CHAPTER 10

RIGGING, TRACK AND BALANCE

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CHAPTER 10

RIGGING, TRACK AND BALANCE

10.000 Rigging, Track and Balance

10.001 Introduction

This section contains the 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.

10.002 Rod End Adjustment Procedures For Rigging

Refer to § 23-34 Push-Pull Tube Rod End Adjustment.

10.100 Rigging

10.110 Main Rotor Flight Controls

10.111 Cyclic Controls

The cyclic control travel is non-adjustable and is controlled by A211-1 stop plate attached to the cyclic box assembly.

> NOTE
>
> If the A121-1 push-pull tube length has been changed or the length of the A205 fork was changed, they must be readjusted to the dimensions shown in Figure 8-3.

a. Place the cyclic stick against the aft stop and the collective control full down.

b. Adjust the A121-3 push-pull tube to obtain a clearance of .130 inch between the aft arm of the jack shaft and the main rotor gearbox upper cap flange.

10.111 Cyclic controls (cont'd)

c) Check for clearance between the forward jackshaft arm and the A121-7 push-pull tube guide with collective stick full up and cyclic stick full forward. Minimum clearance is .125 inch.

d) Place the cyclic control in the neutral position. This point is 8.3 inches to the right of full left travel and at the mid-point of the total fore and aft travel. (See Figure 10-1). Place the collective control full down.

e) Apply full cyclic and collective friction.

NOTE

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

10.112 Swashplate

a) With the cyclic and collective controls locked in position per Section 10.111, adjust the A121-7 and A121-5 push-pull tubes to obtain a constant clearance from the A281-1 flange.
The minimum clearance from the flange is 5/8 inches. (See Figure 10-2) Nominal setting is 3/4 inches.

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 not extend past the top of the slider tube more than .060 inch. If this occurs, adjust the A121-5 and A121-7 push pull tubes as follows:

1. Turn the upper rod ends of the A121-5 and A121-7 push-pull tubes in equally to lower the swashplate.

2. Recheck the uniball-slider tube clearance per Step b above.

10.120 Main Rotor

The main rotor is rigged by determining the average blade angle. Blade angle measurements are taken at the .75 radius of the main rotor (or 37.75 inches in from the blade tip).

