (Refer to Section 75.)

i. Connect the starter switch wiring at the knife disconnect at the aft end of the control stick assembly.

31-10-20. DISASSEMBLY OF COLLECTIVE CONTROL STICK ASSEMBLY. (See figure 31-1-3.)

a. Remove the control stick assembly as described in paragraph 31-10-10.
b. Break the cement bond securing the aft 1-1/2 inches of the rubber throttle grip to the sleeve.
c. Remove the rubber throttle grip.
d. Remove the starter switch and disconnect the wiring at the switch.
e. Twist the grip sleeve so that the holes in the sleeve and the control stick are alined.
f. Drill out the two rivets used to join the sleeve assembly and the torque tube assembly.

CAUTION: BE CAREFUL NOT TO ENLARGE THE RIVET HOLES THROUGH THE MATING PARTS.

g. Remove the grommet and pull the wiring forward out of the control stick assembly through the hole aft of the external wiring shield.
h. Drill out the two blind rivets securing the starter wire plunger spring, plunger and plug to the control stick assembly. Remove the starter wire plunger spring, plunger and plug from the control stick assembly.

CAUTION: BE CAREFUL NOT TO ENLARGE THE RIVET HOLES THROUGH THE MATING PARTS.

i. Remove the throttle control torque tube assembly and the bearing assembly from the aft end of the control stick assembly.

31-10-21. ASSEMBLY OF COLLECTIVE CONTROL STICK ASSEMBLY. (See figure 31-1-3.)

NOTE: Before installing torque tube, run a length of cord through the inside of the control stick assembly, and out through the wire hole at the aft end of the control stick assembly. This will provide a means for pulling the switch wire into place after installation of the torque tube assembly.

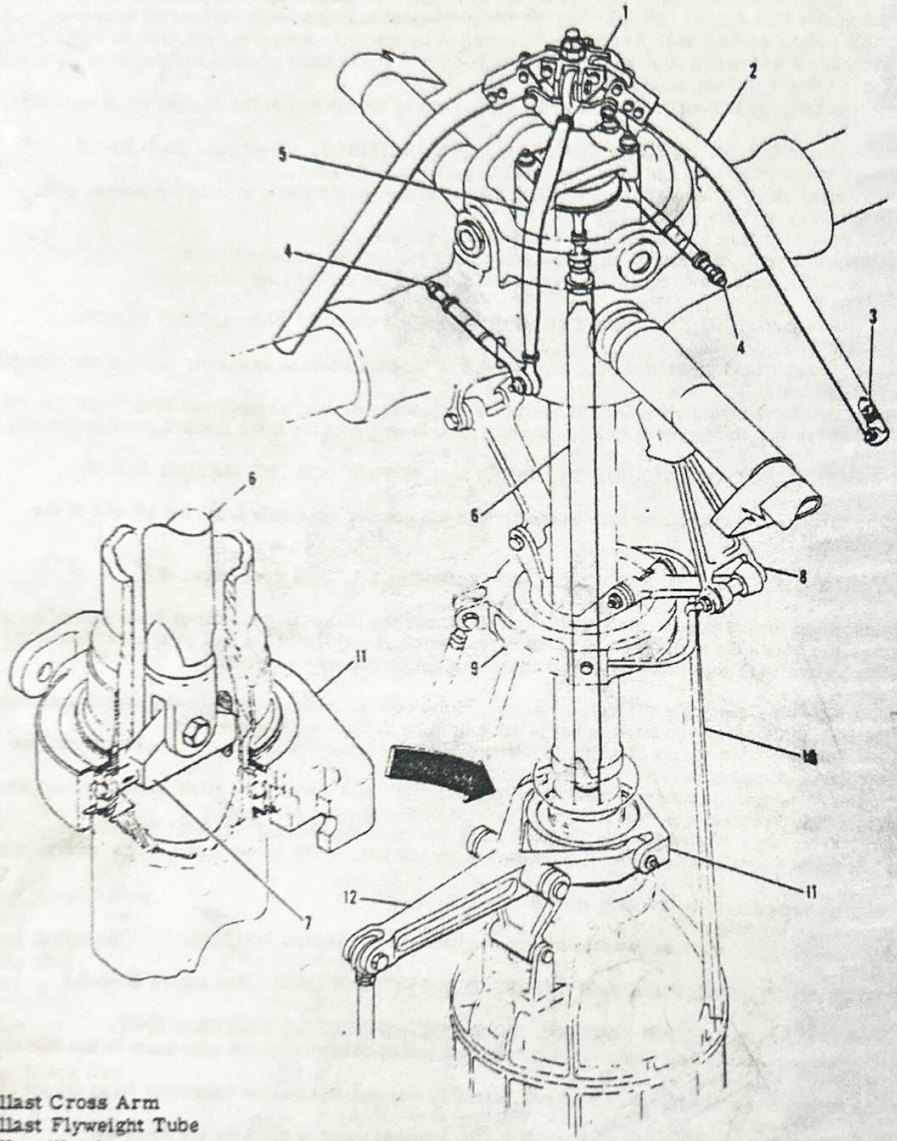
a. Insert the torque tube assembly through the aft end of the control stick and engage the sleeve assembly.
b. Install the bearing retainer and bearing in the aft end of the control stick assembly.
c. Thread the starter switch wiring through the control stick assembly using the cord length to pull the wire through the control stick assembly.
d. Twist the sleeve so that the holes in the torque tube assembly and the control stick assembly tube are alined. Secure the parts together with two AN470-AD3 rivets of the appropriate length.
e. Install the starter wire contact switch plunger spring and plug with two CR127-3-8 blind rivets.
f. Connect the starter switch wiring and install the switch and plug in the forward end of the control stick assembly.
g. Apply fresh rubber cement to the grip sleeve.
h. Install the rubber throttle grip.
i. Install the assembled control stick assembly as described in paragraph 31-10-11.

31-20-1. COLLECTIVE CONTROL TUBE AND ADJUSTABLE FRICTION UNIT. (See figure 31-1-3.)

31-20-10. REMOVAL OF COLLECTIVE CONTROL TUBE AND ADJUSTABLE FRICTION UNIT.

a. Remove the two nuts, bolts and washers securing the inboard collective stick assembly to the inboard torque block base.
b. Remove the lower external collective pushrod assembly rod end and bungee assembly from the control bellcrank.
c. Remove the two nuts, bolts and washers attaching the inboard bearing block to the firewall.
d. Remove the two nuts, bolts and washers securing the dual control shaft to the control tube.
e. Extract the cotter pin and remove the castellated nut and the steel and aluminum washers from the friction knob stud. Unscrew the friction knob assembly from the bearing support block.
f. Remove the two nuts, bolts and washers attaching the friction bearing support block to the firewall and slide the support block from the control tube, taking care to retain the friction shims with the block.
g. Carefully shift the control tube (bellcrank and bearing block attached) toward the right-hand side of the helicopter, and then remove the unit.
h. Remove the two nuts, bolts and washers securing the bellcrank to the control tube and remove the bellcrank and the bearing block.

31-20-11. INSTALLATION OF COLLECTIVE CONTROL TUBE AND ADJUSTABLE FRICTION UNIT. Installation of the collective control tube and the friction knob and support block assembly is essentially the reverse of removal. Observe the following during installation:



1. Ballast Cross Arm
2. Ballast Flyweight Tube
3. Ballast Weights
4. Incidence Arm Assembly
5. Incidence Push Rod Assembly
6. Internal Push Rod Assembly
7. Tee Terminal
8. Scissors Assembly
9. Wobble Plate Assembly
10. Pylon Assembly
11. Collective Ring Assembly
12. Yoke Assembly

Figure 31-1-4. Collective Internal Pushrod Installation

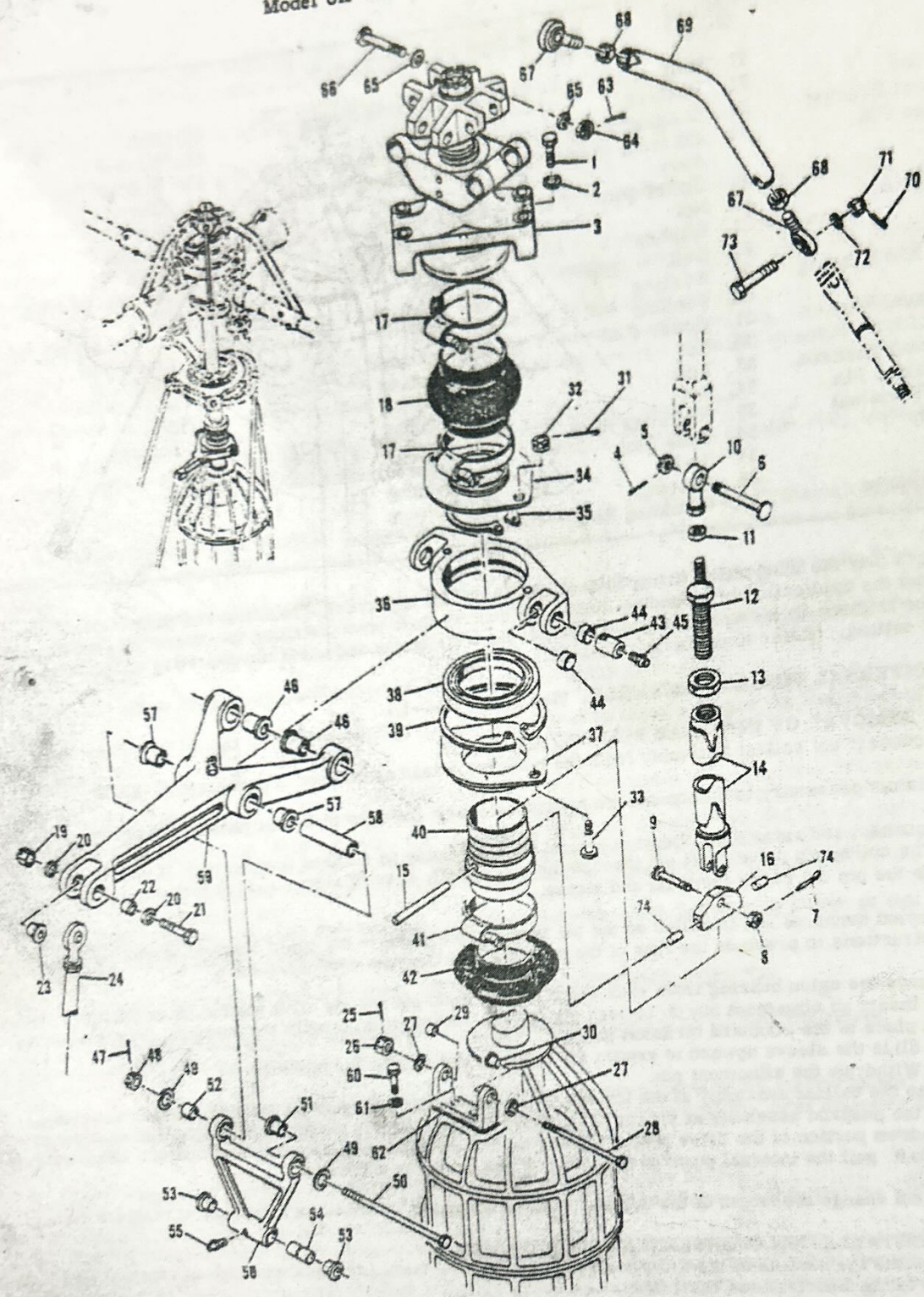


Figure 31-1-5. Upper Collective Controls Installation

INDEX FOR FIGURE 31-1-5

1. Bolt
2. Washer
3. Ballast Bracket
4. Cotter Pin
5. Nut
6. Bolt
7. Cotter Pin
8. Nut
9. Bolt
10. Rod End Bearing
11. Nut
12. Adapter
13. Nut
14. Internal Pushrod
15. Terminal Pin
16. Tee Terminal
17. Clamp
18. Boot
19. Nut
20. Washer
21. Bolt
22. Bushing
23. Bushing
24. External Pushrod Assy
25. Cotter Pin
26. Nut
27. Washer
28. Bolt
29. Bushing
30. Bushing
31. Cotter Pin
32. Nut
33. Bolt
34. Seal
35. Retaining Ring
36. Yoke Ring
37. Seal
38. Bearing
39. Retaining Ring
40. Bearing Sleeve
41. Clamp
42. Lower Boot
43. Retaining Pin
44. Bushing
45. Lubrication Fitting
46. Bushing
47. Cotter Pin
48. Nut
49. Washer
50. Bolt
51. Bushing
52. Bushing
53. Bushing
54. Bushing
55. Lubricating Fitting
56. Yoke Support Link
57. Bushing
58. Bushing
59. Yoke Arm
60. Bolt
61. Washer
62. Bracket
63. Cotter Pin
64. Nut
65. Washer
66. Bolt
67. Rod End Bearing
68. Nut
69. Incidence Pushrod
70. Cotter Pin
71. Nut
72. Washer
73. Bolt
74. Bushing

a. Check that the lubrication fitting in each bearing block is properly positioned and accessible.
b. Avoid the application of a bending load to the control shaft when installing the control tube on the shaft.
c. If the friction shims are damaged or lost, replace the shims and check the collective stick friction for the proper setting. (Refer to paragraph 31-1-32.)

31-30-1. INTERNAL PUSHROD ASSEMBLY. (See figure 31-1-4.)

31-30-10. REMOVAL OF INTERNAL PUSHROD ASSEMBLY.

a. Disconnect the ballast assembly from the main rotor head as outlined in paragraph 31-60-10.

NOTE: It is not necessary to disconnect the ballast crossarm from the incidence pushrod assembly.

b. Disconnect and raise the collective control yoke assembly as outlined in paragraph 31-40-10 to expose the collective drive shaft pin through the drive shaft, bearing sleeve and tee terminal.
c. Push the pin out of the terminal and sleeve.

NOTE: If nylon bushings are installed on the tee terminal pin, remove the pin in accordance with the following instructions to preclude the loss of the bushings into the main drive shaft bore.

d. Remove the nylon bushing from each end of the terminal pin and the drive shaft slots as follows:
(1) Insert an alinement pin (5/16-inch dia. x 2-11/16-inch long) through the bushings, the shaft and tee terminal in place of the standard terminal pin.
(2) Slide the sleeve upward to expose the bushings and remove the bushings.
(3) Withdraw the alinement pin.
e. Grasp the ballast assembly at the top end of the drive shaft and raise the internal pushrod assembly.
f. Tilt the pushrod assembly at the top of the drive shaft so that the tee terminal will tip and slide out of the necked-down portion of the drive shaft. Holding the tee terminal in tilted position against the inside wall of the drive shaft, pull the internal pushrod assembly up and out of the drive shaft.

NOTE: Do not change the length of the internal pushrod assembly, or it will be necessary to rerig the system.

31-30-11. INSTALLATION OF INTERNAL PUSHROD ASSEMBLY.

a. Lubricate the surface of the drive shaft in the vicinity of the tee terminal pin slots in accordance with the instructions in the Lubrication Chart, figure 10-19.
b. Insert the internal pushrod assembly into the top of the drive shaft keeping the tee terminal in a tilted position against the inner wall of the drive shaft.
c. Lower the internal pushrod assembly and ballast assembly, seating the ballast bracket in place over the four bracket attaching bolt inserts on the main rotor hub.
d. Insert the tee terminal pin through the sleeve, the nylon bushings, the slots in the drive shaft, and the tee terminal at the lower end of the internal pushrod assembly. Make certain that the pin passes through the hole in the tee terminal.
e. Reinstall the collective yoke assembly as outlined in paragraph 31-40-11.

f. Secure the collective ballast bracket and ballast assembly shims, if required, to the main rotor hub assembly with the four bolts and washers and safety the boltheads in pairs with lockwire.

31-40-1. COLLECTIVE CONTROL YOKE ASSEMBLY. (See figure 31-1-5.)

31-40-10. REMOVAL OF COLLECTIVE CONTROL YOKE AND RING ASSEMBLY.

a. Remove the main rotor assembly (refer to section 50.)
b. Remove the wobble plate and scissors assembly (refer to section 34.)
c. Remove the bolt attaching the forward end of the yoke assembly to the external pushrod assembly, and the bolt attaching the yoke assembly to the support link assembly.
d. Remove the two bolts securing the upper and lower yoke bearing ring seals to the yoke ring.
e. Slide the upper bearing seal upward and off the drive shaft. Disengage the upper retainer ring used to secure the bearing inner race to the drive shaft sleeve.
f. Slide the control yoke and ring assembly upward and off the top of the drive shaft.
g. If required, disengage support link (56) from bracket (62) by removing cotter pin, nut, two washers and bolt. Note location of washers for reinstallation. Cut lock wire and remove two bolts and washers attaching bracket to transmission housing; remove bracket.

31-40-11. INSTALLATION OF COLLECTIVE CONTROL YOKE AND RING ASSEMBLY.

a. If new RD206SB-8 inserts are installed in transmission housing for attaching bracket (62), install bracket as follows:

(1) Determine washer (AN960PD416L) thickness by inserting bolt (MS20073-04-7) through bracket and measure bolt length. Shim bolt with washers as required to allow 0.50 ± 0.03 inch thread engagement with insert.

(2) Attach bracket to housing with two bolts and the required washers. Torque bolts to 50-70 pounds-inches and safety with lockwire.

b. If removed, attach support link (56) to bracket (62) with a bolt, two washers and nut. Safety the nut with a cotter pin.
c. Place the lower bearing seal and bearing sleeve in place over the drive shaft.

NOTE: The rubber seal lip and the sleeve bearing shoulder must both be located toward the lower end of the drive shaft.

d. Install the pin through the sleeve, drive shaft slots and the tee terminal of the internal rod assembly. If nylon bushings (provided on helicopters Serial No. 2026 and subsequent) are to be installed on the terminal pin ends, install an alinement pin (5/16-inch dia. x 2-11/16-inch long) through the shaft and the tee terminal. Slide the nylon bushings into position on the ends of the alinement pin (in the shaft slots) and lower the bearing sleeve; then insert the standard tee terminal pin through the sleeve, bushings, drive shaft and tee terminal, in place of the alinement pin.
e. Lower the collective yoke and ring assembly into place over the shaft and bearing sleeve so that the bearing retaining ring is facing downward.

CAUTION: DO NOT INSTALL YOKE AND RING ASSEMBLY IN A REVERSED POSITION.

f. Use a soft mallet to gently tap the inner race of the bearing into place on the bearing sleeve.
g. Secure bearing to the sleeve with the upper retainer ring.

NOTE: Make certain the upper retainer ring is installed with the chamfered side of the inner diameter facing toward the top of the drive shaft. After installing the retainer, tap around the outer diameter of the retainer to seat it in the groove of the sleeve.

h. Install seals in conjunction with the collective ring as shown in figure 31-1-5.
i. Wrap the upper and lower protective boots in place on the sleeve and drive shaft so that the boot overlap joints trail the direction of shaft rotation.
j. Secure the upper boot with two clamps. Secure the lower boot with a clamp at the top, and with lockwire at the bottom to the rubber shield. Secure the upper and lower collective bearing seal flanges by inserting the two clevis bolts through the ring. The bolts must be installed with the boltheads located at the lower surface of the assembly.

NOTE: To reduce the tendency of the shield to adhere to the abutting surface of the transmission upper housing, apply a coating of DC-4 Compound (table 10-VI, item 20) between the mating surfaces.

k. Secure the collective yoke assembly to the support link assembly on the upper section of the transmission with the bolt, two washers and nut. Tighten the nut and safety with a cotter pin.

l. Connect the upper rod end bearing of the external pushrod to the yoke arm with the bolt, washers and nut. One thick washer must be installed under the nut adjacent to the flanged bushing in the yoke.

31-41-1. COLLECTIVE PITCH BEARING SLEEVE.

31-41-10. REMOVAL OF COLLECTIVE PITCH BEARING SLEEVE. (See figure 31-1-5.) Remove the collective pitch bearing sleeve as follows.

a. Remove the collective control yoke assembly (paragraph 31-40-10).

b. Push the terminal pin (15) out of the sleeve (40) and tee terminal (16) as outlined in paragraph 31-30-10, step d.

c. Slide the sleeve upward and off the drive shaft.

31-41-11. INSTALLATION OF COLLECTIVE PITCH BEARING SLEEVE. (See figure 31-1-5.) The collective pitch bearing sleeve and associated assemblies are installed as outlined in paragraph 31-40-11.

31-41-50. REPAIR OF COLLECTIVE PITCH BEARING SLEEVE. (See figure 31-1-5A.) Collective pitch bearing sleeves removed from service because of enlarged holes for the terminal pin (15, figure 31-1-5) may be repaired as follows.

CAUTION: THIS REPAIR IS PERMISSIBLE ONLY IF THE LOWER AND UPPER BEARING SURFACES OF THE SLEEVE INNER DIAMETER DO NOT EXCEED 2.768-INCHES.

a. Pilot drill two new holes located 90 degrees from the existing terminal pin holes. Check that the hole centerlines pass through the axial center of the bearing sleeve.

b. Enlarge holes for reaming with a 19/64-inch diameter drill. Ream the new holes to a finished diameter of 0.3135/0.3130-inch.

c. Remove all burrs and magnetic-particle inspect sleeve after reaming.

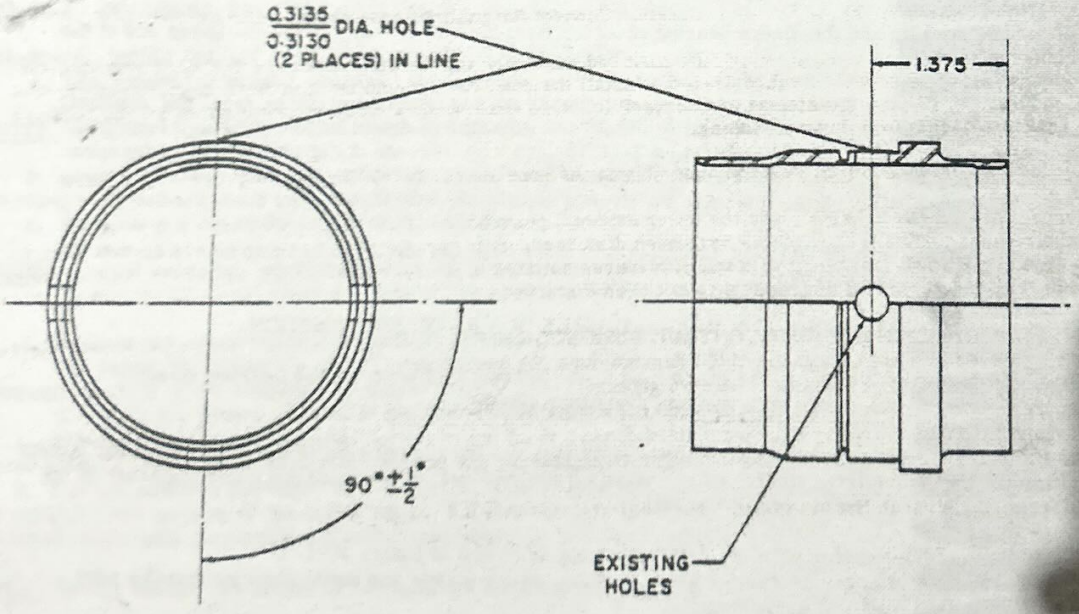


Figure 31-1-5A. Repair of Collective Pitch Bearing Sleeve

31-50-1. COLLECTIVE CONTROL BELLCRANK - BRACKET AND PUSHROD ASSEMBLIES. (See figure 31-1-6.)

31-50-10. REMOVAL OF COLLECTIVE CONTROL BELLCRANK - BRACKET AND PUSHROD ASSEMBLIES. (See figure 31-1-6.)

a. Disconnect the bungee assembly and the lower external pushrod assembly from the control tube bellcrank at the center tube support block assembly.

NOTE: Identify the location and direction of installation of each part to be removed from the collective linkage. Match-mark the rod end bearings. Do not change the length of the adjustable pushrod assemblies.

b. Disconnect the upper external pushrod assembly from the yoke assembly on the upper section of the transmission.

c. Remove the collective control pushrod assemblies and bellcranks from the brackets on the firewall and the lower section of the transmission in whatever order is convenient. If the brackets are removed with the bellcranks and rod assemblies attached, use care in handling the parts.

31-50-11. INSTALLATION OF COLLECTIVE CONTROL BELLCRANK - BRACKET AND PUSHROD ASSEMBLIES.

a. Install the bellcrank-bracket to mounting bracket located on the firewall.

b. Install the transmission bellcrank-bracket as follows:

(1) Position on the bellcrank-bracket on hangers located on transmission and temporarily tighten the two upper attach bolts.

(2) Using a feeler gage, check to determine that no more than 0.010-inch gap exists between the lower hanger and bellcrank-bracket contact points. If more than 0.010-inch gap exists, add AN960PD416 or AN960-416L washers as required at each lower attach bolt location to reduce the gap to a minimum (no more than 0.010-inch). Do not exceed a thickness equivalent to two AN960PD416 washers. If less than 0.010-inch gap exists, all four attach bolts may be permanently installed.

(3) If no gap exists between the bellcrank-bracket and the lower hanger, remove the two upper bolts and temporarily install the two lower bolts. Check to determine that no more than 0.010-inch gap exists between the upper hanger and bellcrank-bracket contact points. Add washers as described in (2) above, to reduce the gap to a minimum. Do not exceed a maximum thickness equivalent to two AN960PD416 washers at any of the four attach bolt hole locations.

CAUTION: DO NOT PERMANENTLY INSTALL THE BELLCRANK BRACKET ATTACH BOLTS WITHOUT CHECKING THE BRACKET- TO-HANGER INSTALLATION GAP DESCRIBED ABOVE. EXCESSIVE PRELOAD WILL EVENTUALLY DAMAGE THE BRACKET.

c. Install the bellcranks on bellcrank-brackets. Connect the pushrod assemblies to bellcranks.

NOTE: Make sure that the bolts attaching the push rod assembly and the bellcranks are installed with the bolt-heads facing as shown in figure 31-1-6. Install the push rod assemblies and bellcranks so that the rod end bearing lubrication fittings are accessible. One thick washer must be installed under any bolthead that is adjacent to a flanged bushing.

d. Connect the upper external pushrod assembly to the yoke assembly on the upper section of the transmission.

e. Connect the bungee assembly and the lower external pushrod assembly to the control tube bellcrank.

f. If the rod end bearing adjustments have been disturbed, or if replacement parts are being installed, rig the collective system in accordance with the procedures outlined in paragraph 31-1-30. Rerigging of the system is not necessary if the rod end bearings have not been disturbed and all parts are reinstalled as in step a, above.

31-50-40. STRAIGHTENING FLIGHT CONTROL PUSH ROD ASSEMBLIES. Flight control push rod assemblies may be straightened in a cold condition if the damage does not exceed the following limitations.

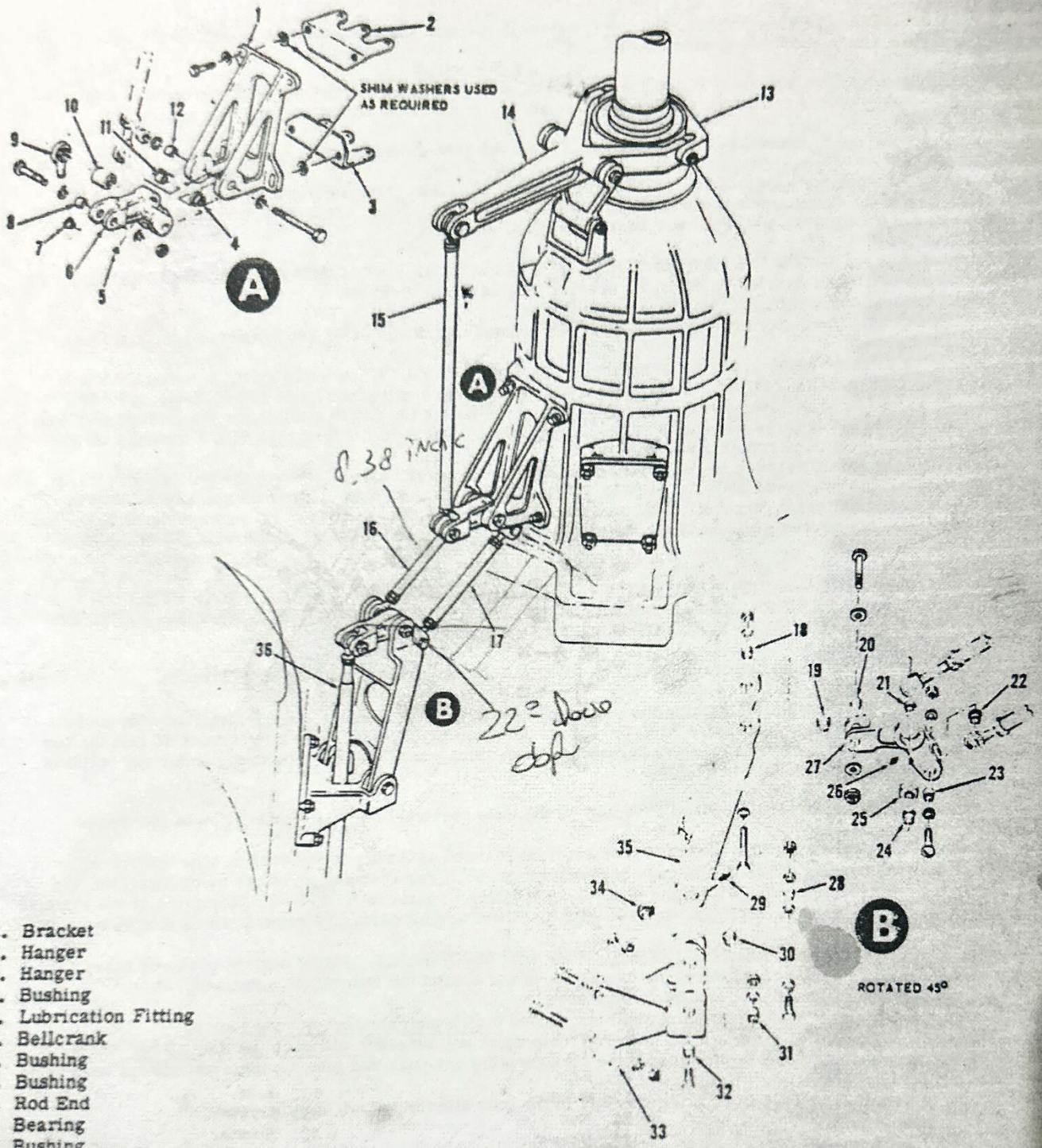
a. Dented or buckled tubes shall not be straightened.

b. Maximum bow prior to straightening shall not exceed 0.005-inch per inch of tube length.

c. Maximum curvature of straightened push rod tubes must not exceed 0.010-inch per foot of rod length.

