

CHAPTER 10

RIGGING, TRACK AND BALANCE

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CHAPTER 10

RIGGING, TRACK AND BALANCE (Continued)

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CHAPTER 10

RIGGING, TRACK AND BALANCE

10.000 Rigging, Track and Balance10.001 Introduction

This section contains procedures necessary to rig the main rotor flight controls, tail rotor flight controls and throttle correlation. The track and balance procedures in this section are to be used in conjunction with Chadwick-Helmuth balancing equipment instructions.

WARNING

A rotor which is smooth after balancing but then goes out of balance again within a few flights is suspect and must be examined by a RHC-authorized component overhaul facility before further flight.

10.002 Rod End Adjustment Procedures

The following procedure is standard for adjustment of rod ends:

1. Loosen palnut and jam nut on rod end shank.
2. Screw rod end in or out of push-pull tube or pitch link as required to obtain proper rigging adjustment.
3. After any rod end adjustment, verify rod end threaded shank blocks passage of 0.020 inch diameter wire thru the witness hole in the push-pull tube or pitch link as shown in Figure 2-1. When no witness hole is provided, refer to Figure 2-1 for maximum rod end extension.
4. Position rod ends to allow as much push-pull tube or pitch link rotation as possible without binding. Refer to Figure 2-1A.
5. C258-1 main rotor pitch links may require adjustment during rigging or tracking. For collective adjustments, both pitch links must be adjusted exactly the same.

Each main rotor pitch link has coarse, medium, and fine length adjustments:

- a. Coarse length adjustments are made by rotating coarse-threaded section of pitch link. Disconnect upper rod end from blade and loosen jam nut in middle of pitch link only. Increase blade angle by unscrewing C258-2 fitting from lower pitch link. Decrease angle by screwing fitting into lower pitch link. One full turn changes blade angle by approximately 0.88°.
- b. Medium length adjustments are made by rotating upper rod end only. Disconnect rod ends from blade and loosen rod end jam nuts. Increase blade angle by unscrewing rod end from pitch link. Decrease angle by screwing rod end into pitch link. One full rod end turn changes blade angle by approximately 0.48°.

10.002 Rod End Adjustment Procedures (cont'd)

- c. Fine length adjustments are made by rotating only the C258-2 fitting. Upper and lower rod ends remain connected. Loosen jam nuts at upper rod end and in the middle of pitch link. Increase blade angle by screwing fitting out of lower pitch link. Decrease blade angle by screwing fitting into lower pitch link. One full turn of fitting changes blade angle approximately 0.40°.

6. Torque jam nuts and palnuts per Section 1.320 and torque stripe per Figure 2-1.

10.100 Rigging

10.110 Main Rotor Flight Controls

10.111 Cyclic Controls

The cyclic control travel is non-adjustable and is controlled by the A211-3 stop plate attached to cyclic box assembly.

NOTE			
The following push-pull tube assemblies and fork assembly between the keel panels are to be adjusted to the noted center-to-center dimensions:			
C121-1	=	51.03	± 0.03 inches
C121-3	=	32.54	± 0.03 inches
C121-19	=	31.38	± 0.03 inches
A205-3, -5	=	03.80	± 0.03 inches

- a) Refer to Figure 10-1. Place cyclic control in neutral position. Cyclic neutral position is 7.0 inches to the right of full-left travel and at mid-point of total fore and aft travel or use MT559-1 rigging blocks. Place collective control full down.
- b) Apply full cyclic and collective friction.

NOTE
Care must be taken not to move cyclic control from neutral position.

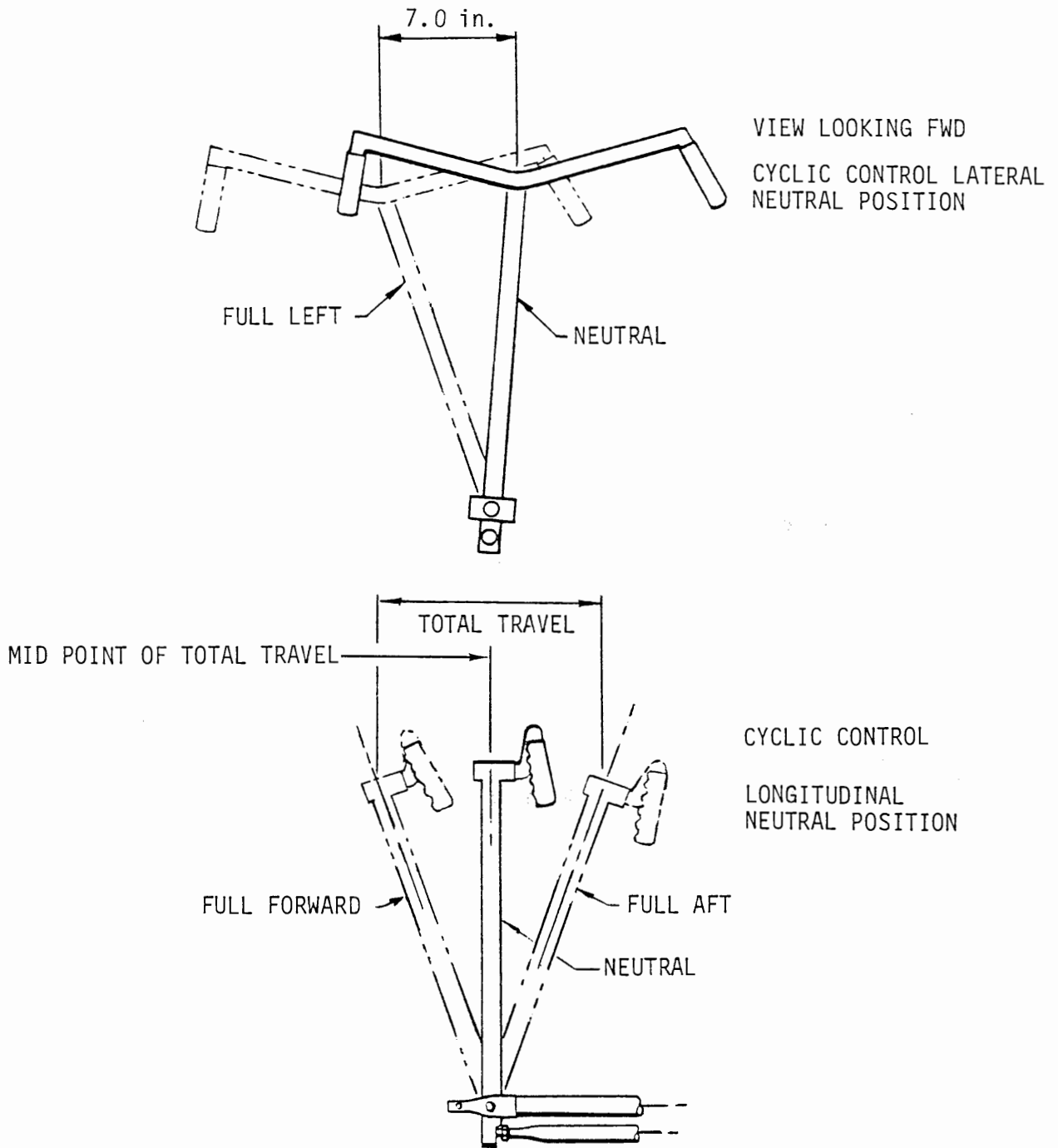


FIGURE 10-1 CYCLIC CONTROL STICK NEUTRAL POSITION

10.112 Swashplate

With the cyclic and collective controls locked in position per Section 10.111, adjust the C121-7 and C121-5 push-pull tubes to obtain a constant clearance from the flange of the C281-1 fitting of 1.069 (see Figure 10-2). MT146-2 swashplate rigging blocks may be used as a spacer to set the 1.069 inch dimension.

10.113 Collective Control

Since the collective slider stop is non-adjustable, this check is to ensure full control travel is obtained and does not interfere with the swashplate travel.

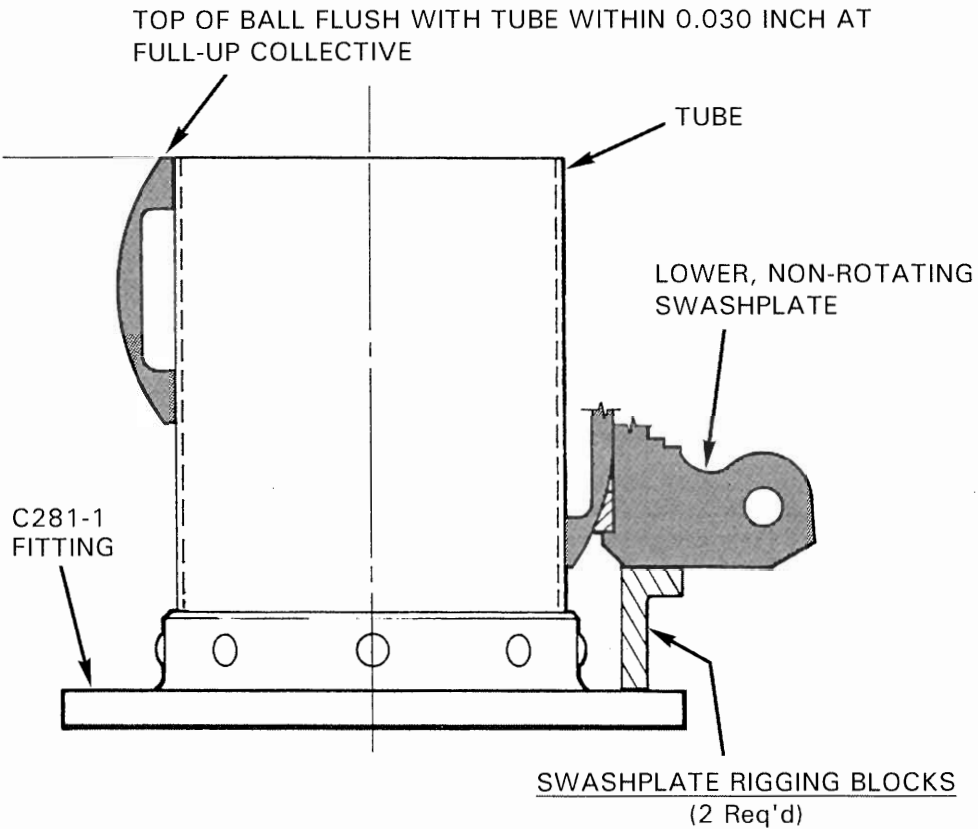
- a) Lift the swashplate boot so the uniball and slider tube may be observed.
- b) Pull the collective control full up. The uniball must be flush with the top of the slider tube within 0.03 inches. If this does not occur, turn the upper rod ends of the C121-5 and C121-7 push-pull tubes in or out equally to raise or lower the swashplate.

10.120 Main Rotor

The main rotor is rigged by determining the average blade angle. Blade angle measurements are taken at the 0.75 radius of the main rotor (or 49.5 inches in from the blade tip).

The main rotor blade angles are measured using the MT525-1 rigging fixture and a Kell-Strom KS113 propeller protractor or a comparable protractor (see Figure 10-4). Use the following procedure to set up for rigging:

- a) Verify that the A205-5 forks at the swashplate are set to the proper length (see Figure 10-3). Measuring to bolt center lines, the lower fork assembly should be 3.70 ± 0.03 inches and the upper fork assembly should be 3.85 ± 0.03 inches.
- b) Level the rotorcraft per Section 1.220 (Method 2, Main Rotor Hub).
- c) Place a tracking stick at the end of one rotor blade and mark the height of the blade tip. Rotate the rotor 180° and mark the height of the opposite blade tip. Teeter the main rotor as necessary to obtain a main rotor track of ± 1 inch.
- d) Zero the propeller protractor to the main rotor hub at the location marked "Level Here". The protractor must be placed parallel to the teeter hinge bolt.



MT146-2 (use with C017-2 Swashplate) 1.069 INCHES high
 MT146-3 (use with C017-4 Swashplate) 0.969 INCH high