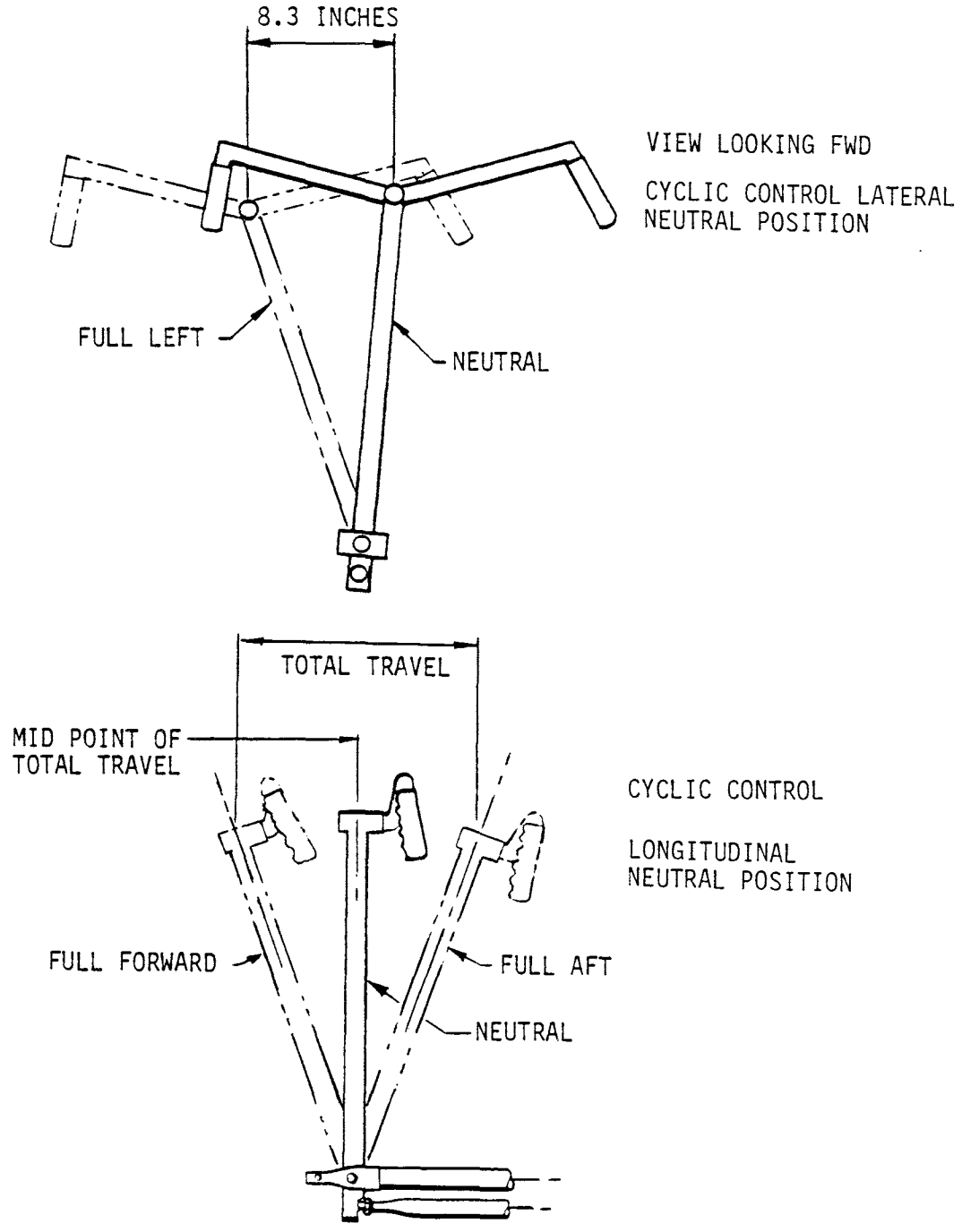

FIGURE 10-1 CYCLIC CONTROL STICK NEUTRAL POSITION

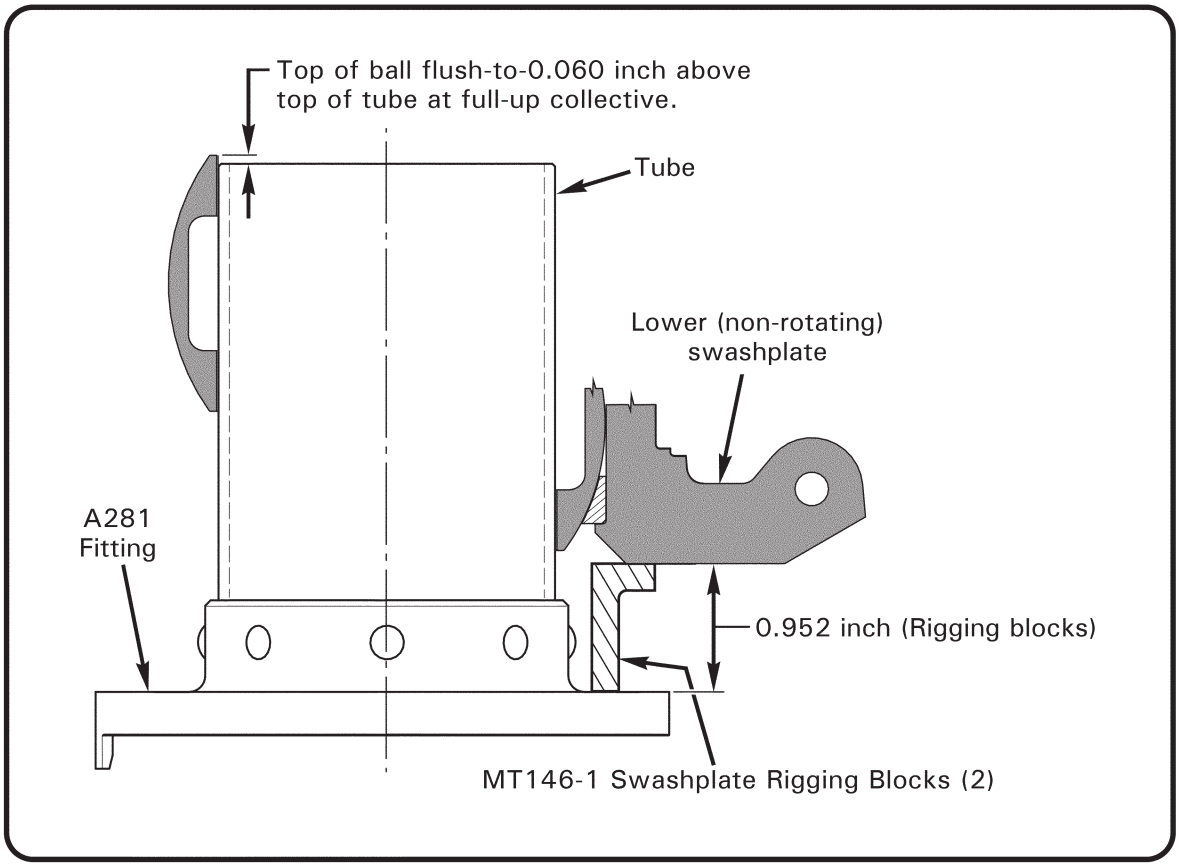

FIGURE 10-2 LOWER SWASHPLATE CLEARANCE

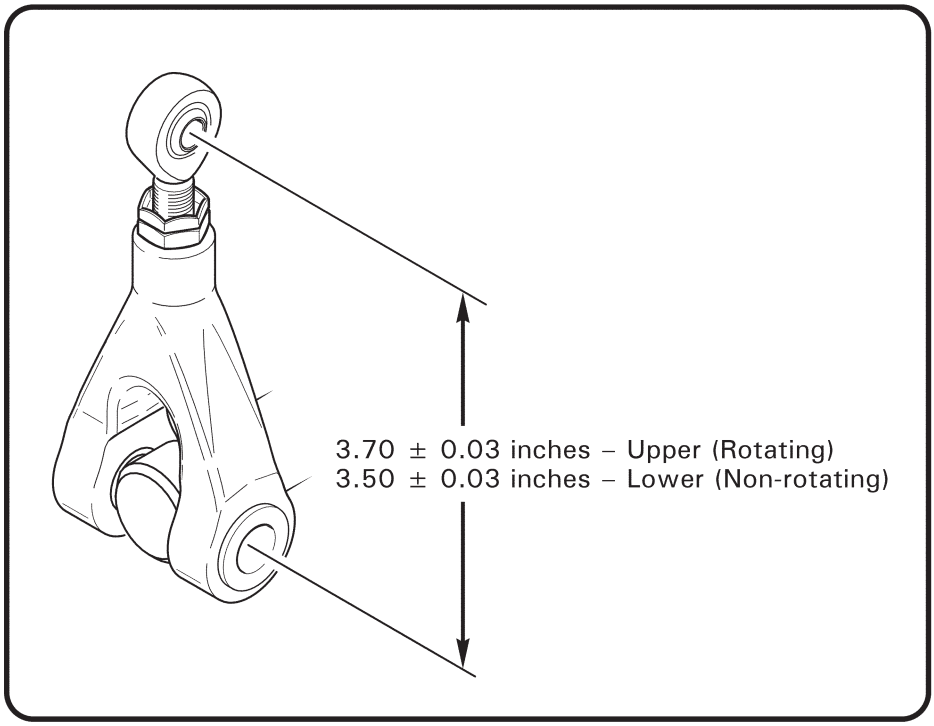

FIGURE 10-3 A205 (-9 SHOWN) DIMENSIONS FOR SWASHPLATE SCISSORS

10.120 Main Rotor

NOTE

Refer to § 23-34 for push-pull tube rod end adjustment procedure.

The main rotor is rigged by determining average blade angle. Blade angle is measured at 37.75 inches inboard from blade tip (main rotor 0.75 radius).

Main rotor blade angles are measured using MT050-1 rigging fixture and a Kell-Strom KS113 propeller protractor or a comparable protractor (refer to Figure 10-4). Use following procedure to set up for rigging:

1. All main rotor flight control rod ends must meet Figure 2-1 radial play & axial play tolerance.
2. Rig swashplate per § 10.112.
3. Initially, adjust both pitch links to 6.82 inches length between rod end centers (final length is determined during autorotation rpm adjustment).
2. Verify A205 forks at swashplate are set to proper length per Figure 10-3. Lower fork assembly must be 3.50 ± 0.03 inches center-to-center and upper fork assembly must be 3.70 ± 0.03 inches center-to-center.
3. Level helicopter laterally and longitudinally via main rotor hub per § 18-12.
4. Place a tracking stick at end of one rotor blade and mark height of blade tip. Rotate rotor 180° and mark height of opposite blade tip. Teeter main rotor as necessary to obtain a main rotor track of ± 1 inch.
5. Using tape, conspicuously mark one MR blade tip. Place protractor atop MR hub parallel to teeter hinge bolt and facing tape-marked blade tip. Zero propeller protractor to main rotor hub.

NOTE

When measuring blade angles, protractor face or dial must always face marked blade tip to avoid doubling of instrument error.

6. Measure in from tip of each main rotor blade 37.75 inches and temporarily mark one blade with red color and opposite blade with blue color

WARNING

Use masking tape, grease pencil, or soft marker to mark rotor blades. Ball point pens or other sharp instruments can scratch blade skins, causing cracks and fatigue failure of blade.

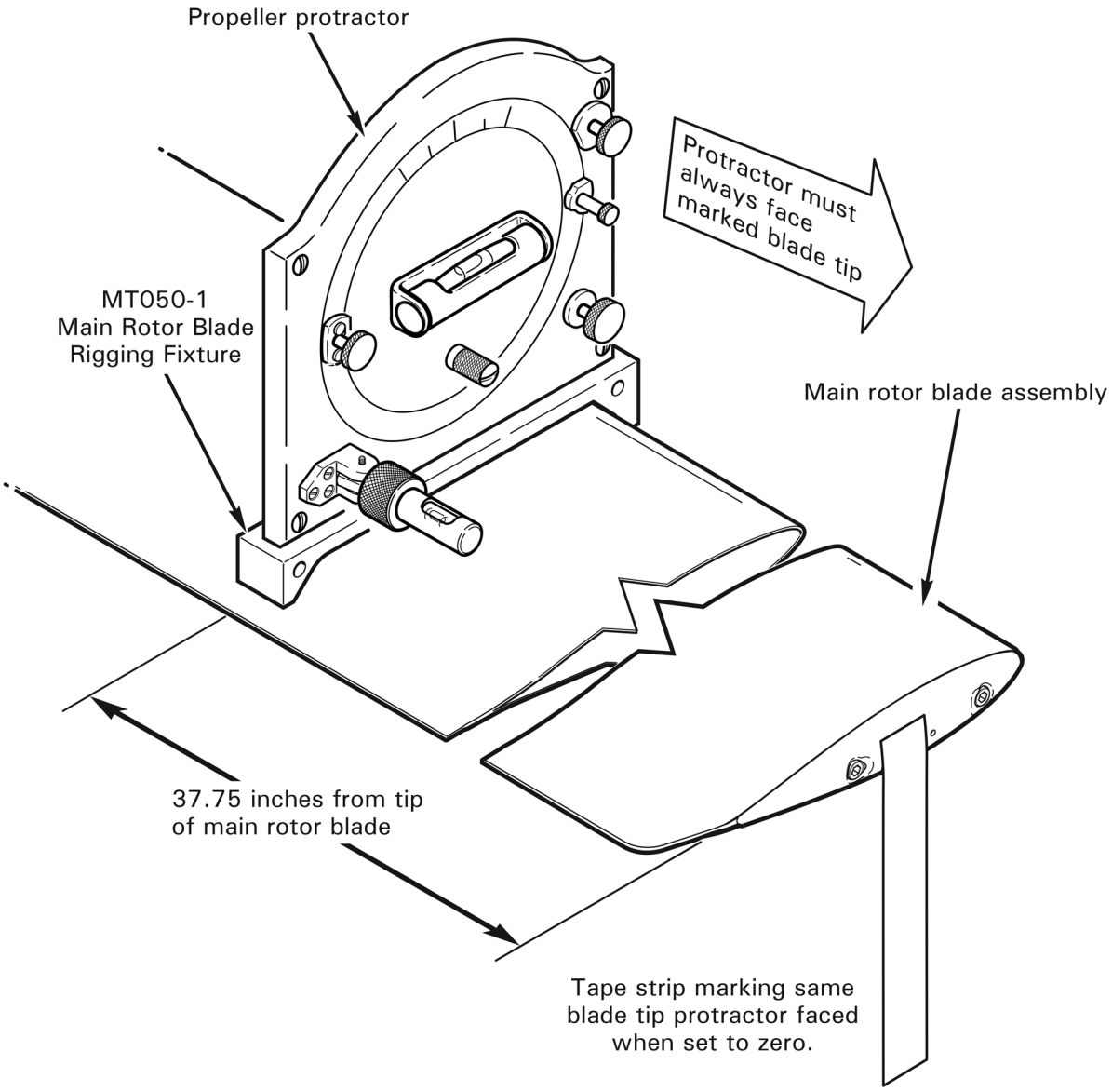

FIGURE 10-4 MAIN ROTOR BLADE RIGGING

10.121 Cyclic Travel Rigging

1. Refer to Figure 10-1. Place collective control full down. Place cyclic control in neutral position laterally and hold against forward stop.