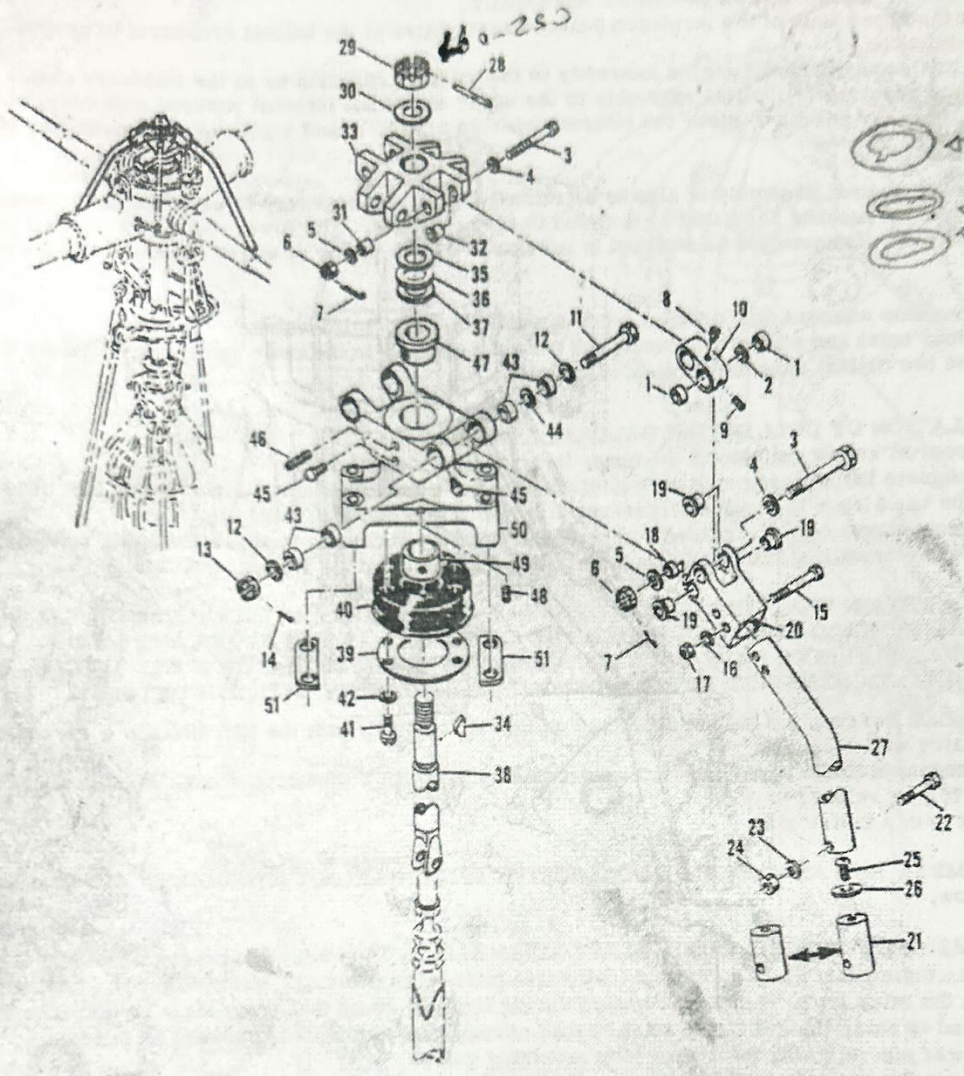
d. The rod end bearing must be replaced after straightening any push rod tube having a permanent bend within repair limits.

e. No dents, buckles or fractures are permitted in the tube after the straightening operation.



1. Bracket
2. Hanger
3. Hanger
4. Bushing
5. Lubrication Fitting
6. Bellcrank
7. Bushing
8. Bushing
9. Rod End
10. Bearing
11. Bushing
12. Bushing
13. Collective Yoke Ring
14. Yoke Arm
15. Upper External Push Rod
16. Push Rod Assembly
17. Push Rod Assembly
18. Bushing
19. Bushing
20. Bushing
21. Bushing
22. Bushing
23. Bushing
24. Bushing
25. Bearing
26. Lubrication Fitting
27. Bellcrank
28. Bushing
29. Lubrication Fitting
30. Bushing
31. Bushing
32. Bushing
33. Firewall Bracket
34. Bearing
35. Collective Control Link
36. Lower External Push Rod

Figure 31-1-6. Collective Pitch Bellcrank-Bracket and Pushrod Installation



1. Bearing
2. Retaining Ring
3. Bolt
4. Washer
5. Washer
6. Nut
7. Cotter Pin
8. Lubrication Fitting
9. Set Screw
10. Link
11. Bolt
12. Washer
13. Nut
14. Cotter Pin
15. Bolt
16. Washer
17. Nut
18. Bushing
19. Bushing
20. Lever
21. Weight
22. Bolt
23. Washer
24. Nut
25. Screw
26. Washer
27. Tube
28. Cotter Pin
29. Nut
30. Washer
31. Bushing
32. Bushing
33. Cross Arm
34. Key
35. Shim CON MUESCA
36. Washer
37. Washer
38. Push Rod
39. Plate
40. Boot
41. Screw
42. Washer
43. Bearing
44. Retaining Ring
45. Lubrication Fitting
46. Set Screw
47. Bushing
48. Set Screw
49. Bushing
50. Bracket
51. Ballast Assembly Shim

Figure 31-1-7. Collective Ballast Assembly
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31-60-1. COLLECTIVE BALLAST ASSEMBLY. (See figure 31-1-5 and -7.)

31-60-10. REMOVAL OF COLLECTIVE BALLAST ASSEMBLY.

a. Match-mark the upper ends of the incidence pushrod assemblies at the ballast crossarm to prevent reversal during reinstallation.

b. Remove the bolt securing each pushrod assembly to the ballast crossarm or to the incidence arm.

c. Remove the nut securing the ballast assembly to the upper end of the internal pushrod assembly. Lift the ballast assembly upward far enough to clear the internal pushrod assembly and remove the woodruff key from the pushrod.

NOTE: If the internal pushrod assembly is also to be removed it is not necessary to separate the crossarm from the internal pushrod assembly as outlined in step c, above. The lower end of the internal pushrod assembly may be disconnected as outlined in paragraph 31-30-10 and removed together with the ballast assembly.

d. Retain the downstop washers and/or shim located under the ballast crossarm.

e. Remove the four bolts and washers securing the ballast assembly to the main rotor hub. Remove the ballast assembly and two ballast assembly shims, if installed.

31-60-11. INSTALLATION OF COLLECTIVE BALLAST ASSEMBLY.

a. Install the woodruff key in the slot on the upper internal pushrod assembly.

b. Install the complete ballast assembly on the internal pushrod assembly end. Place the ballast bracket on the rotor hub with the key slot in the ballast crossarm in line with the woodruff key.

c. Check the match-marks on the threaded rod end bearing of the incidence pushrod assembly and its mating incidence arm to avoid reinstalling the ballast assembly 180 degrees from its original position.

CAUTION: MAKE CERTAIN THAT THE DOWNSTOP SHIM AND WASHERS ARE INSTALLED ON THE INTERNAL PUSHROD ASSEMBLY UNDER THE CROSSARM. IF THE UPPER AND LOWER INTERNAL PUSHRODS HAVE BEEN DISASSEMBLED, REASSEMBLE WITH THE SPECIAL BOLT AND NUT. TIGHTEN NUT TO 5/20 POUND-INCHES. SAFETY WITH COTTER PINS.

d. Secure the ballast bracket and ballast assembly shims (if required) with the four bolts and washers. Safety the bolts in pairs with lockwire.

e. Secure the crossarm to the upper internal pushrod assembly with a washer and nut. Tighten the nut to 160/250 pound-inch torque value.

f. Safety the nut with a cotter pin.

31-60-20. DISASSEMBLY AND ASSEMBLY OF COLLECTIVE PITCH BALLAST ASSEMBLY. Refer to paragraph 31-60-40, below.

31-60-30. ADJUSTMENT OF BUNGEE AND BALLAST ASSEMBLIES. The collective bungee assembly is provided to help maintain main rotor blade incidence (collective pitch stick position) during flight at cruising airspeed and to prevent the stick from "jumping" upward during flight in rough and gusty air. To increase the manual effort required to raise the collective stick beyond normal cruise position, proceed as follows:

a. Loosen the lower nut retaining the spring loop assembly guide.

b. Decrease the gap between the guide and the contact surface of the top spring coil. Retighten the upper nut against the loop assembly guide.

c. Decreasing the manual effort required to raise the collective stick above the cruise position is the opposite of steps a and b.

NOTE: The amount of adjustment required may vary after main rotor blade replacement due to the differences in individual blade characteristics.

d. For adjustment of the collective ballast assembly, refer to section 30.

31-60-40. MINOR REPAIR OF COLLECTIVE BALLAST ASSEMBLY. Disassemble, inspect repair and reassemble the collective ballast assembly as follows.

a. Matchmark and identify the location and direction of installation for all parts of the assembly prior to disassembly. Note that all boltheads are located in the direction of main rotor rotation.

b. Disassemble the collective ballast assembly in any convenient order. (See figure 31-1-7.)

c. Visually inspect all bearings and bushings for wear and corrosion. If the diametral clearance between the upper internal push rod and the bracket assembly bushings exceeds 0.012-inch, check the push rod diameter as given in d, below. If the push rod is serviceable, replace the bracket assembly bushings as follows:

(1) Remove setscrews and press bushings out of bracket.

(2) Coat replacement bushings with zinc chromate primer (table 10-VI, item 3) and install bushings into bracket while primer is still wet.

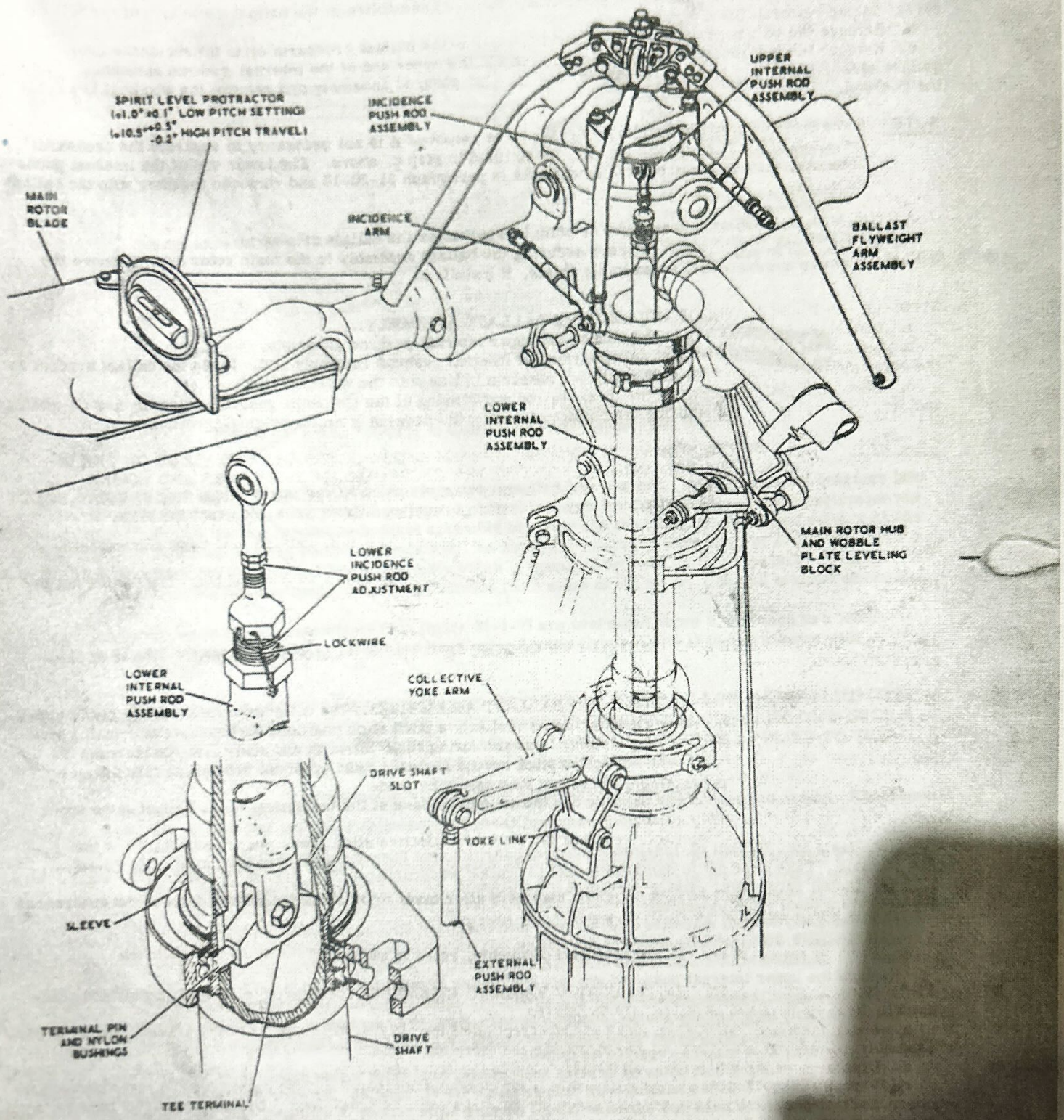


Figure 31-1-8. Upper Collective Controls Adjustments

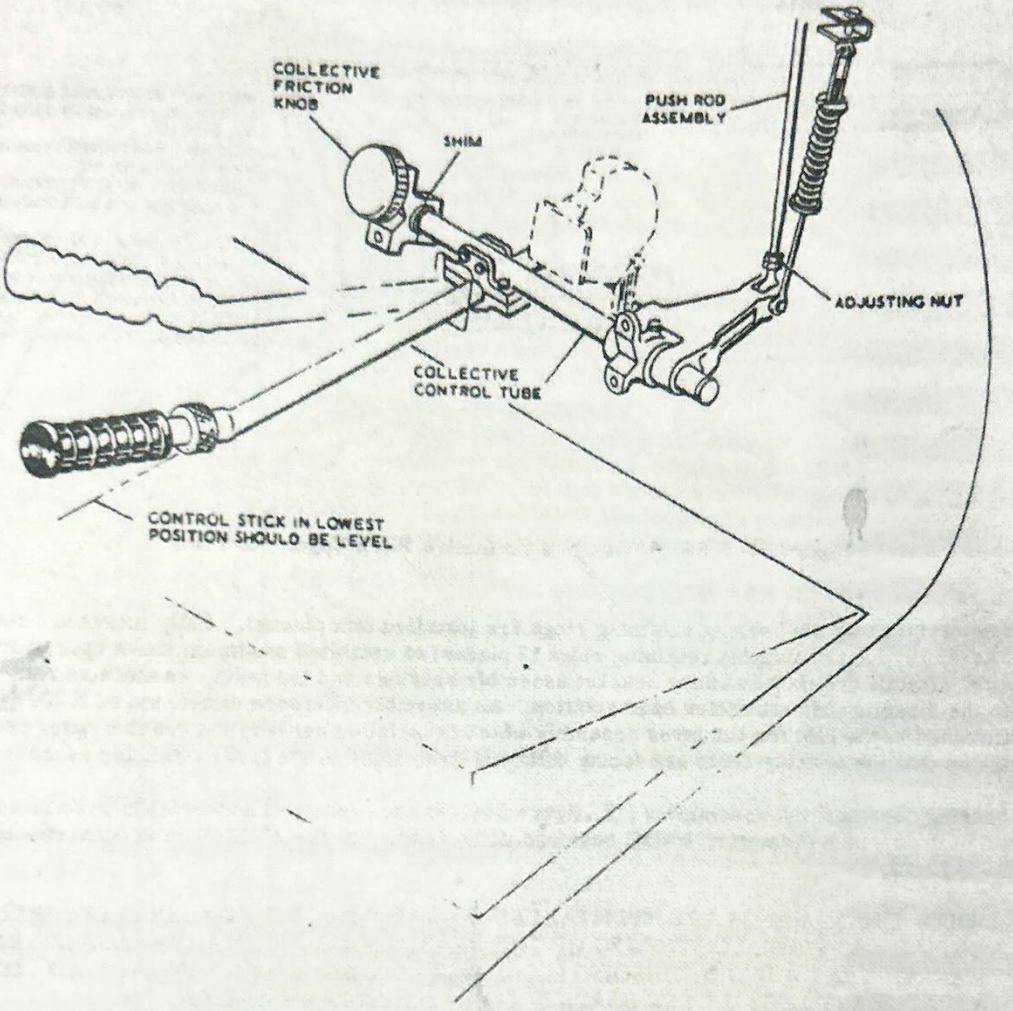


Figure 31-1-9. Collective Control Stick Adjustments

(3) Use a No. 29 drill (0.136-inch diameter) to drill a hole through one side of each bushing at the setscrew location. Take care not to damage threads in bracket while drilling.

(4) Install setscrews, making certain that each setscrew tip enters hole in bushing. Stake setscrews in place to prevent them from loosening.

(5) Use a 47/64-inch diameter drill to drill each bushing inside diameter to 0.735-inch.

(6) Use an 0.750-inch diameter reamer to line ream each bushing inside diameter to 0.751-inch maximum.

d. Replace the upper internal push rod whenever the shank is worn more than 0.0075-inch in depth. (See figure 31-1-9A.) An allowable wear of 0.0075-inch depth is permissible around 50 percent of the pin circumference along the full length of the shank. Install bushings in the rod assembly if the attaching bolt hole diameter exceeds 0.256-inch. An out-of-round hole is permissible provided that the maximum diameter is not exceeded. An oversize hole may be repaired as follows:

(1) Enlarge existing bolt holes by drilling and reaming to a finish inside diameter of 0.3745/0.3750-inch.

(2) Coat an NAS75-4-004 bushing with primer (table 10-VI, item 3). Provide adequate support under the inside surface of one of the push rod ears and install bushing while primer is still wet. Install bushing so that it is flush with the inside surface.

(3) Repeat step (2) for the opposite ear.

NOTE: If either bushing extends beyond the outer surface, use a flat mill file to file the bushing flush with the surface. Make certain that filing does not remove the part serial number.

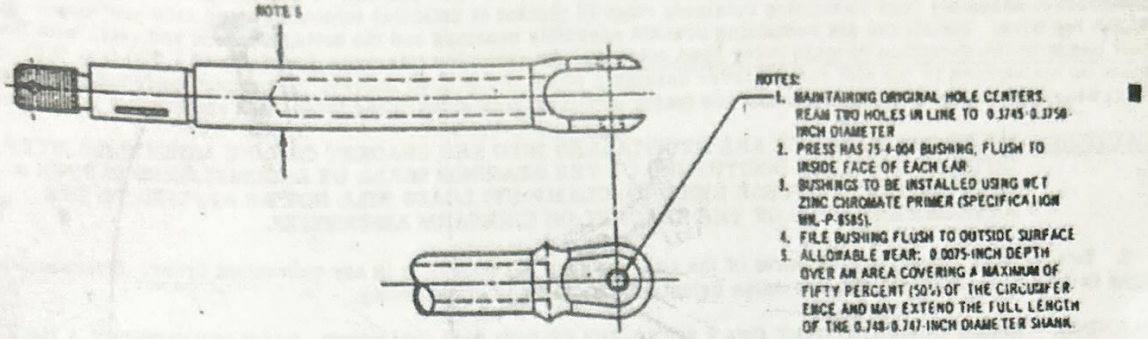


Figure 31-1-9A. Repair of Collective Pitch Upper Push Rod

e. Make certain that the bearing retaining rings are installed (six places). Fully insert the bearings into the bracket assembly lugs containing retaining rings (2 places) to establish minimum inner race protrusion out of the lug bore. Install the six remaining bracket assembly bearings and the bolts, washers and nuts, with the bolt heads in the direction of main rotor head rotation. An assembly tolerance dimension of 1.390 (± 0.010)-inch must be maintained in the slot for the lever assembly which is installed between the bracket inner bearings. Install bearings so that the bearing seals are facing outboard (both sides of the lever, link and bracket assemblies).

NOTE: If bearing bores of link assemblies (10, figure 31-1-7) are oversized above 0.625-inch to a maximum of 0.627-inch diameter, install bearings using Loctite Grade A (10-1) in accordance with MIL-S-22473.

CAUTION: WHEN THE BEARINGS ARE REINSTALLED INTO THE BRACKET OR LINK ASSEMBLIES (STEP e), INITIAL AND FINAL POSITIONING OF THE BEARINGS SHALL BE ACCOMPLISHED IN SUCH A MANNER THAT ADVERSE BENDING (CLAMP-UP) LOADS WILL NOT BE APPLIED TO THE ATTACHMENT LUGS OF THE BRACKET OR CROSSARM ASSEMBLIES.

f. Reassemble the remaining parts of the collective ballast assembly in any convenient order. Reassemble parts in same location and with the same orientation as prior to disassembly.

WARNING: MAKE CERTAIN THAT ONLY SOLID-SHANK ROD END BEARINGS, PART NUMBERS ST-3 OR TST-3 (MANUFACTURED BY SHAFER BEARING DIVISION OF CHAIN BELT COMPANY) OR PART NUMBER MXC36-14TMC (MANUFACTURED BY THE HEIM COMPANY) ARE INSTALLED AT THE LOWER ENDS OF THE TWO CURVED INCIDENCE PUSHRODS CONNECTING THE COLLECTIVE BALLAST CROSSARM AND THE MAIN ROTOR FORK INCIDENCE ARMS. (SEE FIGURE 31-1-4.) NO OTHER ALTERNATE OR SUBSTITUTE ROD END BEARINGS ARE PERMISSIBLE.

g. Coat the hinge bolts (11, figure 31-1-7) with a film of grease prior to reassembly. Use sufficient AN960-10 or AN960-10L washers to provide satisfactory cotter pin security. A minimum of 1 washer under the bolt head and 1 washer under the nut must be maintained. Tighten nut to 40/45 pound-inches torque. Secure with cotter pin.

e. Make certain that the bearing retaining rings are installed (six places). Fully insert the bearings into the bracket assembly lugs containing retaining rings (2 places) to establish minimum inner race protrusion out of the lug bore. Install the six remaining bracket assembly bearings and the bolts, washers and nuts, with the bolt heads in the direction of main rotor head rotation. An assembly tolerance dimension of 1.390 (± 0.010)-inch must be maintained in the slot for the lever assembly which is installed between the bracket inner bearings. Install bearings so that the bearing seals are facing outboard (both sides of the lever, link and bracket assemblies).

CAUTION: WHEN THE BEARINGS ARE REINSTALLED INTO THE BRACKET OR LINK ASSEMBLIES (STEP e), INITIAL AND FINAL POSITIONING OF THE BEARINGS SHALL BE ACCOMPLISHED IN SUCH A MANNER THAT ADVERSE BENDING (CLAMP-UP) LOADS WILL NOT BE APPLIED TO THE ATTACHMENT LUGS OF THE BRACKET OR CROSSARM ASSEMBLIES.

f. Reassemble the remaining parts of the collective ballast assembly in any convenient order. Reassemble parts in same location and with the same orientation as prior to disassembly.

WARNING: MAKE CERTAIN THAT ONLY SOLID-SHANK ROD END BEARINGS, PART NUMBERS ST-3 OR TST-3 (MANUFACTURED BY SHAFER BEARING DIVISION OF CHAIN BELT COMPANY) OR PART NUMBER MXC36-14TMC (MANUFACTURED BY THE HEIM COMPANY) ARE INSTALLED AT THE LOWER ENDS OF THE TWO CURVED INCIDENCE PUSHRODS CONNECTING THE COLLECTIVE BALLAST CROSSARM AND THE MAIN ROTOR FORK INCIDENCE ARMS. (SEE FIGURE 31-1-4.) NO OTHER ALTERNATE OR SUBSTITUTE ROD END BEARINGS ARE PERMISSIBLE.

g. Coat the hinge bolts (11, figure 31-1-7) with a film of grease prior to reassembly. Use sufficient AN960-10 or AN960-10L washers to provide satisfactory cotter pin security. A minumum of 1 washer under the bolt head and 1 washer under the nut must be maintained. Tighten nut to 40/45 pound-inches torque. Secure with cotter pin.

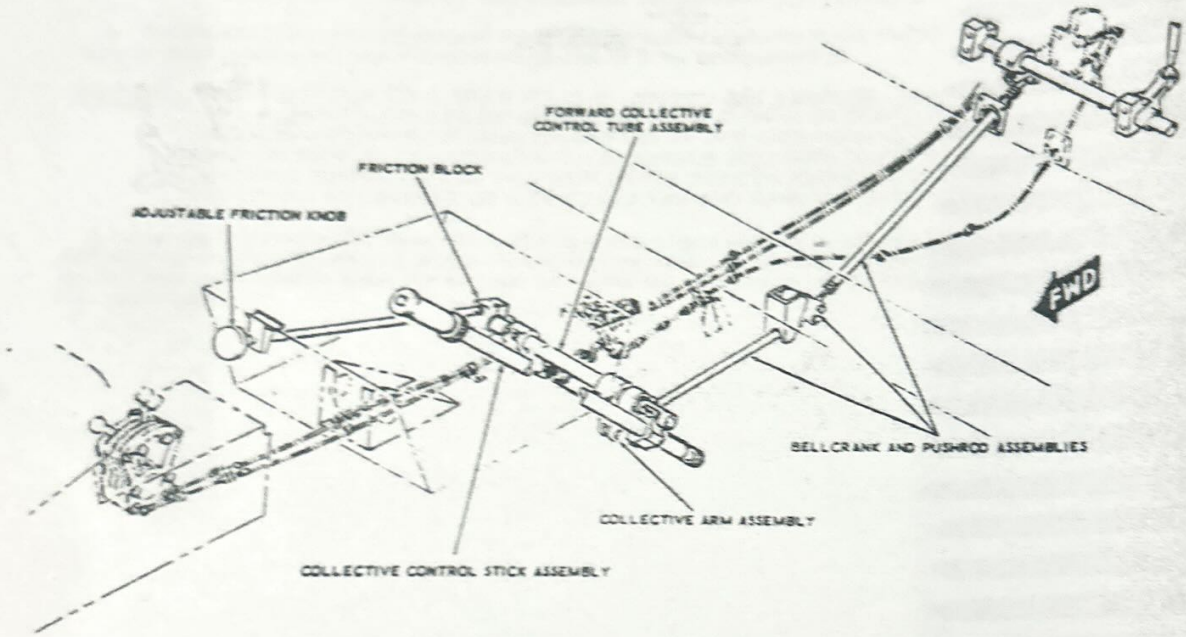


Figure 31-101-1. Collective Controls, Four-Place Configuration

h. Tighten the link and flyweight ballast arm hinge bolts finger-tight; then use a wrench to aline the first castellation of the nut with the cotter pin hole in the bolt. Avoid overtightening of the bolts.

i. Safety the nuts to the hinge bolts with cotter pins. Check that the screws securing the upper and lower bushing inserts of the bracket assembly are staked in place.

j. Remove and check the weights located in the ends of the fly-weight tubes. Make certain that an equal amount of weight is used in each arm.

CAUTION: EFFECTIVE WITH HELICOPTERS SERIAL NUMBERS 2079 AND SUBSEQUENT, THE BALLAST FLYWEIGHT TUBES ARE FABRICATED OF STEEL. DO NOT INSTALL A STEEL FLYWEIGHT TUBE WITH AN ALUMINUM TUBE.

31-101-1. COLLECTIVE CONTROL SYSTEM, FOUR-PLACE CONFIGURATION. (See figure 31-101-1.)

31-101-2. DESCRIPTION. The four-place configuration collective control system consists of the following operational units: a control stick; a forward collective control torque tube (on which are mounted the collective lever assembly arm, bearing block and adjustable friction block); an arm assembly (mounted on the collective tube aft of the firewall); and interconnecting pushrods and bellcrank.

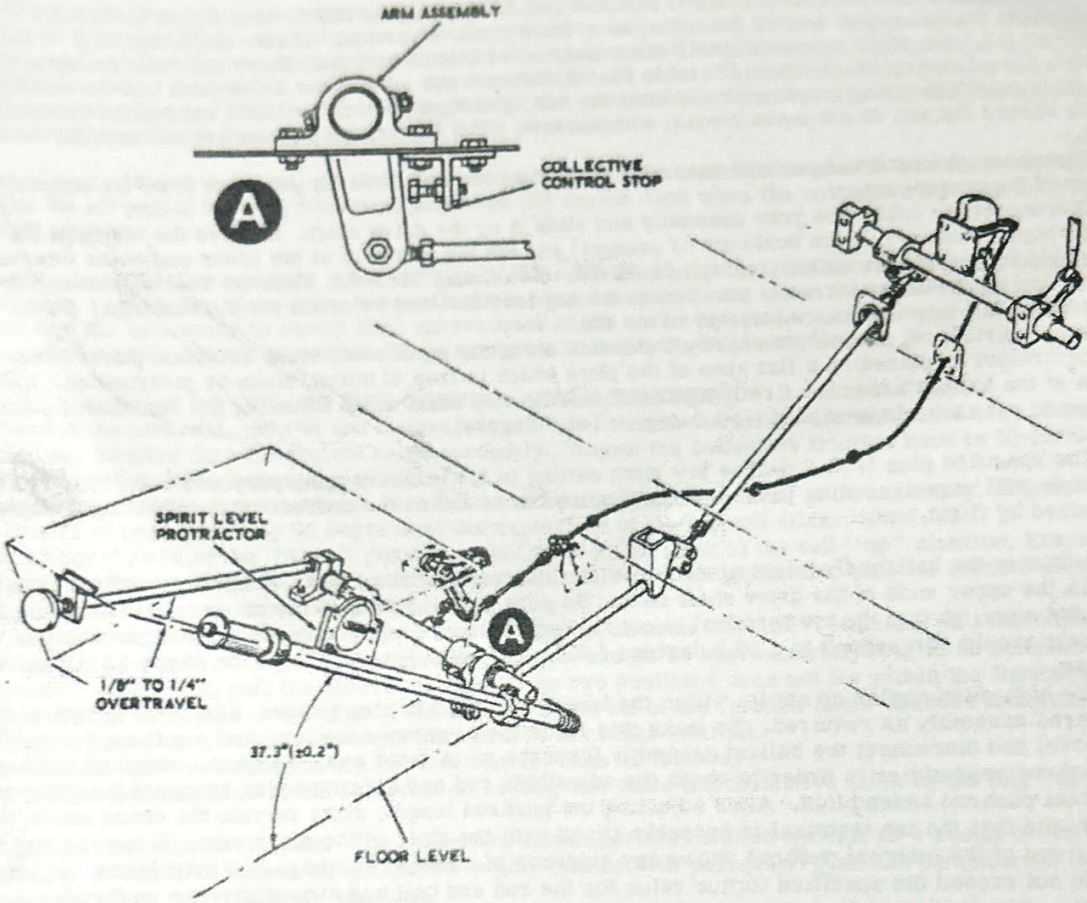


Figure 31-101-2. Collective Control Stick Adjustments, Four-Place Configuration

a. The portion of the collective control system located aft of the firewall is identical to the standard three-place configuration and appropriate paragraphs should be consulted as applicable.