FIGURE 10-2 LOWER SWASHPLATE CLEARANCE

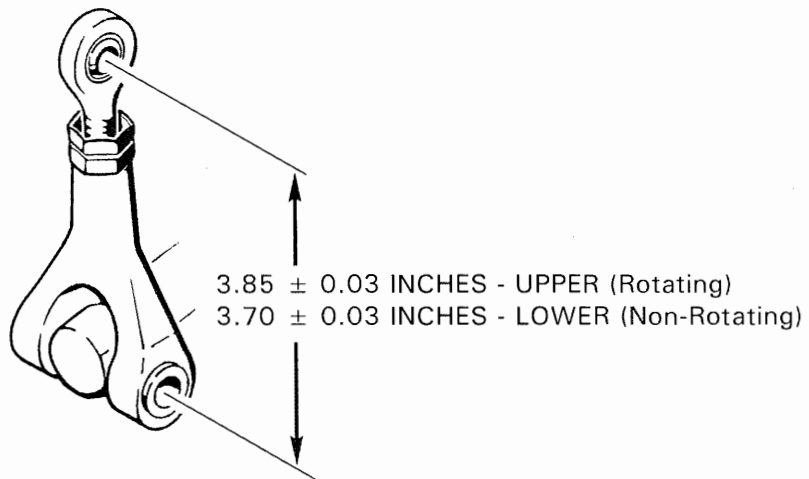


FIGURE 10-3 A205-5 FORK DIMENSIONS FOR SWASHPLATE SCISSORS

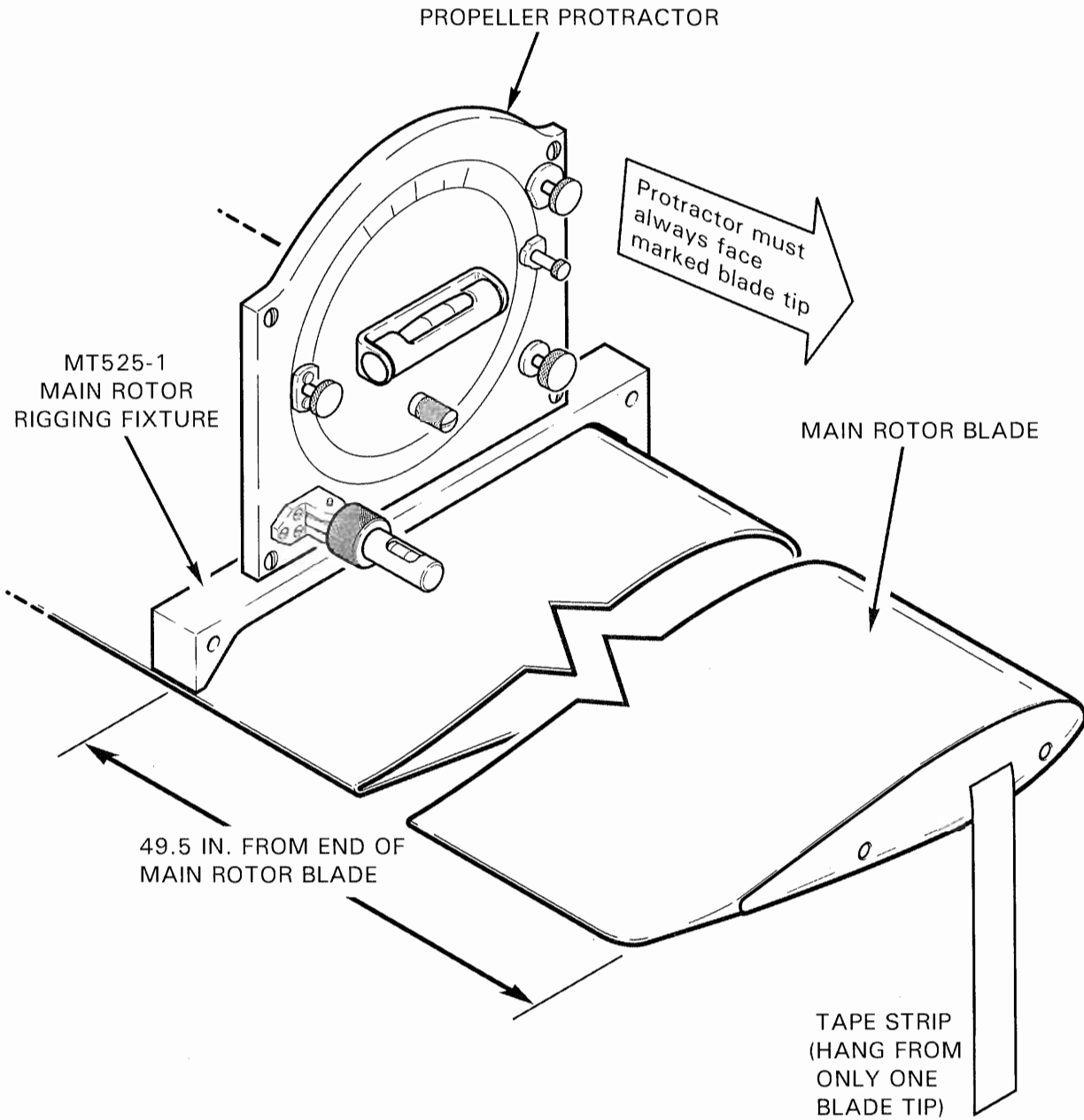


FIGURE 10-4 PLACEMENT OF PROTRACTOR

10.120 Main Rotor (cont'd)**NOTE**

When zeroing the protractor, the face or dial should remain facing one of the rotor blades. Mark this blade with a piece of tape. When making blade angle readings, the face or dial of the protractor must always face the marked blade.

- e) Measure in from the tip of each main rotor blade 49.5 inches and place a piece of 1-inch masking tape chordwise across each blade with the center of the tape over the mark.

WARNING

Do not mark the rotor blades with a ball point pen or other sharp instrument. Use a grease pencil or soft marker. Sharp instruments can scratch the blades skins, causing cracks and fatigue failure of the blade.

- f) Mark each rotor blade with a different color designation such as red or blue. This will be used in recording blade angles.

10.121 Cyclic Travel Rigging**NOTE**

Adjust collective travel rigging before cyclic travel rigging. Hydraulic flight controls must be pressurized prior to measuring blade angles.

- a) Place the collective control full down. Place the cyclic control in the neutral position laterally (7.0 inches to the right of full left travel) and hold against the forward stop.

NOTE

Sand bags may be used to secure cyclic stick against stops to ensure it will not move.

- b) Rotate the blades so the pitch links are aligned with the longitudinal axis of the helicopter. Place the tracking stick at one of the blade tips for reference when rotating the rotor.

10.121 Cyclic Travel Rigging (cont'd)

c) Forward longitudinal cyclic:

- 1) Measure the blade angles and record below. Rotate the rotor 180° and record the blade angles below.

<u>Blue Blade Position</u>	<u>Cyclic Full Forward</u>
Pitch horn aft	_____° nose up
Pitch horn forward	+ _____° nose down
	_____° ÷ 2 = _____°
	(14.25/13.50 degrees required)

<u>Red Blade Position</u>	<u>Cyclic Full Forward</u>
Pitch horn aft	_____° nose up
Pitch horn forward	+ _____° nose down
	_____° ÷ 2 = _____°
	(14.25/13.50 degrees required)

- 2) Adjust the aft swashplate push-pull tube as required (one full turn = 0.44°) to obtain blade angle averages between 13.50° and 14.25°. Additional coarse adjustment is available by simultaneously adjusting the two forward push-pull tubes but they both must be adjusted exactly the same amount.

d) Aft longitudinal cyclic:

- 1) Place the cyclic control in the neutral position laterally and hold against the aft stop.
- 2) Measure the blade angles and record below. Rotate the rotor 180° and record the blade angles below.

<u>Blue Blade Position</u>	<u>Cyclic Full Aft</u>
Pitch horn aft	_____° nose down
Pitch horn forward	+ _____° nose up
	_____° ÷ 2 = _____°
	(14.25/13.50 degrees required)

<u>Red Blade Position</u>	<u>Cyclic Full Aft</u>
Pitch horn aft	_____° nose down
Pitch horn forward	+ _____° nose up
	_____° ÷ 2 = _____°
	(14.25/13.50 degrees required)

10.121 Cyclic Travel Rigging (cont'd)

- 3) Adjust the aft swashplate push-pull tube as required (one full turn = 0.44°) to obtain blade angle averages between 13.50° and 14.25°. Additional coarse adjustment is available by simultaneously adjusting the two forward push-pull tubes, but they both must be adjusted exactly the same amount.

NOTE

If adjustment is required to obtain aft cyclic control blade angles, the forward cyclic must be rechecked.

e) Left Lateral Cyclic:

- 1) Place the cyclic control in the neutral position longitudinally (mid travel) and hold the cyclic against the left stop.
- 2) Rotate the rotor until the pitch links are aligned with the lateral axis of the helicopter. Place the tracking stick at the end of one blade for reference.
- 3) Measure the blade angles and record below. Rotate the rotor 180° and record the blade angles below:

<u>Blue Blade Position</u>	<u>Cyclic Full Left</u>	
Pitch horn right	_____	nose up
Pitch horn left	+ _____	nose down
	= _____	÷ 2 = _____ ° Average (8.5/7.5 degrees required)

<u>Red Blade Position</u>	<u>Cyclic Full Left</u>	
Pitch horn right	_____	nose up
Pitch horn left	+ _____	nose down
	= _____	÷ 2 = _____ ° Average (8.5/7.5 degrees required)

- 4) Adjust either of the two forward push-pull tubes as required (one full turn = 0.6 degree) to obtain blade angle averages between 7.5° and 8.5°.

f) Right lateral cyclic:

- 1) Place the cyclic control in the neutral position longitudinally (mid travel) and hold the cyclic against the right stop.

10.121 Cyclic Travel Rigging (cont'd)

- 2) Measure the blade angles and record below. Rotate the rotor 180° and record the blade angles below:

<u>Blue Blade Position</u>	<u>Cyclic Full Right</u>	
Pitch horn right	_____	nose down
Pitch horn left	+ _____	nose up
	= _____	÷ 2 = _____ ° Average
		(7.0/6.0 degrees required)

<u>Red Blade Position</u>	<u>Cyclic Full Right</u>	
Pitch horn right	_____	nose down
Pitch horn left	+ _____	nose up
	= _____	÷ 2 = _____ ° Average
		(7.0/6.0 degrees required)

- 3) Adjust either of the two forward push-pull tubes as required (one full turn = 0.6 degree) to obtain blade angle averages between 6.0° and 7.0°.

NOTE

If adjustment is required to obtain right cyclic control blade angles, the left cyclic must be rechecked.

10.122 Collective Travel Rigging

- a) Place the cyclic control in the neutral position (see Figure 10-1). Place the collective control full down. Apply full cyclic and collective friction.
- b) Rotate the main rotor to align pitch links with the longitudinal axis of the helicopter. Place the tracking stick at the end of one blade for reference.
- c) Measure the blade angles using the MT525-1 rigging fixture and propeller protractor.

10.122 Collective Travel Rigging (cont'd)

NOTE

The MT525-1 fixture is placed on top of the blade at 49.5 inches from blade tip. The fixture must be held tightly against the leading edge to ensure accurate readings. All measurements must be taken with protractor facing marked blade.

Record blade angles, then rotate rotor 180° and again record angles. Adjust the pitch link of each blade until the two blade angles are within 0.2 degrees of each other when the blade pitch horn is in the forward position. Check the blade angles with each blade pitch horn aft. Average of these angles must be within 0.2 degrees also.

COLLECTIVE FULL DOWN

	<u>Blue Blade</u>	<u>Red Blade</u>
Pitch horn forward	_____ ° nose up	_____ ° nose up
Pitch horn aft	+ _____ ° nose up	+ _____ ° nose up
	_____ ° ÷ 2 = _____ °	_____ ° ÷ 2 = _____ °

(1.0/2.0 degrees required)

- d) Raise collective control to the full up position. Apply full collective friction. Measure the blade angles per Step c) above and record averages below.

	<u>Blue Blade</u>	<u>Red Blade</u>
Pitch horn forward	_____ ° nose up	_____ ° nose up
Pitch horn aft	+ _____ ° nose up	+ _____ ° nose up
	_____ ° ÷ 2 = _____ °	_____ ° ÷ 2 = _____ °

(Average 12.5°/13.5° degrees above collective-down required for rigging; autorotation rpm adjustment will determine final angle)

- e) Track and balance main rotor per Section 10.200.

10.130 Tail Rotor Flight Controls

10.131 Pedals (See Figure 10-5)

Pedal rigging is accomplished as follows:

- a) Insert a 3/16-inch diameter rigging pin through the hole in the right-hand keel panel and the rigging pin holes in the C317-1 bellcrank.
- b) Adjust the C121-9 push-pull tubes as required to obtain a dimension of 2.90 ± 0.03 inches from the pedal to the right hand stop located on the side of the forward console (does not apply to helicopters without stop on lower console).

10.132 C316 Bellcrank (See Figure 10-5)

Remove rigging pin and place left pedal against its stop. Adjust C343-1 push-pull tube to obtain 0.10 - 0.20 inches between C316-1 rod end and bulkhead (0.3 - 0.5 for helicopters without pedal stop on lower console).

10.133 A120-3 Bellcrank

With left pedal at stop, adjust the C121-17 push-pull tube length as required to obtain 0.35 ± 0.03 inch between two faces of pitch control assembly and the housing. (See Figure 10-7).

10.134 Tail Rotor Pitch Links

Adjust the pitch links to a dimension of 2.620 ± 0.010 inches between rod end centers (see Section 8.570).

10.140 Tail Rotor Rigging

- 1) Set up:
 - a) Level the rotorcraft per Section 1.220 (Method 2, Main Rotor Hub).
 - b) Rotate the tail rotor until the blades are parallel to the tailcone.
 - c) Tape a tracking stick to the tailcone at the tip of the fwd blade.

NOTE

A tracking stick can be made using a 1" x 12" strip of aluminum with a 90° bend 2 inches from one end.

- d) Visually align the tail rotor to a zero teeter position and mark the tracking stick where the tip of the tail rotor blade passes.
- e) Rotate the tail rotor 180°, using the forward flex coupling so teeter angle is not disturbed, until the opposite blade tip is aligned with tracking stick. Mark the stick.
- f) Teeter the tail rotor to position the blade tip to the mid point between the marks. Rotate the tail rotor and check that the blades track. Repeat the above procedure as necessary to track the tail rotor.
- g) Place the left pedal against its stop. Mark the tracking stick where the blade tip passes the stick. Place the right pedal against its stop and mark the tracking stick.