NOTE
Sand bags may be used to secure cyclic control against forward stop to ensure it will not move.

2. Rotate blades so pitch links are aligned with longitudinal axis of helicopter. Place tracking stick at tip of one blade for reference when rotating rotor.

3. Forward longitudinal cyclic:

   a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per step 3.b.

BLUE BLADE			**RED BLADE**		
Pitch link aft		_____ °	Pitch link aft		_____ °
Pitch link forward	+	_____ °	Pitch link forward	+	_____ °
	=	_____ °		=	_____ °
	÷ 2 =	_____ °		÷ 2 =	_____ °

10.5°/11.0° required for R22 Alpha, Beta, and Mariner.

8.3°/8.8° required for R22 Standard and HP.

   b. Adjust aft A121-5 push-pull tube at swashplate (one full turn = 0.42°) or both forward A121-7 push-pull tubes at swashplate (both must be adjusted exact same amount), as required to obtain required blade angle averages.

4. Refer to Figure 10-1. Place cyclic control in neutral position laterally and hold against aft stop.

10.121 Cyclic Travel Rigging (continued)

5. Aft longitudinal cyclic:

   a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per step 5.b.

BLUE BLADE			**RED BLADE**		
Pitch link aft		_____ °	Pitch link aft		_____ °
Pitch link forward	+	_____ °	Pitch link forward	+	_____ °
	=	_____ °		=	_____ °
	÷ 2 =	_____ °		÷ 2 =	_____ °

8.5°/9.5° required.

   b. Adjust aft A121-5 push-pull tube at swashplate (one full turn = 0.42°) or both forward A121-7 push-pull tubes at swashplate (both must be adjusted exact same amount), as required.

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

6. Refer to Figure 10-1. Place cyclic control in neutral position longitudinally (mid-travel) and hold cyclic against left stop.

7. Rotate rotor until pitch links are aligned with lateral axis of helicopter. Place tracking stick at tip of one blade for reference when rotating rotor.

8. Left lateral cyclic:

   a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per step 8.b.

BLUE BLADE			**RED BLADE**		
Pitch link right		_____ °	Pitch link right		_____ °
Pitch link left	+	_____ °	Pitch link left	+	_____ °
	=	_____ °		=	_____ °
	÷ 2 =	_____ °		÷ 2 =	_____ °

9.0°/9.5° required.

   b. Adjust right or left (forward) A121-7 push-pull tube at swashplate (one full turn = 0.6°), as required.

10.121 Cyclic Travel Rigging (continued)

9. Refer to Figure 10-1. Place cyclic control in neutral position longitudinally (mid travel) and hold against right stop.

10. Right lateral cyclic:

    a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per step 10.b.

BLUE BLADE			**RED BLADE**		
Pitch link right		_____ °	Pitch link right		_____ °
Pitch link left	+	_____ °	Pitch link left	+	_____ °
	=	_____ °		=	_____ °
	÷ 2 =	_____ °		÷ 2 =	_____ °

5.5°/6.0° required.

    b. Adjust right or left (forward) A121-7 push-pull tube at swashplate (one full turn = 0.6°) as required.

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

11. Perform collective travel rigging per § 10.122.

10.122 Collective Travel Rigging

1. Rotate main rotor to align pitch links with longitudinal axis of helicopter. Place tracking stick at tip of one blade for reference when rotating rotor.
2. Refer to Figure 10-1. Place cyclic control in neutral position or install MT376-1 rigging blocks. Place collective control full down. Apply cyclic and collective friction.
3. Collective full down:
   a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below. Adjust blade angles per steps 3.b.

BLUE BLADE			**RED BLADE**		
Pitch link forward		_____ °	Pitch link forward		_____ °
Pitch link aft	+	_____ °	Pitch link aft	+	_____ °
	=	_____ °		=	_____ °
	÷ 2 =	_____ °		÷ 2 =	_____ °
		2° ± 0.5° nose up required.			2° ± 0.5° nose up required.

   b. Adjust pitch links so blue blade and red blade measurements are within 0.2° of each other when each blade pitch link is in forward position, and when each pitch link is in aft position.

> NOTE
>
> Final collective down blade angles are determined by autorotation RPM requirements per § 10.250.

4. Raise collective control to full up position. Apply collective friction.
5. Collective full up:
   a. Refer to Figure 10-4. Measure blade angles and record below. Rotate rotor 180° and record blade angles below.

BLUE BLADE			**RED BLADE**		
Pitch link forward		_____ °	Pitch link forward		_____ °
Pitch link aft	+	_____ °	Pitch link aft	+	_____ °
	=	_____ °		=	_____ °
	÷ 2 =	_____ °		÷ 2 =	_____ °
		14° ± 0.5° nose up required.			14° ± 0.5° nose up required.

6. Verify top of swashplate ball is flush-to-0.060 inch above top of tube per Figure 10-2.
7. Perform track and balance per § 10.200.

10.130 Tail Rotor Flight Controls

NOTE

Refer to § 23-34 for push-pull tube rod end adjustment procedure.

10.131 Pedals

1. Refer to Figure 10-5. Insert a 3/16-inch diameter rigging pin (a long AN3 or NAS6603 bolt suffices) thru hole in right-side keel panel and rigging pin holes in A317-1 bellcrank.
2. Adjust A121-9 and -11 push-pull tubes as required to obtain a dimension of 2.90 ± 0.03 inches from each pedal to stops located on each side of forward console. Remove rigging pin (or bolt, as applicable).

10.132 A316-1 Bellcrank

1. Refer to Figure 10-5. Place left pedal against forward stop.
2. Adjust vertical A121-13 push-pull tube to obtain a minimum of 0.060 inch between A316-1 bellcrank arm and vertical firewall control tunnel.

10.133 A331-1 Bellcrank

Place right pedal against forward stop. Adjust horizontal A121-15 push-pull tube to obtain a minimum clearance of 0.100 inch between A331-1 bellcrank and actuator gearbox housing (See Figure 10-6).