31-101-3. TROUBLESHOOTING THE COLLECTIVE CONTROL SYSTEM, FOUR-PLACE CONFIGURATION. Consult Table 31-1-L.

31-101-10. REMOVAL OF COLLECTIVE CONTROL SYSTEM, FOUR-PLACE CONFIGURATION. (See figure 31-101-3.)

a. Remove the collective stick assembly. (Refer to paragraph 31-110-10.)
b. Remove the forward collective control torque tube. (Refer to paragraph 31-120-10.)
c. Remove the collective arm assembly. (Refer to paragraph 31-130-10.)
d. Remove the collective bellcrank and pushrod assemblies. (Refer to paragraph 31-140-10.)

31-101-11. INSTALLATION OF COLLECTIVE CONTROL SYSTEM, FOUR-PLACE CONFIGURATION. (See figure 31-101-3.)

a. Install the collective bellcrank and pushrod assemblies. (Refer to paragraph 31-140-11.)
b. Install the collective arm assembly. (Refer to paragraph 31-130-11.)

moval. In addition, accomplish the following:

a. Torque block bolt retaining nuts to 10/15 pound-inches.
b. Wrap the throttle control cable on sheaves of collective lever and collective stick assemblies, taking care to locate the turnbarrel on the top strand.
c. Tighten turnbarrel to provide a cable tension of 17 to 20 pounds.
d. Safety turnbarrel with lock wire.

31-110-20. DISASSEMBLY OF COLLECTIVE CONTROL STICK ASSEMBLY. (See figure 31-101-3.)

a. Remove the control stick assembly as described in paragraph 31-101-10.
b. Break the cement bond securing the aft 1-1/2 inches of the rubber throttle grip to the sleeve.
c. Remove the rubber throttle grip.
d. Remove the starter switch and disconnect the wiring at the switch.
e. Drill out the four rivets used to join the sleeve and the torque tube assembly.

CAUTION: BE CAREFUL NOT TO ENLARGE THE RIVET HOLES THROUGH THE MATING PARTS.

f. Pull the wiring forward out of the control stick assembly.
g. Remove torque block from stick assembly.
h. Remove the throttle control torque tube assembly and the bearing assembly from the aft end of the control stick assembly.
i. Slide boot off control stick assembly.

31-110-21. ASSEMBLY OF COLLECTIVE CONTROL STICK ASSEMBLY. (See figure 31-101-3.)

NOTE: Before installing torque tube, run a length of cord through the inside of the control stick assembly. This will provide a means for pulling the switch wires into place after installation of the torque tube assembly.

a. Insert the torque tube assembly through the forward end of the control stick assembly.
b. Install the bearing assembly in the aft end of the control stick assembly.
c. Turn the sleeve so that the holes in the torque tube assembly and the control stick sleeve are alined. Secure the parts together with four MS20426-AD3 rivets of the appropriate length.
d. Thread the starter switch wiring through the control stick assembly, using the cord length to pull the wires through the control stick assembly.
e. Install sleeve, washer and knurled friction nut.
f. Connect the starter switch wiring and install the switch and plug in the forward end of the control stick assembly.
g. Apply fresh rubber cement to the grip sleeve.
h. Install the rubber throttle grip.
i. Slide boot on stick assembly.
j. Install torque block assembly to stick assembly. Tighten torque block bolts to 10/15 pound-inch torque value.
k. Safety stud to one torque block bolt with lockwire.
l. Install sheave fitting to torque tube assembly, taking care to install ring on sheave fitting shoulder. Secure with bolt, washer and nut.
m. Install the assembled control stick assembly as described in paragraph 31-101-11.

31-120-1. FORWARD COLLECTIVE CONTROL TORQUE TUBE. (See figure 31-101-3.)

31-120-10. REMOVAL OF FORWARD COLLECTIVE CONTROL TORQUE TUBE.

a. Proceed with steps a through i of paragraph 31-110-10.
b. Disconnect the forward collective rod assembly at the collective arm.
c. Disconnect the throttle link assembly at the lever assembly.

NOTE: Take care not to lose the two small spacers located on each side of the rod end bearing. (See figure 75-101-2.)

d. Remove bolts securing the bearing blocks to cabin floor. Withdraw collective control torque tube.
e. Remove outboard snap ring, collective friction bearing block and inboard snap ring from torque tube.
f. Remove bolts securing arm assembly and lever assembly to torque tube. Slide arm assembly and lever assembly off torque tube.

31-120-11. INSTALLATION OF FORWARD COLLECTIVE CONTROL TORQUE TUBE. Installation of forward collective control torque tube is essentially the reverse order of removal. Be sure to install a small spacer on each side of the throttle link rod end bearing and sheave lever at collective lever assembly. (Refer to step c of paragraph 31-120-10 and figure 75-101-1.)

31-130-1. COLLECTIVE ARM ASSEMBLY. (See figure 31-101-3.)

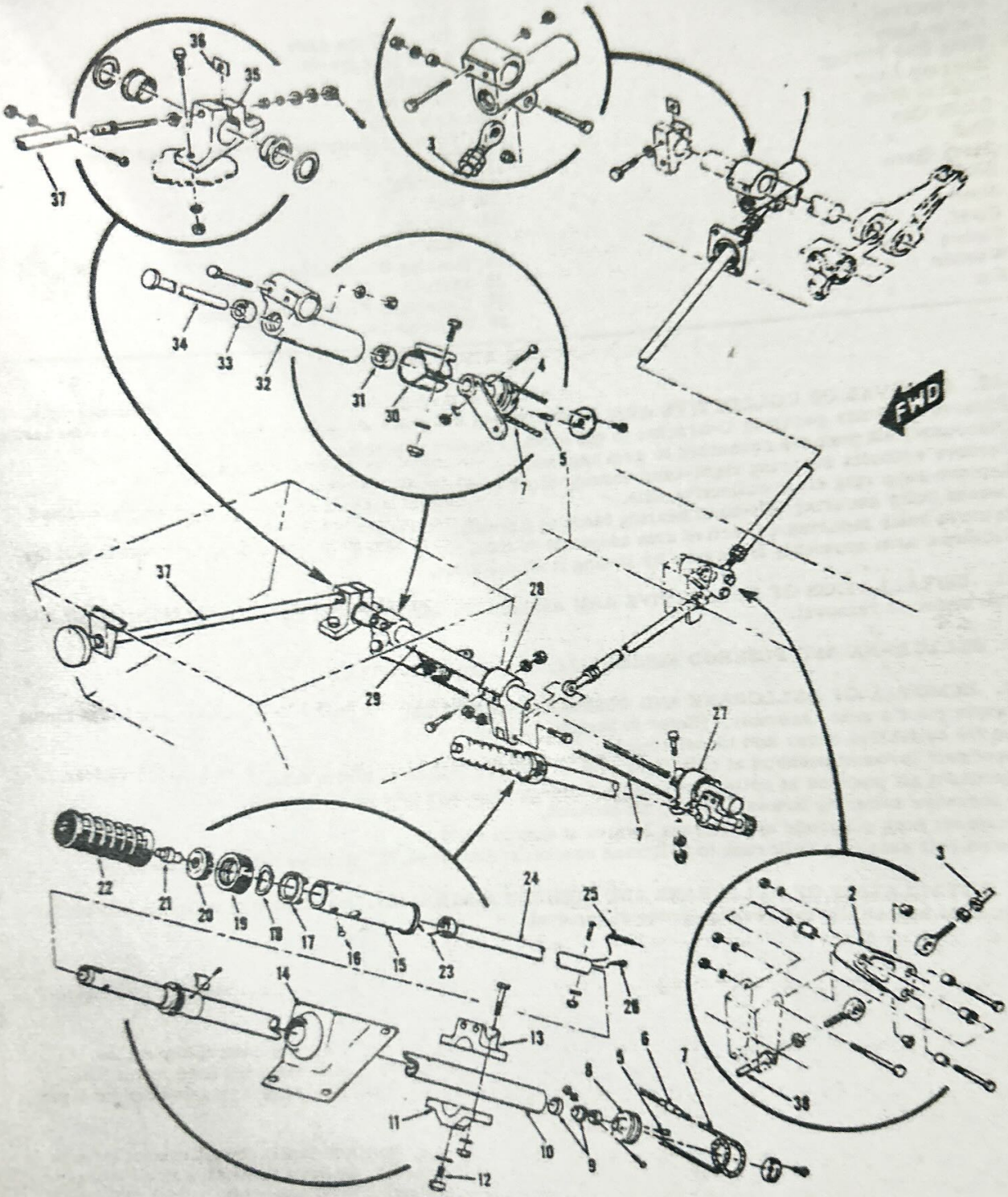


Figure 31-101-3. Collective Control Installation, Four-Place Configuration, (Exploded View)

INDEX FOR FIGURE 31-101-3

1. Arm Assy
2. Bellcrank Assy
3. Pushrod Assy
4. End Fitting
5. Sleeve
6. Turnbarrel
7. Cable Assy
8. Stick End Fitting
9. Bearing Assy
10. Control Stick
11. Block Cap
12. Stud
13. Block Base
14. Boot
15. Sleeve
16. Rivet
17. Sleeve
18. Washer
19. Nut
20. Plug
21. Starter Switch
22. Grip
23. Wire
24. Torque Tube Assy
25. Knife Disconnect
26. Terminal
27. Block Assy
28. Arm Assy
29. Forward Collective Control Torque Tube
30. Clamp
31. Bearing
32. Arm
33. Bearing
34. Tube
35. Bearing Block Assy
36. Shim
37. Collective Friction Tube Assy
38. Pushrod Assy

31-130-10. REMOVAL OF COLLECTIVE ARM ASSEMBLY.

a. Remove the bolts securing U-bracket to the forward pushrod eyebolts.
b. Disconnect aft pushrod connected to arm assembly.
c. Remove eyebolts securing right-hand bearing block to firewall.
d. Remove snap ring from collective tube.
e. Loosen bolts securing left-hand bearing block to firewall.
f. Remove bolts securing collective arm assembly to tube.
g. Withdraw arm assembly from tube by sliding it off the shaft.

31-130-11. INSTALLATION OF COLLECTIVE ARM ASSEMBLY. Installation of the arm assembly is essentially the reverse order of removal.

31-140-1. BELLCRANK AND PUSHROD ASSEMBLIES. (See figure 31-101-3.)

31-140-10. REMOVAL OF BELLCRANK AND PUSHROD ASSEMBLIES.

a. Remove pilot's seat assembly. (Refer to Section 85.)
b. Remove collective cover and tunnel cover.
c. Disconnect forward pushrod at collective arm on forward collective torque tube.
d. Disconnect aft pushrod at collective lever located on collective tube aft of firewall.
e. Cut lockwire securing firewall boot to aft pushrod.
f. Disconnect both pushrods at bellcrank located at Station 44.75.
g. Remove bolt securing bellcrank to bellcrank bracket at Station 44.75. Remove bellcrank assembly.

31-140-11. INSTALLATION OF BELLCRANK AND PUSHROD ASSEMBLIES. Installation of bellcrank and pushrod assemblies is essentially the reverse order of removal.

RUDDER CONTROLS

32-1-1. DIRECTIONAL CONTROL SYSTEM. (See figure 32-1-1.)

32-1-2. DESCRIPTION. Directional control of the helicopter is accomplished by varying the amount of sideward thrust provided by the tail rotor. The tail rotor is driven through a mechanical drive system geared to the main transmission. The thrust of the tail rotor is varied by changing the pitch of the blades. The pitch change mechanism includes a set of rudder pedals, connecting cable assemblies and the pitch change mechanism incorporated in the tail rotor gear box and rotor hub.

32-1-3. TROUBLESHOOTING THE DIRECTIONAL CONTROL SYSTEM. Table 32-1-I lists in the order of likely occurrence the most frequent directional control system troubles, their probable causes and suggested remedies.

32-1-10. REMOVAL OF DIRECTIONAL CONTROL SYSTEM. (See figures 31-1-2 through 31-1-7.)

a. Remove the intermediate rudder cable assemblies from the tail boom. (Refer to paragraph 32-10-10.)
b. Remove the aft rudder cable assemblies and cable drum guard assembly from the tail rotor speed decreaser. (Refer to paragraph 32-20-10.)
c. Remove the forward rudder cable assemblies from the engine deck and the cabin enclosure. (Refer to paragraph 32-30-10.)
d. Remove the rudder balance cable assembly from the cabin enclosure. (Refer to paragraph 32-40-10.)
e. Remove the rudder pedal assemblies from the rudder control torque tube assemblies.
f. Remove the rudder control torque tube assemblies from the cabin enclosure. (Refer to paragraph 32-60-10.)
g. Remove the rudder cable pulley brackets from the engine deck under the cabin floor and the tail boom. (Refer to paragraph 32-50-10.)
h. If required, remove the tail rotor pitch change mechanism. (Refer to section 55.)

32-1-11. INSTALLATION OF DIRECTIONAL CONTROL SYSTEM. (See figures 31-1-2 through 31-1-7.)

a. Install the cable assembly pulley brackets on the engine deck under the cabin floor and the tail boom. (Refer to paragraph 32-50-11.)
b. Install the rudder control torque tube assemblies. (Refer to paragraph 32-60-10.)
c. Install the rudder balance cable assembly. (Refer to paragraph 32-40-11.)
d. Install the rudder pedal assemblies on the torque tube assemblies.
e. Install the forward rudder cable assemblies in the cabin enclosure and the engine deck. (Refer to paragraph 32-30-11.)
f. Install the aft rudder cable assemblies and cable drum guard assembly at the tail rotor gear box. (Refer to paragraph 32-20-11.)
g. Install the intermediate rudder cable assemblies on the tail boom. (Refer to paragraph 32-10-11.)
h. If removed, install the tail rotor pitch change mechanism. (Refer to section 55.)
i. Rig the rudder cable assemblies. (Refer to paragraph 32-1-30 or to 32-1-30A.)
j. Adjust the tail rotor blade pitch. (Refer to paragraph 32-1-31.)

32-1-30. RIGGING THE RUDDER CABLE ASSEMBLIES. (See figures 32-1-1 through 32-1-8.)

a. Operate the rudder control pedals from one extreme to the other and check that the exposed portion of the pitch change rod assembly in the tail rotor speed decreaser travels a minimum of 7/8-inch from one extreme position to the other. Apply a wrap of pressure sensitive tape or a soft pencil mark to the rod as a reference point to indicate the neutral, or mid-travel position of the rod.

b. Lock the two left-hand rudder pedal arms together by removing the two pip pins and inserting a length of 1/4-inch steel rod through the pip pin holes, or by using two blocks of hard wood and a C-clamp to clamp the two pedal arms together in a neutral position.

c. Adjust the length of the two turnbarrels located between the two forward rudder cable assemblies and the two intermediate rudder cable assemblies in order to position the pitch change rod assembly in the tail rotor speed decreaser in its neutral or mid-travel position. Refer to the reference mark applied in step a above.

d. Adjust the two turnbarrels equally to provide a cable tension of 6 to 8 pounds, taking care not to alter the neutral position of the tail rotor gear box pitch change rod assembly.

e. Remove the steel rod or C-clamp used to secure the rudder pedal arms in the neutral position and operate the rudder pedals through their full travel range. Verify that the pitch change rod assembly is in its neutral position when the rudder pedals are in neutral. (Refer to step a above.)

CAUTION: CHECK TO DETERMINE THAT THERE IS NO INTERFERENCE IN THE SYSTEM WHEN THE RUDDER PEDALS ARE OPERATED FROM ONE EXTREME POSITION TO THE OTHER, PAYING PARTICULAR ATTENTION TO THE CLEARANCE BETWEEN THE PEDALS AND THE INSTRUMENT PANEL AND BETWEEN THE PEDALS AND THE WINDSHIELD (DUAL CONTROL PEDALS). IF INTERFERENCE IS DETECTED, IT WILL BE NECESSARY TO LENGTHEN OR SHORTEN THE

Table 32-1-1. Troubleshooting the Directional Control System

TROUBLE	PROBABLE CAUSE	REMEDY
Stiffness in system	Binding or incorrectly routed cable assemblies	Check cable assembly routing. Inspect cable under the protection panel.
	Bent pitch change rod in the tail rotor gear box	Replace defective parts.
	Binding tail rotor blade yoke	Remove blade, clean and lubricate yoke bearings.
Insufficient system control	Improperly rigged tail rotor or control cable assemblies	Re-rig control cable assemblies and tail rotor.

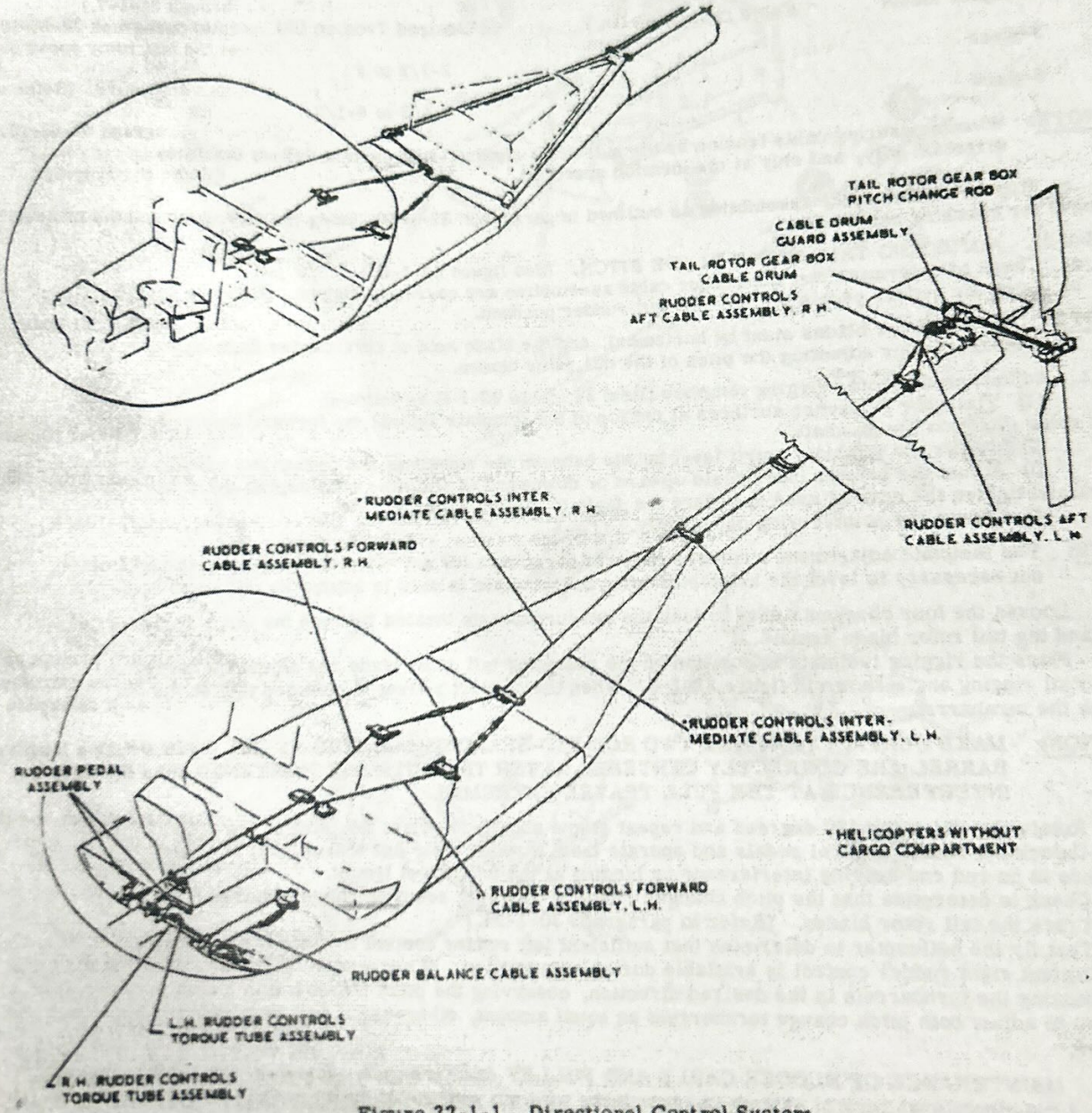


Figure 32-1-1. Directional Control System

FORWARD RUDDER CABLE ASSEMBLY TO INTERMEDIATE RUDDER CABLE ASSEMBLY TURNBARRELS AND THE RUDDER BALANCE CABLE TURNBARREL TO REPOSITION THE RUDDER PEDAL SHAFT ARMS.

f. Secure the system turnbarrels with lockwire and check that the remaining parts are correctly secured.
g. Adjust the pitch of the tail rotor. (Refer to paragraph 32-1-31.)

32-1-30A. ALTERNATE METHOD FOR RIGGING THE RUDDER CABLE ASSEMBLIES. If a low tension scale tensiometer is not available, the following method may be used for measuring rudder control cable tension.

a. Attach the hook of a pull scale (0 to 25-pound range) to either the left or right-hand rudder cable at a point midway between the two fairlead locations (approximately 22.8-inches apart) just aft of the cardan joint. In conditions where interference will not permit measurements at this location, the same method may be used between Stations 130 and 149.

b. Apply sufficient pull on the scale to deflect the cable exactly 1-1/2 inches inboard from its normal undeflected position, and note the scale reading. The following scale readings (in pounds) should be obtained if cables are properly tensioned.

Helicopter Model	Cable Deflection (in.)	Desired Tension (lb)	Acceptable Tension (lb)
3-place	1.5	2-1/2 to 3	2-1/4 to 3-1/2
4-place	1.5	5-1/2 to 6-1/2	5 to 6-3/4

NOTE: When measuring cable tension by the pull scale method, take care to deflect the cable in the inboard direction only, and only at the location specified.

c. Rig the rudder cable assemblies as outlined in paragraph 32-1-30, using the alternate method outlined above for checking cable tension.

32-1-31. ADJUSTING TAIL ROTOR BLADE PITCH. (See figure 32-1-8.)

a. Check to determine that the rudder cable assemblies are correctly rigged. (Refer to paragraph 32-1-30.)
b. Lock the rudder pedals in their full left rudder position.

NOTE: The tail rotor blades must be horizontal, and the blade held at zero degree flapping angle when measuring or adjusting the pitch of the tail rotor blades.

c. Adjust the tail rotor rigging template (item 38, table 92-1-1) as follows:
(1) Place the reference surfaces at the top of the template against the forward and lower surfaces of the tail rotor gear box pinion shaft.
(2) Center the tamplate spirit level bubble between the markings and tighten the pointer wind nut.
(3) Adjust the pointer index scale upward or downward to align the zero degree mark with the pointer mark and tighten the screws used to secure the scale to the template.
(4) Loosen the pointer wing nut slightly.

NOTE: The template adjustment steps are required to correct for any off-level attitude of the helicopter. It is not necessary to level the helicopter when the template is used to adjust the tail rotor blade pitch.

d. Loosen the four checknuts used to lock the two turnbarrels located between the tail rotor pitch change arm and the tail rotor blade arms.
e. Place the rigging template in position on the rearmost tail rotor blade and adjust the turnbarrel to provide the initial rigging angle shown in figure 32-1-8. When the correct setting is obtained tighten the two checknuts to lock the turnbarrel.

CAUTION: MAKE CERTAIN THAT THE TWO ROD END BEARINGS LOCATED AT THE ENDS OF THE TURNBARREL ARE CORRECTLY CENTERED AFTER THE NUTS ARE TIGHTENED TO PREVENT INTERFERENCE AT THE FULL TRAVEL EXTREMES.

f. Rotate the tail rotor 180 degrees and repeat step e above, to adjust the pitch of the opposite blade.
g. Unlock the rudder control pedals and operate them through their full travel limit in order to determine that there is no rod end bearing interference or binding at the full travel limits.
h. Check to determine that the pitch change linkage is properly secured where required.
i. Track the tail rotor blades. (Refer to paragraph 30-1-34.)
j. Test fly the helicopter to determine that sufficient left rudder control is available in hover and climb, that sufficient right rudder control is available during autorotation. If necessary, increase tail rotor blade by readjusting the turnbarrels in the desired direction, observing the pitch travel limits shown in figure 32- take care to adjust both pitch change turnbarrels an equal amount, otherwise it will be necessary to retrack tail rotor.

32-1-40. MAINTENANCE OF RUDDER CABLE AND PULLEY ASSEMBLIES. Maintain the proper lubricat throughout the directional control system in accordance with the specifications shown on the Lubrication Ch (see figure 10-19). Maintain the rudder cable assemblies as follows:

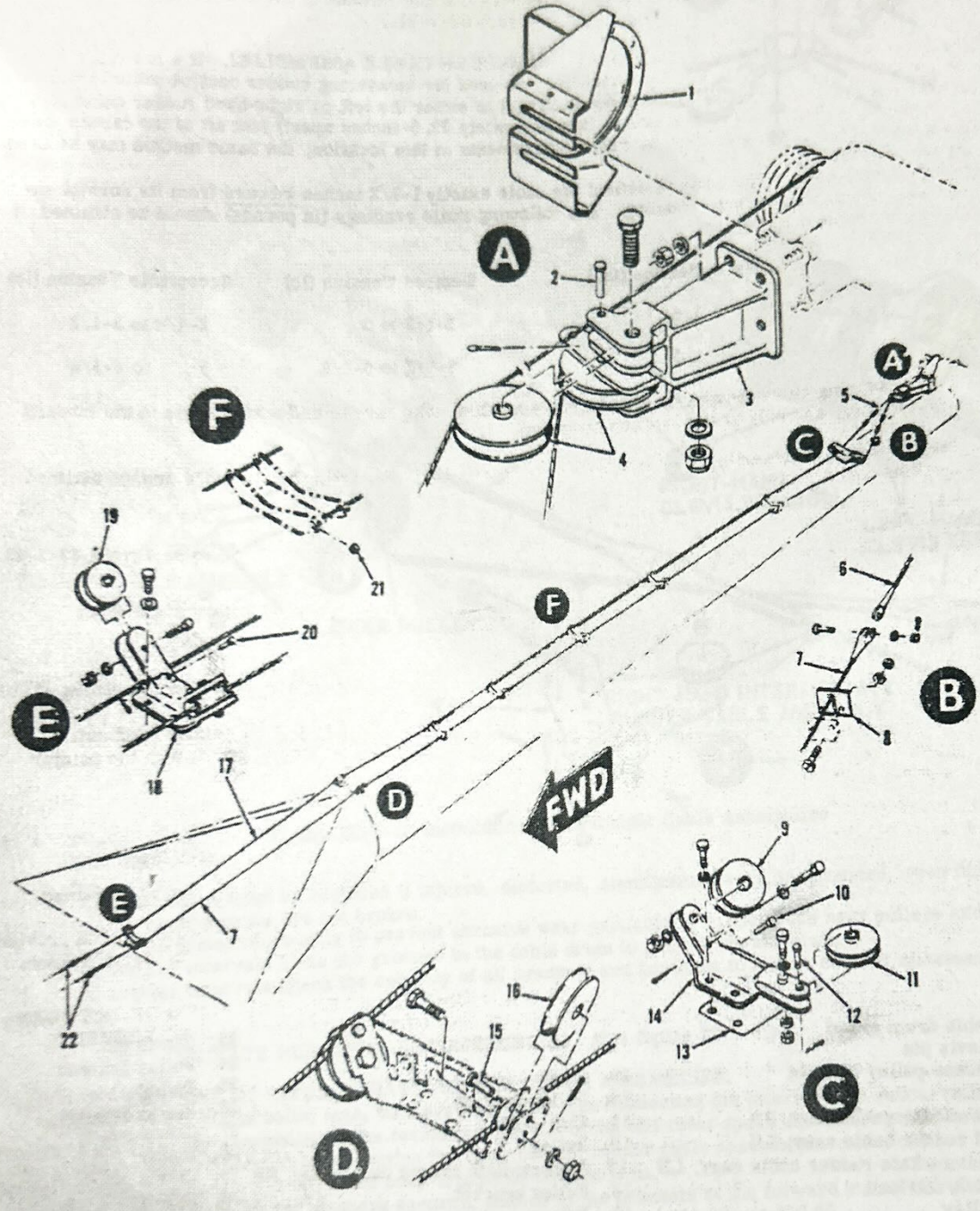
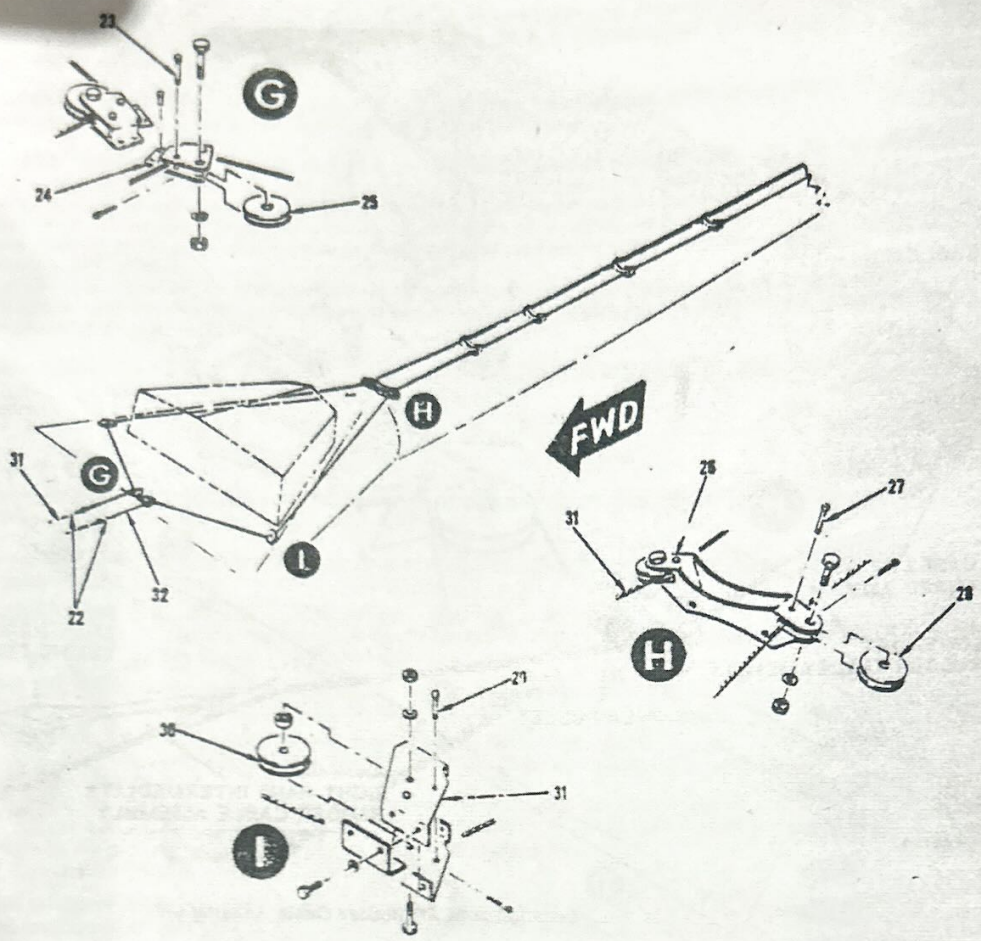