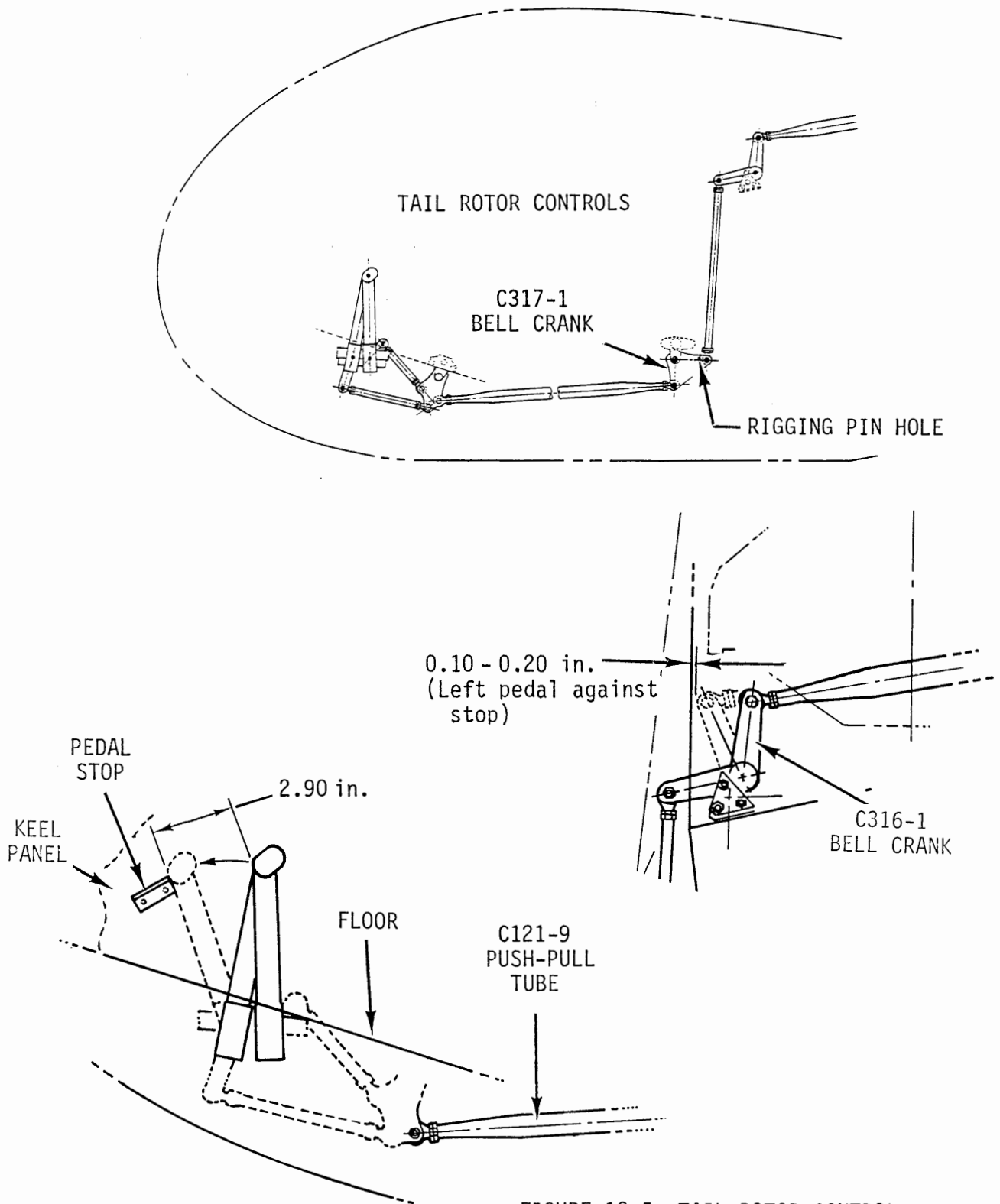


FIGURE 10-5 TAIL ROTOR CONTROL PEDAL RIGGING

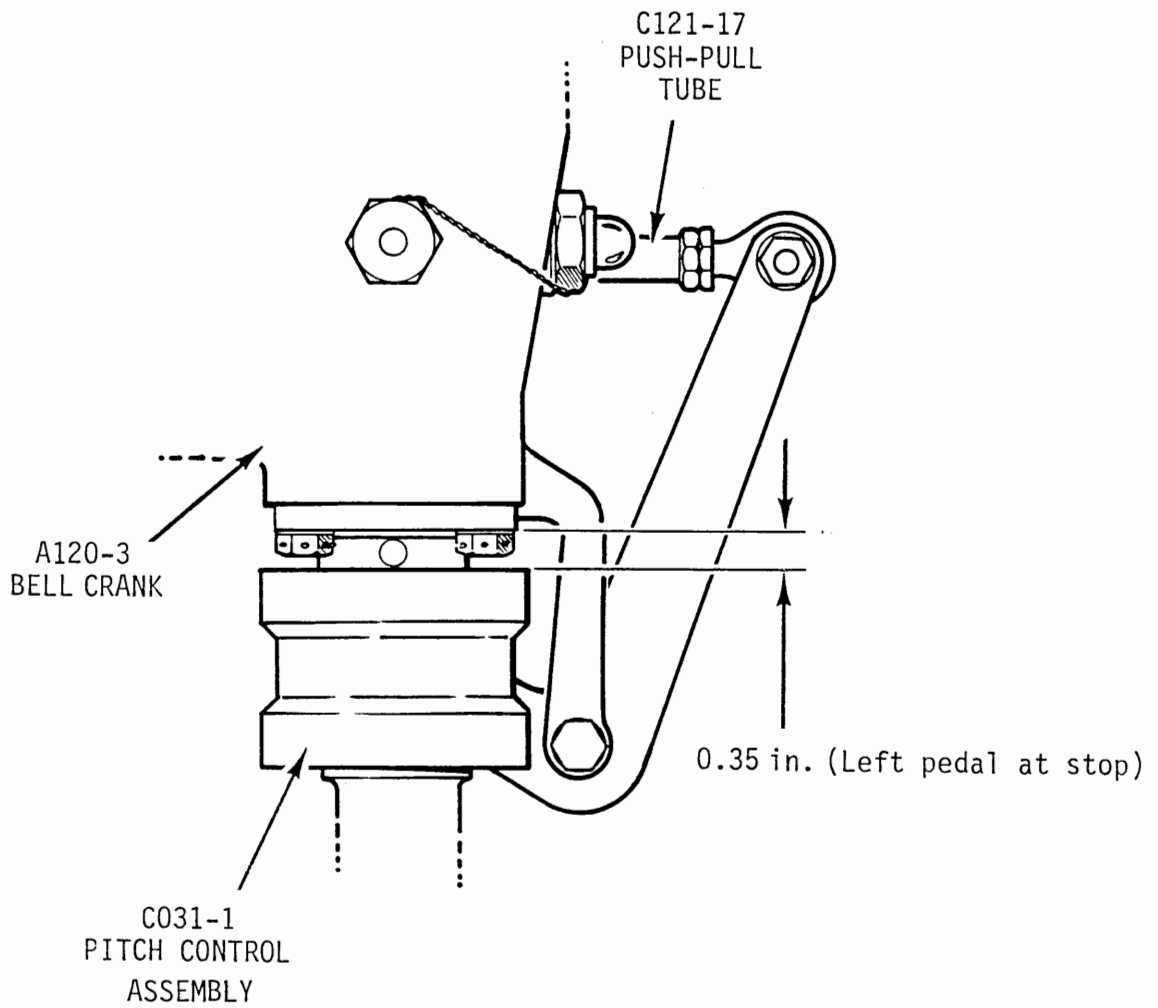


FIGURE 10-6 A120-3 BELL CRANK RIGGING

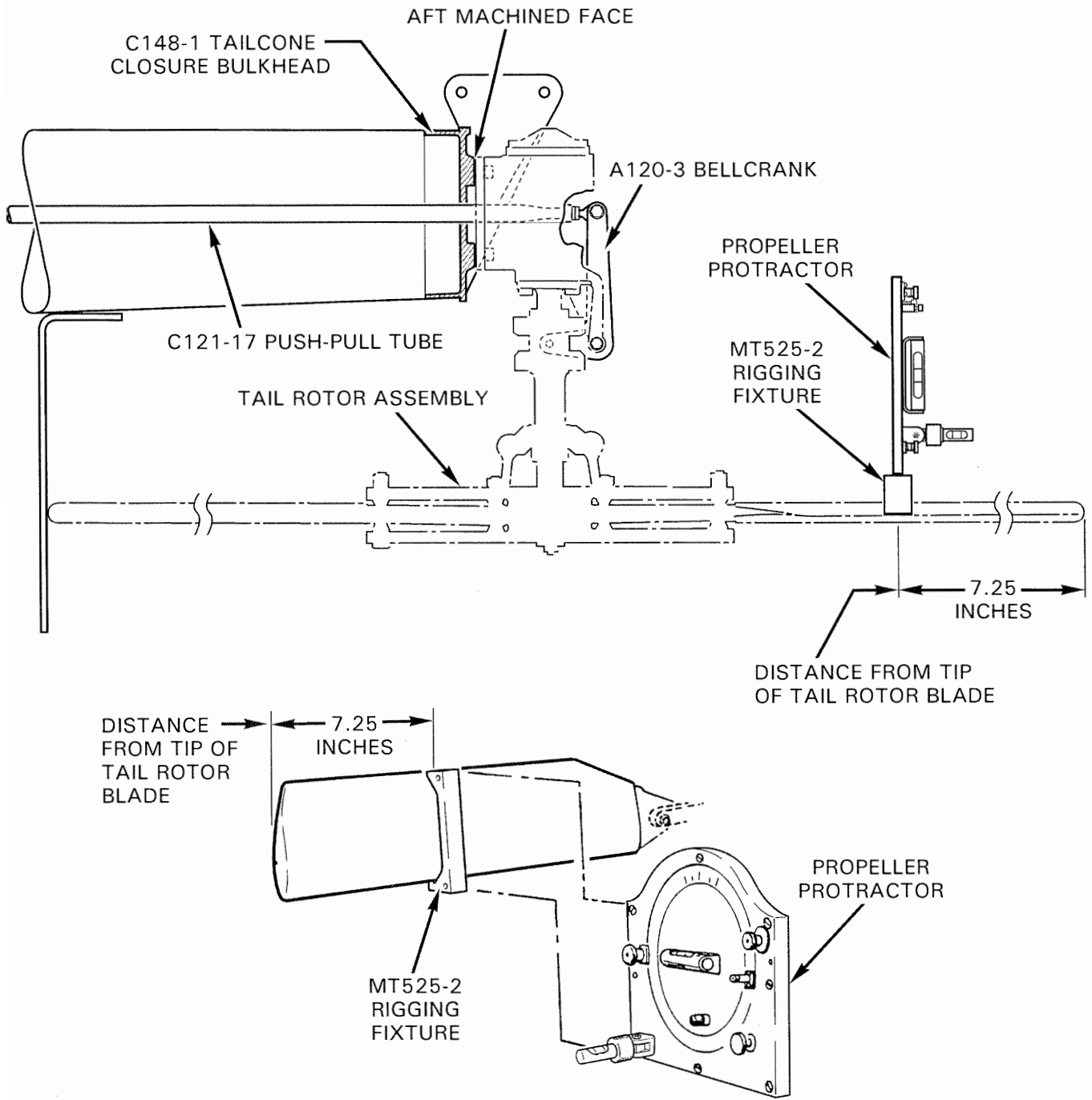


FIGURE 10-7 TAIL ROTOR RIGGING

10.140 Tail Rotor Rigging (cont'd)

2) Measure the tail rotor blade angles as follows:

- a) Using a soft marker or grease pencil mark each blade as red or blue.
- b) Measure in from each blade tip 7.25 inches and place 3/4 inch masking tape chordwise on each blade at this point.
- c) Have someone hold one blade tip at left pedal track mark with left pedal against its stop.
- d) Place MT525-2 rigging fixture on aft blade inboard side.

NOTE

MT525-2 fixture must straddle masking tape.

- e) Using a propeller protractor measure blade angle and record below. Rotate tail rotor 180 degrees and record opposite blade angle.

Pedals Full Left

Blue Blade _____ ° nose right

Red Blade + _____ ° nose right

_____ ° ÷ 2 = _____
 (18.5/19.0 degrees required)

CAUTION

For acceptable track, differences between Blue and Red blade angles must not exceed 0.4 degree. If blade angles cannot be adjusted to within 0.4 degree of each other using adjustable pitch links then remove tail rotor assembly and rotate it one-half revolution, reinstall and repeat above procedure. If blade angles still cannot be adjusted to within 0.4 degree of each other then replace blade(s). Contact factory for blade matching assistance.

NOTE

Adjustable pitch link jam nuts must be tight to ensure accurate blade angle measurements.

10.140 Tail Rotor Rigging (cont'd)

WARNING

Both pitch links must be same part number (same type and material). Mixing one-piece with adjustable-length pitch links is prohibited. Mixing steel one-piece with aluminum one-piece pitch links is prohibited.

- f. Adjustment of blade angles is made using rod ends of C121-17 push-pull tube. One full turn of rod end will change blade angles 0.33 degrees. Adjust rod end as necessary to obtain 18.5 to 19.0 degrees.
- g. Place right pedal against its stop. Measure blade angles and record below using right pedal track mark.

Pedals Full Right

Blue Blade _____ ° nose left

Red Blade + _____ ° nose left

_____ ° ÷ 2 = _____
 (15.5/16.5 degrees required)

- h. Adjust C121-17 push-pull tube as necessary to obtain blade angles of 15.5 to 16.5 degrees.

NOTE

If adjustment is required to obtain right pedal blade angles, left pedal angles must be rechecked.

- i. If blade angle range, for left and right pedal settings, cannot be obtained using above procedure, this indicates pedal travel is either too great or too small. Use following procedure to check and adjust pedal travel:
 - 1) Add right and left pedal angles together. If total is less than 34.0° pedal total travel is too small. If total is greater than 35.5° total travel is too great.
 - 2) If total travel is too small, first increase right pedal travel by increasing length of C121-9 push-pull tube. To increase left pedal travel, decrease length of C343-3 push-pull tube.