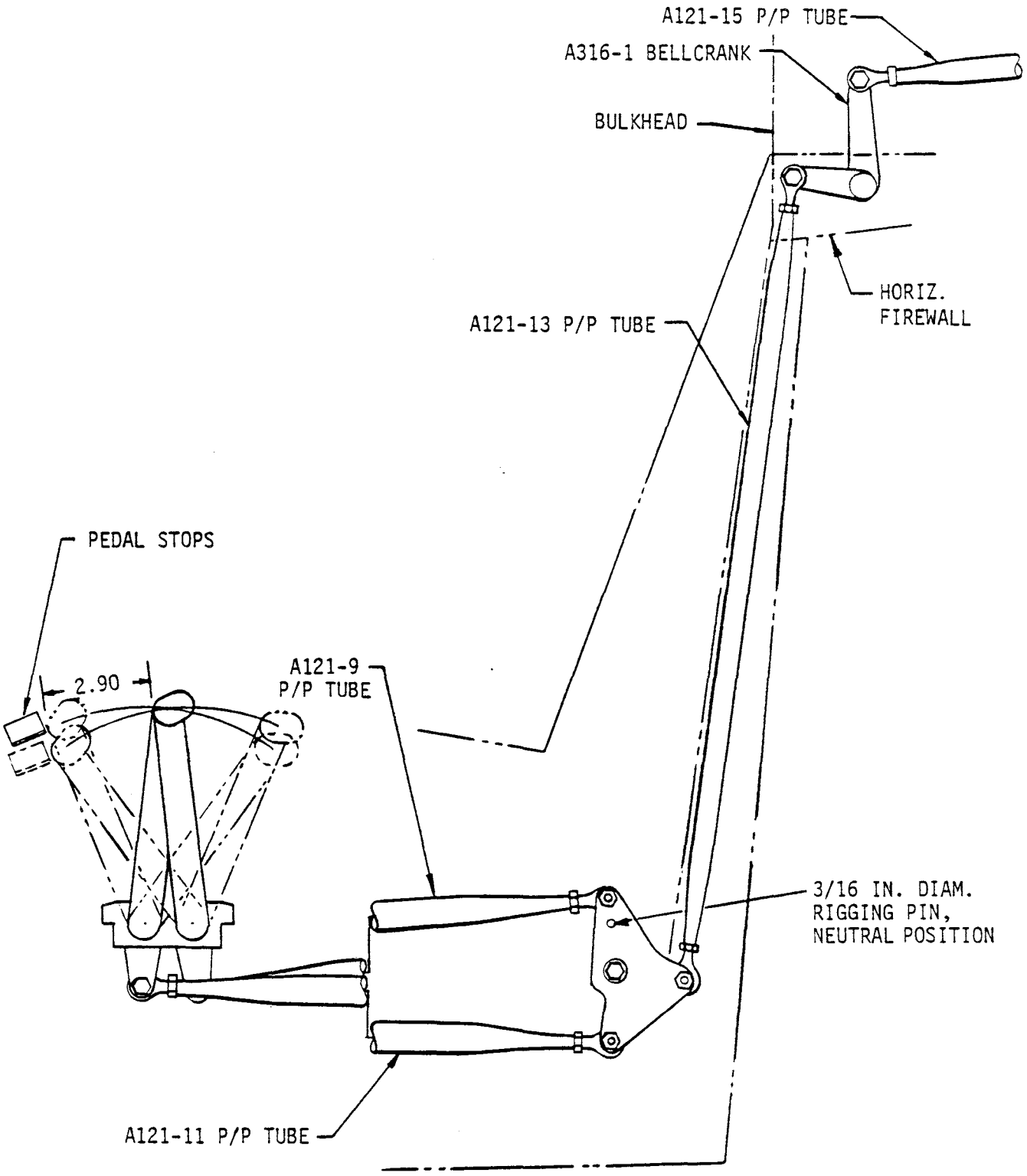

FIGURE 10-5 PEDAL CONTROL INSTALLATION

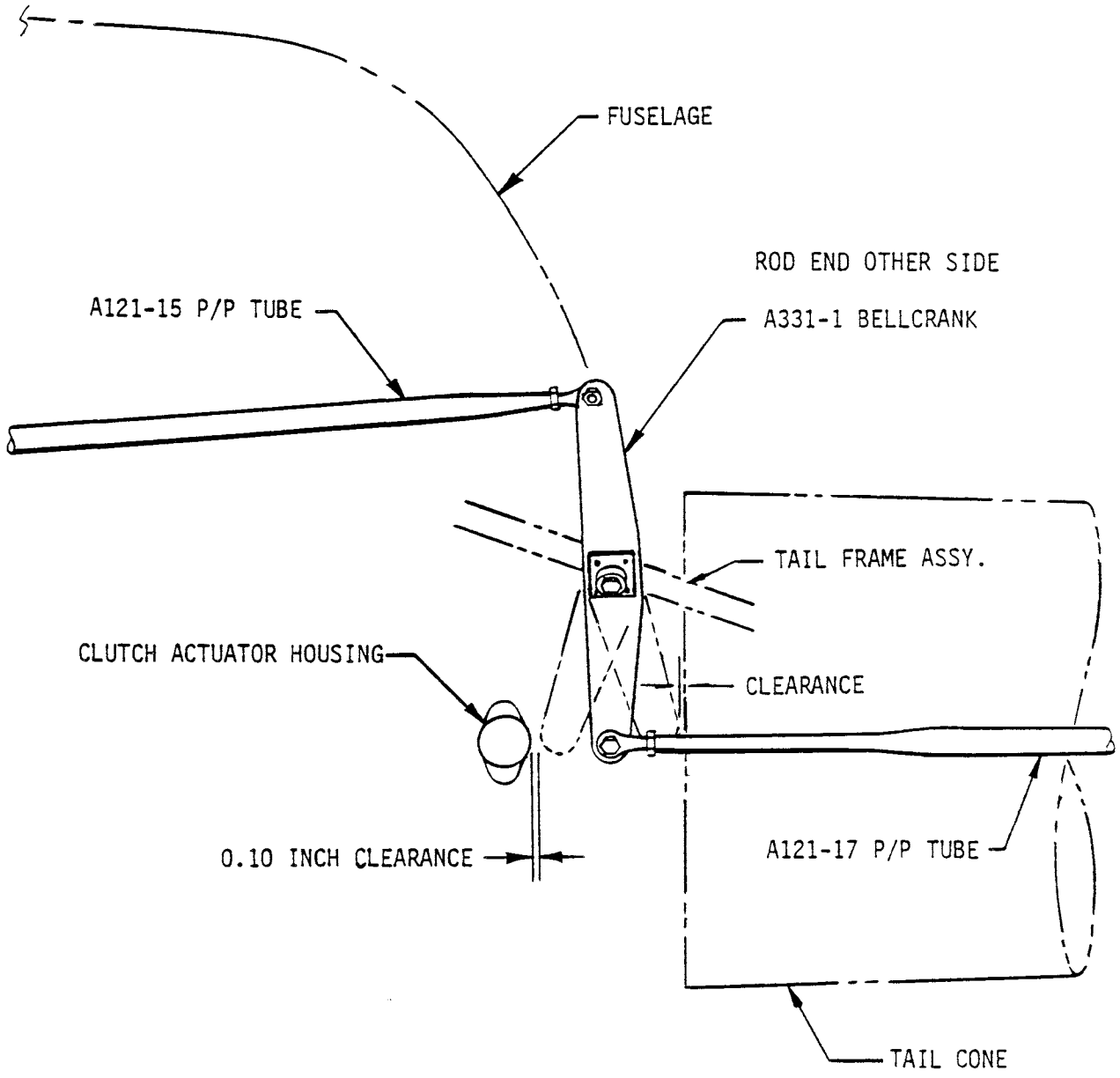

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FIGURE 10-6 A331 BELLCRANK INSTALLATION

10.133 A120-3 Bellcrank (cont'd)

NOTE
Actuator must be disengaged when adjusting A331 bellcrank to check closest point.

Place left pedal against its stop and check for clearance between A331-1 bellcrank and tailcone.

10.134 A120-1 Bellcrank

With tail rotor pedals in neutral position, adjust A121-17 push-pull tube as required to obtain a nominal dimension of 4.85 inches between bellcrank arm center line and machined face of tailcone casting (see Figure 10-7).

10.135 Tail Rotor Pitch Links

If applicable, adjust pitch links to a dimension of 2.360 inches between rod end centers (See Section 8.570).

10.140 Tail Rotor Rigging

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.

1. Set up:

   a. Ensure removable pedals are installed.

   b. Level rotorcraft per Section 1.220 Method 2, Main Rotor Hub.

   c. Rotate tail rotor until forward blade is parallel to tailcone.

   d. Tape a tracking stick to tailcone at tip of forward blade.

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

   e. Place left pedal against its stop. Using a tip drain hole as a reference, first mark tracking stick where blade tip passes stick.

   f. Using clutch shaft so teeter angle is not disturbed, rotate tail rotor 180° until opposite blade tip drain hole is aligned with tracking stick. Mark stick.

10.140 Tail Rotor Rigging (cont'd)

g. Adjust teeter of tail rotor to position blade tip mid point between marks. This will be the left-pedal tacking mark. Rotate tail rotor and check that the blades track. Repeat above procedure as necessary to track tail rotor within 0.125 inch.

2. Measure 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 5.25 inches (0.75 radius) and place a mark chordwise on each blade at this point (soft marker or grease pencil).

c. Have some one hold forward blade tip at left pedal track mark.