Figure 32-1-2. Aft and Intermediate Rudder Cable Installations (sheet 1 of 2)
March 1961



1. Cable drum guard
2. Clevis pin
3. Rudder pulley bracket
4. Pulley
5. Aft rudder cable assy, RH
6. Aft rudder cable assy, LH
7. Intermediate rudder cable assy, LH
8. Cable fairlead
9. Pulley
10. Clevis Pin
11. Pulley
12. Clevis pin
13. Shim
14. Pulley bracket
15. Clevis Pin
16. Pulley
17. Intermediate rudder cable assy, RH
18. Pulley bracket
19. Pulley
20. Clevis pin
21. Grommet
22. Turnbarrel
23. Clevis pin
24. Pulley bracket
25. Pulley
26. Pulley bracket
27. Clevis pin
28. Pulley
29. Clevis pin
30. Pulley
31. Intermediate cable assy, RH
32. Intermediate cable assy, LH

Figure 32-1-2. Aft and Intermediate Rudder Cable Installations (sheet 2 of 2)

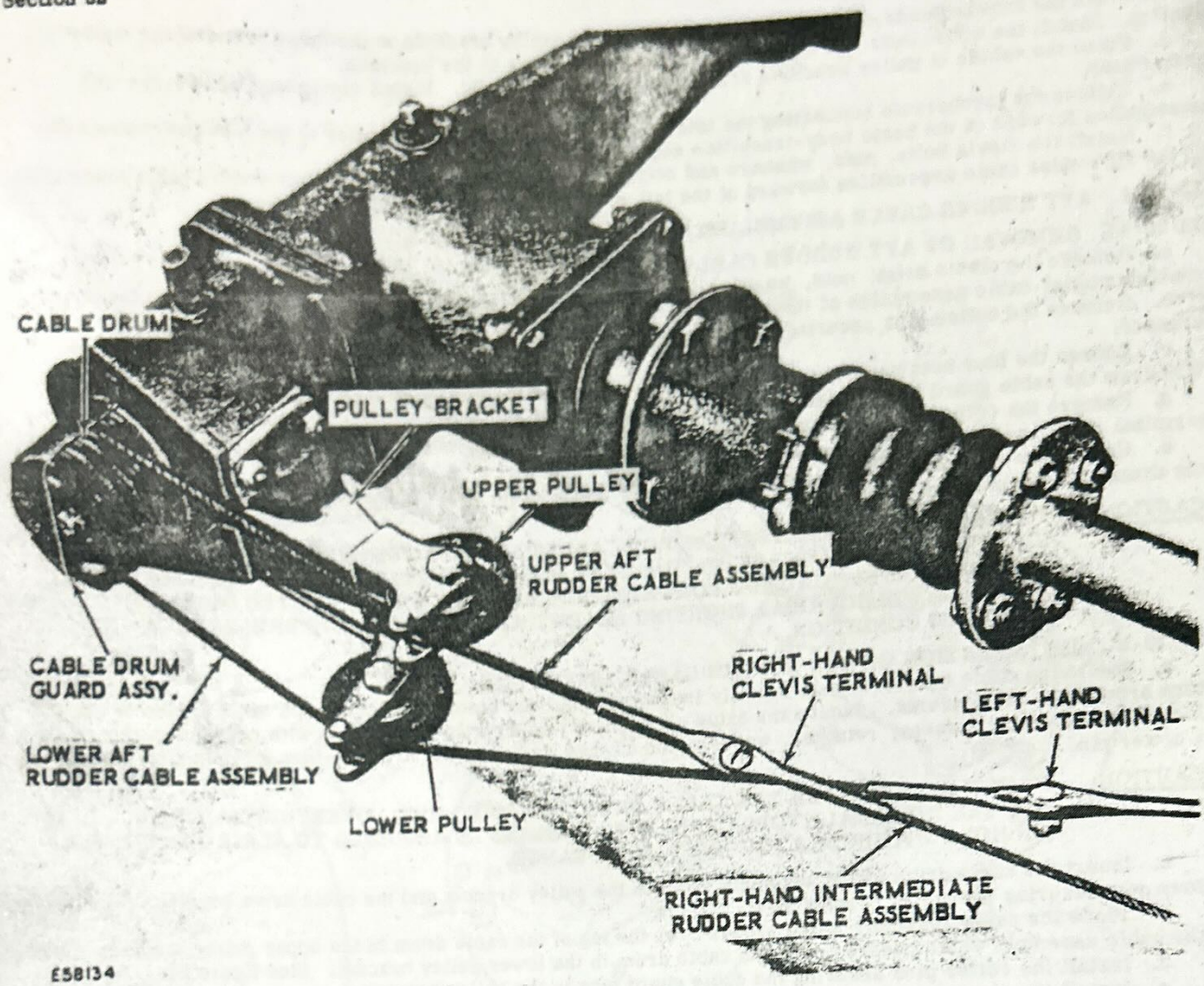


Figure 32-1-3. Installation of Aft Rudder Cable Assemblies

a. Control cables must be replaced if injured, distorted, significantly worn or corroded, even though the individual wires or strands are not broken.
b. Clean the cables thoroughly to prevent abrasive wear particularly in the areas near pulleys and fairleads.
c. At regular intervals clean the grooves in the cable drum to prevent abrasive wear.
d. At regular intervals check the security of all brackets and fairleads to insure correct alinement of pulleys.

32-10-1. INTERMEDIATE RUDDER CABLE ASSEMBLIES. (See figure 32-1-2.)

32-10-10. REMOVAL OF INTERMEDIATE RUDDER CABLE ASSEMBLIES.
a. Remove the clevis bolts, nuts, washers and cotter pins connecting the intermediate rudder cable assemblies to the aft cable assemblies at the terminals forward of the tail rotor speed decreaser pulley brackets.
b. Unscrew the turnbarrels connecting the intermediate rudder cable assemblies to the forward rudder cable assemblies forward of the basic body-transition section joint.
c. Remove bolts, nuts and washers securing pulleys in the brackets at the forward end of tail boom.
d. Remove cotter pins from pulley brackets at tail boom stations 54.00 and 200.00.
e. Carefully remove the nylon grommets from cable guide brackets.

32-10-11. INSTALLATION OF INTERMEDIATE RUDDER CABLE ASSEMBLIES.
a. Press the nylon grommets onto the cable assemblies.
b. Carefully press the nylon grommets and cable assemblies into the slots in the guide brackets on the tail boom.

c. Place the forward ends of the cable assemblies in the pulley brackets at the forward end of the transition section. Install the bolts, nuts and washers, securing the pulleys in the brackets.

d. Place the cables in pulley brackets at Stations 54.00 and 200.00. Install clevis pins and secure with cotter pins.

e. Tighten the turnbarrels connecting the intermediate rudder cable assemblies to the forward rudder cable assemblies forward of the basic body-transition section joint.

f. Install the clevis bolts, nuts, washers and cotter pins connecting the intermediate rudder cable assemblies to the aft rudder cable assemblies forward of the tail rotor speed decreaser pulley bracket.

32-20-1. AFT RUDDER CABLE ASSEMBLIES. (See figures 32-1-2 and -3.)

32-20-10. REMOVAL OF AFT RUDDER CABLE ASSEMBLIES.

a. Remove the clevis bolts, nuts, washers and cotter pins connecting the aft cable assemblies to the intermediate rudder cable assemblies at the terminals forward of the tail rotor speed decreaser pulley brackets.

b. Remove the cotter pins securing the cable guard pins in the pulley brackets on the tail rotor speed decreaser.

c. Loosen the four nuts securing the tail rotor speed decreaser pulley bracket to the cable drive housing. Withdraw the cable guard housing from the bracket and housing.

d. Remove the cotter pin, nut, alinement washers and retainer from the cable drum to expose the cable ball terminal retention sleeves.

e. Unwind the aft rudder cable assemblies from the cable drum and withdraw the cable ball terminals from the drum sleeves in a radial direction.

CAUTION: IF INTERMEDIATE RUDDER CONTROL CABLES ARE NOT REMOVED, MAINTAIN TENSION ON BOTH INTERMEDIATE CABLES. CABLE SLACK CAN GATHER WITHIN INSTRUMENT PEDESTAL AND TUNNEL, CAUSING FORWARD CABLES TO BECOME REROUTED OUTSIDE INSULATOR CHANNELS. ELECTRICAL SHORTING AGAINST ADJACENT CIRCUIT BREAKERS CAN RESULT FROM THIS CONDITION.

32-20-11. INSTALLATION OF AFT RUDDER CABLE ASSEMBLIES.

a. Insert the cable ball terminals radially into the cable drum sleeve and wrap each cable assembly one full turn around the cable drums. Secure the cable assemblies temporarily to the drum with pressure sensitive tape. Install the retention sleeves, retainer, washers and nut and tighten to 30/60 pound-inch torque value. Safety with a cotter pin.

CAUTION: DO NOT OVERTIGHTEN THE CABLE DRUM RETAINING NUT. OVERTIGHTENING WILL DAMAGE THE INTERNAL STOPS. SHIM WITH WASHERS AS REQUIRED TO ALINE THE COTTER PIN HOLE WITHIN THE PROPER TORQUE RANGE.

b. Insert the cable drum guard assembly between the pulley bracket and the cable drive housing. Tighten the four nuts securing the pulley bracket to the housing.

c. Place the cable assembly which passes over the top of the cable drum in the upper pulley bracket. Place the cable assembly which passes under the cable drum in the lower pulley bracket. (See figure 32-1-3.)

d. Install the cotter pins securing the cable guard pins in the pulley brackets.

e. Install the clevis bolts, nuts, washers and cotter pins connecting the aft rudder cable assemblies to the intermediate cable assemblies at the terminals forward of the tail rotor speed decreaser pulley brackets.

CAUTION: THE AFT RUDDER CABLE ASSEMBLY WHICH WRAPS OVER THE TOP OF THE CABLE DRUM AND PASSES THROUGH THE UPPER PULLEY BRACKET MUST BE CONNECTED TO THE RIGHT-HAND SIDE INTERMEDIATE RUDDER CABLE ASSEMBLY. THE AFT RUDDER CABLE ASSEMBLY WHICH WRAPS UNDER THE CABLE DRUM AND PASSES THROUGH THE LOWER PULLEY BRACKET MUST BE CONNECTED TO THE LEFT-HAND SIDE INTERMEDIATE RUDDER CABLE ASSEMBLY. THE LOWER BRACKET LEFT-HAND SIDE CONNECTION MUST BE MADE BELOW THE UPPER BRACKET RIGHT-HAND SIDE CONNECTION.

f. Remove the pressure sensitive tape securing the aft rudder cable assemblies to the cable drum.

g. Rig the rudder cable assemblies. (Refer to paragraph 32-1-30.)

32-30-1. FORWARD RUDDER CABLE ASSEMBLIES. (See figure 32-1-4.)

32-30-10. REMOVAL OF FORWARD RUDDER CABLE ASSEMBLIES.

a. Unthread the turnbarrels connecting the forward rudder cable assemblies to the intermediate rudder cable assemblies forward of the basic body transition section joint.

b. Remove the cotter pins securing the cable guard pins in the pulley bracket on the engine deck at station 84.25.

c. Remove the lockwire, screw and washer on the inboard side of pulley brackets on the engine deck at the firewall.

d. Remove the cotter pin securing the cable guard pin in the pulley brackets in the forward end of the instrument pedestal at station 25.00.

e. Remove the bolts, nuts, washers and cotter pins securing the forward end terminals of the forward rudder cable assemblies to the rudder control torque tube assemblies.

f. Bend the rudder cable assemblies carefully out of the fairlead under the center seat cushion at station 44.75.

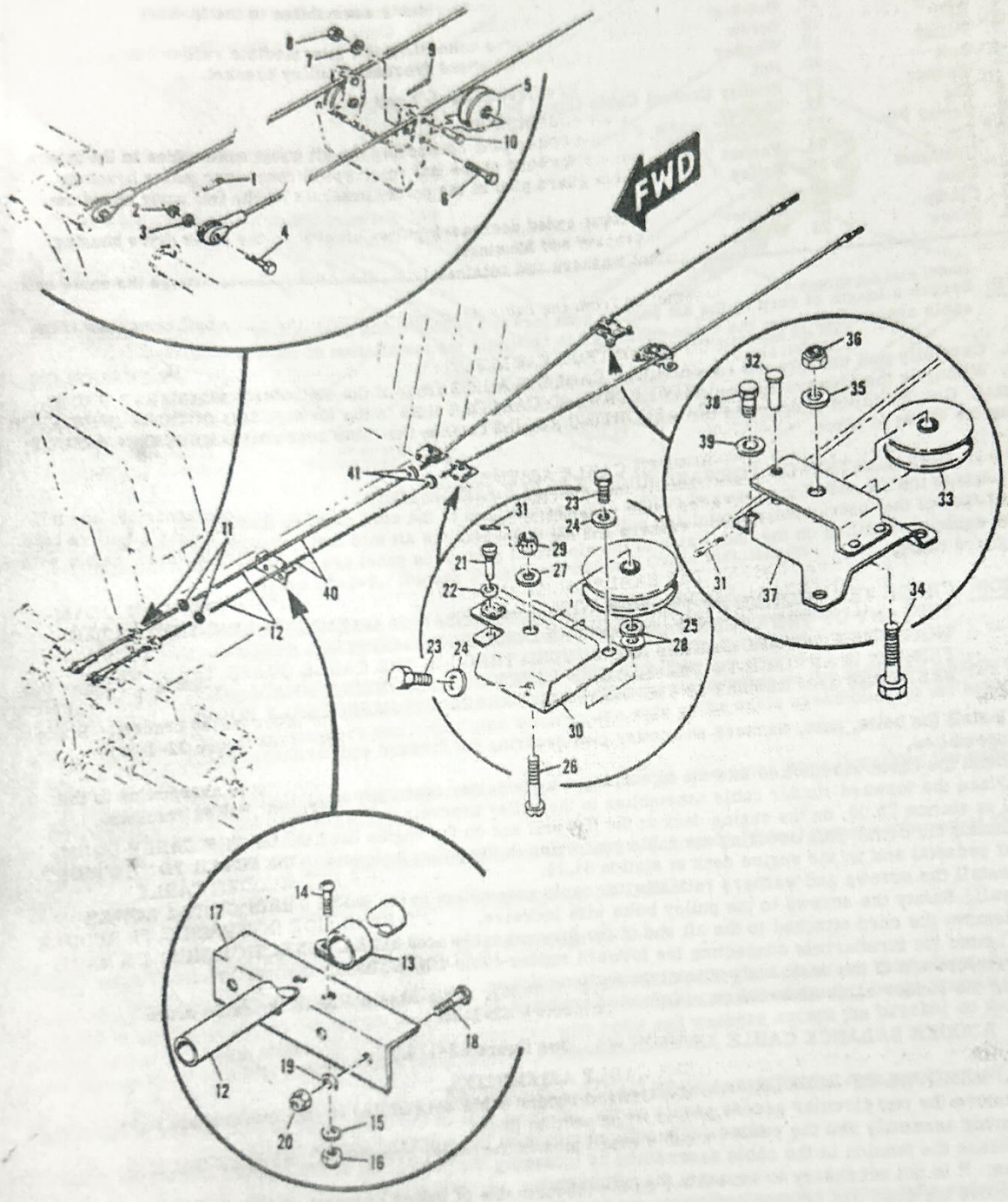


Figure 32-1-4. Forward Rudder Cable Assembly Installation

INDEX FOR FIGURE 32-1-4

1. Cotter Pin
2. Nut
3. Washer
4. Bolt
5. Pulley
6. Bolt
7. Washer
8. Nut
9. Cotter Pin
10. Pin
11. Grommet
12. Tube
13. Clamp
14. Screw
15. Washer
16. Nut
17. Bracket
18. Screw
19. Washer
20. Nut
21. Rudder Control Cable Guard Screw
22. Washer
23. Bolt
24. Washer
25. Pulley
26. Bolt
27. Washer
28. Washer
29. Nut
30. Rudder Pulley Bracket Assy
31. Cotter Pin
32. Pin
33. Pulley
34. Bolt
35. Washer
36. Nut
37. Rudder Control Pulley Bracket Assy
38. Bolt
39. Washer
40. Forward Rudder Control Cable Assy
41. Grommet

NOTE: Secure a length of cord to the aft ends of both forward rudder cable assemblies prior to removal of the cable assemblies from the cabin enclosure to facilitate the installation of the cable assemblies.

g. Carefully pull the forward rudder cable assemblies out the front of the instrument pedestal.

h. Withdraw the forward rudder cable assemblies through the slots in the forward face of the instrument pedestal. Cut the cords attached to the cable assemblies and remove the cable assemblies from the helicopter, leaving the cords in place.

32-30-11. INSTALLATION OF FORWARD RUDDER CABLE ASSEMBLIES.

a. Attach the aft end of the forward rudder cable assemblies to the cord exposed through the slots on the forward face of the instrument pedestal and pull the cable assemblies aft into their approximate location. Check that the cable assemblies on the under side of the electrical protection panel are properly routed through the cable guard tubes.

CAUTION: CHECK THE ROUTING OF THE FORWARD RUDDER CABLE ASSEMBLIES BEFORE RECONNECTING ANY OF THE OTHER PARTS OF THE DIRECTIONAL CONTROL SYSTEM. MAKE CERTAIN THAT THE FORWARD CABLES ARE ROUTED THROUGH THE CABLE GUARD TUBES WHEN TENSION IS APPLIED TO THE CABLES. ELECTRICAL SHORTING TO ADJACENT CIRCUIT BREAKERS CAN RESULT IF THE FORWARD CABLES ARE IMPROPERLY ROUTED.

b. Install the bolts, nuts, washers and cotter pins securing the forward end terminals of the forward rudder cable assemblies.

c. Bend the cable assemblies into the fairlead under the center seat cushion at station 44.75.

d. Place the forward rudder cable assemblies in the pulley brackets in the forward end of the instrument pedestal at station 25.00, on the engine deck at the firewall and on the engine deck at station 84.25.

e. Install the cotter pins securing the cable guard pins in the pulley brackets in the forward end of the instrument pedestal and on the engine deck at station 84.25.

f. Install the screws and washers retaining the cable assemblies in the pulley brackets on the engine deck at the firewall. Safety the screws to the pulley bolts with lockwire.

g. Remove the cord attached to the aft end of the forward cable assemblies.

h. Tighten the turnbarrels connecting the forward rudder cable assemblies to the intermediate rudder cable assemblies forward of the basic body-transition section joint.

i. Rig the rudder cable assemblies. (Refer to paragraph 32-1-30.)

32-40-1. RUDDER BALANCE CABLE ASSEMBLIES. (See figures 32-1-5 and -6.)

32-40-10. REMOVAL OF RUDDER BALANCE CABLE ASSEMBLIES.

a. Remove the two circular access panels on the left-hand side of the cabin floor to gain access to the cable tension spring assembly and the rudder cable pulley bracket on the bulkhead station 44.75.

b. Release the tension in the cable assemblies by loosening the turnbarrel at the inboard ends of the cable assemblies. It is not necessary to separate the turnbarrel.

c. Remove the bolt, nut, washer and cotter pin securing the pulley in the bracket on the forward face of the bulkhead at station 44.75.

d. Remove the bolts, nuts, washers and cotter pins securing both ends of the rudder balance cable assemblies to the arms on the rudder torque tube assemblies.

NOTE: Take care not to lose the insert bushings from the torque tube arms when the cable assemblies are removed.

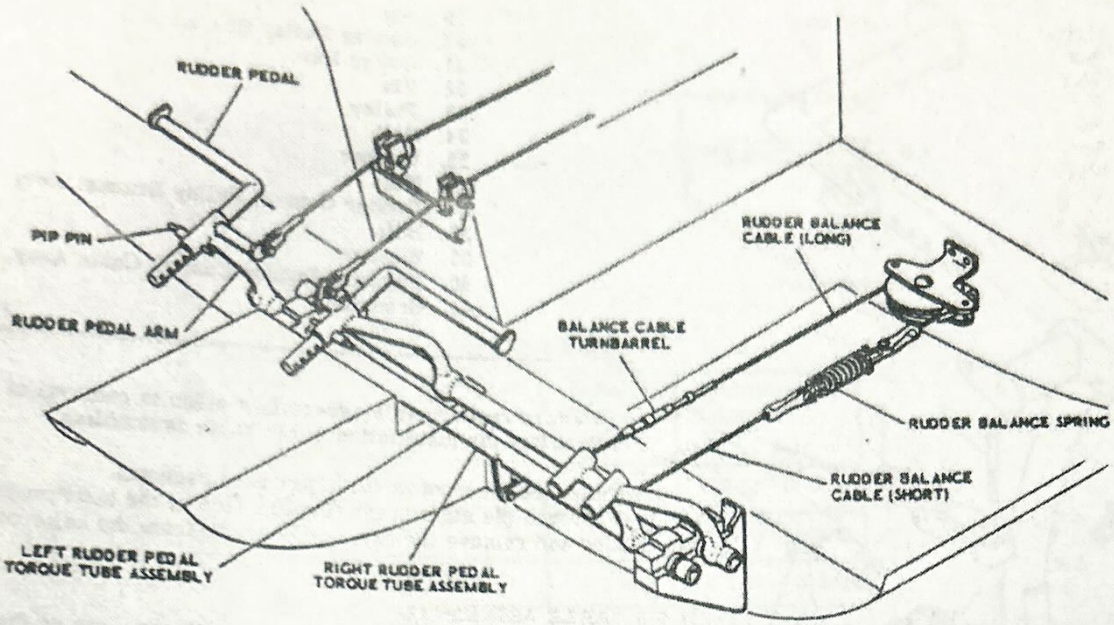


Figure 32-1-5. Rudder Pedals and Balance Cable Installation

e. Remove the rudder balance cable assemblies through one of the access holes.
f. Disassemble the tension spring assembly and the two cable assemblies as necessary.

32-40-11. INSTALLATION OF RUDDER BALANCE CABLE ASSEMBLIES.

a. Install the bolt, nut, washer and cotter pin securing the pulley in the bracket on the bulkhead station 44.75.
b. Install the bolts, nuts, washers and cotter pins securing the ends of the cable assemblies to the arms of the torque tube assemblies.

NOTE: Make certain that the insert bushings are installed in the torque tube arms when installing the cable assembly fork and clevis fittings.

c. Tighten the turnbarrel until the maximum allowable number of threads (three) remain exposed at the cable assembly terminal and fork fittings.
d. Rig the rudder cable assemblies. (Refer to paragraph 32-1-30.)

32-50-1. PULLEY BRACKETS. (See figures 32-1-4 through 32-1-6.)

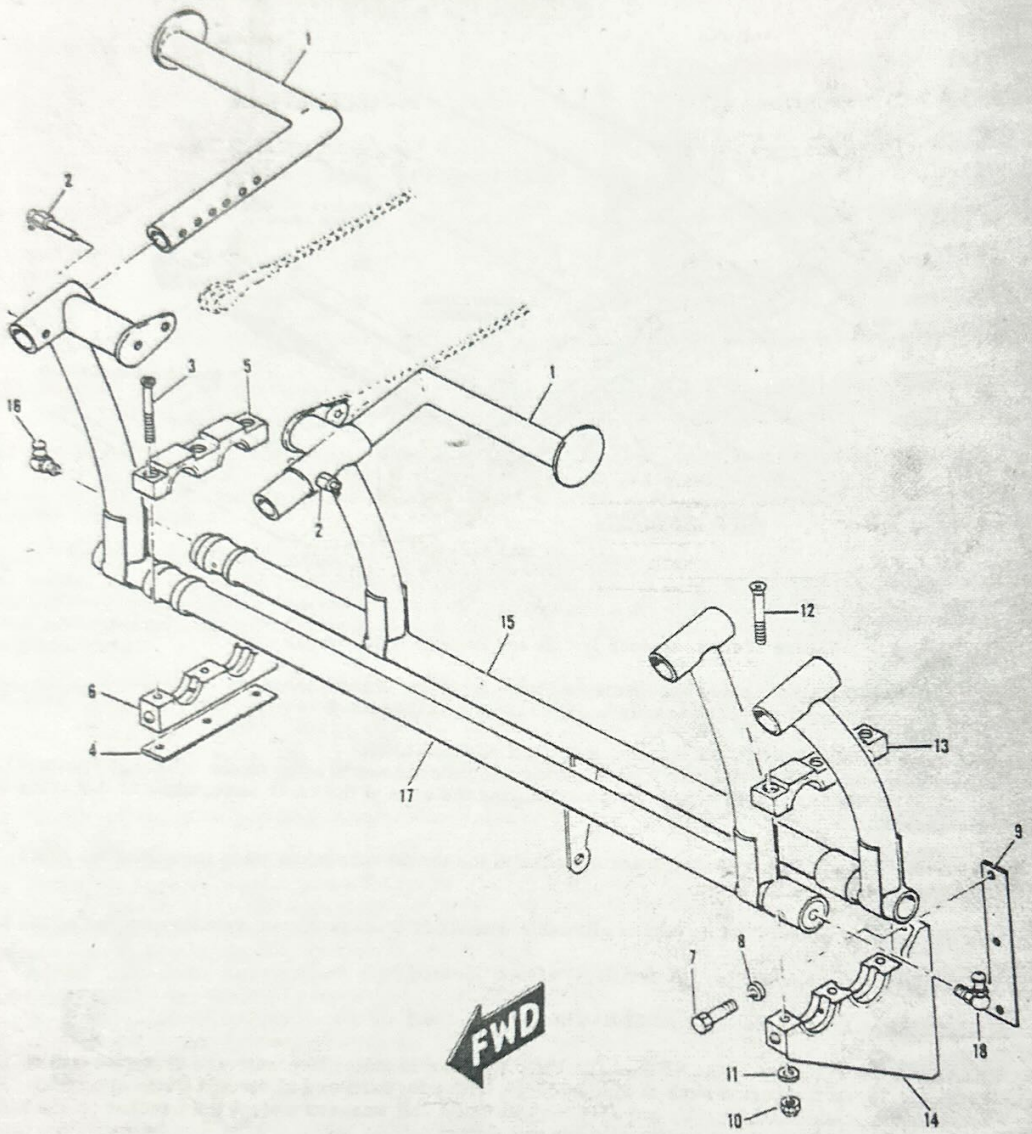
32-50-10. REMOVAL OF PULLEY BRACKETS. The only removeable pulley brackets are those located on the bulkhead at station 44.75, on the engine deck at station 84.25, at the forward end of the tail boom transition station, and at tail boom station 200.00. All are secured with bolts and washers except the bracket on the bulkhead station 44.75 which is attached with bolts, nuts and washers.

32-50-11. INSTALLATION OF PULLEY BRACKETS. Install any pulley bracket in the reverse order of removal.

32-60-1. RUDDER TORQUE TUBE ASSEMBLIES. (See figure 32-1-7.)

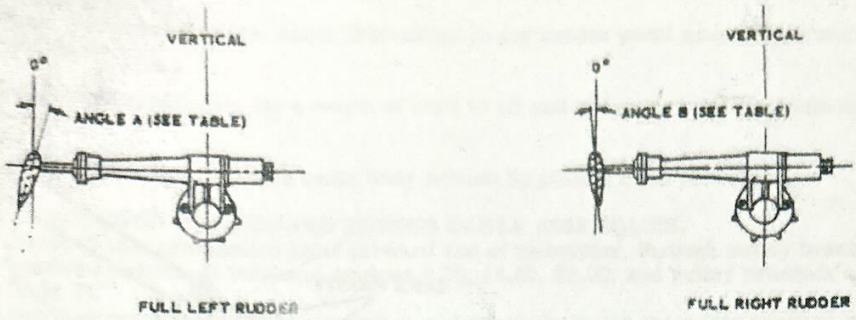
32-60-10. REMOVAL OF RUDDER TORQUE TUBE ASSEMBLIES.

a. Disconnect the forward ends of the forward rudder cable assemblies from the torque tube assemblies.
b. Remove the rudder pedals from the torque tube assemblies.
c. Remove the pedal boots.
d. Remove the screws securing the scuff plates to the cabin floor and remove the scuff plates.
e. Disconnect the forward ends of the rudder balance cable assemblies. (Refer to paragraph 32-40-10.)