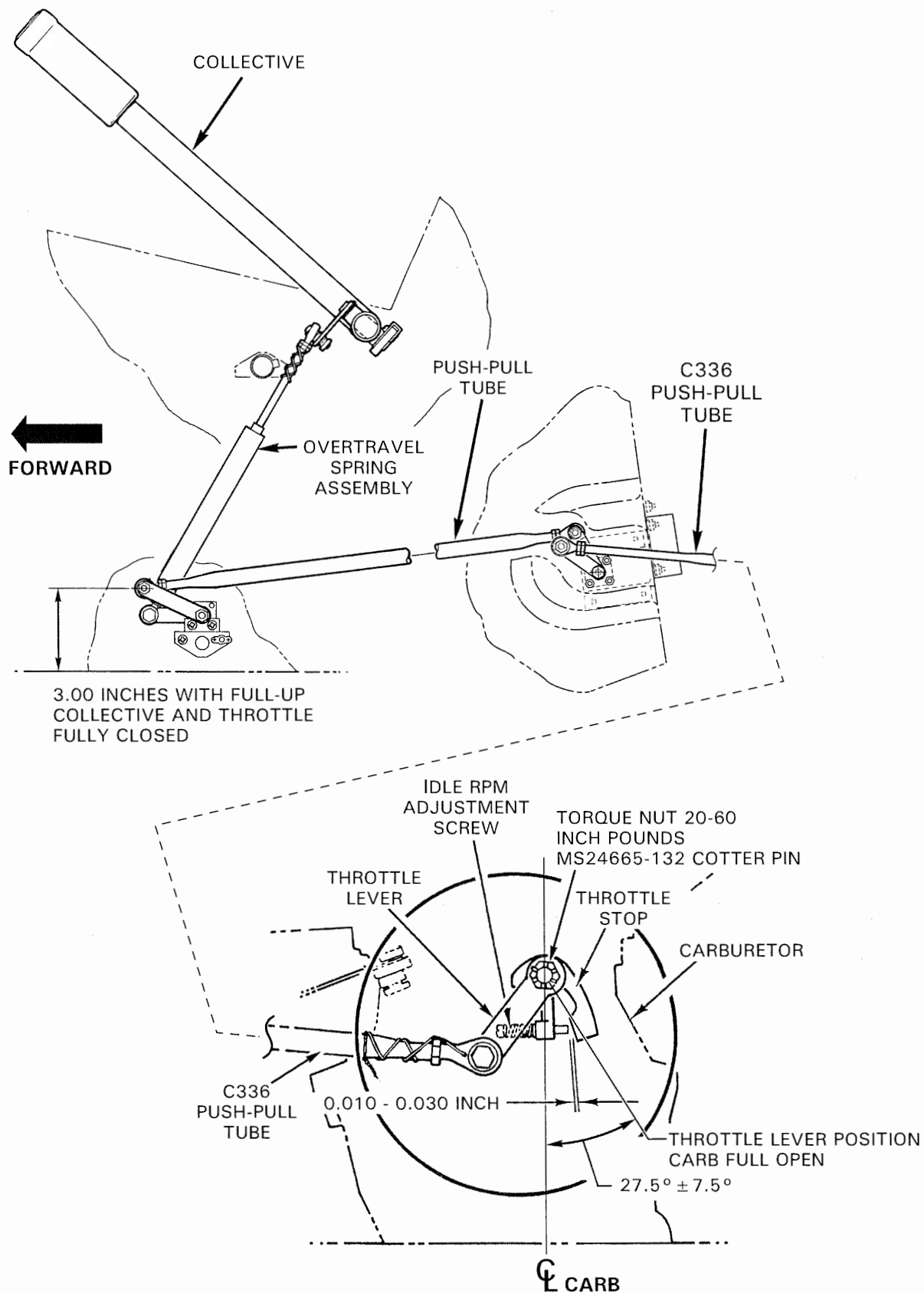


FIGURE 10-8 THROTTLE CORRELATION RIGGING (CARBURETED SHIPS)

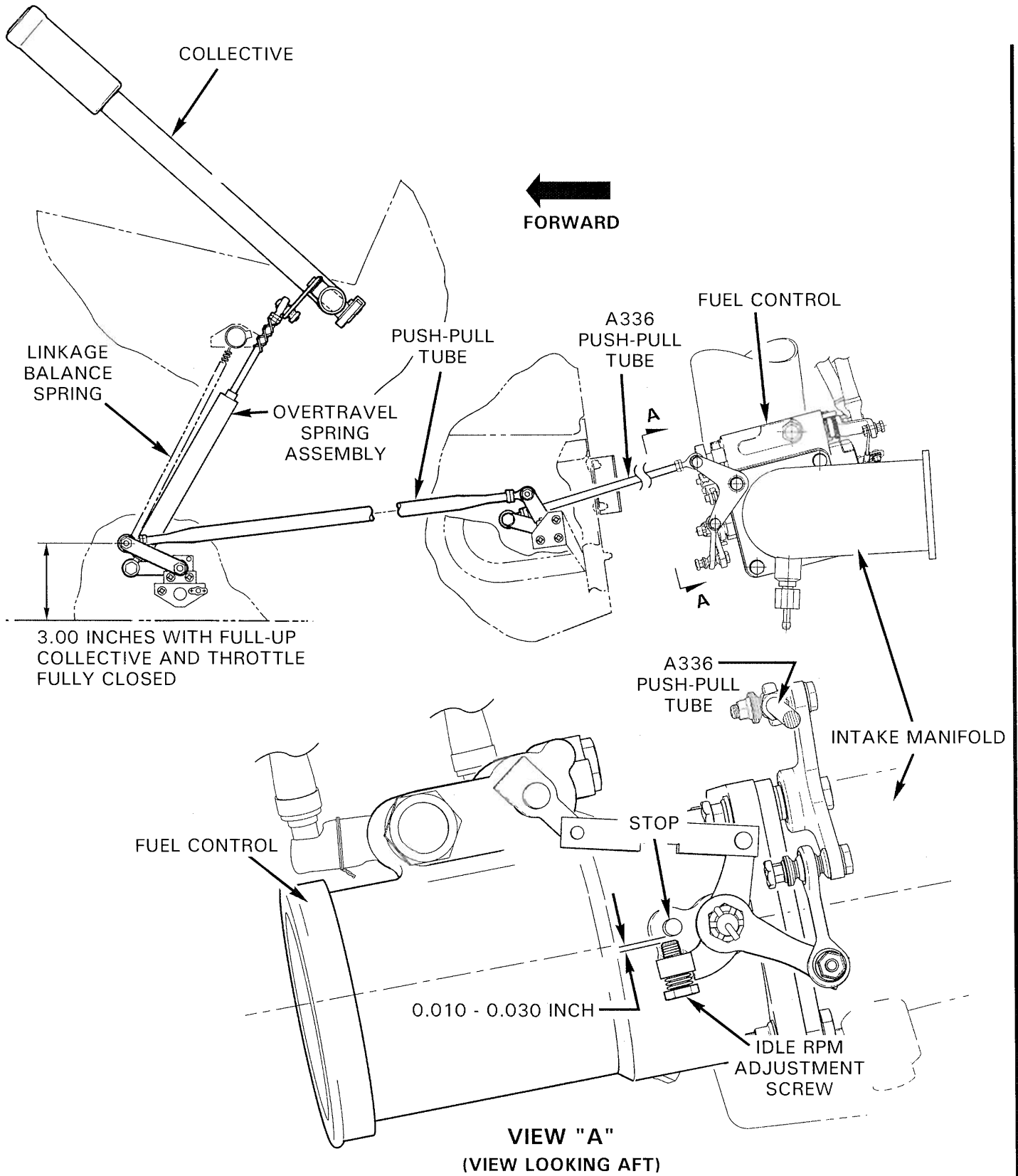


FIGURE 10-8A THROTTLE CORRELATION RIGGING (FUEL INJECTED SHIPS)

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10.140 Tail Rotor Rigging (cont'd)

- 3) To decrease the total travel, shorten the C121-9 push-pull tube for right pedal travel and increase the length of C343-3 or C343-9 push-pull tube for left pedal travel.
- 4) Recheck the tail rotor blade angles per steps e) through h) above.
- j) Ensure all rod ends are installed properly by checking the push-pull tube witness holes. Tighten all rod end palnuts and jam nuts. Torque stripe all nuts.
- k) Balance tail rotor per Section 10.240.

10.150 Throttle Correlation Rigging (see Figure 10-8)

For in-service check and adjustment:

1. Verify idle rpm is correct with engine warm, clutch fully engaged, and throttle closed. Adjust O-540 idle to 53-57% and IO-540 idle to 58-62%.
2. Shut down helicopter.
3. Rotate twist-grip throttle fully closed through overtravel spring pressure to positive stop. Holding throttle tight against stop, raise collective full up while observing throttle arm on carburetor or fuel control, as applicable. Throttle arm should move 0.010-0.030 inch off of idle stop screw when collective up-stop is reached.
4. If necessary, adjust length of throttle push-pull tube at carburetor or fuel control, as applicable.
5. Standard torque jam nut(s) per Section 1.320, check witness holes, and torque stripe per Figure 2-1.

10.160 Actuator Rigging

No field adjustment of actuator-engaged belt tension is permitted. Adjust actuator's down-limit stop screw so there is a delay of less than 5 seconds before rotor starts turning when actuator is engaged at start up.

10.200 TRACK AND BALANCE

The Chadwick-Helmuth Vibrex system, the TEC ACES system, the Dynamic Solutions Systems' MicroVib system, or equivalent equipment is required to perform dynamic rotor balancing and in-flight tracking checks.

10.210 Equipment Requirements

The following list of equipment may be used on the R44 for track and balance:

- a) Balancers
 - Chadwick-Helmuth 177M05
 - Model Number 177M-6
 - 177M-6A
 - 177M-7
 - 177M-7A
 - 8350 series
 - M192 series
 - or equivalent equipment

- b) Strobex
 - Chadwick-Helmuth 135M-10*
 - Model Number 135M-10A*, B* and C*
 - 135M-11
 - or equivalent equipment

* When tracking the main rotor using the 135M-10 series Strobex a double interrupter must be used.

- c) Cables, accelerometers/velocimeters, pickups, and targets**

Chadwick-Helmuth	3140	D.C. Adapter Cable
Model Number	3030	Magnetic pickup
	3319-1 or 10808-25	Magnetic pickup cable
	4177	Accelerometer
	4296-1 and -2	Accelerometer Cable
	3300	Target Patches
	4270	Target Patches
	7310	Velocimeter
	11210-20/-50	Velocimeter Cable

- d) Brackets**
 - Robinson MT121-1 Magnetic Pickup Bracket

- e) Charts**
 - Robinson Main Rotor Chart
 - Tail Rotor Chart

** As required by the balancing equipment being used.

10.220 Equipment Installation

10.221 Main Rotor Equipment Installation (see Figure 10-9A)

Refer to specific manufacturer's installation instructions when using balancing equipment other than Chadwick-Helmuth. Install Chadwick-Helmuth equipment as follows:

- a) Install the accelerometer/velocimeter under the upper console left-side attachment screw with cable connector pointing outboard.