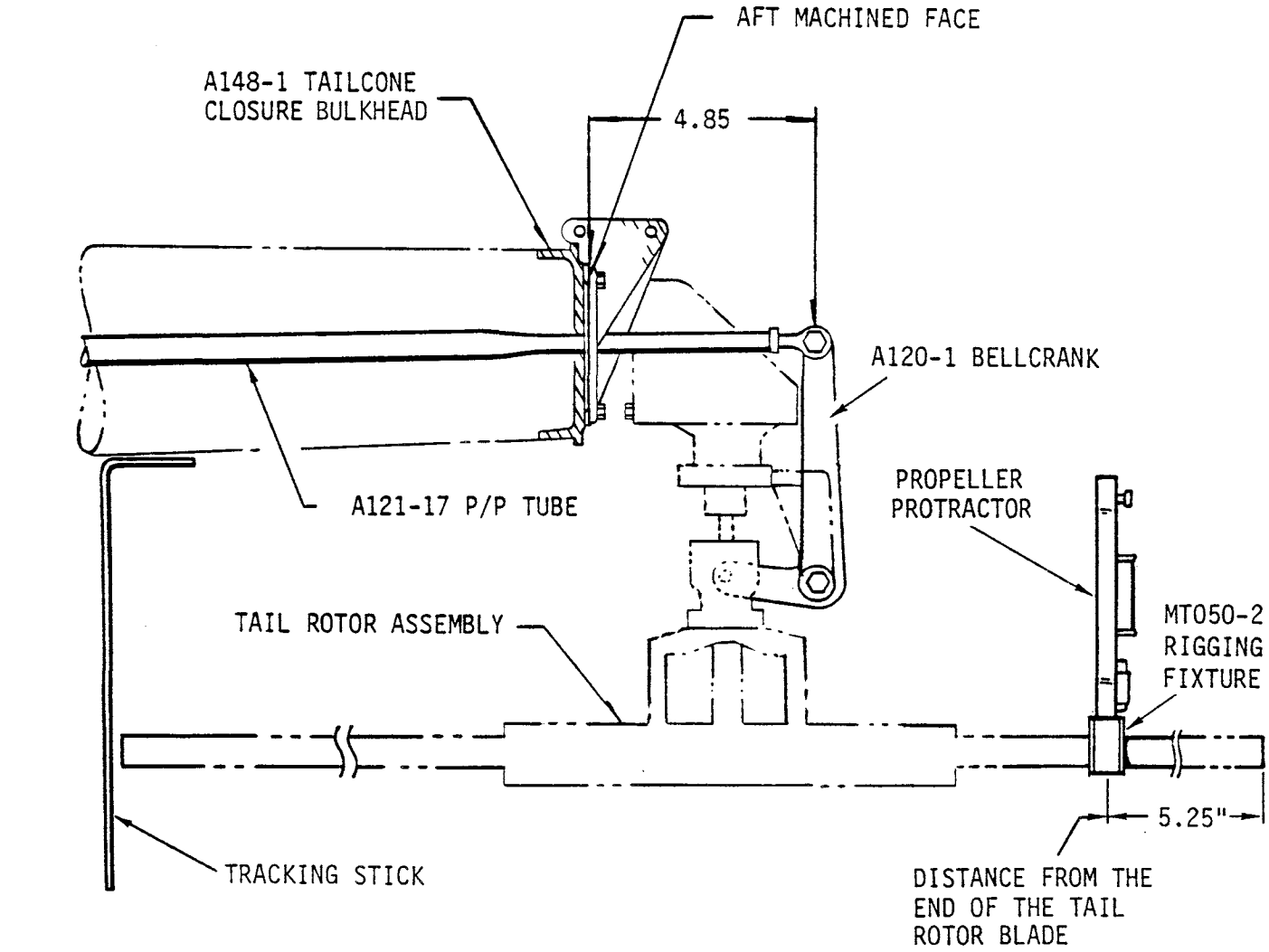
d. Place MT050-2 rigging fixture on aft blade inboard side.

NOTE
The MT050-2 fixture must be centered on 0.75 radius mark.

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

Pedals Full Left

Blue Blade _____ °nose right
Red Blade + _____ °nose right
= _____ °
÷2 = _____ °
(19.0°/19.5° required)



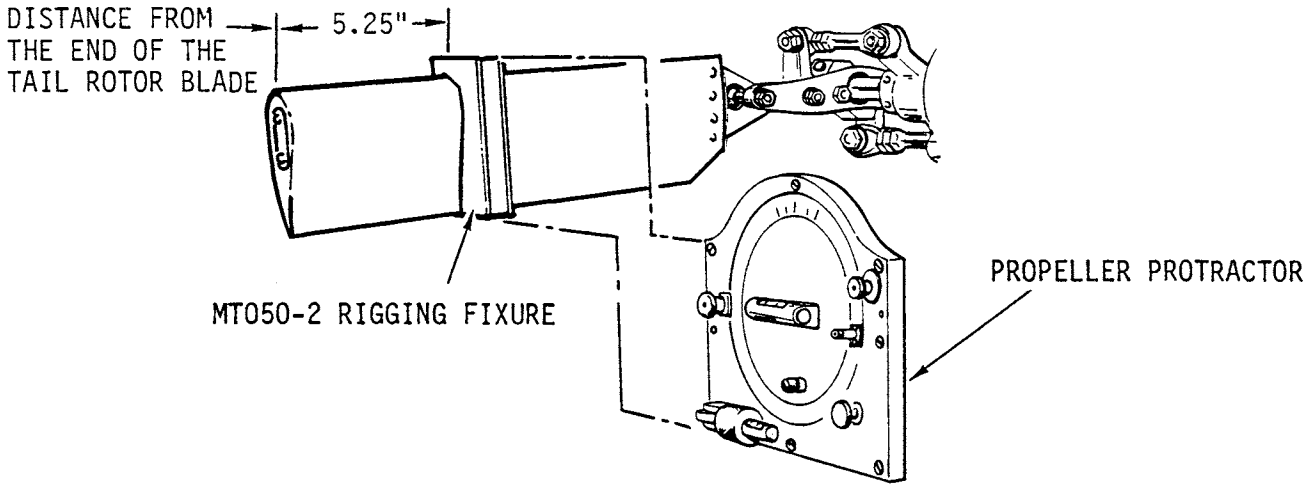


FIGURE 10-7 A120-1 BELLCRANK INSTALLATION

10.140 Tail Rotor Rigging (cont'd)

CAUTION

For acceptable track, differences between Blue and Red blade angles must not exceed .4 degrees. If the blade angles cannot be adjusted to within .4 degrees of each other using the pitch links they should be replaced.

NOTE

Pitch link jamnuts must be tight to ensure accurate blade angle measurements.

f) Adjustment of the blade angles is made using the rod ends of the A121-17 push-pull tube. One full turn of the rod end will change the blade angles .42 degrees. Adjust the rod end as necessary to obtain 19.0 to 19.5 degrees.

g) Place the right pedal against its stop. Measure the blade angles and record below.

NOTE

When pedal is placed against the right stop, a new tracking mark must be placed on the track stick as the tip path will change due to blade angle change.

	Pedals Full Right
Blue Blade	_____°nose left
Red Blade	+_____°nose left
	_____°÷2=_____° (9.6/10.6 deg. req'd)

h) Adjust the A121-17 push-pull tube as necessary to obtain blade angles of 9.6 to 10.6 degrees.

NOTE

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

10.140 Tail Rotor Rigging (cont'd)

i) If the blade angle range, for left and right pedal settings, cannot be obtained using the above procedure, this indicates the pedal travel is either too great or too small. Use the following procedure to check and adjust pedal travel:

1) Add the right and left pedal angles together. If the total is less than 28.6° the pedal total travel is too small. If the total is greater than 30.1° the total travel is too great.

2) To increase the total travel, lengthen the A121-9 and -11 push-pull tubes attached to the tail rotor pedals.

3) To decrease the total travel, shorten the A121-9 and -11 push-pull tubes.

NOTE

These changes should be made in 1/2 turn increments of the push-pull tube rod ends.

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 jamnuts. Torque stripe all jamnuts.

10.150 Throttle Correlation Rigging (See Figure 10-8)

a) For inservice check and adjustment, perform the following:

1) Rotate the throttle in "off" direction through the overtravel spring to the positive stop.

2) Holding the throttle tight against the stop, raise collective to full up stop while observing throttle bellcrank on carburetor. Throttle bellcrank should just barely start to move when the collective up stop is reached.