1. Rudder Pedal
2. Pip Pin
3. Screw
4. Shim
5. Bearing Support Cap, RH
6. Bearing Support, RH
7. Bolt
8. Washer
9. Shim
10. Nut
11. Washer
12. Screw
13. Bearing Support Cap, LH
14. Bearing Support, LH
15. Torque Tube, LH
16. Lubrication Fitting
17. Torque Tube, RH
18. Lubrication Fitting

Figure 32-1-7. Rudder Pedals and Torque Tube Assembly



Blade Pitch Angles

Angle	Gear Box Assy Part No.	Initial Rigging Angle	Operating Limits
A	25200	+15 deg	+13 to +17 deg
	25200-3 or -5	+16 deg	+14 to +18 deg
B	25200	- 3 deg	- 1 to - 5 deg
	25200-3 or -5	- 4 deg	- 2 to - 6 deg

todo 13 f.

todo derecho

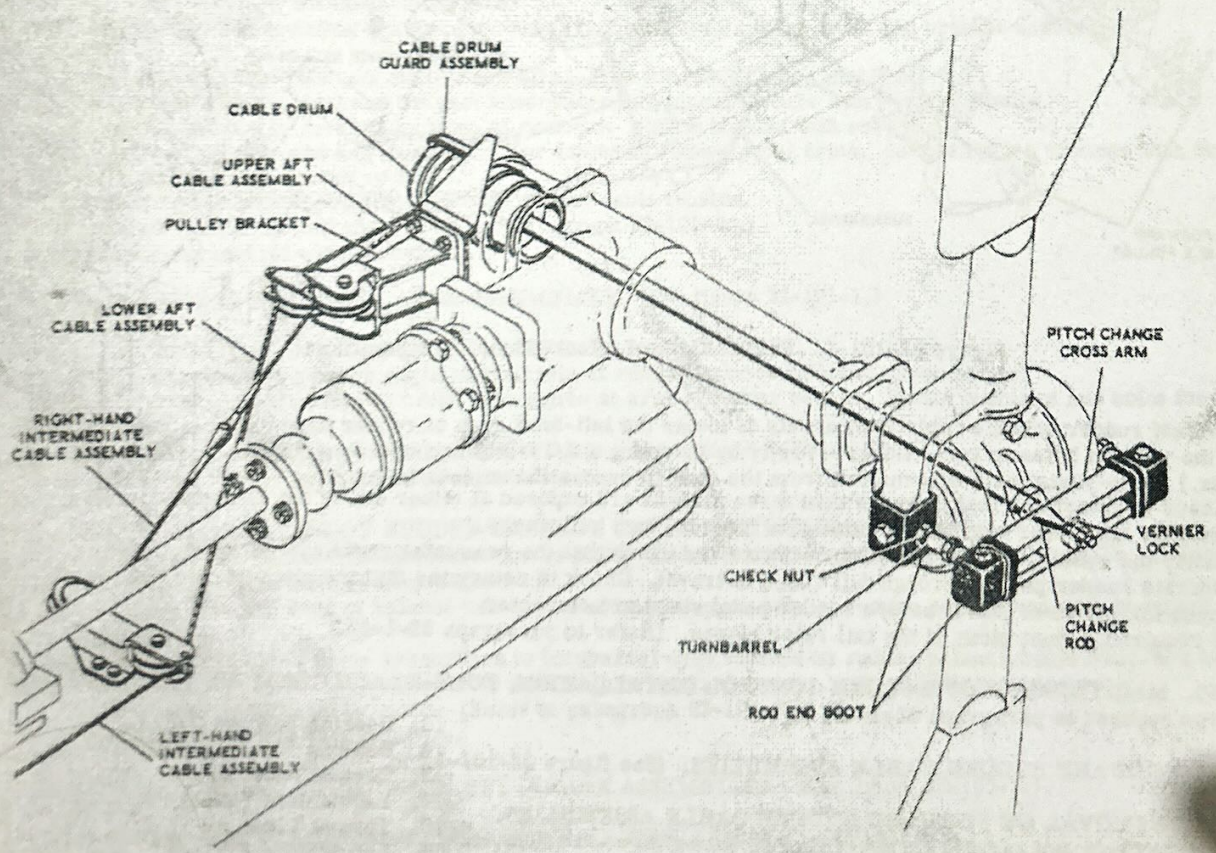


Figure 32-1-8. Adjusting Tail Rotor Blade Pitch

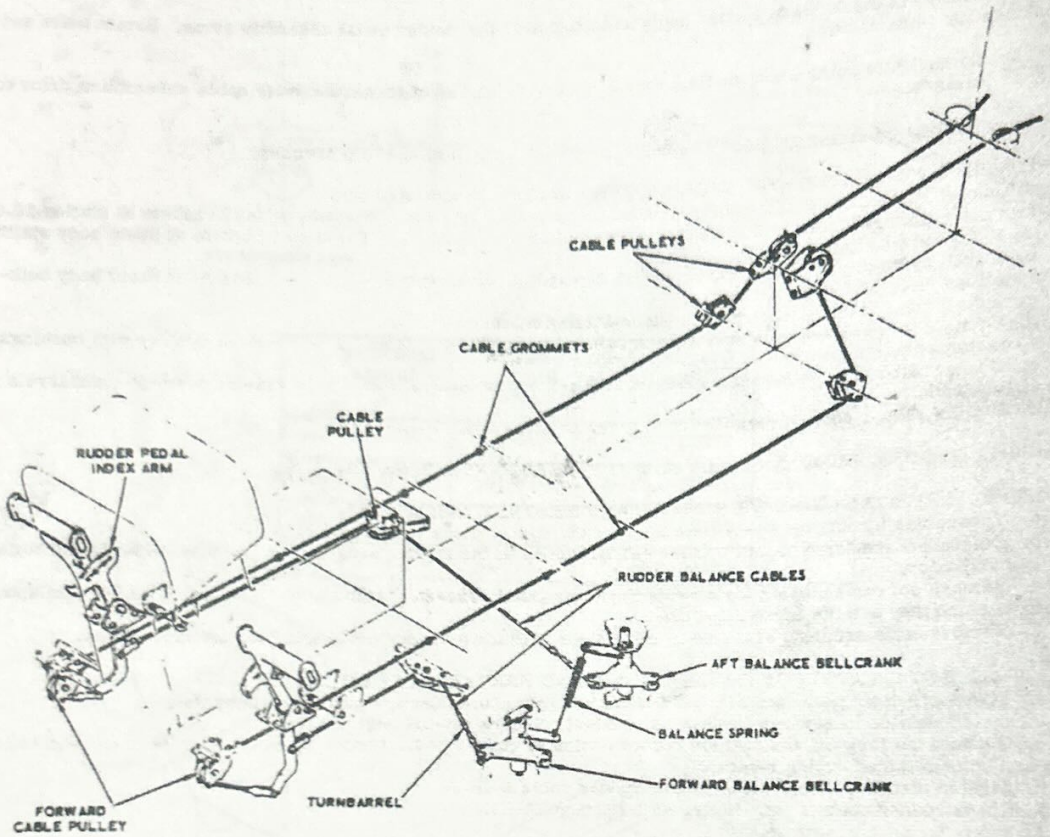


Figure 32-101-1. Rudder Control, Four-Place Configuration

f. Adjust rudder balance cable turnbarrels to locate the left-hand ears of rudder balance cable bellcranks beneath the witness holes in cabin floor. (Verify by inserting a 3/16-inch rod or a long AN3 bolt in each bellcrank ear.) Snap-plugs must be removed from the deck to expose the witness holes.

g. Check to determine that no more than three threads are exposed at either end of the cable turnbarrels.

h. Unblock aft rudder cables. Remove pins from balance bellcranks.

i. Safety the system turnbarrels with lockwire and check that the remaining parts are correctly safetied.

j. Operate rudder pedals through full range of travel. Check to determine that the pitch change rod operates through full range of travel before rudder pedal stops are contacted.

k. If required, adjust pitch of the tail rotor blades. (Refer to paragraph 32-1-31.)

32-101-40. MAINTENANCE OF RUDDER CONTROL INSTALLATION, FOUR-PLACE CONFIGURATION. Follow procedures outlined in paragraph 32-1-40.

32-110-1. FORWARD RUDDER CABLE ASSEMBLIES. (See figure 32-101-1.)

32-110-10. REMOVAL OF FORWARD RUDDER CABLE ASSEMBLIES.

a. Cut lockwire and remove turnbarrels connecting forward rudder cable assemblies to intermediate cable assemblies at engine deck.

b. Remove nuts, washers and bolts securing pulleys in the brackets at the following basic body stations: 10.69, 44.75, 62.00 and 84.75.

c. Carefully press the nylon grommets out of the bulkheads at stations 8.00, 18.50 and 25.00. Retain the grommets for reinstallation.

d. Disconnect the forward rudder cable assemblies at the rudder pedal assembly arms. Retain bolts and bushings for reinstallation.

NOTE: To facilitate reinstallation, tie a length of cord to aft end of forward rudder cable assemblies prior to removal.

e. Withdraw cable assemblies from basic body section by pulling them forward.

32-110-11. INSTALLATION OF FORWARD RUDDER CABLE ASSEMBLIES.

a. Install rudder cable assemblies from forward end of helicopter, through pulley brackets at station 10.69, through the grommet locations at bulkhead stations 8.00, 18.50, 25.00, and pulley brackets at basic body stations 44.75, 62.00 and 84.75.

b. Install nylon grommets on cable assemblies and carefully insert them into position at basic body bulkhead stations 8.00, 18.50 and 25.00.

c. Install pulleys in pulley brackets and secure with bolts, washers and nuts.

d. Connect forward ends of cable assemblies to lower hole of rudder pedal arm assemblies with bushings, bolts, washers and nuts.

e. Connect aft end of cable assemblies to forward end of intermediate cable assemblies with turnbarrels at the engine deck.

f. Rig the rudder control installation. (Refer to paragraph 32-101-30.)

32-120-1. RUDDER PEDAL AND BRACKET ASSEMBLIES. (See figure 32-101-1.)

32-120-10. REMOVAL OF RUDDER PEDAL AND BRACKET ASSEMBLIES.

a. Loosen one turnbarrel connecting the forward rudder cable to intermediate cable.

b. Disconnect the forward and balance rudder cables at the rudder pedal arms. Retain bushings and bolts for reinstallation.

c. Remove screws securing the shields to rudder pedal brackets. Identify the location of the shields upon removal since they are not interchangeable.

d. Remove bolts securing brackets to cabin floor, withdraw rudder pedal and bracket assemblies.

32-120-11. INSTALLATION OF RUDDER PEDAL AND BRACKET ASSEMBLIES.

a. Position rudder pedal and bracket assemblies into place. Secure with mounting bolts.

b. Install shields in reverse location of removal. Secure shields with screws.

c. Connect the forward and balance rudder cables to rudder pedal arms. Secure cables to arms with bushings and bolts retained during removal.

d. Tighten turnbarrel to provide proper rudder cable tension.

e. Check rudder control rig. (Refer to paragraph 32-101-30.)

f. Safety turnbarrel with lockwire.

32-130-1. RUDDER BALANCE CABLE ASSEMBLIES. (See figure 32-101-1.)

32-130-10. REMOVAL OF RUDDER BALANCE CABLE ASSEMBLIES.

a. Cut lockwire and remove cable turnbarrels at rudder balance bellcrank assemblies.

b. Disconnect rudder balance cable assemblies at arm of rudder pedals. Retain bushings and bolts for reinstallation.

c. Remove pulleys from pulley brackets at basic body stations 8.00 and 18.50.

d. Withdraw rudder balance cable assemblies.

32-130-11. INSTALLATION OF RUDDER BALANCE CABLE ASSEMBLIES.

a. Insert rudder balance cable assemblies in pulley brackets at basic body stations 8.00 and 18.50. Install pulleys and secure with bolts, washers and nuts.

b. Connect forward ends of balance cable assemblies to upper hole of rudder pedal arms with bushings, bolts, washers and nuts.

c. Connect aft ends of cable assemblies to turnbarrel-eyes located on rudder balance cable bellcrank assemblies. Take care to connect left-hand cable assembly to forward rudder balance bellcrank assembly.

d. Rig rudder control installation. (Refer to paragraph 32-101-30.)

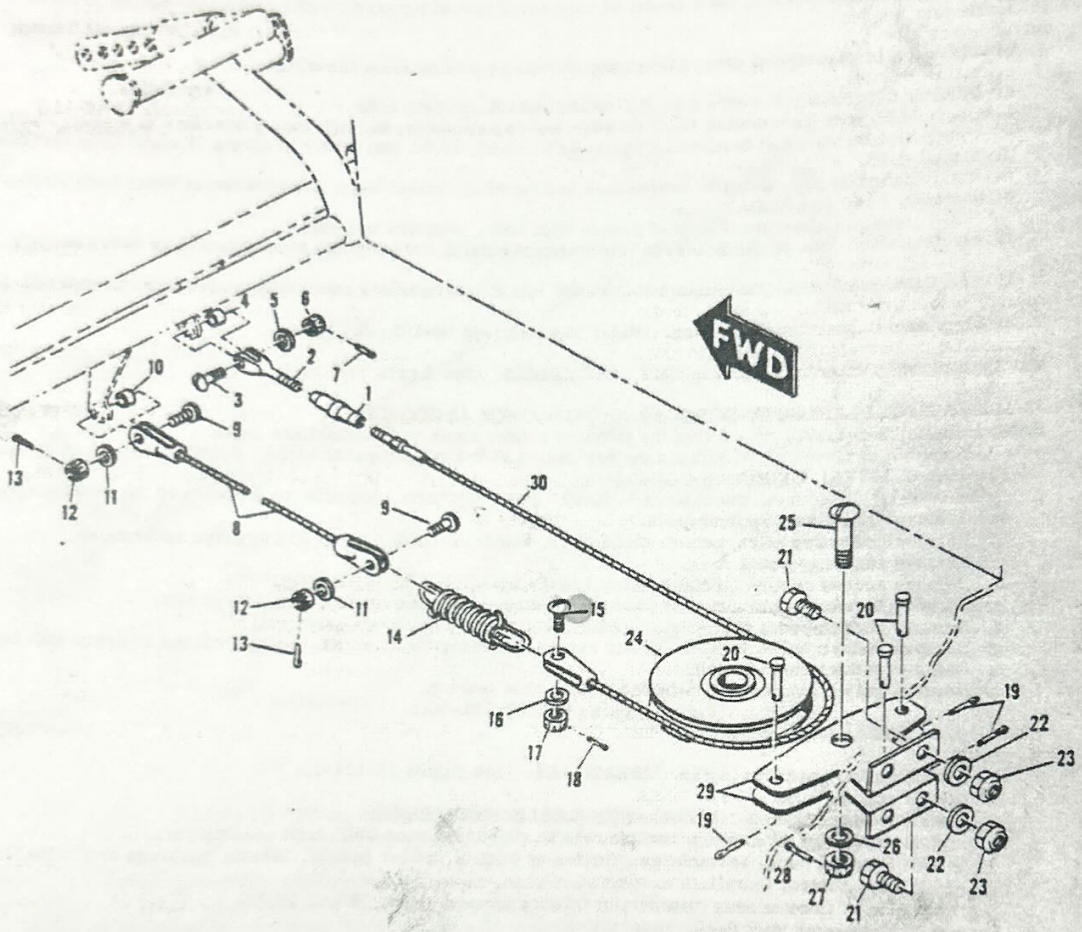
e. Safety turnbarrels with lockwire.

32-140-1. RUDDER BALANCE CABLE BELLCRANK ASSEMBLIES. (See figure 32-101-1.)

32-140-10. REMOVAL OF RUDDER BALANCE CABLE BELLCRANK ASSEMBLIES.

a. Cut lockwire and loosen one turnbarrel of rudder balance cable assembly. The turnbarrel need not be completely removed.

b. Remove clevis bolts securing turnbarrel eyes to bellcrank assemblies. Remove balance spring.



1. Turnbarrel
2. Turnbarrel Fork
3. Bolt
4. Bushing
5. Washer
6. Nut
7. Cotter Pin
8. Rudder Balance Cable Assembly
9. Bolt
10. Bushing
11. Washer
12. Nut
13. Cotter Pin
14. Rudder Balance Spring Assembly
15. Bolt
16. Washer
17. Nut
18. Cotter Pin
19. Cotter Pin
20. Clevis Pin
21. Bolt
22. Washer
23. Nut
24. Pulley
25. Bolt
26. Washer
27. Nut
28. Cotter Pin
29. Rudder Control Pedal Return Bracket
30. Rudder Balance Cable Assembly

Figure 32-1-6. Rudder Balance Cable Assembly

f. Match-mark the support caps, support and torque tube bearing locations to facilitate correct location of parts during assembly.
g. Remove the screws, nuts and washers securing the support caps to the support assembly.
h. Lift off the support caps and remove the torque tube assemblies from the helicopter.

32-60-11. INSTALLATION OF RUDDER TORQUE TUBE ASSEMBLIES.
a. Inspect the bearing surfaces for freedom from gouges, nicks and scratches. Make certain all bearing surfaces are clean.
b. Place the torque tube assemblies in place on the support assemblies.
c. Install the screws, nuts, and washers securing the support caps to the support assemblies.
d. Connect the forward ends of the rudder balance cable assemblies. (Refer to paragraph 32-40-11.)
e. Connect the forward ends of the forward rudder cable assemblies to the torque tube assemblies. (Refer to paragraph 32-30-11.)
f. Install the screws securing the scuff plates to the cabin floor.
g. Install the rudder pedal boots.
h. Install the rudder pedals in the torque tube assemblies.

32-101-1. RUDDER CONTROL INSTALLATION, FOUR-PLACE CONFIGURATION. (See figure 32-101-1.)

32-101-2. DESCRIPTION. The major components and operation of the rudder control installation, four-place configuration, are basically similar to the standard UH-12E rudder control installation, except that a pair of in-flight adjustable rudder pedals are incorporated in the four-place configuration.
a. The rudder control system installed aft of the firewall is identical to the standard UH-12E configuration and appropriate paragraphs should be consulted as applicable.

32-101-3. TROUBLESHOOTING THE RUDDER CONTROL INSTALLATION, FOUR-PLACE CONFIGURATION. Refer to table 32-1-I.

32-101-10. REMOVAL OF RUDDER CONTROL INSTALLATION, FOUR-PLACE CONFIGURATION. (See figure 32-101-1.)
a. Remove pilot's seat assembly. (Refer to Section 85.)
b. Remove collective stick cover and tunnel.
c. Remove passenger seat deck.
d. Remove access covers on cabin floor and shields located at forward end of floor.
e. Remove forward cable assemblies. (Refer to paragraph 32-110-10.)
f. Remove rudder pedal and bracket assemblies. (Refer to paragraph 32-120-10.)
g. Remove rudder balance cable assemblies. (Refer to paragraph 32-130-10.)
h. Remove rudder balance bellcranks. (Refer to paragraph 32-140-10.)
i. Remove pulley brackets if required.

32-101-11. INSTALLATION OF RUDDER CONTROL INSTALLATION, FOUR-PLACE CONFIGURATION. (See figure 32-101-1.)
a. Install pulley brackets in reverse order of removal.
b. Install rudder balance bellcranks. (Refer to paragraph 32-140-11.)
c. Install rudder balance cable assemblies. (Refer to paragraph 32-130-11.)
d. Install rudder pedal and bracket assemblies. (Refer to 32-120-11.)
e. Install forward cable assemblies. (Refer to paragraph 32-110-11.)
f. Rig rudder control installation. (Refer to paragraph 32-101-30.)
g. Install cabin floor access covers and shields located at forward end of cabin floor.
h. Install passenger seat deck.
i. Install collective stick cover and tunnel.
j. Install pilot's seat assembly. (Refer to Section 85.)
k. Rig the control cables. (Refer to paragraph 32-101-30.)

32-101-30. RIGGING RUDDER CONTROL INSTALLATION, FOUR-PLACE CONFIGURATION. (See figure 32-101-2.)
a. Tighten aft turnbarrels until cables are taut (approximately 10 to 20 pounds.)
b. Locate the pitch change rod of tail rotor speed decreaser in its mid-travel (neutral) position.
c. Using soft wooden blocks and two C-clamps, clamp the aft rudder cables together while pitch change rod is in neutral position.
d. Adjust the rudder pedals so that they are located in the second hole of the rudder pedal index arms.
e. Adjust the aft turnbarrels and rudder balance cable turnbarrels alternately to obtain a cable tension of 17 to 25 pounds while both rudder pedals are located at an angle of 23.5 degrees (±3.0 degree) forward of the vertical (neutral) position.

NOTE: Whenever a low scale tensiometer is not available cable tension may be adjusted by the pull scale method (paragraph 32-1-30A).

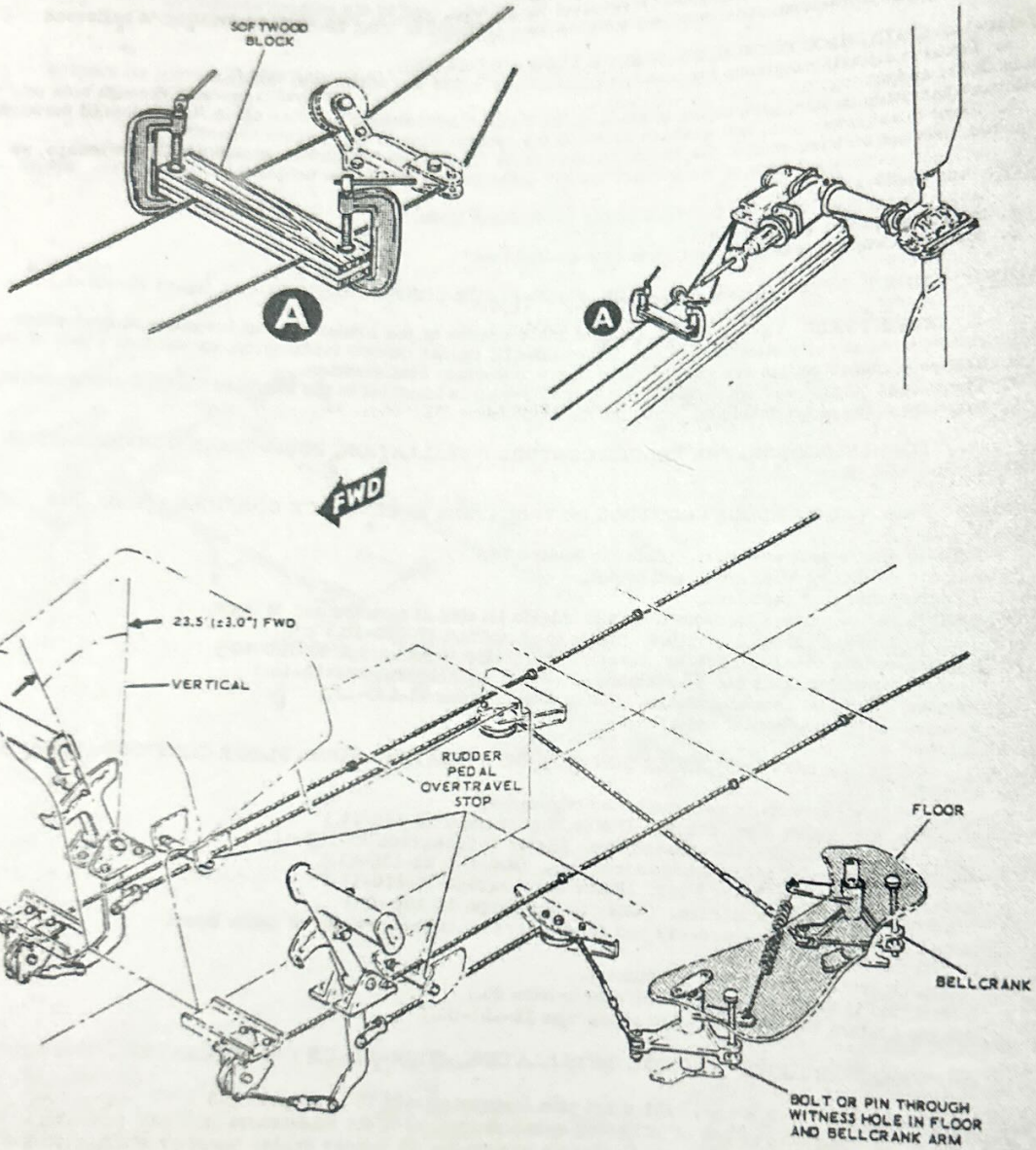


Figure 32-101-2. Rigging Rudder Control Installations Four-Place Configuration
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c. Remove screws securing bellcrank shaft to floor of cabin.
d. Withdraw bellcrank shafts. Take care to note the number of spacer washers located between shoulder of each bellcrank shaft and upper end of bellcrank assembly.
e. Remove bellcranks and disconnect turnbarrel eyes. Take care to note relative location of bellcrank assemblies prior to removal since they are NOT interchangeable.

32-140-11. INSTALLATION OF RUDDER BALANCE CABLE BELLCRANK ASSEMBLIES.
a. Position aft bellcrank assembly into proper location. Insert bellcrank shaft assembly through hole in cabin floor, and through the bellcrank and flange bushing installed in doubler under cabin floor. Install forward bellcrank assembly in similar manner.
b. Remove any vertical play from bellcrank assemblies by adding AN960-416 or AN960-416L washers, as required, between shoulder of bellcrank shaft and upper end of bellcrank assembly.

NOTE: Add only a sufficient number of washers to remove play without permitting binding.

c. Secure bellcrank shafts to cabin floor with attaching screws.
d. Install balance spring between bellcranks and connect turnbarrel eyes to bellcranks with clevis bolts.

CAUTION: DO NOT TIGHTEN THE NUTS SECURING TURNBARREL EYES TO BELLCRANKS BEYOND FINGER TIGHT. TO DO SO WOULD PERMIT BINDING TO OCCUR BETWEEN TURNBARREL EYES AND THE BELLCRANK EARS.

e. Secure clevis bolts with cotter pins.
f. Tighten the loosened turnbarrel and check rudder cable rig. (Refer to paragraph 32-101-30.)
g. Safety turnbarrel with lockwire.

CYCLIC PITCH CONTROLS

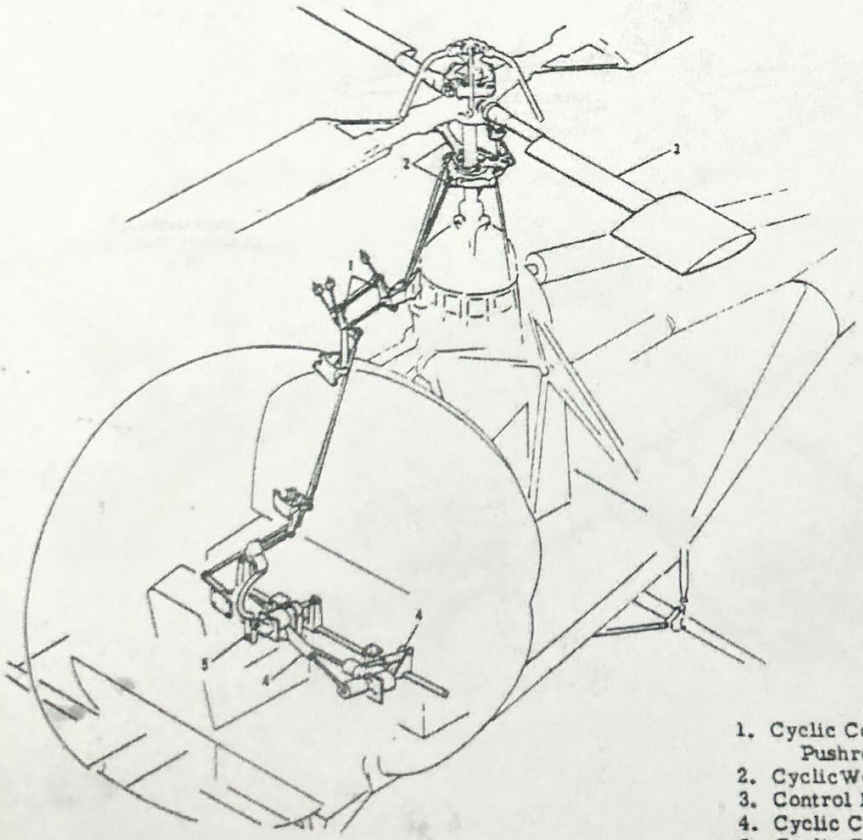
33-1-1. CYCLIC CONTROL SYSTEM. (See figure 33-1-1.)

33-1-2. DESCRIPTION. Changing the pitch of the control rotor blades causes the main rotor to tilt, effecting the forward, backward and sideward movements of the helicopter in flight. The cyclic control stick assembly, mounted on the seat front bulkhead in the cabin, actuates the wobble plate through a system of bellcranks and pushrod assemblies. A scissor type linkage connects the wobble plate to the control rotor blades, causing the change in rotor blade pitch. Longitudinal and lateral trim provisions are incorporated in the control system.

33-1-3. TROUBLESHOOTING THE CYCLIC CONTROL SYSTEM. Refer to table 33-1-I for cyclic control system troubleshooting information.

Table 33-1-I. Troubleshooting the Cyclic Control System

TROUBLE	PROBABLE CAUSE	REMEDY
Binding or notchiness in system (rotor static)	Control rotor bearings	Replace control rotor bearings.
	Scissor bearings	Replace scissor bearings.
	Wobble plate bearings	Replace wobble plate bearings.
Rough stick in flight	Same as above	Same as above.



1. Cyclic Control Bellcrank-Bracket and Pushrod Assemblies
2. Cyclic Wobble Plate and Scissors Assy
3. Control Rotor Blade Assembly
4. Cyclic Control Trim Actuating System
5. Cyclic Control Stick Assembly

Figure 33-1-1. Cyclic Control System

33-1-10. REMOVAL OF CYCLIC CONTROL SYSTEM. (See figures 33-1-2 through 33-1-4.)

a. Remove the cyclic control stick. (Refer to paragraph 33-10-10.)
b. Remove the lateral and longitudinal trim actuators. (Refer to section 38.)
c. Remove the lateral and longitudinal trim spring assemblies. (Refer to paragraph 33-10-10.)
d. Remove the bellcrank-bracket and pushrod assemblies. (Refer to paragraph 33-30-10.)
e. Remove the wobble plate and scissors. (Refer to section 34.)