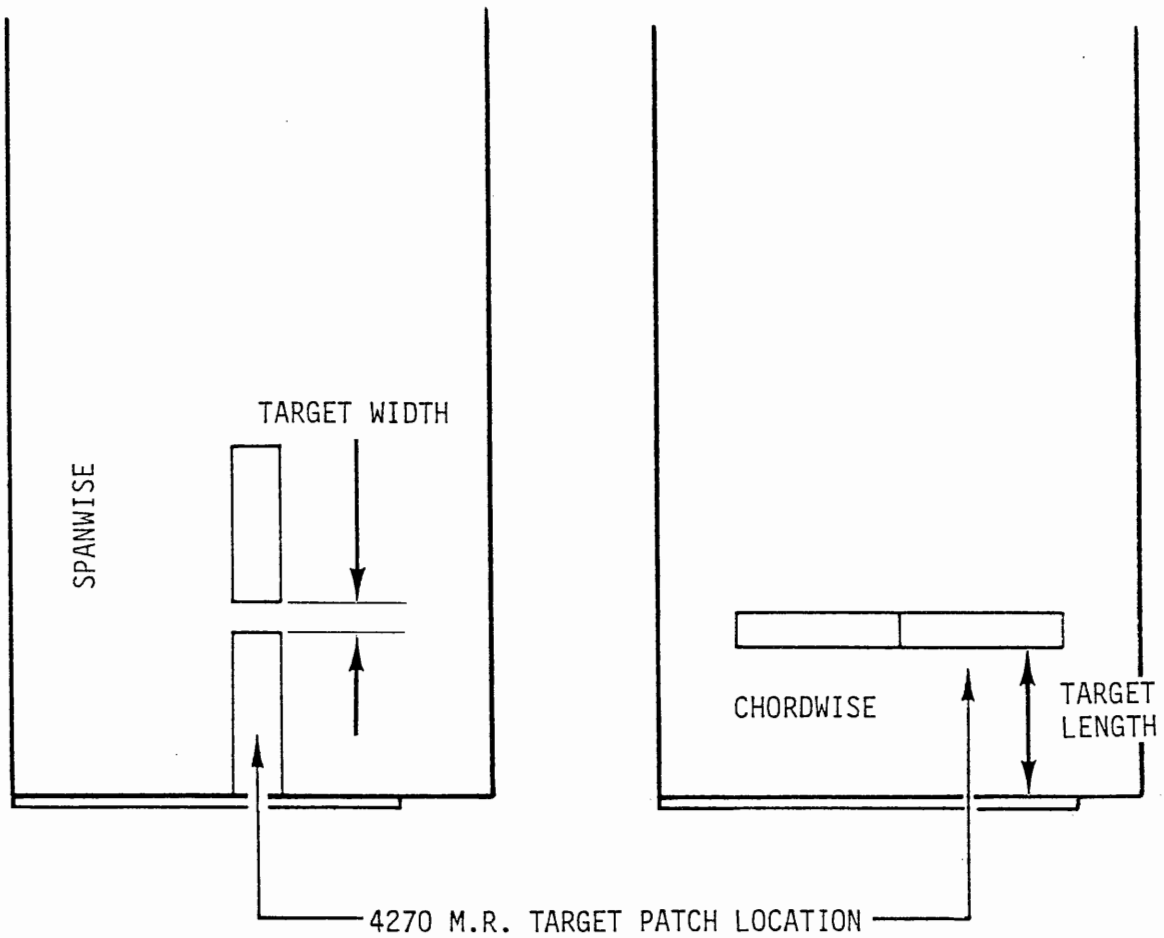


FIGURE 10-9 MAIN ROTOR TARGET PATCH LOCATION

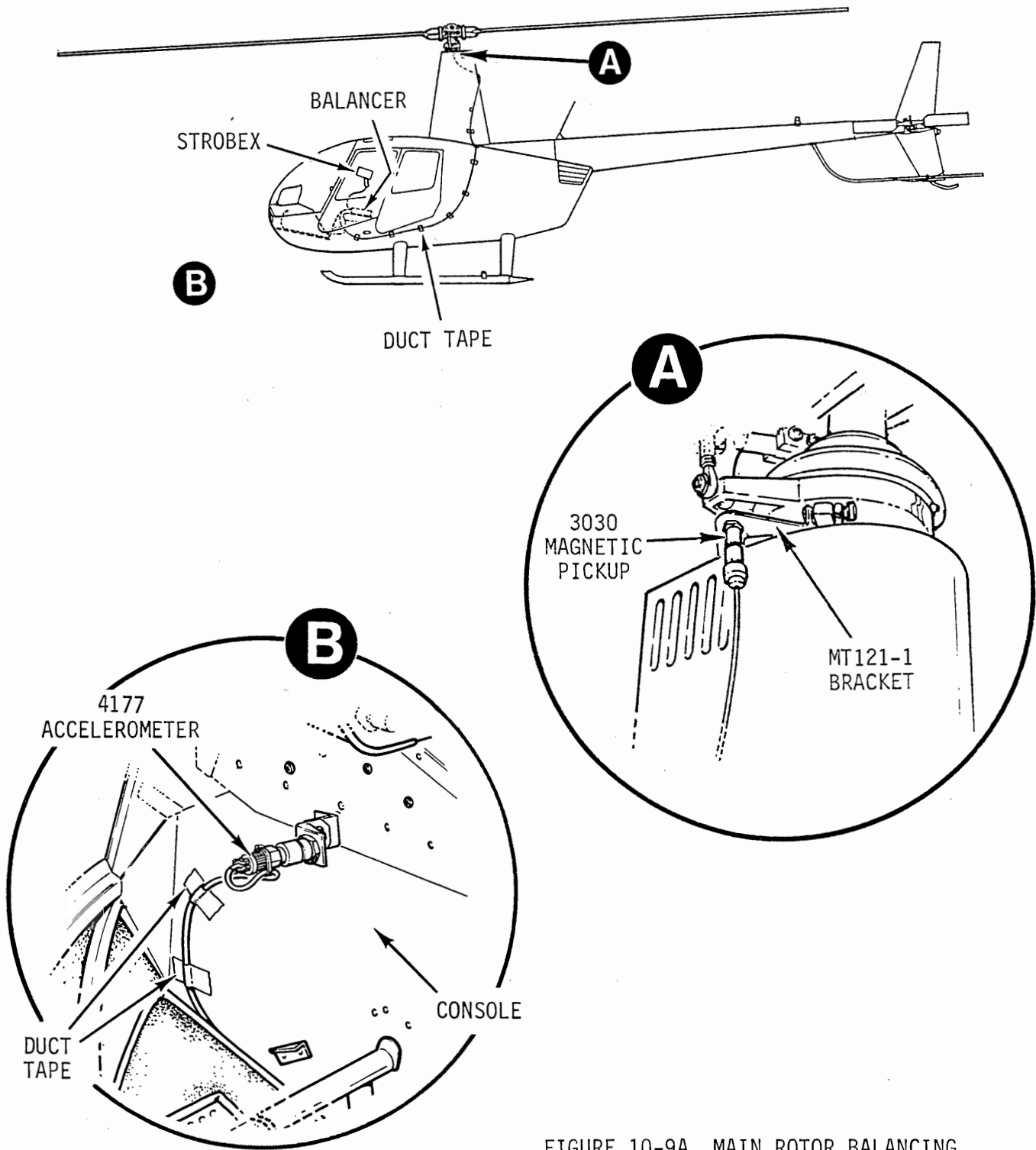


FIGURE 10-9A MAIN ROTOR BALANCING EQUIPMENT INSTALLATION

10.221 Main Rotor Equipment Installation (cont'd)

- b) Install MT121-1 Bracket onto the lower right-hand side of the swashplate.

WARNING

Ensure attachment bolts are torqued to 200 in.-lb plus nut drag. The MT121-1 Bracket will remain installed for in-flight track and balance.

- c) Install the 3030 magnetic pickup onto the MT121-1 Bracket. Set the interrupter pickup gap to $0.030" \pm 0.010"$.
- d) Attach the cable to the magnetic pickup. Pull collective stick full up and cyclic stick full left. Secure the cable to the mast fairing with duct tape. Route the cable to the lower front of the left door frame. Secure the cable every 12 inches with duct tape.

CAUTION

Security of the cable is essential as the helicopter will be flown at Vne.

- e) Attach the cable to the accelerometer/velocimeter mounted on the left forward hold down screw of the console. Secure with duct tape.

CAUTION

Ensure the cable cannot become entangled with tail rotor pedals.

- f) Attach the cables to the balancer and secure excess cable to the bracket in front of the left seat.
- g) Apply the 4270 target tapes to the main rotor blades per Figure 10-9.

10.222 Tail Rotor Equipment Installation (see Figures 10-9C and 10-9D)

NOTE

Prior to installing balancing equipment, verify blades are clean and smooth, no debris under tip covers (square tip blades), rod end and spherical bearing play are within limits, and elastomeric bearings (if applicable) are satisfactory.

1. Install accelerometer/velocimeter bracket under upper forward tail rotor gearbox output seal housing attachment bolt. Connector end of accelerometer/velocimeter must point up.
2. If using a Vibrex 2000-series balancer with photocell, install photocell bracket between velocimeter and velocimeter bracket as shown in Figure 10-9C.
3. If using Strobex to obtain clock angle, install a target tape spanwise facing outboard on one arm of tail rotor hub. If using photocell to obtain clock angle, install a target tape spanwise facing inboard on one arm of tail rotor hub.
4. Connect cable(s) to accelerometer/velocimeter and photocell (if used). Route cable(s) forward and wrap around tailcone several times. Secure with duct tape.

WARNING

Ensure cable(s) cannot entangle tail rotor.

5. If using Strobex to obtain clock angle, route cable to a position located approximately 20 feet to left of tail rotor. Place sandbags (or similar) on cable to prevent cable movement. If using photocell to obtain clock angle, cables may be routed into cabin and secured with duct tape to prevent cable movement.
6. Connect cable(s) to balancer.

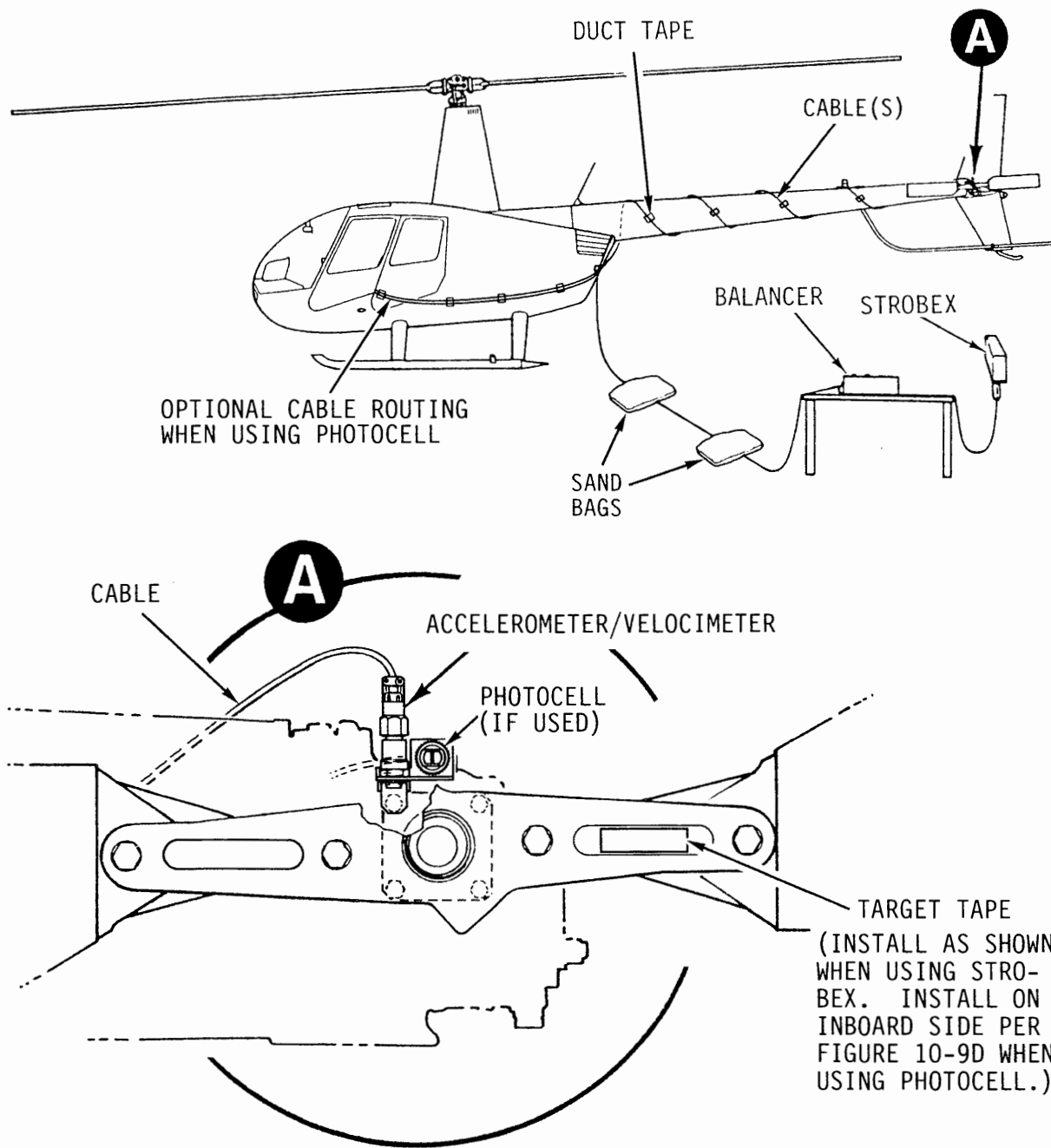
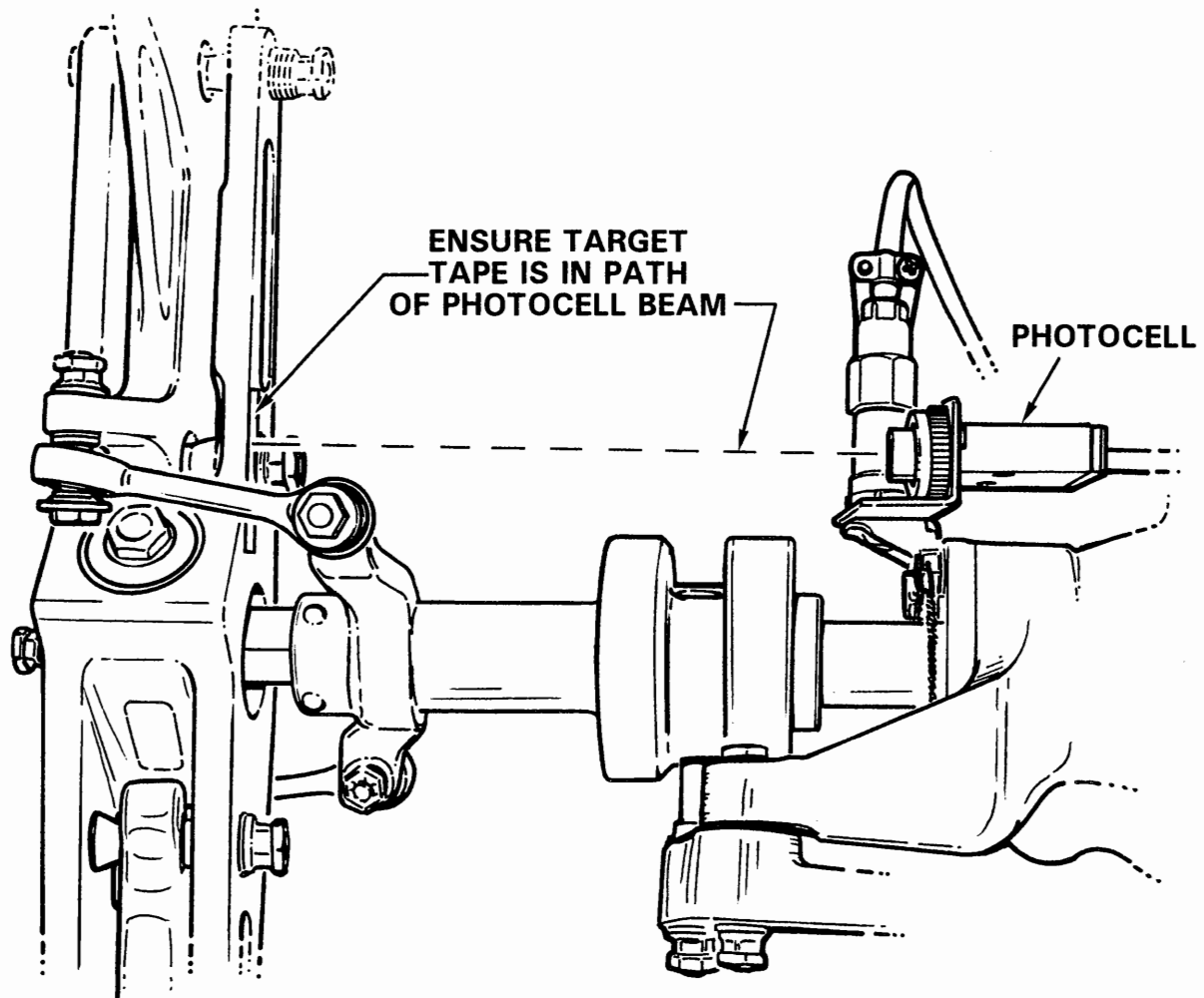


FIGURE 10-9C
TAIL ROTOR BALANCING EQUIPMENT INSTALLATION



(VIEW LOOKING FORWARD)

FIGURE 10-9D

TAIL ROTOR PHOTOCELL INSTALLATION

10.230 Main Rotor Track and Balance Procedure**NOTE**

Prior to installing balancing equipment, verify blades are clean and smooth, rod ends and spherical bearings play are within limits, correct swashplate tilting friction, and correct teeter and coning hinge frictions.