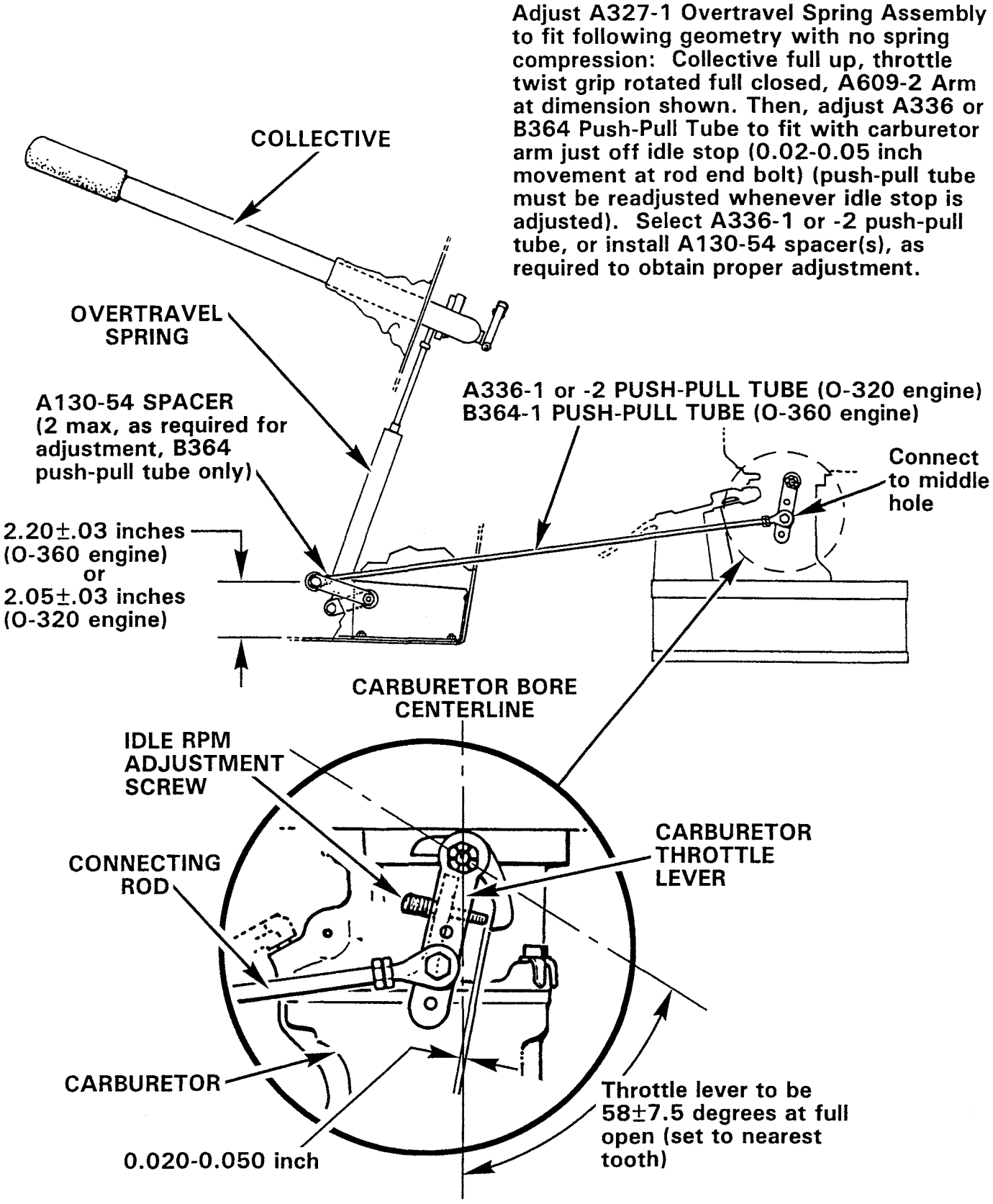


FIGURE 10-8 THROTTLE CORRELATION RIGGING

10.150 Throttle Correlation Rigging (continued)

NOTE

Before adjusting throttle connecting rod, ensure idle RPM and engine shimming are correctly adjusted per §§ 2.210 and 6.130.

3. See Figure 10-8. If required, adjust length of throttle connecting rod for 0.020–0.050 inch gap between carburetor butterfly bellcrank and idle RPM adjustment screw when performing step 2.
4. Tighten jamnut(s), check witness holes, and safety wire rod end, as required. (Note: If A933-3 rod end is installed, B330-7 palnut is required.)

10.200 Track and Balance

10.210 Equipment Requirements

NOTE

Calibrate track and balance equipment per manufacturer's recommendation, at least once a year, or if equipment is dropped, misused, or calibration is suspect.

NOTE

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 track checks.

10.220 Equipment Installation

10.221 Main Rotor Equipment Installation

NOTE

Use the following track & balance procedures in conjunction with approved equipment manufacturer's balancing instructions.

CAUTION

Cable security is critical; helicopter will be flown at V_{NE}.

a. Refer to Figure 10-9A. Using appropriate hardware, attach brackets to vibration transducer and attach assembly A359-1 panel as shown. Remove removable controls.
b. Install magnetic pickup bracket onto swashplate if not previously installed.

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10.221 Main Rotor Equipment Installation (cont'd)

> **WARNING**
>
> Ensure attachment bolts are torqued to 100 in.-lbs plus nut drag. The PT121 bracket will remain installed for inflight track and balance.

c) Install the 3030 magnetic pickup onto the PT121 bracket. Set the interrupter pickup gap to .030" ± .010".

d) Attach the 3319-1 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" with duct tape.

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

e) Attach the 4296-1 cable to the accelerometer mounted on the console. Secure with duct tape.

> **CAUTION**
>
> Ensure the cable cannot become tangled 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 Figure 10-9C)

a) Install the 4177 accelerometer under the top forward tail rotor gearbox output cartridge attachment bolt. Connector end of accelerometer must point up.

b) Connect the 4296-2 cable to the accelerometer. Wrap cable around the tailcone several times towards the forward end. Secure with duct tape.