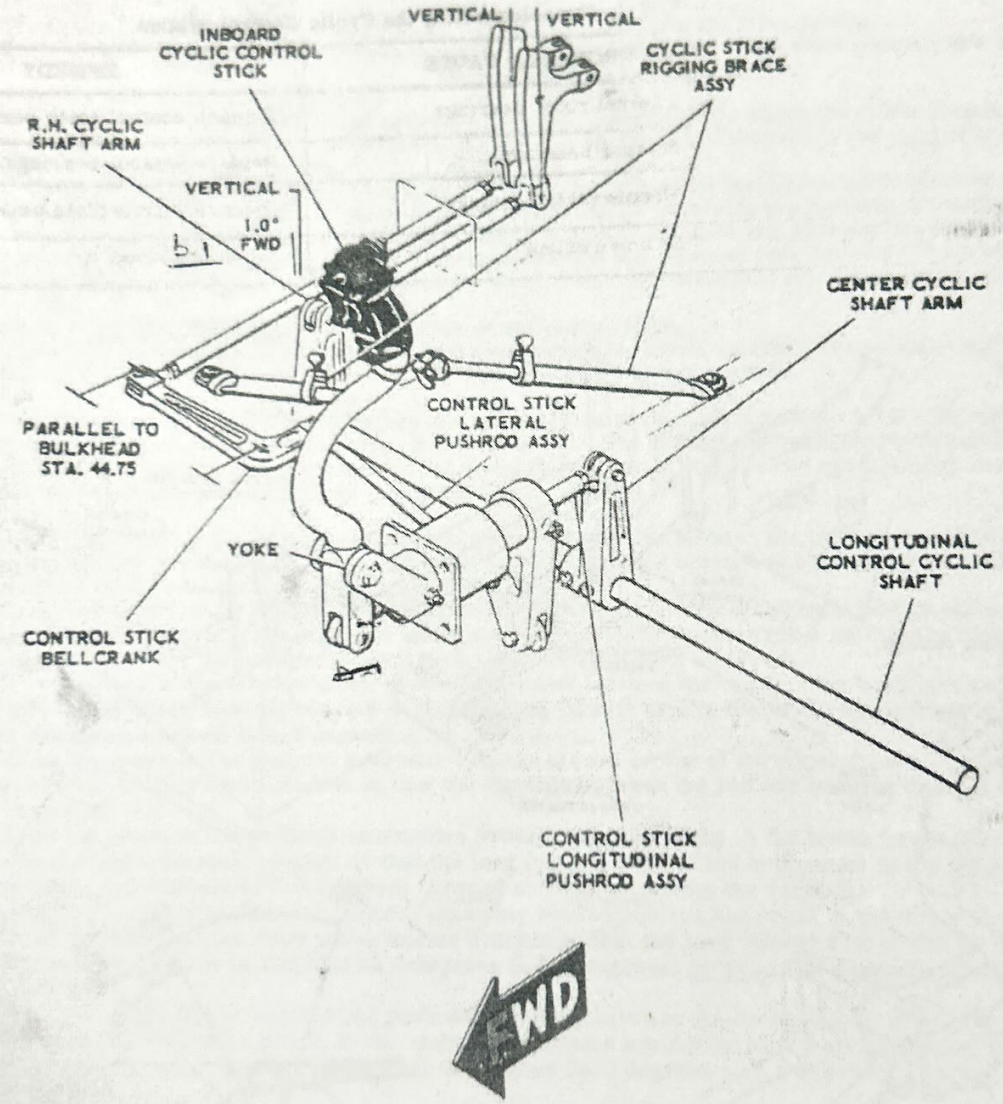


Figure 33-1-2. Cyclic Control Stick Adjustments (sheet 1 of 2)

33-1-11. INSTALLATION OF CYCLIC CONTROL SYSTEM.

a. Install the wobble plate and scissors. (Refer to section 34.)
b. Install the bellcrank-bracket and pushrod assemblies. (Refer to paragraph 33-30-11.)
c. Install the lateral and longitudinal trim spring assemblies. (Refer to paragraph 33-30-11.)
d. Install the lateral and longitudinal trim actuators. (Refer to section 38.)
e. Install the cyclic control stick. (Refer to paragraph 33-10-11.)

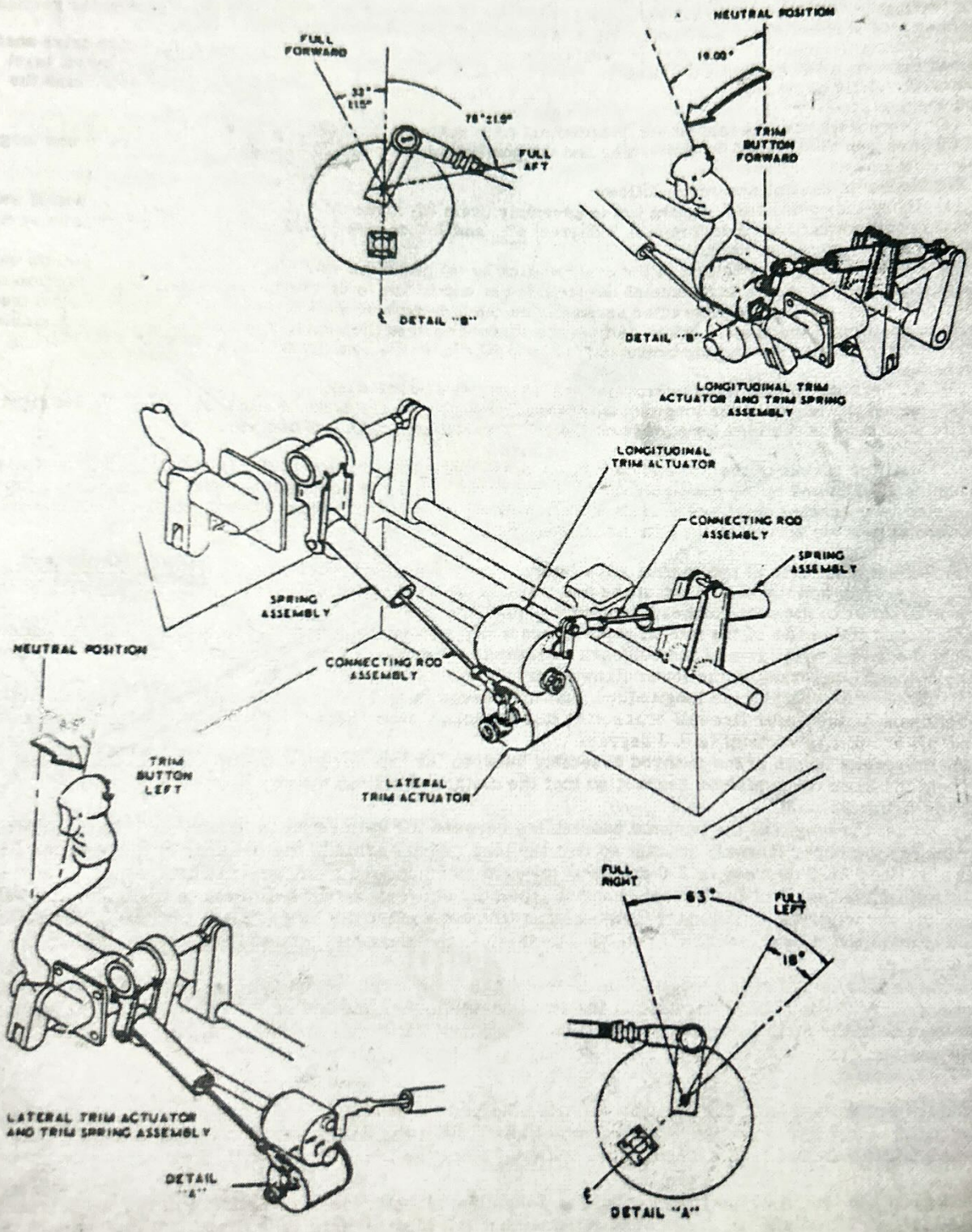


Figure 33-1-2. Cyclic Control Stick Adjustments (sheet 2 of 2)

33-1-30. RIGGING THE CYCLIC CONTROL SYSTEM. (See figures 33-1-2 and -3.)

a. Prepare the helicopter for rigging of the cyclic control system as follows:

NOTE: A precision vernier spirit level propeller protractor graduated in increments of one-tenth of a degree is required to perform rigging procedures.

(1) Level the helicopter. (Refer to Section 10.)

(2) Adjust the length of the left-hand (lateral) engine snubber assembly so that the main rotor drive shaft is vertical (± 0.2 degree) viewed from the front of the helicopter. Place a spirit level protractor vertically along either side surface of the main rotor drive shaft to determine the position of the shaft.

(3) Adjust the length of the aft (longitudinal) engine snubber assembly so that the main rotor drive shaft is inclined forward from the vertical 1.0 degree (± 0.2 degree) viewed from either side. Place a spirit level protractor vertically along either the front or the back surface of the main rotor drive shaft to determine the position of the shaft.

(4) Disconnect both the lateral and longitudinal trim spring rods from the trim motors.

(5) Recheck the level of the helicopter and the position of the main rotor drive shaft laterally and longitudinally.

b. Rig the cyclic control system as follows:

(1) Using the cyclic stick rigging brace assembly (item 33, table 92-1-1), clamp the cyclic control stick in a neutral position that is 1.0 degree (± 0.2 degree) aft, and 1.0 degree (± 0.2 degree) to the right of a vertical position as viewed looking forward.

(2) Check the neutral position of the control stick by (a) placing a spirit level protractor vertically on the machined surface of the forward face of the stick lower end fitting to determine the fore and aft position of the stick, and (b) by placing the protractor vertically on the side face of the stick end fitting to determine the side-to-side position of the control stick. Adjust the control stick to the required position with the adjustable length telescoping rods in the rigging brace assembly anchored on the seat structure aft of the control stick. (See figure 33-1-2.)

(3) Recheck the lateral and longitudinal position of the control stick.

(4) Adjust the length of the longitudinal pushrod assembly of the cyclic control stick so that the right-hand cyclic shaft arm is inclined forward from the vertical 1.0 degree (± 0.2 degree).

NOTE: Thread the shanks of the rod end bearings into the pushrods at least as far as the 1/16-inch witness holes at each end of the push-pull rods. Make certain that rod end bearing lubrication fittings (lubricated type bearing only) are accessible in the installed position. Turn the rod end bearings one-half turn to provide access to the fittings if necessary.

(5) Adjust the length of the control stick lateral pushrod assembly between the cyclic control stick torque tube assembly and the short arm of the bellcrank in the under-seat bracket so that the long arm of the bellcrank is parallel to the seat bulkhead (station 44.75).

(6) Adjust the length of the lateral pushrod assembly between long arm of the bellcrank in the underseat bracket and the long (lower) arm of the outboard bellcrank in the lower firewall bracket so that the long (lower) arm of the outboard bellcrank in the lower firewall bracket is vertical (± 0.2 degree).

(7) Adjust the length of the longitudinal pushrod assembly between the cyclic shaft control arm and the inboard bellcrank in the lower firewall bracket so that the long (lower) arm of the inboard bellcrank in the lower firewall bracket is vertical (± 0.2 degree).

(8) Adjust the length of the pushrod assembly between the top center of the upper firewall bracket link assembly and the main transmission bracket so that the distance between the rod end bearing centers is 8.50-inches. (See figure 33-1-3)

(9) Adjust the length of the pushrod assemblies between the bellcranks in the lower firewall bracket and the bellcranks in the upper firewall bracket so that the long (upper) arms of the bellcranks in the upper firewall bracket are inclined 26.0 degrees (± 2.0 degrees) forward and outboard from the vertical.

(10) Adjust the length of the lateral pushrod assembly between the aft bellcrank in the upper firewall bracket and the aft bellcrank in the main transmission bracket so that the long (upper) arm of the aft bellcrank in the main transmission bracket is inclined 33.0 degrees (± 2.0 degrees) forward and outboard from the vertical. (See figure 33-1-3.)

(11) Adjust the length of the longitudinal pushrod assembly between the forward bellcrank in the upper firewall bracket and the forward bellcrank in the main transmission bracket so that the long (upper) arm of the forward bellcrank in the main transmission bracket is inclined 26.0 degrees (± 2.0 degrees) forward and outboard from the vertical.

NOTE: Before proceeding with the next steps, raise the nose jack so that the main rotor drive shaft is vertical (± 0.2 degree) when viewed from either side of the helicopter. Recheck to verify that the shaft is vertical (± 0.2 degree) when viewed from the front of the helicopter.

(12) Adjust the length of the lateral pushrod assembly between the aft bellcrank in the main transmission bracket and the right-hand side of the wobble plate so that the wobble plate is inclined 0.7 degree (± 0.5 degree) downward from the horizontal on the left-hand side of the main rotor shaft (tilted to the left).

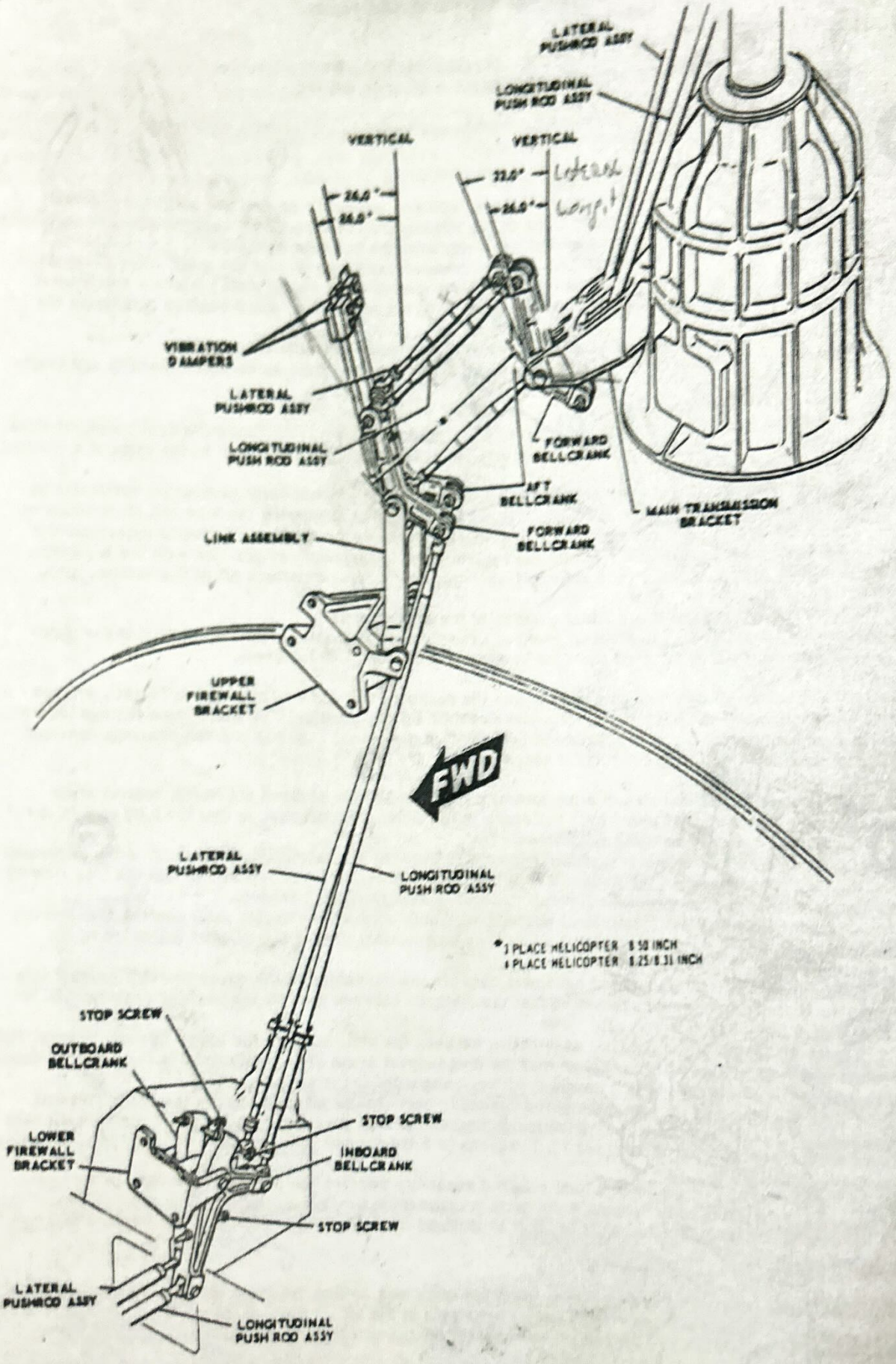


Figure 33-1-3. Cyclic Bellcrank-Bracket and Pushrod Adjustment

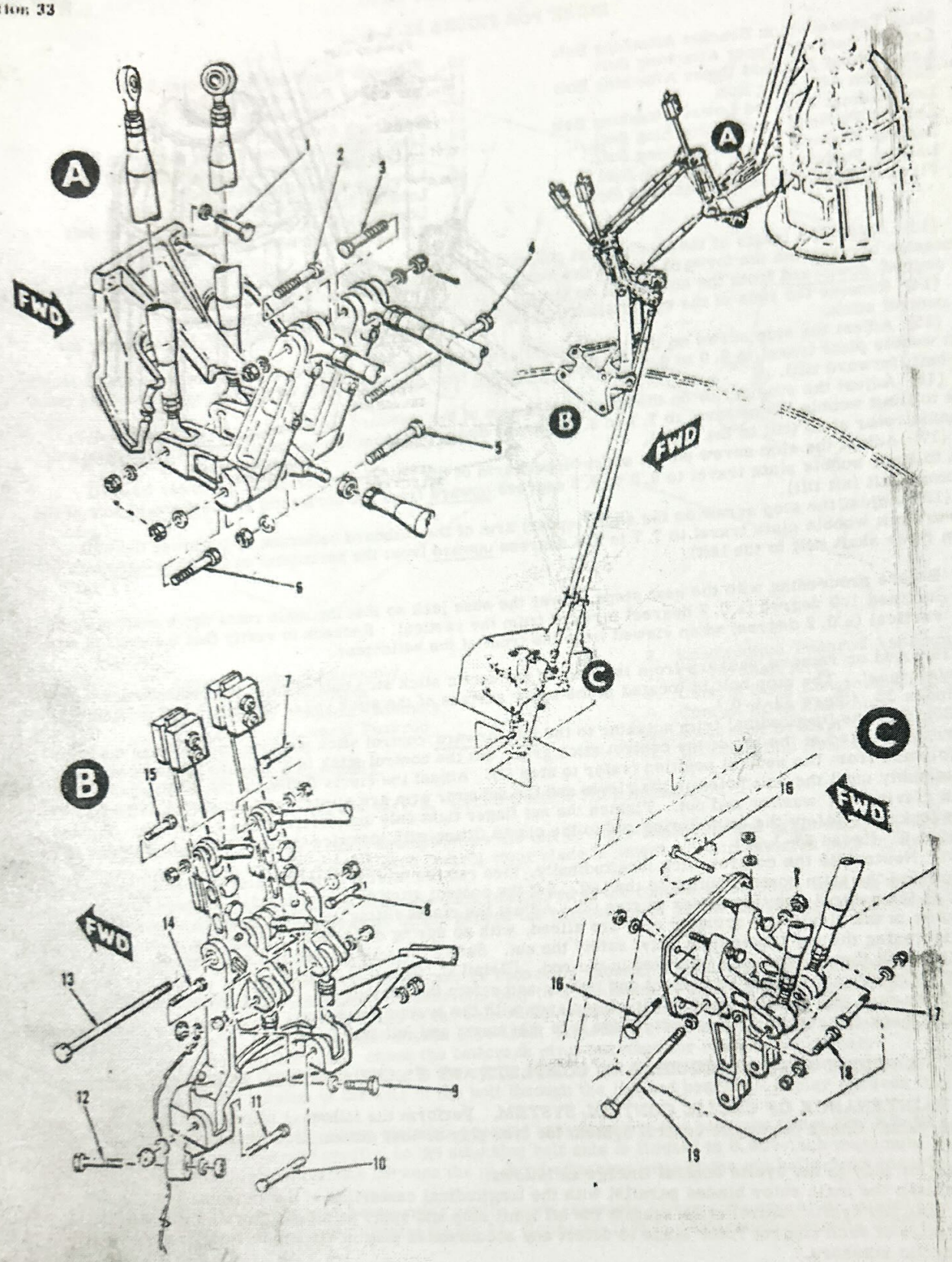


Figure 33-1-4. Cyclic Bellcrank - Bracket Pushrod Attachments

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INDEX FOR FIGURE 33-1-4

1. Main Transmission Bracket Attaching Bolt
2. Lateral Pushrod Upper Attaching Bolt
3. Longitudinal Pushrod Upper Attaching Bolt
4. Bellcrank Attaching Bolt
5. Longitudinal Pushrod Lower Attaching Bolt
6. Lateral Pushrod Lower Attaching Bolt
7. Lateral Pushrod Lower Attaching Bolt
8. Lateral Pushrod Upper Attaching Bolt
9. Firewall Brace Forward Attaching Bolt
10. Firewall Brace Aft Attachment Bolt
11. Link Assy Fwd Attaching Bolt
12. Upper Bracket Attaching Bolt
13. Bellcrank Attaching Bolt
14. Longitudinal Pushrod Upper Attaching Bolt
15. Longitudinal Pushrod Lower Attaching Bolt
16. Lower Bracket Attaching Bolt
17. Lateral Pushrod Lower Attaching Bolt
18. Longitudinal Pushrod Lower Attaching Bolt
19. Bellcrank Attaching Bolt

(13) Adjust the length of the longitudinal pushrod assembly between the forward bellcrank in the main transmission bracket and the forward side of the wobble plate so that the wobble plate is inclined 0. 5 degree (± 0. 2 degree) downward from the horizontal on the aft side of the main rotor shaft (tilted aft).

(14) Remove the rods of the cyclic stick rigging brace assembly (item 33, table 92-1-I) securing the cyclic control stick.

(15) Adjust the stop screw on the long (lower) arm of the inboard bellcrank in the lower firewall bracket to limit wobble plate travel to 8. 0 to 8. 5 degrees downward from the horizontal on the forward side of the main rotor shaft (forward tilt).

(16) Adjust the stop screw on the long (lower) arm of the outboard bellcrank in the lower firewall bracket to limit wobble plate travel to 7. 7 to 8. 3 degrees downward from the horizontal on the right-hand side of the main rotor shaft (tilt to the right).

(17) Adjust the stop screw on the short (upper) arm of the inboard bellcrank in the lower firewall bracket to limit wobble plate travel to 9. 0 to 9. 2 degrees upward from the horizontal on the forward side of the main rotor shaft (aft tilt).

(18) Adjust the stop screw on the short (upper) arm of the outboard bellcrank in the lower firewall bracket to limit wobble plate travel to 7. 7 to 8. 3 degrees upward from the horizontal on the right-hand side of the main rotor shaft (tilt to the left).

NOTE: Before proceeding with the next steps, lower the nose jack so that the main rotor drive shaft is again inclined 1. 0 degree (± 0. 2 degree) forward from the vertical. Recheck to verify that the shaft is still vertical (± 0. 2 degree) when viewed from the front of the helicopter.

(19) Add or remove washers from the head of the cyclic stick stop bolt to limit the control stick to 0. 5-degree overtravel. The stop bolt is located in the upper surface of the stick yoke, directly aft of the control stick. (Index 33, figure 33-1-6.)

(20) Run the longitudinal trim actuator to the full forward control stick position by operating the trim control button located at the top of the control stick grip. Set the control stick in a position 19 degrees (± 0. 2 degree) forward from the neutral position (refer to step (1). Adjust the clevis fitting on the longitudinal trim spring assembly until the bolt holes in the clevis and the actuator arm are alined, with no spring deflection. Install the clevis bolt, washer and nut. Tighten the nut finger tight only and safety with a cotter pin. Tighten the clevis locknut. Safety the trim spring rod to the clevis fitting with lockwire through the hole provided in the rod. (Detail C, figure 38-1-1.)

(21) Neutralize the control stick longitudinally, then run the lateral trim actuator to the full left stick limit by moving the trim control button to the left. Set the control stick in a position 6. 5-degrees (± 0. 2 degree) to the left of the neutral position (refer to step (2). Adjust the clevis fitting on the trim spring assembly until the bolt holes in the clevis and actuator arm are alined, with no spring deflection. Install the clevis bolt, washer and nut, tightening the nut finger tight only; safety the nut. Safety the trim spring rod to the clevis fitting with lockwire inserted through the hole provided in the rod. .(Detail C, figure 38-1-1).

(22) Remove all rigging equipment and tighten and safety the various nuts, bolts and screws in the system. Take care that none of the lockwire interferes with the system operation.

(23) Check the cyclic control system for free movement and full travel.

CAUTION: A FLIGHT TEST IS REQUIRED TO COMPLETE ANY FLIGHT CONTROL RIGGING OPERATION.

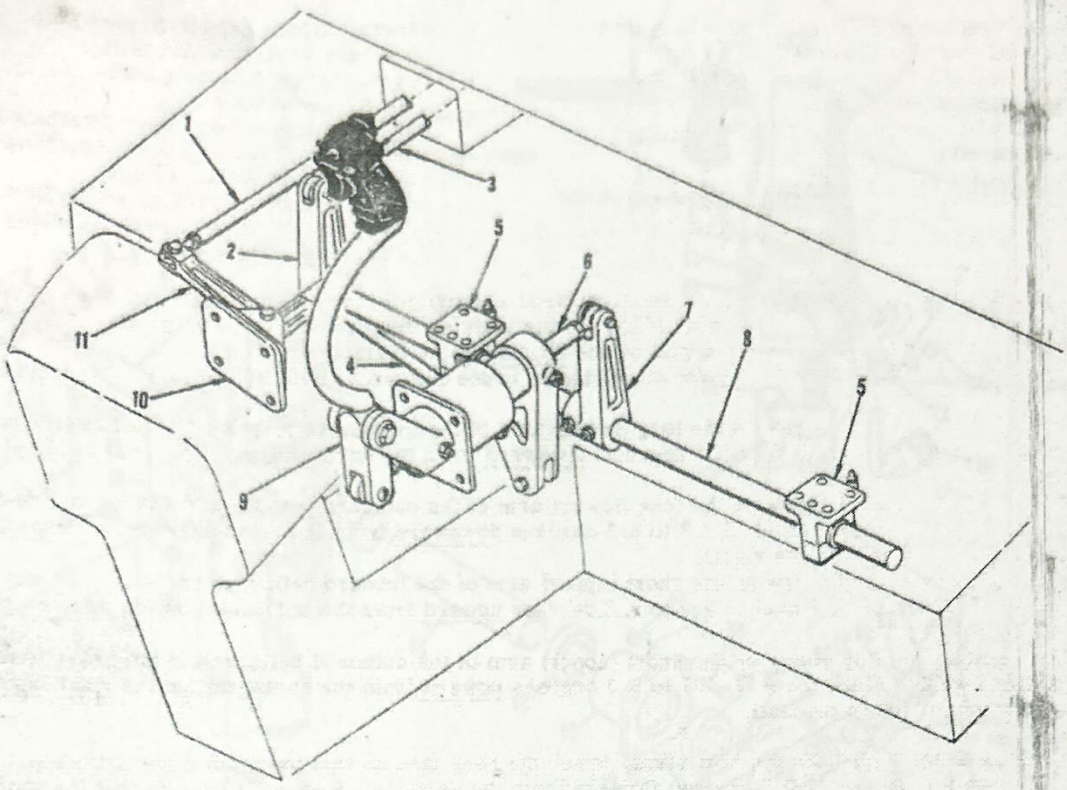
33-1-40. MAINTENANCE OF CYCLIC CONTROL SYSTEM. Perform the following maintenance procedures at regular intervals. Check the cyclic control system for free play or lost motion according to the following instructions:

a. Check for play in the cyclic control linkage as follows:

(1) Aline the main rotor blades parallel with the longitudinal centerline of the helicopter.

(2) Hold the cyclic control stick against the aft limit stop and apply an alternating up and down force to the trailing edge of each control rotor blade to detect any accumulated play in the longitudinal cyclic control linkage or cyclic scissors.

(3) Turn the main rotor blades to a position 90 degrees off the longitudinal centerline of the helicopter.



1. Lateral Pushrod Assembly
2. R. H. Cyclic Shaft Arm
3. Longitudinal Pushrod Assembly
4. Control Stick Lateral Pushrod Assembly
5. Torque Block Assembly
6. Longitudinal Pushrod Assembly
7. Cyclic Shaft Arm
8. Control Stick Longitudinal Shaft Assy
9. Control Stick Assembly
10. Bellcrank Bracket
11. Control Stick Bellcrank

Figure 33-1-5. Cyclic Control Stick Installation

(4) Hold the cyclic control stick against either the left or right-limit stop and again apply an alternating up and down force to the trailing edge of each control rotor blade to detect any accumulated play in the lateral cyclic control linkage.

(5) If the accumulated play exceeds 1/4-inch (measured at the control rotor blade trailing edge), isolate the source of play by bridging one hand or finger across the various hinge points and linkage connections to detect any play in the parts.

(6) Replace worn parts as required.

(7) Check for accumulated play which may be caused by excessive axial clearance between the rod end bearings and their attaching bellcranks. Reduce this play to a minimum by shifting the standard (plain) bushing.