In-flight track and balance is accomplished using the following testing and adjustment sequence:

1. Check main rotor track in a hover. When using Vibrex 177- or 8350-series equipment, place Function knob in track position, RPM (flash rate) on Strobex to 326. Adjust track by shortening high blade pitch link per Section 10.232 to bring track within 0.25 inch.
2. Check main rotor balance in a hover. For Vibrex 177- or 8350-series equipment, place Function knob in "A" position, RPM on Phazor to 408. Adjust balance as indicated by main rotor balance chart (maximum 0.2 IPS).
3. Fly the helicopter at 50, 60, 70, 80, 90, 100, 110, 120, and 130 knots. Check track at each airspeed and record.

WARNING

Do not exceed Vne of helicopter when checking track.

4. Make slight tab adjustment to correct for a climbing blade by bending trim tab down per Section 10.233.

WARNING

Blades with two trim tabs are obsolete and must be removed from service.

5. Repeat Steps 3 & 4 as required until track will remain on at all airspeeds within 3/8 inch.
6. Readjust main rotor balance in a hover (maximum 0.2 IPS).
7. Check autorotational RPM per Section 10.250. Adjust as required.
8. Evaluate collective trim and adjust as required (non-hydraulic aircraft only).
9. Check main rotor balance in a hover. Adjust as required.

10.230 Main Rotor Track and Balance Procedure (cont'd)10.231 Main Rotor Balance Adjustments

Spanwise balance adjustments are made by adding or subtracting weight as indicated by the balance chart. Weight is changed by removing the blade tip cover and changing C298 tip weights. Fine adjustments may be made with AN960-10 or -10L washers and also by trimming washers.

Coarse adjustment of chordwise balance is accomplished by shifting rotor hub (see Section 9.124) as indicated on balance chart. Fine adjustment of chordwise balance is accomplished by adding or subtracting A255-1 or -2 chord weights or AN970-4 washers as indicated by balance chart. A maximum of four A255-2 weights (four A255-2 weights equal twelve A255-1 weights) may be installed.

Three A255-1 Weights = One A255-2 Weight

Eight AN970-4 Washers = A255-1 Weight

10.232 Main Rotor Pitch Link Adjustment

Two length adjustments can be made on the main rotor pitch link. Coarse adjustment is made by loosening upper rod end jam nut, disconnecting rod end from blade pitch horn and turning rod end up or down (one-half turn of rod end changes track approximately 0.25 inch).

Fine adjustment is made by leaving rod end connected to pitch horn and loosening rod end jam nut, loosening barrel jam nut, and then screwing barrel up or down. One barrel revolution is equivalent to one-half turn of rod end. Partial turns of barrel can be made by counting number of hex flats rotated (see Figure 10-11).

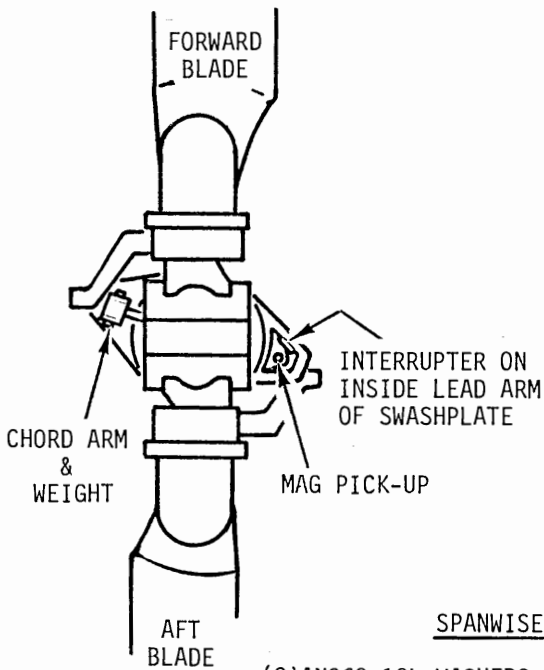
CAUTION

After adjusting pitch link, verify 0.020 inch diameter safety wire cannot pass through witness holes.

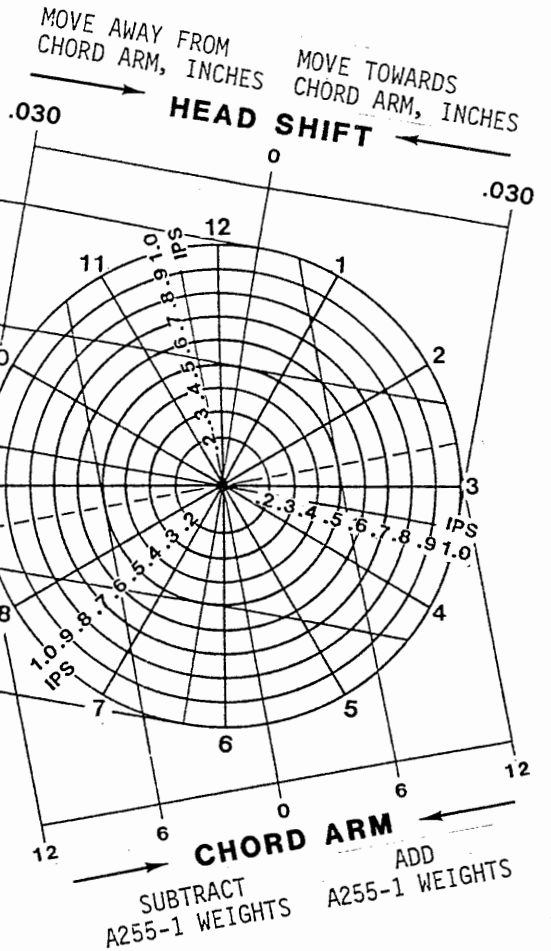
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MAIN ROTOR TRACK AND BALANCE CHART

MOUNT ACCELEROMETER ON LEFT SIDE OF CONSOLE POINTED LEFT



SPANWISE
 ADD TO AFT BLADE AN960-10 WASHERS
 ADD TO FWD BLADE AN960-10 WASHERS



SPANWISE WEIGHTS

- (2)AN960-10L WASHERS = (1)AN960-10 WASHER
- (5)AN960-10 WASHERS = (1)C298-2 WEIGHT
- (11)AN960-10 WASHERS = (1)C298-3 WEIGHT
- (4)C298-3 WEIGHTS = (1)C298-4 WEIGHT

CHORD ARM WEIGHTS

- (8)AN970-4 WASHERS = (1)A255-1 WEIGHT
- (3)A255-1 WEIGHTS = (1)A255-2 WEIGHT

BALANCE		TRACK (KNOTS)										
CLOCK	IPS	HOVER	CLIMB	50	60	70	80	90	100	110	120	130

CHANGE MADE: _____

--	--	--	--	--	--	--	--	--	--	--	--	--

CHANGE MADE: _____

--	--	--	--	--	--	--	--	--	--	--	--	--

CHANGE MADE: _____

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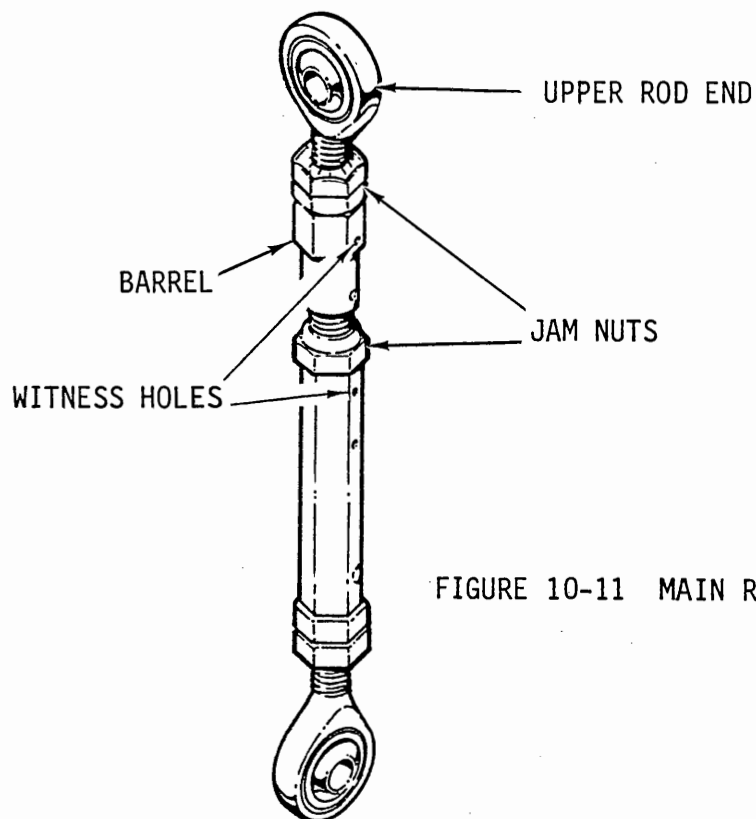