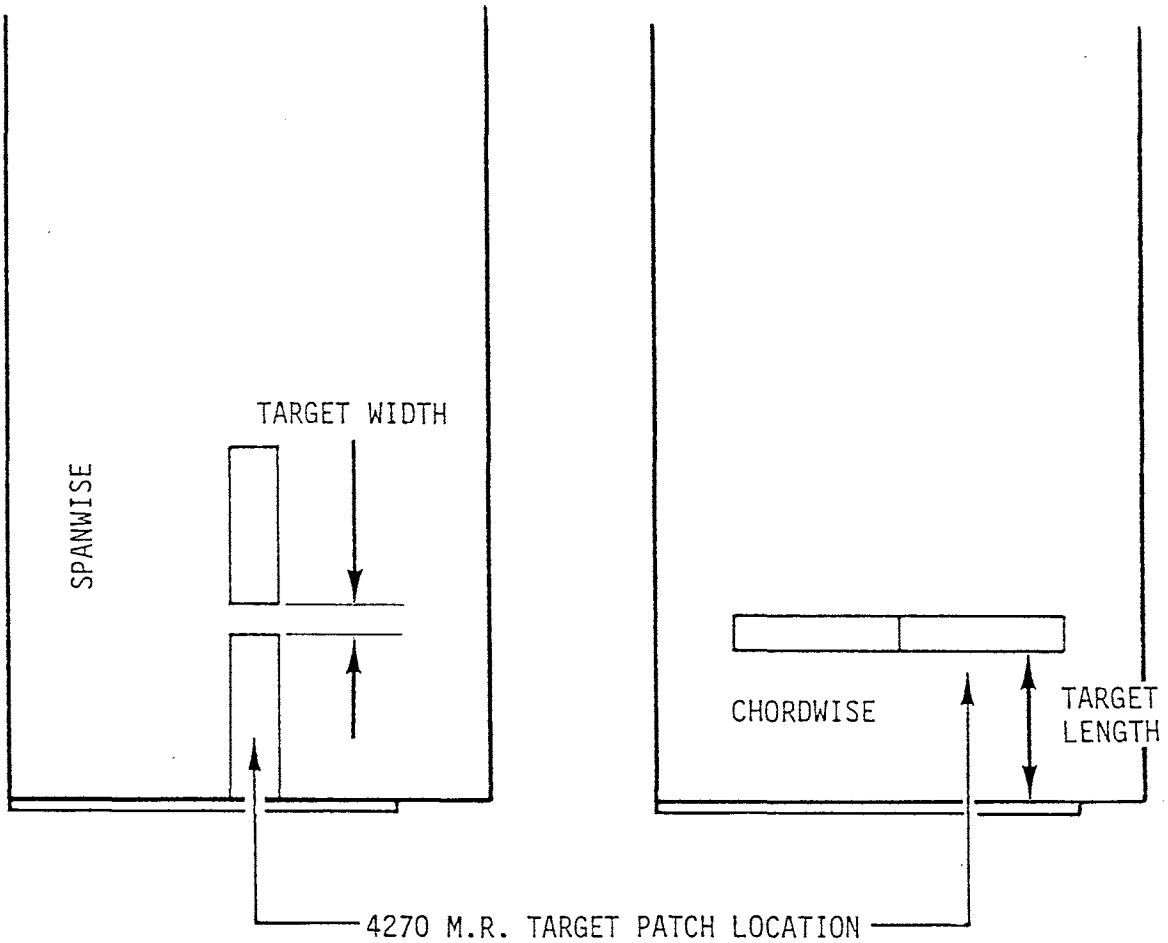

FIGURE 10-9 MAIN ROTOR TARGET PATCH LOCATION

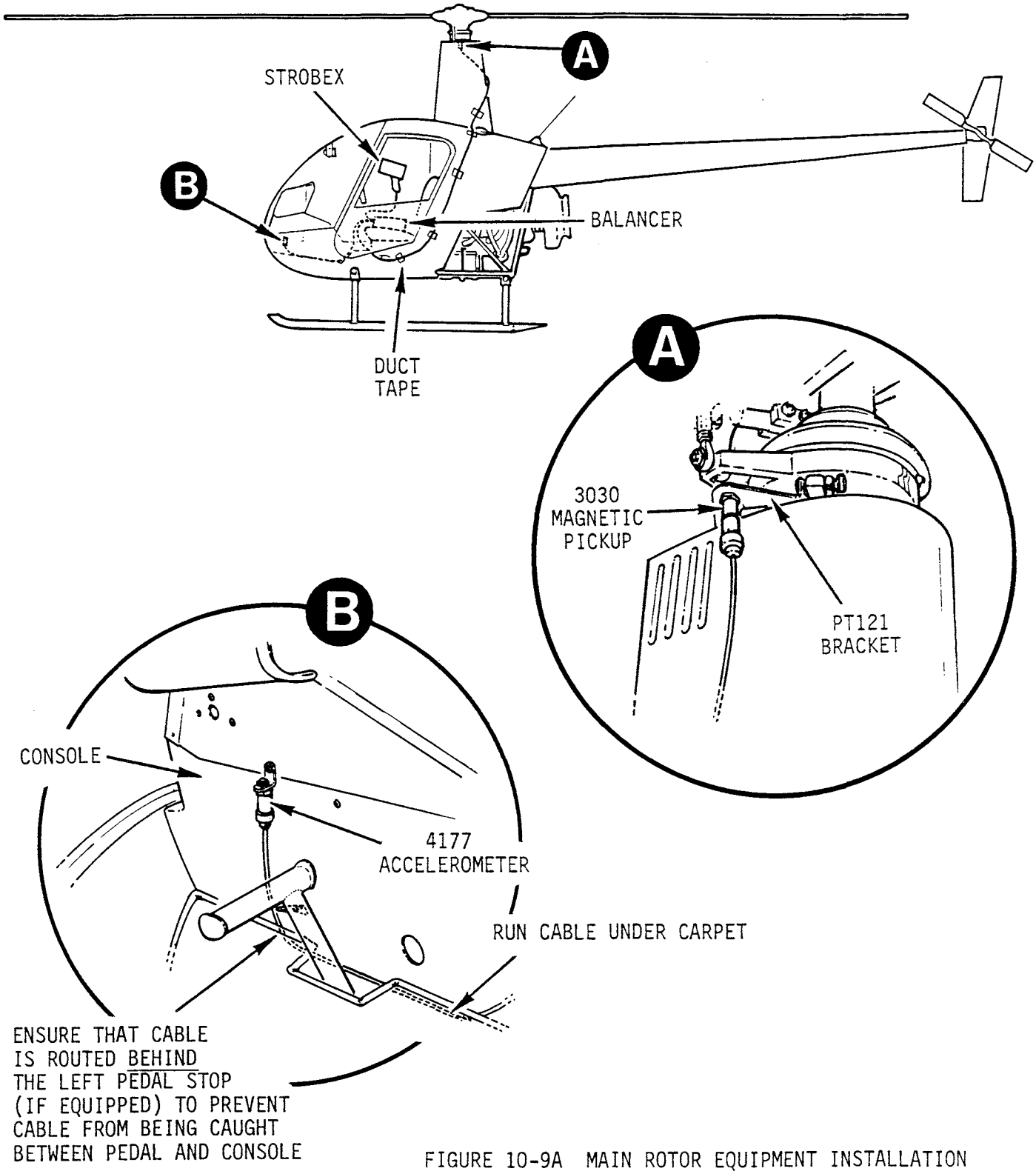

FIGURE 10-9A MAIN ROTOR EQUIPMENT INSTALLATION

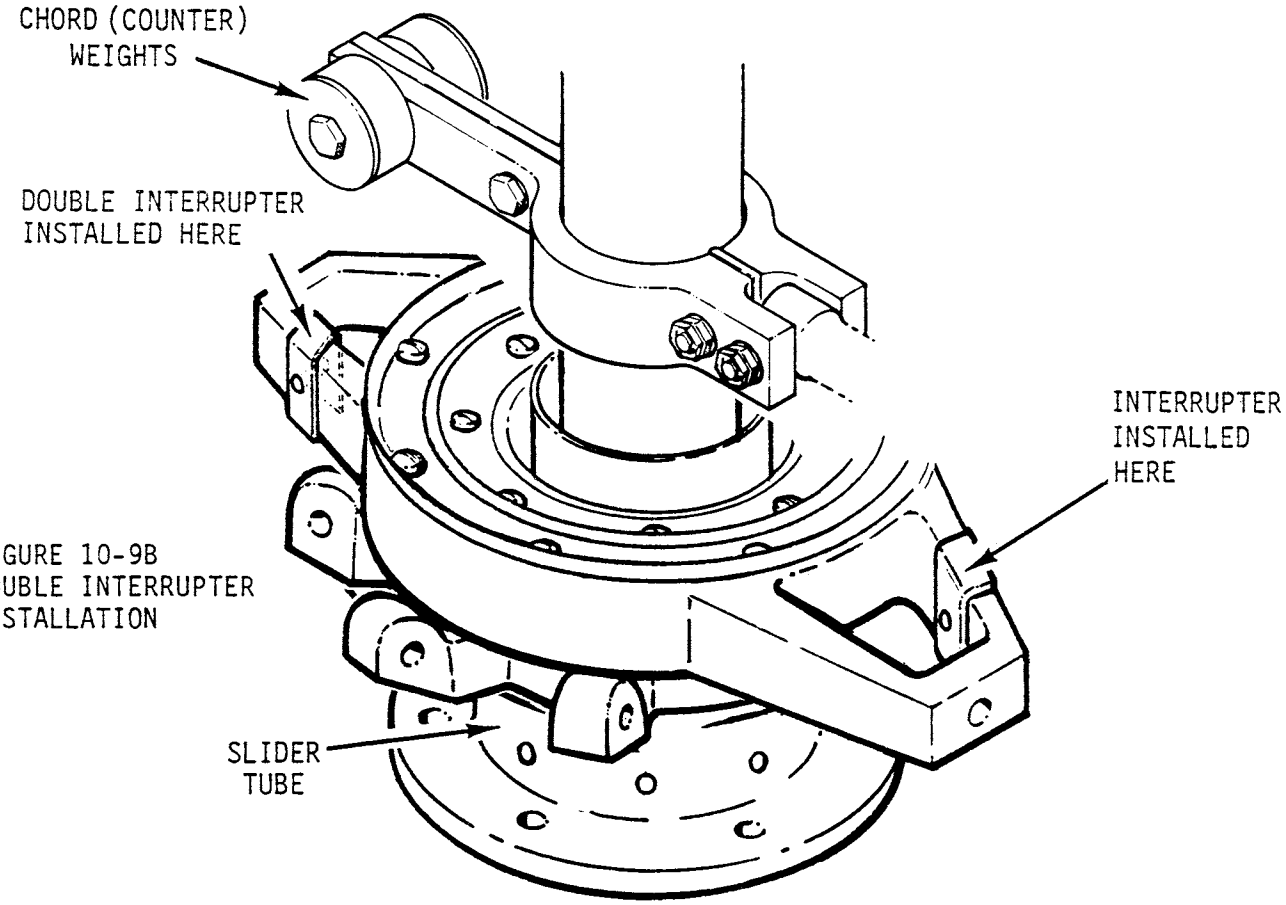

FIGURE 10-9B
DOUBLE INTERRUPTER
INSTALLATION

If the interrupters are installed as shown above the Main Rotor Balancing Chart will be out of phase.