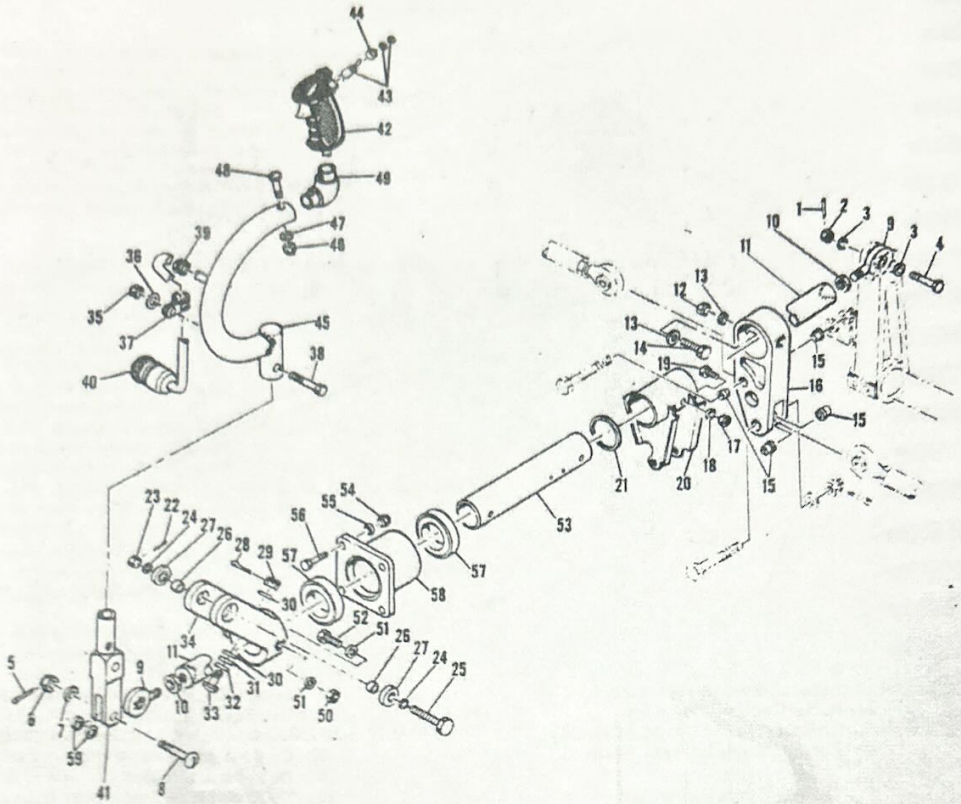
b. Check for side play at the long arms of the bellcranks located at the upper firewall and on the main transmission assembly. Play should not exceed 1/16-inch, measured at the extreme end of the long arm of the bellcrank. If play exceeds this limit, check the bellcrank pivot bearings for looseness or wear.

c. Check for excessive side (axial) play in the cyclic control rod end bearings. Maximum permissible play is 0.022-inch measured parallel to the axis of the bolt through the rod end bearing. If play exceeds this limit, replace the rod end bearing.

d. Check for side (axial) play in the isolation pushrod assembly rod end bearings (Part No. HE-5S series). Permissible side play measured parallel to the attaching bolt axis is limited to 0.005-inch maximum.

e. Check for possible interference between the pushrod attaching bolts at the six bellcranks located aft of the firewall.

f. Check for excessive end play between the cyclic stick assembly torque tube spacer or lateral trim crank and the stick bearing support. Install shims (index 21, figure 33-1-6) as required to maintain 0.000-inch to 0.002-inch end play.



1. Cotter Pin
2. Nut
3. Washer
4. Bolt
5. Cotter Pin
6. Nut
7. Washer
8. Bolt
9. Rod End Bearing
10. Nut
11. Control Stick Longitudinal Pushrod
12. Nut
13. Washer
14. Bolt
15. Bushing
16. Torque Tube Arm
17. Nut
18. Washer
19. Bolt
20. Lateral Trim Crank
21. Shim
22. Cotter Pin
23. Nut
24. Washer
25. Bolt
26. Spacer
27. Bearing
28. Cotter Pin
29. Nut
30. Washer
31. Washer (as required)
32. Washer (as required)
33. Bolt (special)
34. Control Stick Yoke
35. Nut
36. Washer
37. Cable Clamp
38. Bolt
39. Grommet
40. Connector Plug
41. Stick End Fitting
42. Grip
43. Switch
44. Adapter
45. Control Stick Tube
46. Nut
47. Washer
48. Screw
49. Adapter
50. Nut
51. Washer
52. Bolt
53. Torque Tube
54. Nut
55. Washer
56. Bolt
57. Bearing
58. Stick Support
59. Washer

Figure 33-1-6. Cyclic Control Stick Assembly

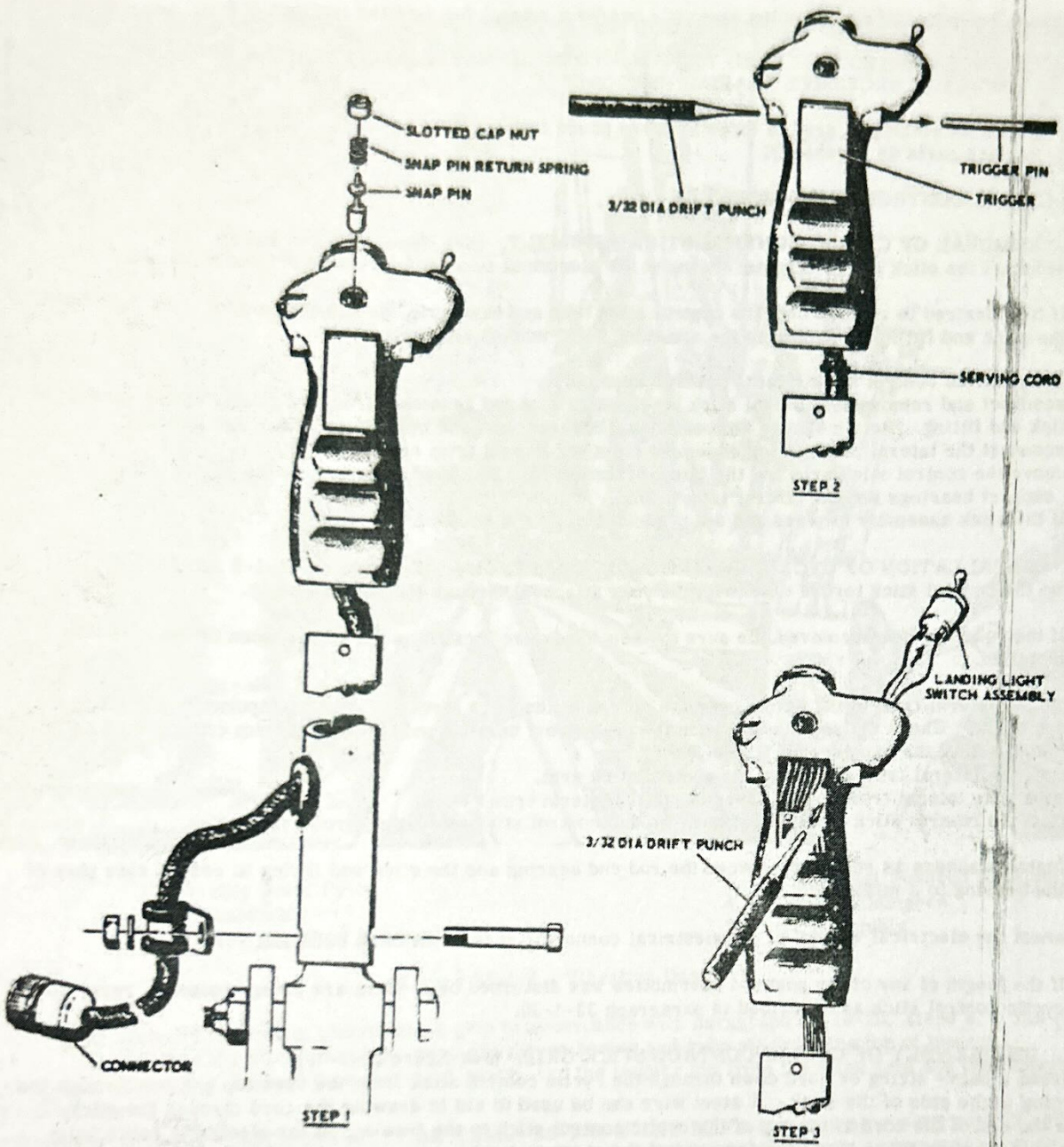


Figure 33-1-7. Landing Light Switch Replacement

NOTE: To increase the fore and aft cyclic stick friction, remove shims from both torque block assemblies that support the control stick longitudinal shaft assembly. Do not increase friction to the point that the cyclic trim motor produces sluggish or erratic stick movement.

g. Check for vertical movement in the control rotor cuff and trunnion assembly as follows:

(1) Disconnect the rotor blade assembly from the upper scissors assembly.

(2) Lock the main rotor hub assembly securely with the main rotor blade and wobble plate leveling block (table 92-1-I, item 28).

(3) Exert slight pressure at the blade tip sufficient to detect movement in the cuff and trunnion. Measure movement at the balance screw on the outboard tip of the control rotor blade; a maximum vertical movement of 0.125-inch is allowable.

(4) If the maximum vertical movement is exceeded, or if cyclic control system malfunction is determined to originate within the cuff and trunnion assembly, check the cuff retaining nut for correct torque of 840-

pound-inches. Refer to cuff and trunnion assembly overhaul manual for detailed instructions.

CAUTION: DO NOT EXCEED SPECIFIED TORQUE. TO DO SO MAY DAMAGE BEARING SPACER AND RESULT IN EXCESSIVE BEARING PRELOAD.

(6) Check for rotational drag of three to seven pound inches.
(7) Replace parts as necessary.

33-10-1. CYCLIC CONTROL STICK ASSEMBLY.

33-10-10. REMOVAL OF CYCLIC CONTROL STICK ASSEMBLY. (See figures 33-1-5 and 33-1-6.)

a. Disconnect the stick grip electrical wiring at the electrical connector at the seat front bulkhead.

NOTE: If it is desired to remove only the control stick tube and hand grip, detach the control stick tube from the stick end fitting by removing the attaching bolt, washer and nut.

b. Disconnect the control stick lateral pushrod assembly.
c. Disconnect and remove the control stick longitudinal pushrod assembly from the center cyclic shaft arm and the stick end fitting. Retain spacer washers found between rod end bearing and stick end fitting.
d. Disconnect the lateral trim spring assembly from the lateral trim crank.
e. Remove the control stick arm and the lateral trim crank. Be careful not to lose the shims located between the support bearings and the lateral trim crank.
f. Pull the stick assembly forward and out of the control stick support.

33-10-11. INSTALLATION OF CYCLIC CONTROL STICK ASSEMBLY. (See figures 33-1-5 and 33-1-6.)

a. Slide the control stick torque tube (with the yoke attached) through the support block.

NOTE: If the yoke has been removed, be sure the bolt heads are located on the inside when the yoke is reinstalled.

b. Slide the lateral trim crank shims over the aft end of the stick torque tube and temporarily install the lateral trim crank. Check the end play between the aft support bearing and the lateral trim crank. Add extra shims as required, if the gap exceeds 0.002-inch.
c. Install the lateral trim crank and the control stick arm.
d. Connect the lateral trim spring assembly to the lateral trim crank.
e. Install the control stick longitudinal pushrod and control stick lateral pushrod assemblies.

NOTE: Install washers as required between the rod end bearing and the stick end fitting to reduce side play of the bearing to a minimum.

f. Connect the electrical wiring at the electrical connector at the seat front bulkhead.

NOTE: If the length of any of the pushrod assemblies was disturbed or if parts are being replaced, rerig the cyclic control stick as described in paragraph 33-1-30.

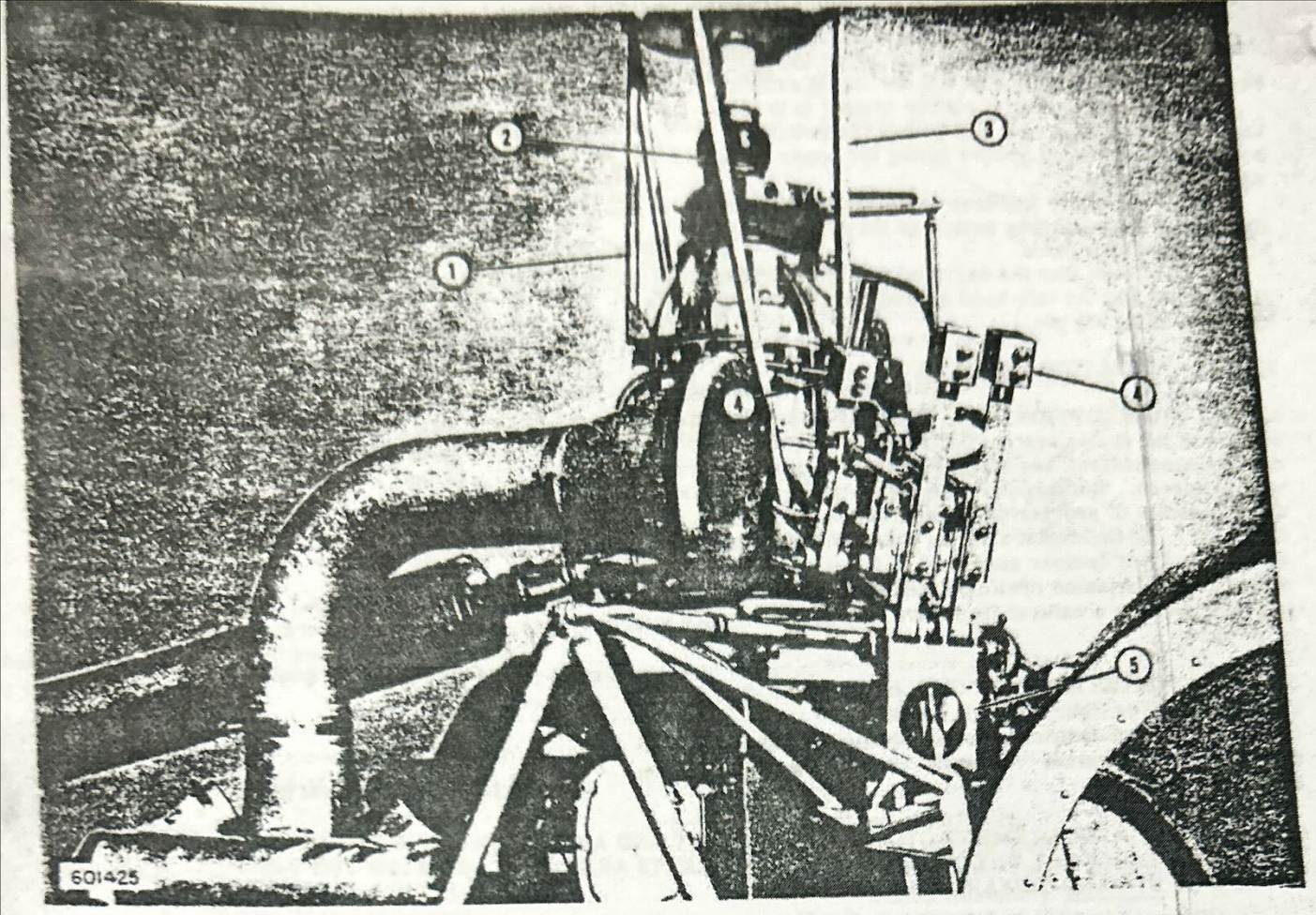
33-10-20. DISASSEMBLY OF CYCLIC CONTROL STICK GRIP. (See figure 33-1-7.)

a. Thread a heavy string or cord down through the cyclic control stick from the open top and out through the cable opening in the side of the stick. A steel wire can be used to aid in drawing the cord through the stick.
b. Tie the end of the cord at the top of the cyclic control stick to the free end of the electrical cable from the cyclic control stick grip. Tape the free end of the electrical cable as necessary to achieve a smooth shape which may be easily pulled out through the cable opening in the side of the cyclic control stick.
c. Carefully pull the electrical cable through the control stick, down through the open top and out through the cable opening in the side. Take care to avoid scraping the insulation against the edges of the openings. Install the rubber grommet in the cable opening.
d. Position the control stick grip on the top of the control stick. Pull the excess electrical cable through the cable opening in the side of the cyclic control stick. Aline the grip and stick screw holes and install the retainer screw at the bottom of the control stick grip.
e. Connect the wires of the electrical cable to the cyclic control stick plug connector. Be sure to reconnect the wires to the proper plug pins. Refer to the electrical wiring diagrams in section 83 for plug wiring data.
f. Connect the cyclic control stick plug connector to its receptacle on the forward face of the seat structure.

33-10-40. MINOR REPAIR AND MAINTENANCE OF CYCLIC CONTROL STICK GRIP. (See figure 33-1-7.)

Disconnect each cyclic control stick plug connector from its receptacle in the seat deck structure. Check the operation of all the switches of each cyclic control stick grip by using an ohmmeter at the pins of each cyclic control stick plug connector. Refer to the wiring diagrams of Section 83 for connections. Repair or replace either unit if it is defective.

a. Remove a defective landing light switch assembly (miniature toggle switch and adapter) in the following manner:



1. Wobble Plate Pylon Assembly
2. Lateral Pushrod Assembly
3. Longitudinal Pushrod Assembly
4. Vibration Dampers
5. Link Assembly

Figure 33-1-8. Vibration Dampers

(1) Remove the cyclic control stick grip in accordance with paragraph 33-10-20, steps a, b and e.
(2) Remove the slotted cap nut, snap pin return spring and snap pin from the top of the grip.
(3) Using a 3/32-inch diameter drift punch, tap the trigger pin from the stick grip and the trigger switch trigger.

CAUTION: THE TRIGGER PIN MUST BE REMOVED FROM THE LEFT-HAND SIDE OF THE GRIP AS THE SERRATIONS OF LEFT-HAND END OF THE PIN WILL SPLIT THE PLASTIC TRIGGER IF DRIVEN TOWARD THE RIGHT-HAND SIDE OF THE CYCLIC STICK GRIP.

(4) Cut the serving cord securing the plastic tubing to the wire cable and slide back the tubing.
(5) Using moderate hand pressure only, push a small amount of wire slack into the cyclic grip.
(6) Hold the cyclic grip firmly and insert a 3/32-inch diameter drift punch upward into the grip cabity until the tip of the punch contacts the base of the toggle switch.

CAUTION: USE CARE TO KEEP THE PUNCH FROM CONTACTING THE EXPOSED TRIGGER SWITCH AS THE SPRINGLOADED MECHANISM CAN BE EASILY DAMAGED.

(7) Push the landing light switch assembly slowly out of the grip; check to make certain that there is sufficient slack in the wire to permit removal.
(8) When the landing light switch is removed, unsolder the wires connected to the switch terminals.

NOTE: It is not necessary to identify the wiring. Either wire may be reconnected to either terminal.

b. Install a replacement landing light switch assembly in the reverse order of removal and observe the following:
(1) Connect the wiring to the terminals at the same side of the switch as the index groove in the threaded area.

(2) Aline the index key and install the adapter between the two locking nuts and the toggle switch.

(3) Apply a coat of rubber cement to the landing light switch assembly and install the switch assembly with the index groove facing the upper surface of the cyclic grip.

(4) Carefully withdraw the slack wire from the base of the stick grip switch as the switch assembly is pushed into place.

(5) Check that the serrated end of the trigger pin is located at the left-hand side of the cyclic grip while installing the pin.

33-20-1. VIBRATION DAMPERS.

33-20-2. DESCRIPTION. (See figure 33-1-8.) Vibration in the cyclic system is dampened by two damper assemblies, one installed on each upper firewall bellcrank. Rectangular weights on the dampers are adjustable to provide the damper with a neutral frequency. On helicopters Serial No. 2027 and subsequent, a third damper assembly is installed on the outboard transmission cyclic bellcrank; this damper is preadjusted to a natural frequency of 1480 cpm (± 10 cpm).

33-20-30. ADJUSTMENT OF CYCLIC VIBRATION DAMPERS. (See figure 33-1-9.) Adjust the upper firewall vibration damper assemblies to correct undesirable cyclic system "feedback" (2-per-rev vibration) as follows.

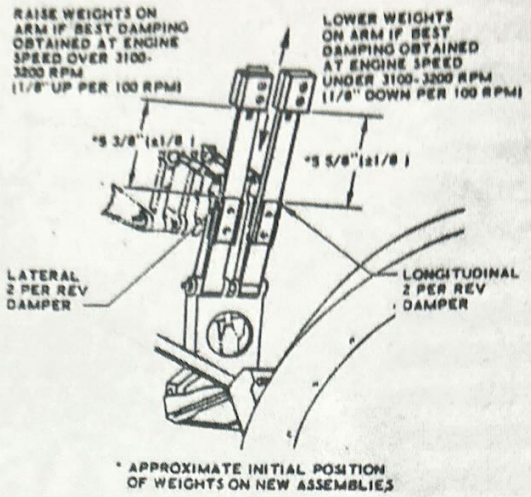


Figure 33-1-9. Adjustment of Damper Weights

CAUTION: IF REPLACEMENT OF A DAMPER WEIGHT AND ARM ASSEMBLY IS REQUIRED, MAKE CERTAIN THAT THE TWO ATTACHING BRACKETS ARE INSTALLED WITH THE BEVELED ENDS UPWARD TOWARD THE WEIGHT.

a. Test fly helicopter and vary engine speed between 2900 rpm and 3300 rpm. Observe and record rpm at which vibration in cyclic control sticks is at minimum in both lateral and longitudinal directions.

NOTE: The direction of stick movement (vibration) is important, since lateral and longitudinal vibration must be observed and treated separately. The lateral damper has little or no effect on longitudinal damping, nor does the longitudinal damper affect lateral stick vibrations.

b. After helicopter shutdown, reposition damper weight on assembly arm by loosening attaching bolts and sliding weights upward or downward in lateral (outboard) or longitudinal (inboard) arm slots, as applicable.

(1) Check rpm record for engine speed and stick position at which minimum vibration was felt in sticks.

(2) If best damping was below 3100 rpm to 3200 rpm, slide weight downward approximately 1/8-inch per 100 rpm increase necessary to raise critically damped speed so that it falls between 3100 rpm to 3200 rpm.

(3) If best damping was above 3100 rpm to 3200 rpm, slide weight upward by approximately 1/8-inch per 100 rpm decrease necessary to lower critically damped speed so that it falls between 3100 to 3200 rpm.

(4) Tighten bolts securing weight to arm to 20/25 pound-inches.

c. Repeat a and b above as necessary to obtain proper cyclic control damping.

33-30-1. CYCLIC CONTROL BELLCRANK - BRACKET AND PUSHROD ASSEMBLIES. (See figure 33-1-3 and 33-1-4.)

33-30-10. REMOVAL OF CYCLIC CONTROL BELLCRANK - BRACKET AND PUSHROD ASSEMBLIES.

a. Disconnect cyclic control pushrods at bellcranks.

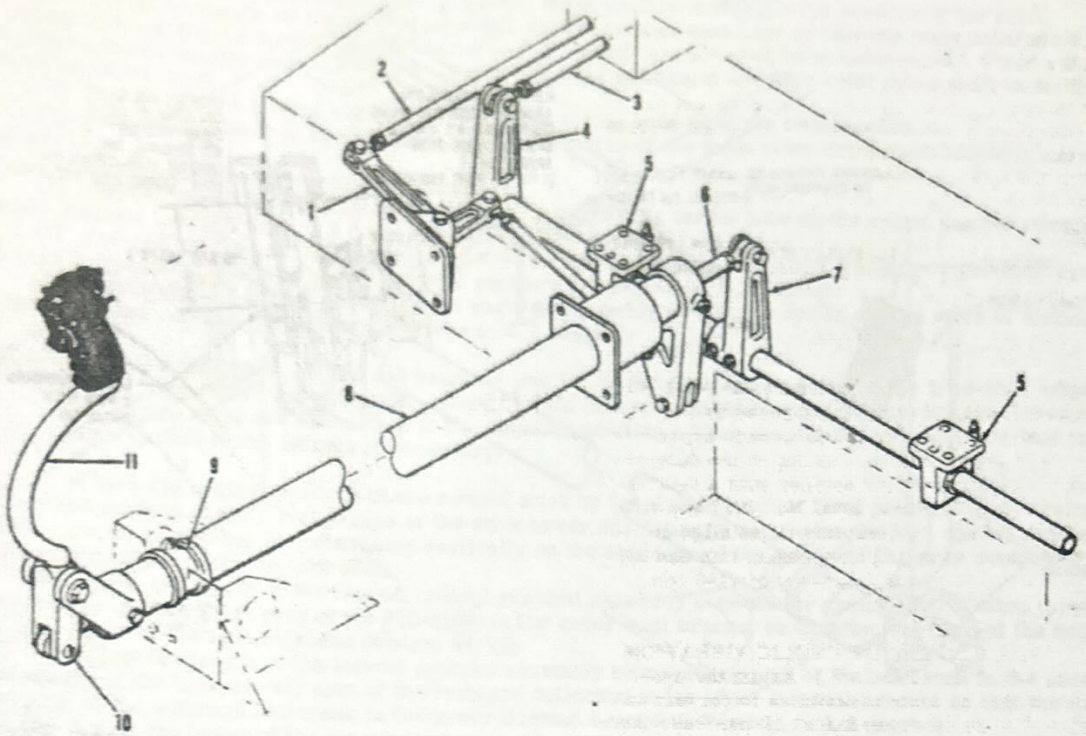
b. Remove attach bolts securing firewall bracket brace to the bellcrank bracket assembly. Pivot the brace as required to clear firewall bracket assembly.

c. Remove bolts securing bellcrank-bracket to firewall. Remove bellcrank-bracket.

33-30-11. INSTALLATION OF CYCLIC CONTROL BELLCRANK-BRACKET AND PUSHROD ASSEMBLIES. Installation of the cyclic control bellcrank-bracket and pushrod assemblies is the reverse of removal. Accomplish the following additional steps.

a. Make certain that the washers installed under the internal wrenching bolt heads have the chamfered inside diameter against the bolt head.

b. Shim as required to eliminate any gap between the brace legs and the attaching points with washers of the



1. Control Stick Bellcrank
2. Lateral Pushrod Assembly
3. Longitudinal Pushrod Assembly
4. Right-hand Cyclic Shaft Arm
5. Torque Block Assembly
6. Longitudinal Pushrod Assembly
7. Cyclic Shaft Arm
8. Cyclic Torque Tube
9. Cyclic Torque Tube Friction Clamp Assembly
10. Cyclic Stick End Fitting Assembly
11. Cyclic Control Stick Assembly

Figure 33-101-1. Cyclic Control Installation, Four-Place Configuration

appropriate size. A minimum of one washer must be installed under each brace leg.

c. If the rod end bearing adjustments have been disturbed, or if replacement parts are being installed, rig the cyclic system in accordance with paragraph 33-1-30.

33-30-40. STRAIGHTENING FLIGHT CONTROL PUSH ROD ASSEMBLIES. (Refer to Section 31.)

33-101-1. CYCLIC CONTROL SYSTEM, FOUR-PLACE CONFIGURATION. (See figures 33-101-1 and -2.)

33-101-2. DESCRIPTION. The cyclic control system in the four-place configuration is identical in operation to the standard UH-12E cyclic system. Only those components peculiar to the four-place configuration are discussed in this section. Paragraph references to the standard configuration cyclic controls are made where applicable.

33-101-3. TROUBLESHOOTING THE CYCLIC CONTROL SYSTEM, FOUR-PLACE CONFIGURATION. Refer to table 33-1-1.

33-101-10. REMOVAL OF CYCLIC CONTROL SYSTEM, FOUR-PLACE CONFIGURATION.

a. Remove pilot's seat. (Refer to Section 85.)
b. Remove screws attaching tunnel and cover assembly to cabin floor.
c. Disconnect adjustable friction tube at collective friction bearing block.
d. Remove access covers from passenger seat deck.
e. Remove cyclic stick assembly as follows:
   (1) Disconnect electrical connector at cabin floor.
   (2) Remove two clamps securing cyclic stick electrical wires.
   (3) Remove attach bolt at cyclic stick end.
   (4) Remove cyclic stick assembly.
f. Remove throttle lever bracket assembly as follows:
   (1) Disconnect rod end bearings at throttle coordination lever assembly.

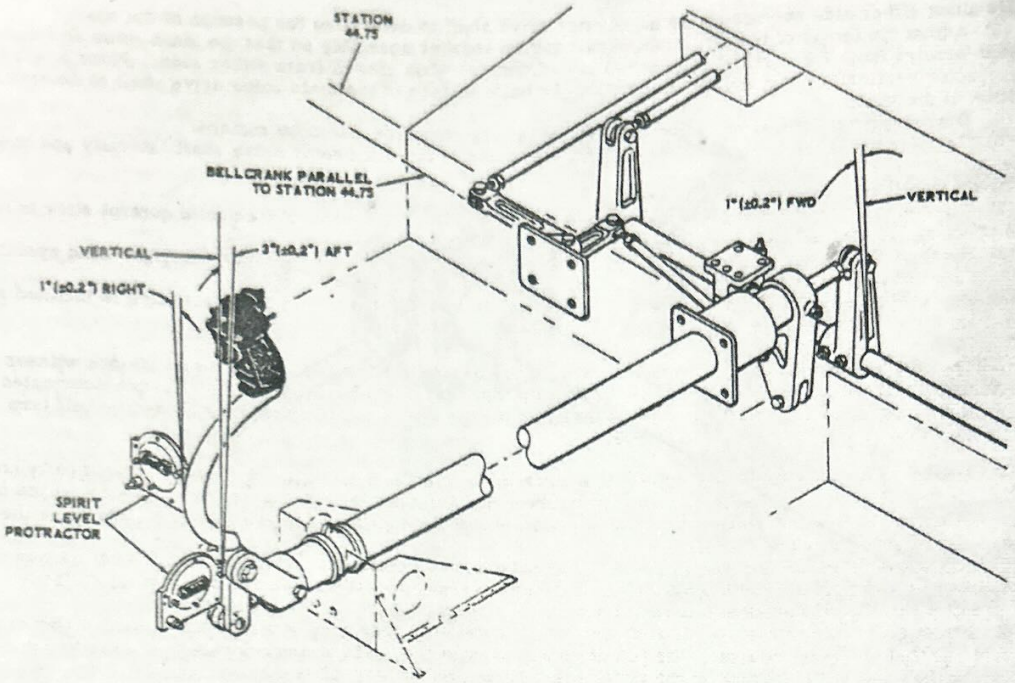


Figure 33-101-2. Rigging Cyclic Control Stick, Four-Place Configuration

(2) Remove clamps securing carburetor heat and mixture push-pull control cables to bracket assembly.
(3) Remove nuts and bolts securing bracket assembly to cabin floor.

g. Remove bolts securing torque tube support to brace at Station 18.50.
h. Disconnect longitudinal pushrod at arm of cyclic control shaft and stick end fitting.
i. Disconnect lateral pushrod at the torque tube arm assembly.
j. Disconnect lateral trim spring housing assembly.
k. Remove bolts securing torque tube arm bellcrank assemblies to torque tube. Slide torque tube arm and bellcrank assemblies off torque tube. Take care not to lose shims located between aft bearing and bellcrank assembly.
l. Remove bolts securing torque tube bearing support to bulkhead at Station 44.75.
m. Withdraw cyclic torque tube.
n. Slide forward support off torque tube. Take care not to damage the nylon bushing.
o. Remove cyclic stick end from yoke.
p. Remove yoke from torque tube.

33-101-11. INSTALLATION OF CYCLIC CONTROL SYSTEM, FOUR-PLACE CONFIGURATION. Installation of cyclic control stick and torque tube is essentially the reverse of removal. Accomplish the following additional steps.

a. Add shims as needed to provide 0.000 to 0.002-inch play between aft bearing and bellcrank assembly.
b. Rerig the cyclic control system if the length of any of the pushrod assemblies were altered, or if parts are being replaced that would affect cyclic rigging.