FIGURE 10-11 MAIN ROTOR PITCH LINK

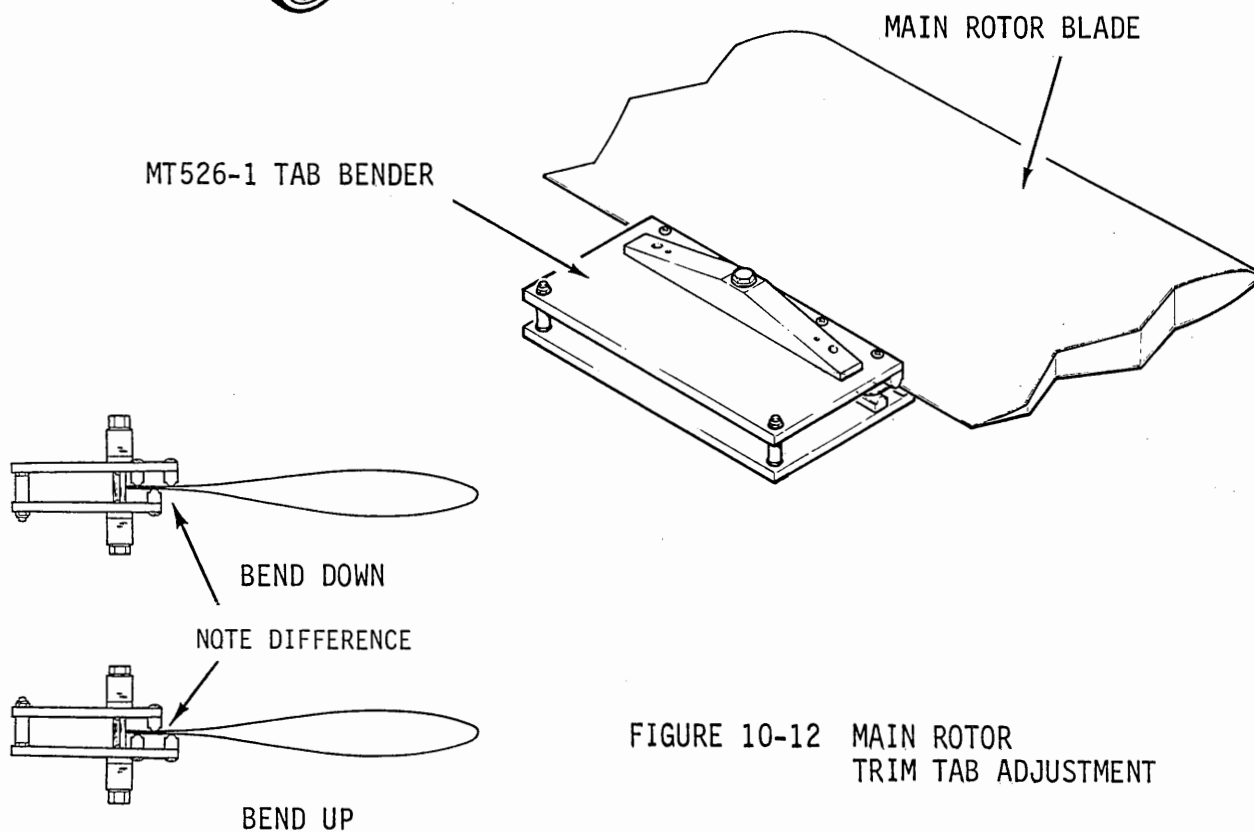


FIGURE 10-12 MAIN ROTOR TRIM TAB ADJUSTMENT

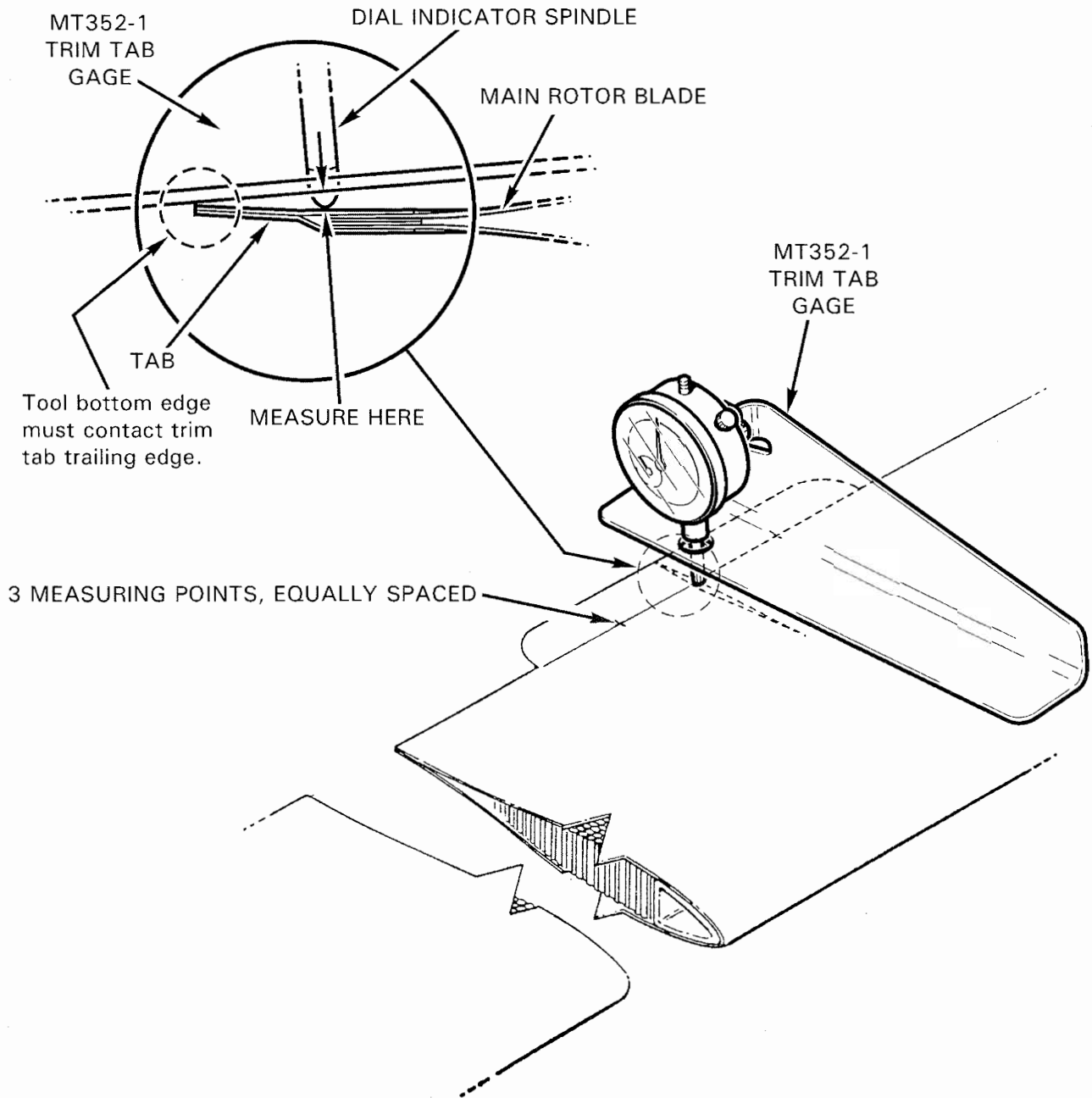


FIGURE 10-13 MAIN ROTOR TRIM TAB MEASUREMENT

10.233 Main Rotor Blade Trim Tab Adjustment

Main rotor blade trim tab adjustments are made using the MT526-1 tab bender and the MT352-1 trim tab gage. Refer to Figure 10-13. Using a felt marker, draw a line across top of trim tab aligned with blade trailing edge. Mark line with three equally spaced measuring points. Place trim tab gage chordwise across upper surface of blade and trim tab trailing edge with dial indicator stylus resting on a marked measuring point. Set dial indicator scale to zero. Similarly measure both remaining measuring points and verify they are within 0.005 inch of first.

CAUTION

MT352-1 gage must contact trim tab trailing edge. Space between edge of gage and trailing edge of trim tab indicates trim tab bent beyond limit.

To bend trim tab, loosen bolt on MT526-1 tab bender and slide tab bender over trim tab trailing edge as far toward leading edge as possible. Ensure single-rib side of tool contacts blade bottom surface to bend tab down and vice-versa. Tighten bolt to bend tab. Clamping action of tool is sufficient to bend tab; do not use tool like a lever. Refer to Figure 10-12. Make very slight bends downward on trim tab. Do not bend trim tab upward unless absolutely necessary; bending trim tab upward can increase cyclic stick shake. A trim tab bend of approximately 0.015 inch will move tip of main rotor blade approximately 0.2 inch. Remeasure trim tab with MT352-1 gage. Adjust bend in trim tab as required to keep three measuring points within 0.005 inch.

CAUTION

Do not use main rotor blade trim tab bending tools manufactured by other helicopter manufacturers. Use of these tools will damage main rotor blade.

10.234 Main Rotor Track and Balance Troubleshooting

<u>Symptom</u>	<u>Probable Cause</u>	<u>Correction</u>
1. Excessive Cyclic or Stick Shake	Rough or binding A205-5 fork assembly (upper swashplate).	Replace or refer to Section 8.6.
	Brinelled spindle bearing (rough movement).	Send blade(s) to RHC or Service Center for spindle bearing replacement.
	Rough blade surface (chipped paint).	Repair blades per Section 9.130.
	Rough or binding pitch links.	Replace pitch link rod ends
	MR blade boot misaligned.	Realign or replace boot per Sections 9.113 & 9.114.
	MR teeter or coning hinge binding.	Replace bearings per Section 9.126.
	MR blade trim tabs bent upward.	Bend trim tabs evenly down per Section 10.233.
2. Excessive Ship Vibration	Blade mismatch.	Send blade(s) to RHC for replacement.
	MR out of track and balance.	Track and balance per Section 10.230.
	MR teeter or coning hinge friction.	Adjust hinge friction per Section 9.124.
	MR teeter or coning hinge binding.	Replace bearings per Section 9.126.
	Brinelled spindle bearing (rough movement).	Send blade(s) to RHC or Service Center for spindle bearing replacement.
3. Excessive Cyclic Stick Forces	MR teeter hinge bearings worn.	Replace bearings per Section 9.126.
	Brinelled spindle bearing (rough movement).	Send blade(s) to RHC or Service Center for spindle bearing replacement.
4. Intermittent Blade Track Picture	MR teeter or coning hinge friction	Adjust hinge friction per Section 9.124.
	MR coning hinge binding.	Replace bearings per Section 9.126.
	MR teeter hinge not "broken-in."	Track and balance per Section 10.230. Adjust track to minimize error.
5. Radical Changes to Cyclic Trim	Brinelled spindle bearing (rough movement).	Send blade(s) to RHC or Service Center for spindle bearing replacement.
	MR teeter hinge bearings worn.	Replace bearings per Section 9.126.
6. Lateral Intermittent Ship Vibration	Engine misfiring due to malfunction in spark plugs, ignition leads, magneto, or engine not "broken-in."	Refer to Textron-Lycoming Maintenance Instructions.
7. 4 per second Fore/Aft Oscillation	Aircraft CG out of limits.	Operate aircraft within CG envelope.
	Deteriorated / contaminated main gearbox rubber mount(s).	Replace main gearbox mounts.

10.240 Tail Rotor Balance Procedure

Refer to specific manufacturer's installation instructions when using balancing equipment other than Chadwick-Helmuth Vibrex system.

Install Chadwick-Helmuth equipment per Section 10.222. Set Function Knob on Balancer to appropriate channel. Set balancer RPM Range knob to X10 and set RPM to 231. With helicopter running with governor ON, view tail rotor assembly with Strobex. Tune Balancer while viewing target tape and adjusting RPM dial on Balancer. Record clock angle and IPS on tail rotor balance chart. Adjust as required until balance is less than 0.2 IPS.

Spanwise balance adjustments for C029-1 square-tip blades are made by adding, subtracting, or exchanging weights under the removable tip cover. Use C134-1 or -2 tip weights or AN960-8 or -8L washers. -8L washers may be trimmed as a very fine adjustment.

Spanwise balance adjustments for C029-2 and C029-3 round-tip blades are made by exchanging different diameter washers under nut securing blade's outboard retaining bolt. The bolt has sufficient length to allow necessary spanwise weight changes; verify 2-4 threads protruding past nut after torquing per Section 1.320.

Chordwise balance is adjusted by adding, subtracting, or exchanging A141-14, A214-3, NAS1149F0463P/F0432P, or NAS1149D0463J/D0432J washers under nut securing blade's pitch link attaching bolt. Change pitch link attaching bolt length as required for proper thread engagement (see Section 1.310, refer to IPC for allowable lengths).

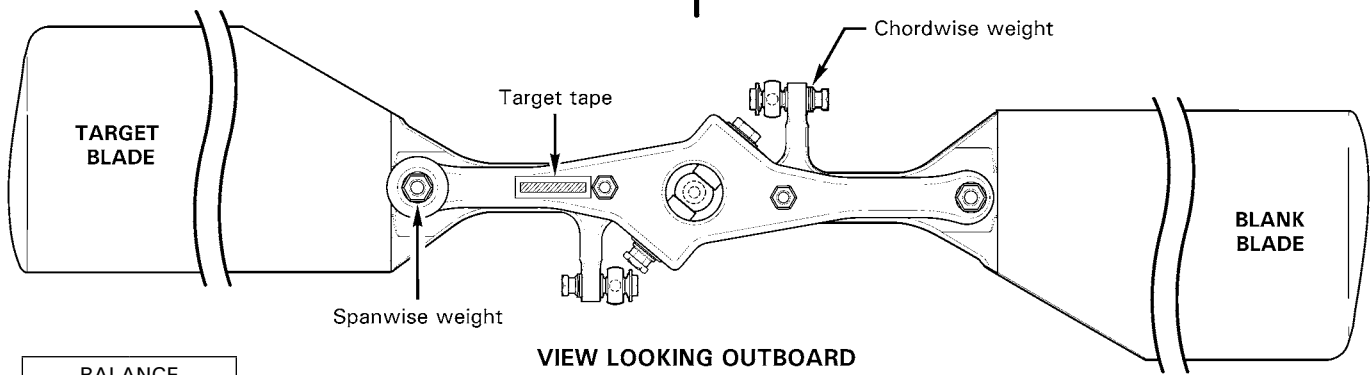
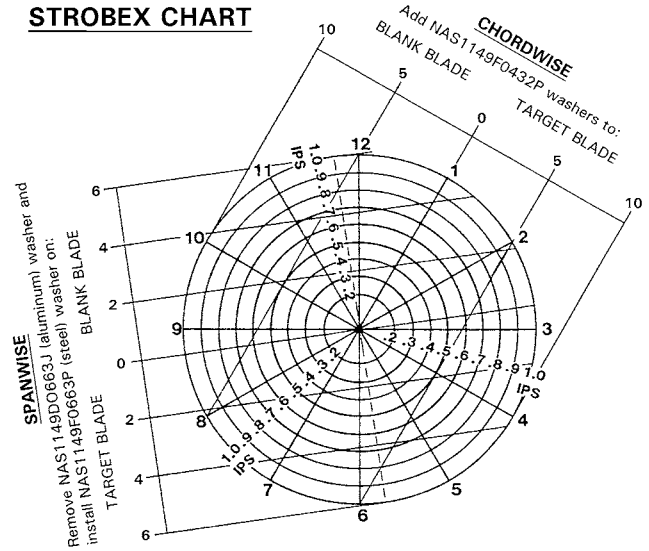
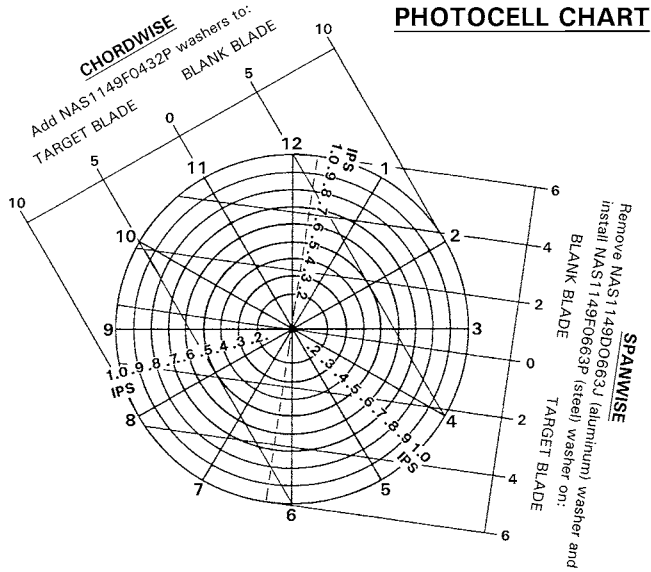
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C008-9 TAIL ROTOR ASSEMBLY

CHORDWISE WEIGHTS			
(1) NAS1149F0463P Washer	=	(2)	NAS1149F0432P Washers
(1) A214-3 Washer	=	(3.5)	NAS1149F0432P Washers
(1) A141-14 Washer	=	(5)	NAS1149F0432P Washers

SPANWISE WEIGHTS			
(1) C141-23 Washer	=	(3.5)	NAS1149F0663P Washers
(1) C141-24 Washer	=	(7)	NAS1149F0663P Washers
(2) NAS1149F0632P	=	(1)	NAS1149F0663P Washer



BALANCE	
CLOCK	IPS

ADJUSTMENT: _____

ADJUSTMENT: _____

ADJUSTMENT: _____

ADJUSTMENT: _____

FIGURE 10-14 C008-9 TAIL ROTOR ASSEMBLY DYNAMIC BALANCE CHART

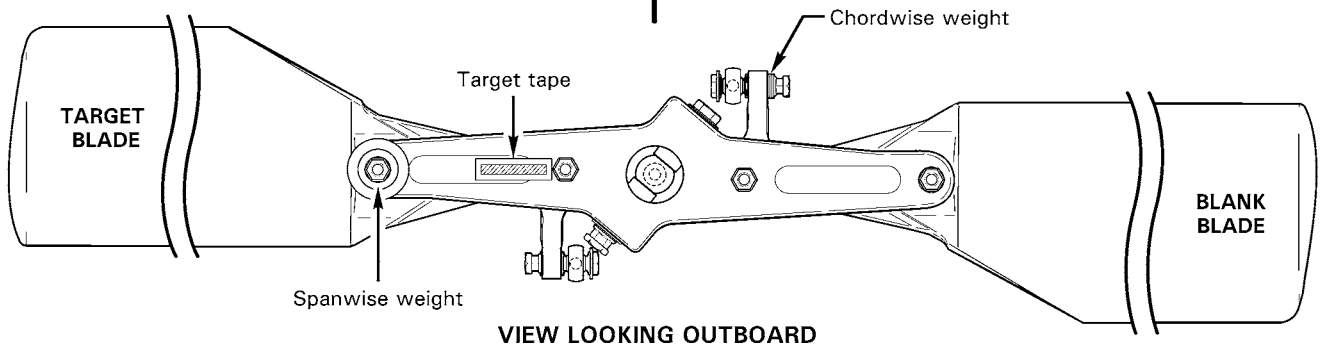
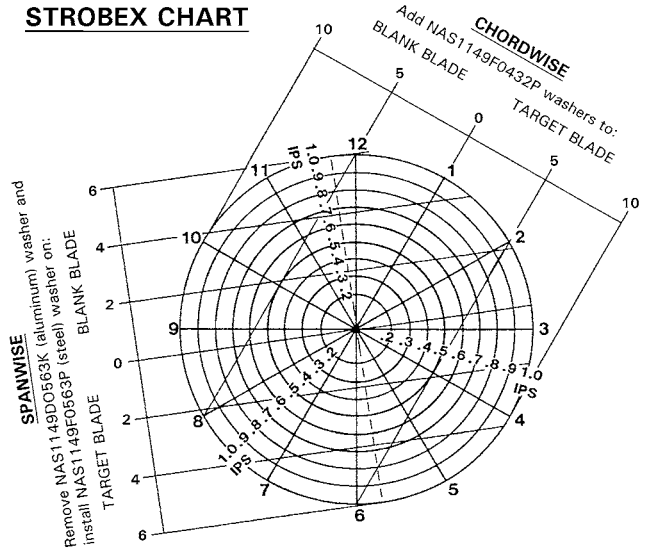
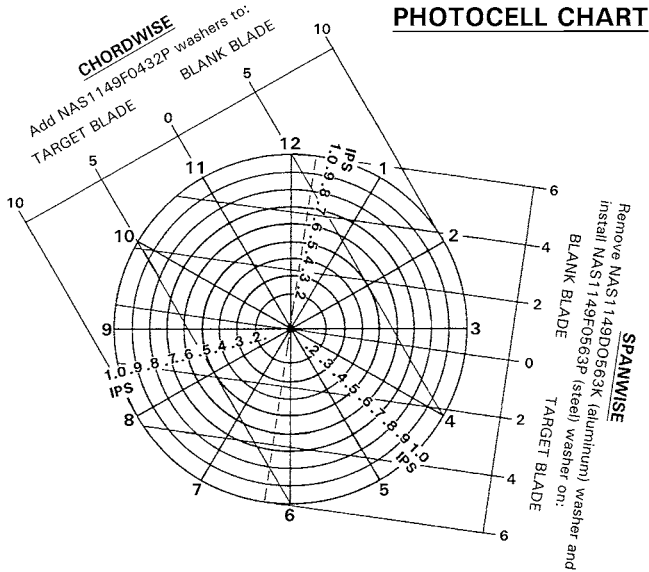
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C008-4 TAIL ROTOR ASSEMBLY

CHORDWISE WEIGHTS			
(1) NAS1149F0463P Washer	=	(2)	NAS1149F0432P Washers
(1) A214-3 Washer	=	(3.5)	NAS1149F0432P Washers
(1) A141-14 Washer	=	(5)	NAS1149F0432P Washers

SPANWISE WEIGHTS			
(1) C141-20 Washer	=	(5)	NAS1149F0563P Washers
(1) AN970-5 Washer	=	(13)	NAS1149F0563P Washers



BALANCE	
CLOCK	IPS

ADJUSTMENT: _____

ADJUSTMENT: _____

ADJUSTMENT: _____

ADJUSTMENT: _____

FIGURE 10-15 C008-4 TAIL ROTOR ASSEMBLY DYNAMIC BALANCE CHART

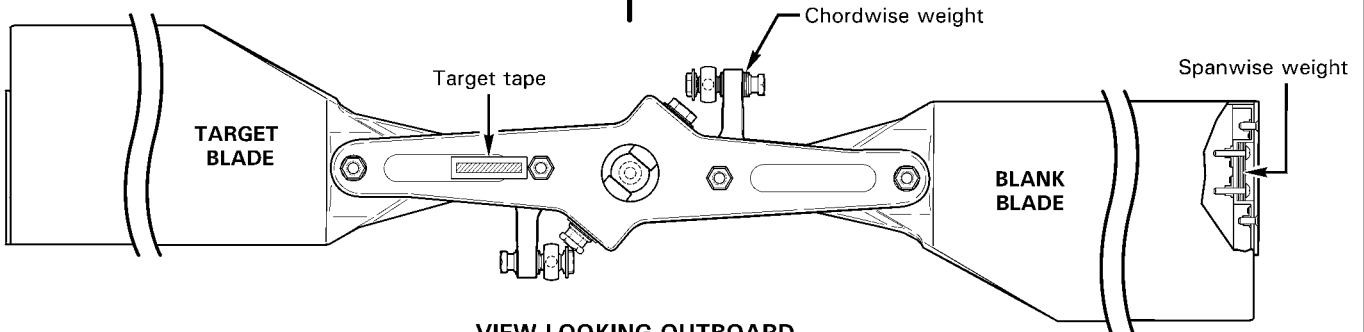
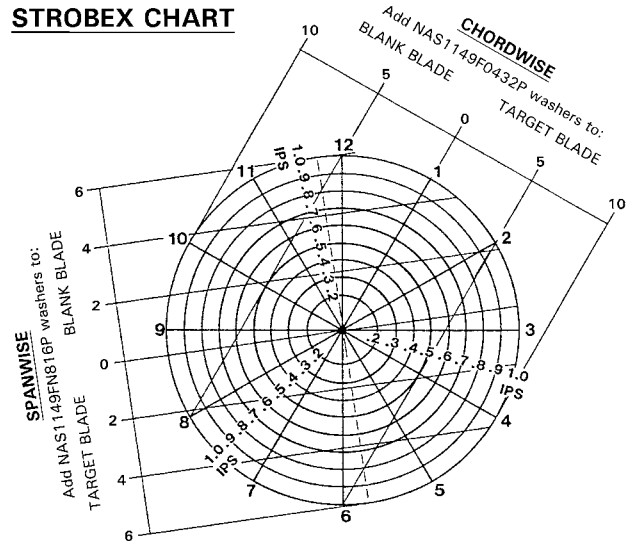
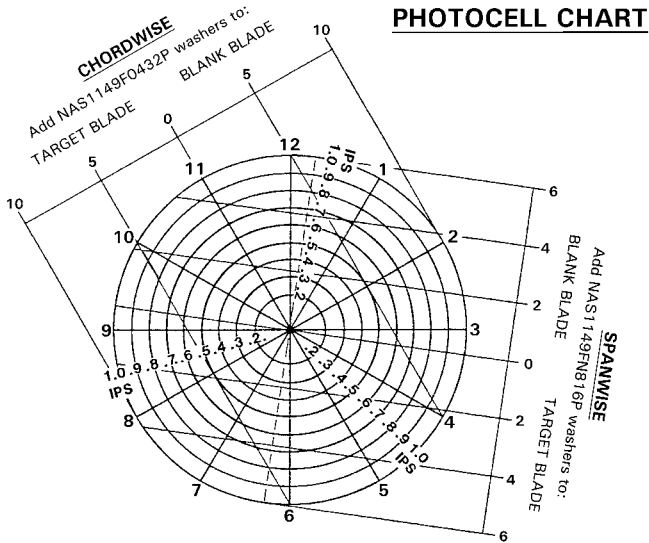
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C008-2 TAIL ROTOR ASSEMBLY

CHORDWISE WEIGHTS			
(1) NAS1149F0463P Washer	=	(2)	NAS1149F0432P Washers
(1) A141-14 Washer	=	(5)	NAS1149F0432P Washers

SPANWISE WEIGHTS			
(1) NAS1149FN832P	=	(2)	NAS1149FN816P Washers
(1) C134-1 Weight	=	(14)	NAS1149FN816P Washers



VIEW LOOKING OUTBOARD

BALANCE	
CLOCK	IPS

ADJUSTMENT: _____

ADJUSTMENT: _____

ADJUSTMENT: _____

ADJUSTMENT: _____

FIGURE 10-16 C008-2 TAIL ROTOR ASSEMBLY DYNAMIC BALANCE CHART

Intentionally Blank

INTENTIONALLY BLANK

10.250 Autorotational RPM Adjustment

Use the following procedure for checking and adjusting autorotational RPM:

WARNING

Failure to properly adjust autorotational RPM (RPM too low) may prevent the rotorcraft from achieving proper RPM at low gross weights.

- a) Perform autorotation RPM check at less than 1900 lb gross weight. Calculate the takeoff gross weight of the helicopter. Record the time on the hour meter.

Take-Off gross weight _____

Take-Off hourmeter reading _____

- b) Set the altimeter to 29.92" Hg (1013.2 millibars) prior to performing the autorotation. Autorotate with the collective control firmly held against the down stop with an airspeed of 50 KIAS.

WARNING

Do not allow the rotor to overspeed when performing autorotation checks. Progressively lengthen both main rotor pitch link rod ends until full down collective can be obtained without overspeeding the rotor.

Take at least 3 RPM readings at 500 to 1000 foot altitude intervals.

Record the following in-flight data:

Test #	Hourmeter Reading	OAT	Pressure Altitude	Test %RPM
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____
5	_____	_____	_____	_____

10.250 Autorotational RPM Adjustment (cont'd)

c) After test flight, refer to Figure 10-15 chart and determine following:

Test #	Elapsed Time (in-flight hourmeter reading minus take-off hourmeter reading)	lbs of Fuel Consumed (elapsed time x 93 lb/hr)	Test Gross Weight (take-off gross weight minus fuel consumed)	Test Longitudinal Center of Gravity	Chart % RPM *	Test % RPM (from in-flight data)	RPM Correction (chart % RPM minus Test % RPM)
1	_____	_____	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____	_____	_____

* Chart Instructions:

1. Start at outside air temperature, and draw a vertical line up to pressure altitude.
2. Draw a horizontal line from pressure altitude to rotorcraft gross weight at time of autorotation.
3. Draw a vertical line down from autorotation gross weight to required auto RPM.

Notes:

- i. Increase rotor RPM 0.75% for every inch that CG is forward of FS 100.0.
- ii. Decrease rotor RPM 2% for model R44 II.

d) Adjust pitch links based on average RPM correction required. Lengthen both pitch links to decrease RPM if test RPM is greater than chart RPM; shorten both pitch links to increase RPM. One full rod end turn will change RPM 3½%. Adjust both pitch links exactly the same so track will not be affected.

e) Repeat steps (a) through (d) as required until the RPM correction is ± 1% of chart RPM.

AUTOROTATION RPM

COLLECTIVE FULL DOWN

50 KIAS

(One full turn of rod ends = approximately 3½% RPM change)

(One full turn of rod end = 1⅙ turns of barrel)

NOTES:

1. Increase Rotor RPM 0.75% for every inch that CG is forward of FS 100.0.
2. Decrease Rotor RPM 2% for Model R44 II.

Example: R44 II, OAT = 25° C, Hp = 2000 lb, GW = 1900 lb, CG = FS 98.0

Design RPM = 104% - 2% + (2 x 0.75%) = 103.5%

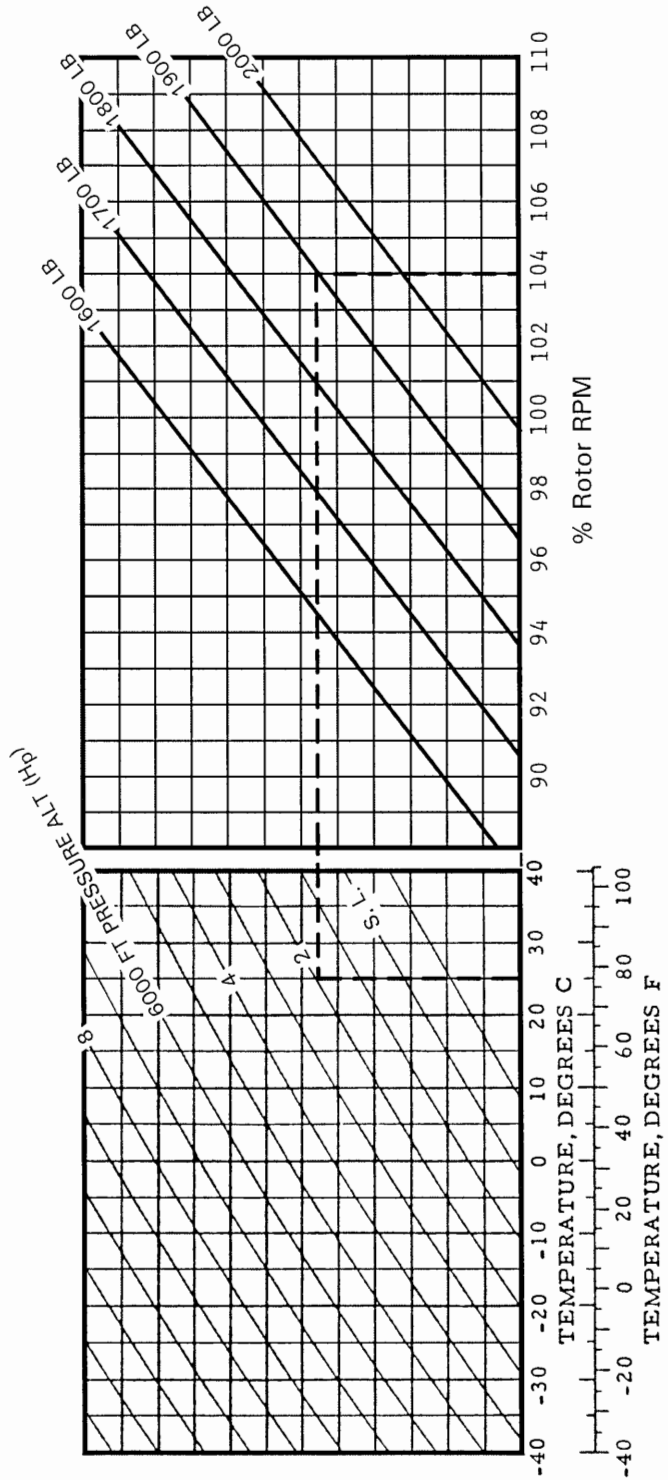


FIGURE 10-15