33-101-30. RIGGING THE CYCLIC CONTROL SYSTEM, FOUR-PLACE CONFIGURATION. (See figures 33-101-2, 33-1-2 and 33-1-3.)

a. Prepare the helicopter for rigging of the cyclic control system as follows.

NOTE: A precision vernier spirit level propeller protractor graduated in increments of one-tenth of a degree is required to perform rigging procedures.

(1) Level the helicopter. (Refer to Section 10.)
(2) Adjust the length of the left-hand (lateral) engine snubber assembly so that the main rotor drive shaft is vertical (± 0.2 degree) when viewed from the front of the helicopter. Place a spirit level protractor

vertically along either side surface of the main rotor drive shaft to determine the position of the shaft.

(3) Adjust the length of the aft (longitudinal) engine snubber assembly so that the main rotor drive shaft is inclined forward from the vertical 1.0 degree (± 0.2 degree) when viewed from either side. Place a spirit level protractor vertically along either the front or the back surface of the main rotor drive shaft to determine the position of the shaft.

(4) Disconnect the lateral and longitudinal trim spring rods from the trim motors.

(5) Recheck the level of the helicopter and the position of the main rotor drive shaft laterally and longitudinally.

b. Rig the cyclic control system as follows:

(1) Tighten the friction clamp on the forward end of cyclic torque tube so the cyclic control stick is in (neutral) position 1.0 degree (± 0.2 degree) to the right of vertical.

(2) Remove shims from the left-hand pillow block and retighten block bolt while the right-hand cyclic shaft arm is inclined forward from the vertical position 1.0 degree (± 0.2 degree).

(3) Adjust the length of the longitudinal pushrod assembly so that the cyclic control stick is inclined aft (neutral) from the vertical position 3.0 degrees (± 0.2 degree).

NOTE: Thread the shanks of the rod end bearings into the pushrods at least as far as the 1/16-inch witness holes at each end of the pushrods. Make certain that rod end bearing lubrication fittings (lubricated type bearing only) are accessible in the installed position. Turn the rod end bearings one-half turn to gain access to the fittings if necessary.

(4) Check the neutral position of the control stick by (a) placing a spirit level protractor vertically on the machined surface of the forward face of the stick lower end fitting to determine the fore and aft position of the stick, and (b) by placing the protractor vertically on the side face of the stick end fitting to determine the side-to-side position of the control stick.

(5) Adjust the length of the lateral control pushrod assembly between the cyclic control stick torque tube assembly and the short arm of the bellcrank in the under-seat bracket so that the long arm of the bellcrank is parallel to the seat bulkhead (station 44.75).

(6) Adjust the length of the lateral pushrod assembly between long arm of the bellcrank in the under-seat bracket and the long (lower) arm of the outboard bellcrank in the lower firewall bracket so that the long (lower) arm of the outboard bellcrank in the lower firewall bracket is vertical (± 0.2 degree).

(7) Adjust the length of the longitudinal pushrod assembly between the cyclic shaft control arm and the inboard bellcrank in the lower firewall bracket so that the long (lower) arm of the inboard bellcrank in the lower firewall bracket is vertical (± 0.2 degree).

(8) Adjust the length of the pushrod assembly between the top center of the upper firewall bracket link assembly and the main transmission bracket so that the distance between the rod end bearing centers is 8.25/8.31 inches.

(9) Adjust the length of the pushrod assemblies between the bellcranks in the lower firewall bracket and the bellcranks in the upper firewall bracket so that the long (upper) arms of the bellcranks in the upper firewall bracket are inclined 26.0 degrees (± 2.0 degrees) forward and outboard from the vertical.

(10) Adjust the length of the lateral pushrod assembly between the aft bellcrank in the upper firewall bracket and the aft bellcrank in the main transmission bracket so that the long upper arm of the aft bellcrank in the main transmission bracket is inclined 33.0 degrees (± 2.0 degrees) forward and outboard from the vertical.

(11) Adjust the length of the longitudinal pushrod assembly between the forward bellcrank in the upper firewall bracket and the forward bellcrank in the main transmission bracket so that the long (upper) arm of the forward bellcrank in the main transmission bracket is inclined 26.0 degrees (± 2.0 degrees) forward and outboard from the vertical.

NOTE: Before proceeding with the next steps, raise the nose jack so that the main rotor drive shaft is vertical (± 0.2 degree) when viewed from either side of the helicopter. Recheck to determine that the shaft is vertical (± 0.2 degree) when viewed from the front of the helicopter.

(12) Adjust the length of the lateral pushrod assembly between the aft bellcrank in the main transmission bracket and the right-hand side of the wobble plate so that the wobble plate is inclined 0.7-degree (± 0.5-degree) downward from the horizontal on the left-hand side of the main rotor shaft (tilted to the left).

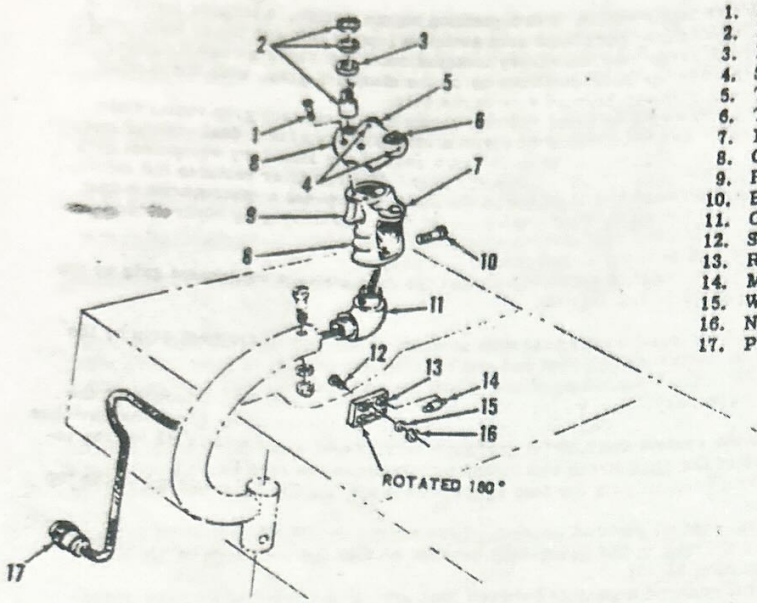
(13) Adjust the length of the longitudinal pushrod assembly between the forward bellcrank in the main transmission bracket and the forward side of the wobble plate so that the wobble plate is inclined 0.5-degree (± 0.2 degree) downward from the horizontal on the aft side of the main rotor shaft (tilted aft).

(14) Loosen the clamp on cyclic torque tube and reinstall shims in left-hand pillow block.

(15) Adjust the stop screw on the long (lower) arm of the inboard bellcrank in the lower firewall bracket to limit wobble plate travel to 8.0 to 8.5 degrees downward from the horizontal on the forward side of the main rotor shaft (forward tilt).

(16) Adjust the stop screw on the long (lower) arm of the outboard bellcrank in the lower firewall bracket to limit wobble plate travel to 7.7 to 8.3 degrees downward from the horizontal on the right-hand side of the main rotor shaft (tilted to the right).

(17) Adjust the stop screw on the short (upper) arm of the inboard bellcrank in the lower firewall bracket to limit wobble plate travel to 9.0 to 9.2 degrees upward from the horizontal on the forward side of the main rotor shaft (tilted aft).



1. Screw
2. Landing Light Toggle Switch Assy
3. Landing Light Switch Adapter
4. Setscrew
5. Trim Switch
6. Two-position Toggle Switch
7. Push-button Switch
8. Cyclic Control Stick Grip
9. Radio (trigger) Switch
10. Bolt
11. Grip Assembly Adapter
12. Screw
13. Rectifier Mounting
14. Microphone Rectifier
15. Washer
16. Nut
17. Plug Connector

Figure 33-201-1. Auxiliary Cyclic Control Stick Grip Installation

(18) Adjust the stop screw on the short (upper) arm of the outboard bellcrank in the lower firewall bracket to limit wobble plate travel to 7.7 to 8.3 degrees upward from the horizontal on the right-hand side of the main rotor shaft (tilted to the left).

NOTE: Before proceeding with the next steps, lower the nose jack so that the main rotor drive shaft is again inclined 1.0 degree (± 0.2-degree) forward from the vertical. Recheck to determine that the shaft is still vertical (± 0.2-degree) when viewed from the front of the helicopter.

(19) Add or remove washers from the head of the cyclic stick stop bolt to limit the control stick to 0.5-degree overtravel. The stop bolt is located in the upper surface of the stick yoke, directly aft of the control stick.

(20) Run the longitudinal trim actuator to the full forward control stick position by operating the trim control button located at the top of the control stick grip. Set the control stick in a position 19 degrees (± 0.2-degree) forward from the neutral position (refer to step (3). Adjust the clevis fitting on the longitudinal trim spring assembly until the bolt holes in the clevis and the actuator arm are alined, with no spring deflection. Install the clevis bolt, washer and nut. Tighten the nut finger tight and safety with a cotter pin. Tighten the clevis locknut. Safety the trim spring rod to the clevis fitting with lockwire through the hole provided in the rod. (See figure 33-1-2.)

(21) Neutralize the control stick longitudinally, then run the lateral trim actuator to the full left stick limit by moving the trim control button to the left. Set the control stick in a position 6.5 degrees (± 0.2-degree) to the left of the neutral position (refer to step (1). Adjust the clevis fitting on the trim spring assembly until the bolt holes in the clevis and actuator arm are alined, with no spring deflection. Install the clevis bolt, washer and nut. Tighten the nut finger tight and safety the trim spring rod to the clevis fitting with lockwire through the hole provided in the rod. (See figure 33-1-2.)

(22) Remove all loose equipment and tighten and safety the various nuts, bolts and screws in the system. Take care that none of the lockwire interferes with the system operation.

(23) Check the cyclic control system for free movement and full travel.

CAUTION: A FLIGHT TEST IS REQUIRED TO COMPLETE ANY FLIGHT CONTROL RIGGING OPERATION.

33-101-40. MAINTENANCE OF CYCLIC CONTROL SYSTEM. Refer to paragraph 33-1-40.

33-201-1. AUXILIARY EQUIPMENT CYCLIC CONTROL STICK GRIP INSTALLATION. (See figure 33-201-1.)

33-201-2. DESCRIPTION. An auxiliary equipment cyclic control stick grip installation is required whenever either the rescue hoist kit or cargo hook is installed on the helicopter. The auxiliary equipment grip installation consists of a grip assembly, an upper adapter, and a harness and rectifier assembly. The grip assembly

contains five switches: a momentary contact toggle switch, a two-position toggle switch, a trigger switch, a trim switch and a push button switch. The auxiliary equipment grip switches (upper left and lower left) control either the rescue hoist kit installation or the cargo hook accessory installation. The radio switch (trigger) and cyclic trim switch (upper center) are located in the same positions as on the standard grip, with the landing light toggle switch moved from the left-hand to the right-hand side of the grip.

a. The auxiliary equipment grip installation may be used: (1) for single cyclic control grip replacement; (2) for dual cyclic control grip replacement; or (3) in conjunction with a standard grip for a dual control installation. A harness and rectifier assembly, with mounting, is provided as a part of the auxiliary equipment grip installation but is used only if radio equipment is installed in the helicopter. The rectifier isolates the microphone circuit of one grip installation from the other grip installation (if used) to prevent a microphone output power loss. A single rectifier mounting accommodates both rectifiers if dual auxiliary grip controls are installed.

33-201-10. REMOVAL OF THE AUXILIARY EQUIPMENT GRIP. Remove the auxiliary equipment grip by the same method described in paragraph 33-10-20.

33-201-11. INSTALLATION OF AUXILIARY EQUIPMENT GRIP. Install the auxiliary equipment grip by the same method described in paragraph 33-10-21.

33-201-40. MINOR REPAIR AND MAINTENANCE OF THE AUXILIARY EQUIPMENT GRIP. Disconnect the electrical plug connector from its receptacle in the seat deck structure. Check the operation of all the switches by using an ohmmeter at the pins of the plug connector. Refer to the wiring diagrams of Section 83 for the installation connections that apply to each accessory. Replace a defective switch as follows:

a. Separate the top and bottom halves of the grip by removing the two attaching screws recessed in the top of the grip.
b. Remove the slotted head bolt from the base of the grip.
c. Remove the wire clamp from the electrical cable and push a small amount of wire slack into the cyclic stick.
d. Carefully slide the grip from the cyclic stick.
e. Remove the headless setscrew prior to removal of the trim switch or auxiliary equipment switch.
f. Carefully remove, disconnect and replace the defective switch.

WOBBLE PLATE

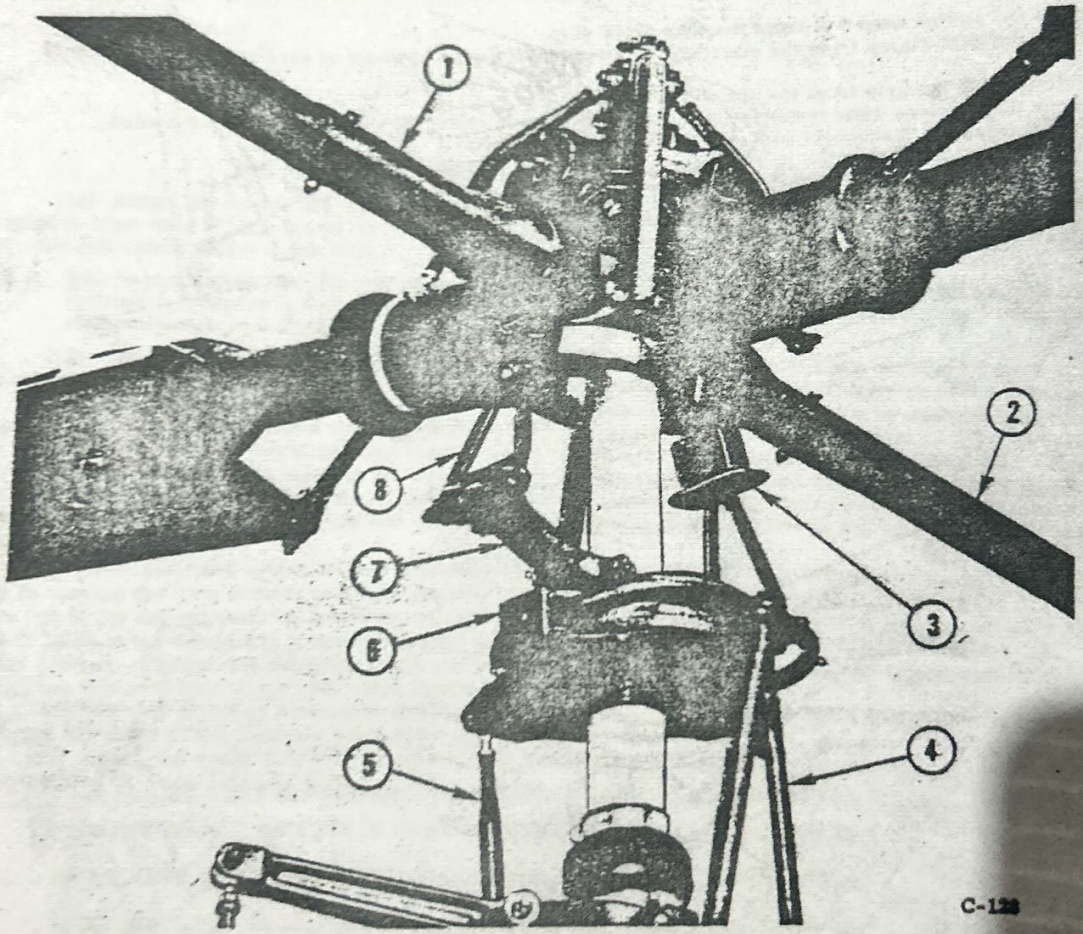
34-1-1. WOBBLE PLATE AND SCISSORS.

34-1-2. DESCRIPTION. (See figure 34-1-1.) The principal function of the wobble plate and scissors assembly is to transmit forward, aft and lateral motions of the cyclic control stick to the control rotor and thus produce the desired main rotor tilt. The entire assembly is supported on the main rotor drive shaft. Pivot joint action is provided between the upper scissors and the control rotor cuff.

34-1-10. REMOVAL OF WOBBLE PLATE AND SCISSORS.

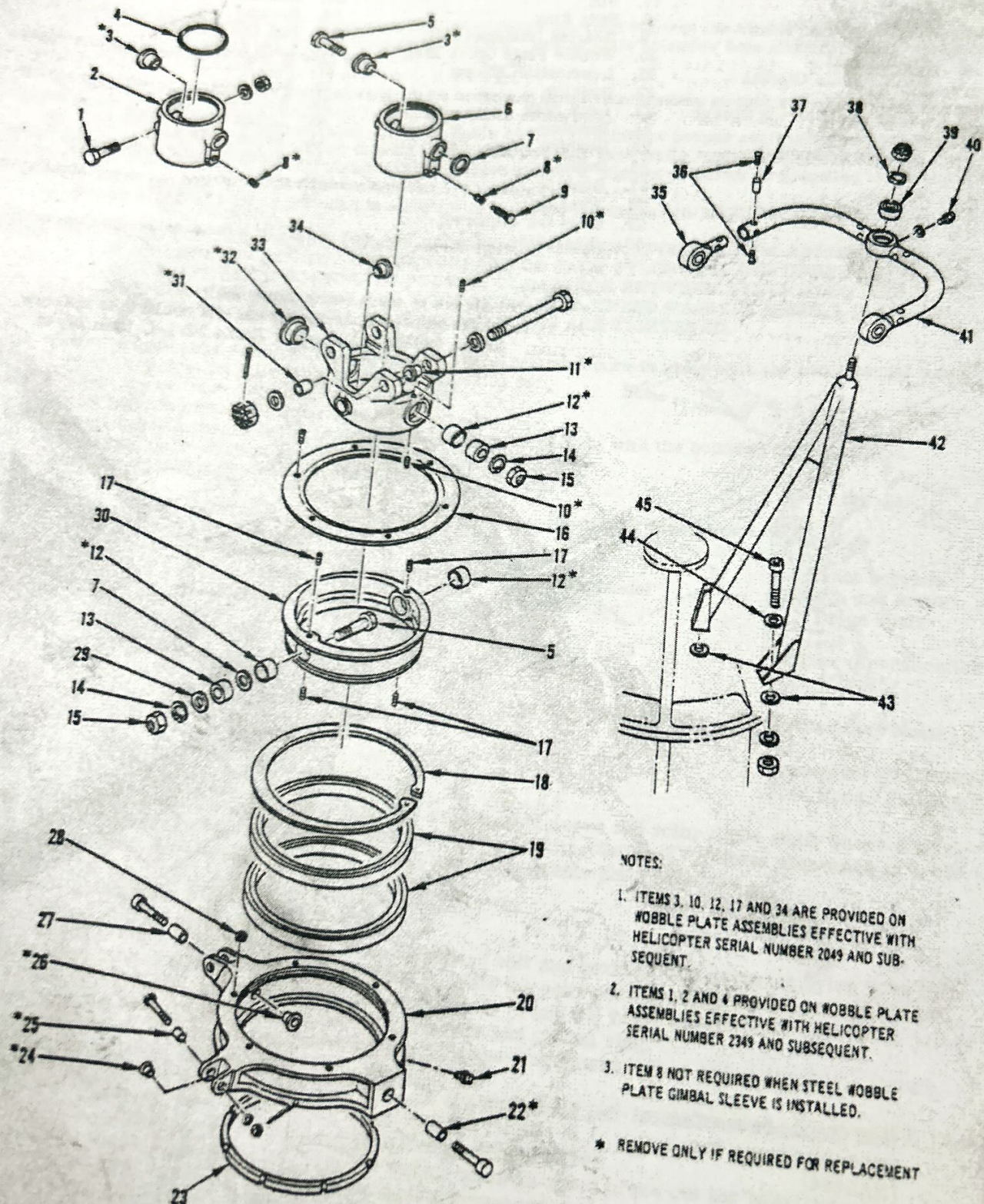
NOTE: Use colored paint or chalk to indicate that side of the assembly which the scissors and the control rotor blade nuts and bolts are removed.

a. Remove main rotor assembly. (Refer to Section 50.)
b. Disconnect wobble plate from the two push rods.
c. Disconnect pylon yoke from pylon assembly.
d. Remove setscrew holding wobble plate gimbal sleeve to main rotor drive shaft.
e. If required, remove scissors assemblies from the wobble plate, being careful not to lose spacers located between the lower scissors and gimbal ring. Attach wobble plate puller (table 92-1-I, Item 18) to remove wobble plate from drive shaft.



1. Cuff and Trunnion
2. Control Rotor
3. Cyclic Scissor Boot
4. Wobble Plate Pylon
5. Longitudinal Pushrod
6. Wobble Plate
7. Lower Scissor Arm
8. Upper Scissor Arm

Figure 34-1-1. View of Upper Cyclic Controls Installation



NOTES:

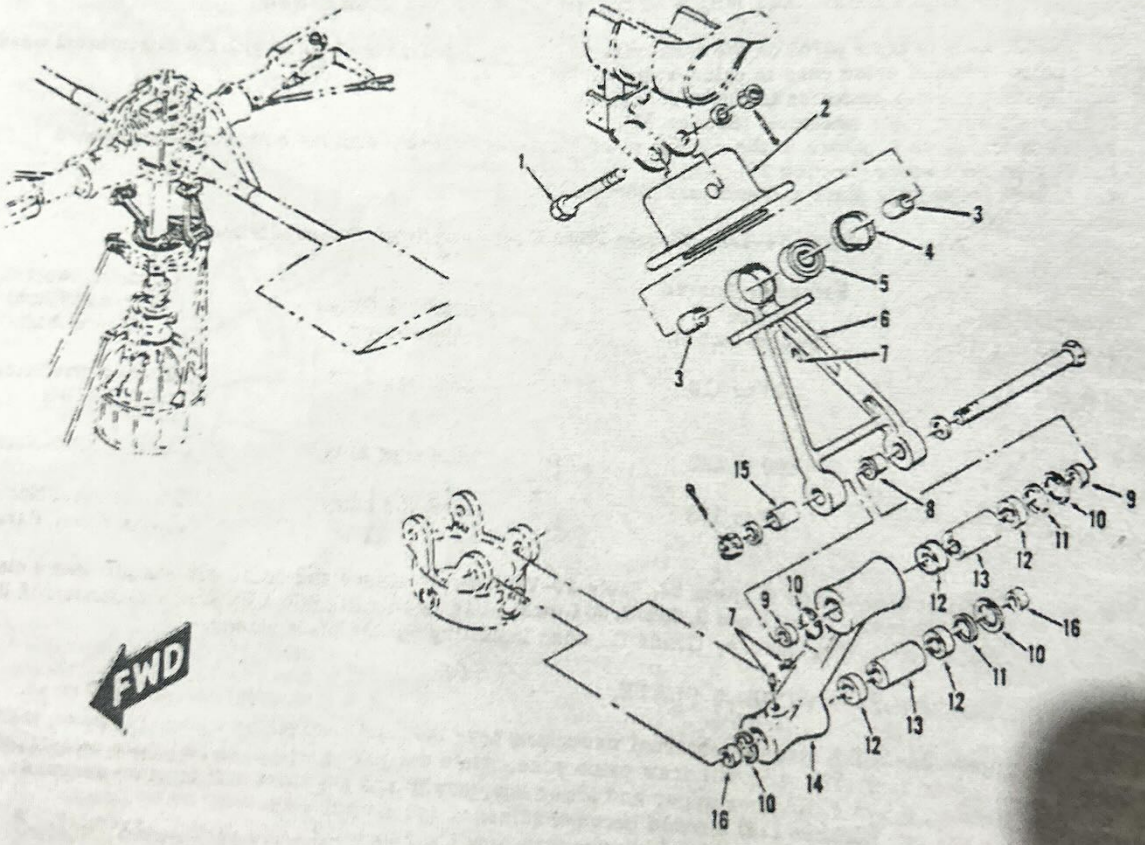
1. ITEMS 3, 10, 12, 17 AND 34 ARE PROVIDED ON WOBBLE PLATE ASSEMBLIES EFFECTIVE WITH HELICOPTER SERIAL NUMBER 2049 AND SUBSEQUENT.
2. ITEMS 1, 2 AND 4 PROVIDED ON WOBBLE PLATE ASSEMBLIES EFFECTIVE WITH HELICOPTER SERIAL NUMBER 2349 AND SUBSEQUENT.
3. ITEM 8 NOT REQUIRED WHEN STEEL WOBBLE PLATE GIMBAL SLEEVE IS INSTALLED.

* REMOVE ONLY IF REQUIRED FOR REPLACEMENT

Figure 34-1-2. Wobble Plate and Pylon Assembly

INDEX FOR FIGURE 34-1-2

1. Bolt (sleeve clamp-up)
2. Wobble Plate Gimbal Sleeve Assy
3. Flanged Bushing
4. O-Ring Packing
5. Gimbal Bolt
6. Wobble Plate Gimbal Sleeve Assy
7. Laminated Bearing Spacer
8. Thread Insert
9. Tapered Setscrew
10. Pin
11. Bushing
12. Bushing
13. Bearing
14. Snap Ring
15. Nut
16. Ring Shield
17. Pin
18. Snap Ring
19. Bearing (matched set)
20. Wobble Plate Outer Ring
21. Lubrication Fitting
22. Bushing
23. Lock Ring
24. Bushing
25. Bushing
26. Insert
27. Bushing
28. Washer
29. Shim (as required)
30. Inner Ring
31. Bushing
32. Bushing
33. Gimbal Ring
34. Bushing
35. Rod End Bearing
36. Lock Screw
37. Roll Pin
38. Snap Ring
39. Bearing
40. Lubrication Fitting
41. Pylon Yoke Assy
42. Wobble Plate Pylon Assy
43. Washer
44. Special Washer (MS20002-C5)
45. Bolt (internal wrenching head)



1. Bolt (Scissors-to-Control Rotor Incidence Bracket) [NAS464]
2. Boot
3. Spacer
4. Retainer Ring
5. Bearing
6. Upper Scissor Arm
7. Lubrication Fitting
8. Bushing
9. Spacer Bushing
10. Retainer Ring
11. Shim
12. Bearings (Matched Bearing Sets)
13. Spacers (Matched Spacer Sets)
14. Lower Scissor Arm
15. Bushing
16. Spacer

Figure 34-1-3. Cyclic Scissors Assembly

34-1-11. INSTALLATION OF WOBBLE PLATE AND SCISSORS. Assemble and install all parts according to their identification coding, as marked prior to disassembly.

NOTE: Refer to table 34-1-I for acceptable sealant or lubricant used between the wobble plate sleeve and rotor drive shaft. When primer is used as the sealant, wobble plate setscrew hole alignment shall be accomplished while primer is still wet.

a. Carefully slide wobble plate on rotor drive shaft and lower into position so that setscrew holes in sleeve and rotor drive shaft are aligned for installation of setscrew.
b. Tighten setscrew to torque value shown in Table 34-1-I. To insure proper seating of taper on setscrew, apply rotational force by hand pressure to wobble plate gimbal ring ears while applying specified torque to setscrew. If wobble plate is fitted with split type aluminum sleeve, tighten setscrew to specified torque before tightening clamp-up bolt to standard torque.
c. Secure setscrew to hole provided in sleeve with lockwire (Specification MS20995C32).

CAUTION: WHEN INSTALLING THE PYLON, INSTALL SUFFICIENT AN960PD516 OR AN960PDL516 WASHERS BETWEEN THE LOWER SURFACE OF EACH PYLON LEG AND UPPER SURFACE OF TRANSMISSION HOUSING TO PROVIDE CLEARANCE BETWEEN PYLON FOOT AND TRANSMISSION CASE RADII. FAILURE TO INSTALL THESE WASHERS RESULT IN CRACKING THE PYLON LEGS WHEN ATTACHING BOLTS ARE TIGHTENED.

d. Install wobble plate pylon on the transmission housing and secure in place with the two internal wrenching head bolts. Attach pylon yoke to pylon with self-locking nut.
e. Connect the two pushrods to the wobble plate.
f. Install main rotor assembly [Section 50].
g. Connect upper scissors to the control rotor incidence bracket, with the bolthead facing inward.
h. Rig control rotor [Section 36].
i. Lubricate wobble plate and scissors [Section 10].

Table 34-1-I. Wobble Plate Sleeve and Setscrew Installation

Wobble Plate Sleeve Part No.	Setscrew Torque Value (Pound-Inches)	Helicopter Model Application	Sealant between Sleeve and Rotor Drive Shaft
34120	90 to 110	2001 thru 2123	Primer (Specification MIL-P-8585)
34163	160 to 190	2124 thru 2348	Loctite (See Note)
34038	90 to 120	2349 and subq.	Lubriplate (No. 630AA, Fisk Bros. Refining Co)

Note: Use Loctite, Grade C (item 24, table 10-VI) between sleeve and rotor drive shaft where diametral clearance is between 0.000/0.004 inch. Use Loctite, Grade EV, where clearance is 0.004/0.010 inch. Use Loctite, Grade D, when installing wobble plate setscrew.

34-1-20. DISASSEMBLY OF WOBBLE PLATE.

a. (See figure 34-1-2.) Remove internal wrenching head bolt and hexhead bolt securing pylon yoke (41) to wobble plate outer ring (20), and withdraw pylon yoke. Note the yoke position to facilitate reinstallation.
b. (See figure 34-1-3.) Remove upper and lower scissors (6 and 14) from wobble plate assembly, taking care not to lose the two spacers (16) located between scissors and gimbal ring.
c. (See figure 34-1-2.) Remove the 6 screws attaching the ring shield (16) to ring assembly. Retain shield-to-ring spacer washers (28) (AN960-10).
d. Use lock ring spanner wrench (table 92-1-I, item 40) to remove left-hand threaded lock ring (23) from inner ring (30).
e. Press the wobble plate inner ring from the duplex bearing set (19).
f. Extract wobble plate snap ring (18) from the wobble plate ring and press out the bearings.
g. Tilt gimbal ring for access, and remove nuts (15), laminated spacers (7) and gimbal bolts (5) securing gimbal sleeve (6) to the gimbal ring (33), and remove the gimbal sleeve.
h. Remove nuts (15), laminated spacers (7) and gimbal bolts (5) attaching the gimbal ring to the wobble plate inner ring and separate the two assemblies.
i. Extract snap rings (14) from the gimbal ring and inner ring. Press out the four bearings (13).
j. Remove lubrication fittings (21) from the wobble plate outer ring.