Using a model 135M-10 Strobex with the interrupters installed per above drawing and using Doubler Interrupter Logic on the Balance Box, the Forward Blade must be relabeled as Aft. The Aft Blade must be relabeled Forward. Adding and subtracting chord weights and rotor head shifts would also be out of phase.

To use the Main Rotor Track and Balance Chart without correcting it, you must reverse the interrupters. The double interrupter must be on the opposite side of the driveshaft as the Chord (counter) weights.

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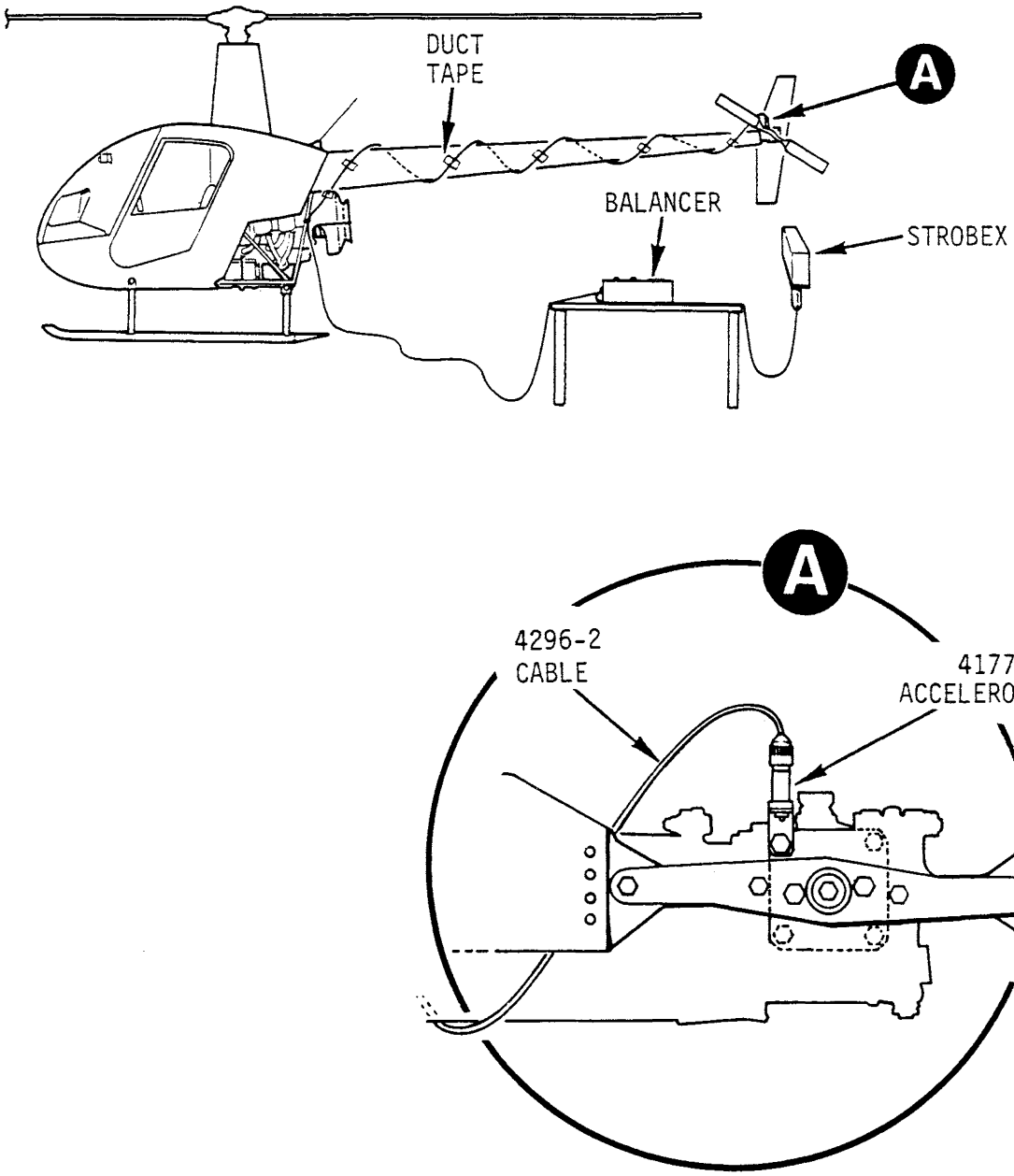
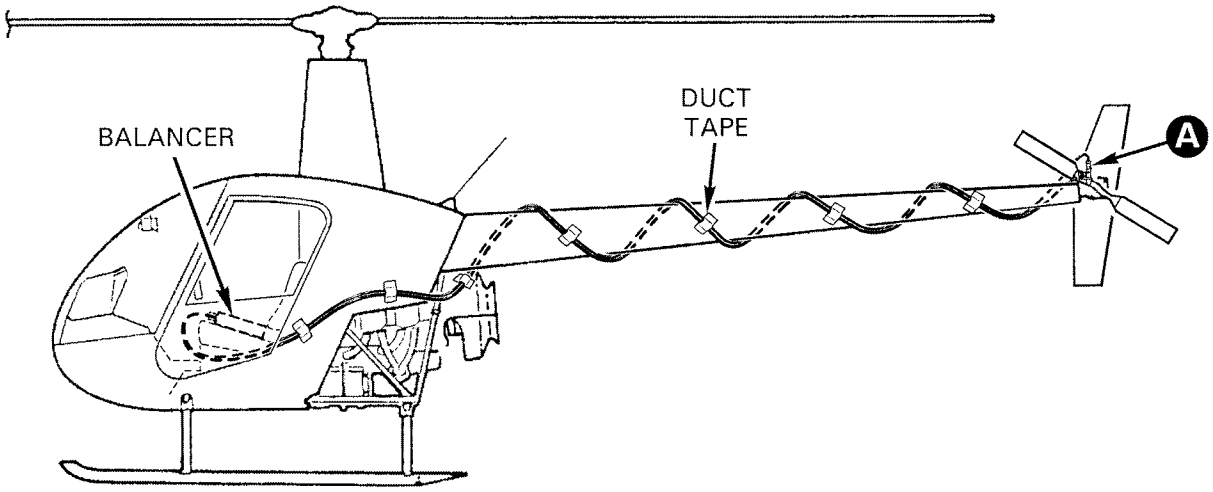
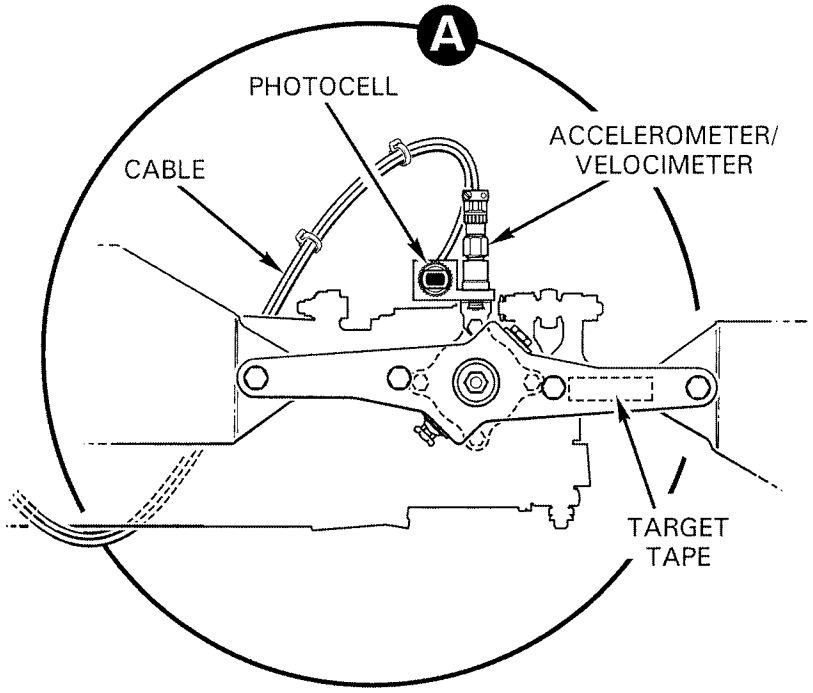


FIGURE 10-9C TAIL ROTOR EQUIPMENT INSTALLATION

10.222 Tail Rotor Equipment Installation (cont'd)



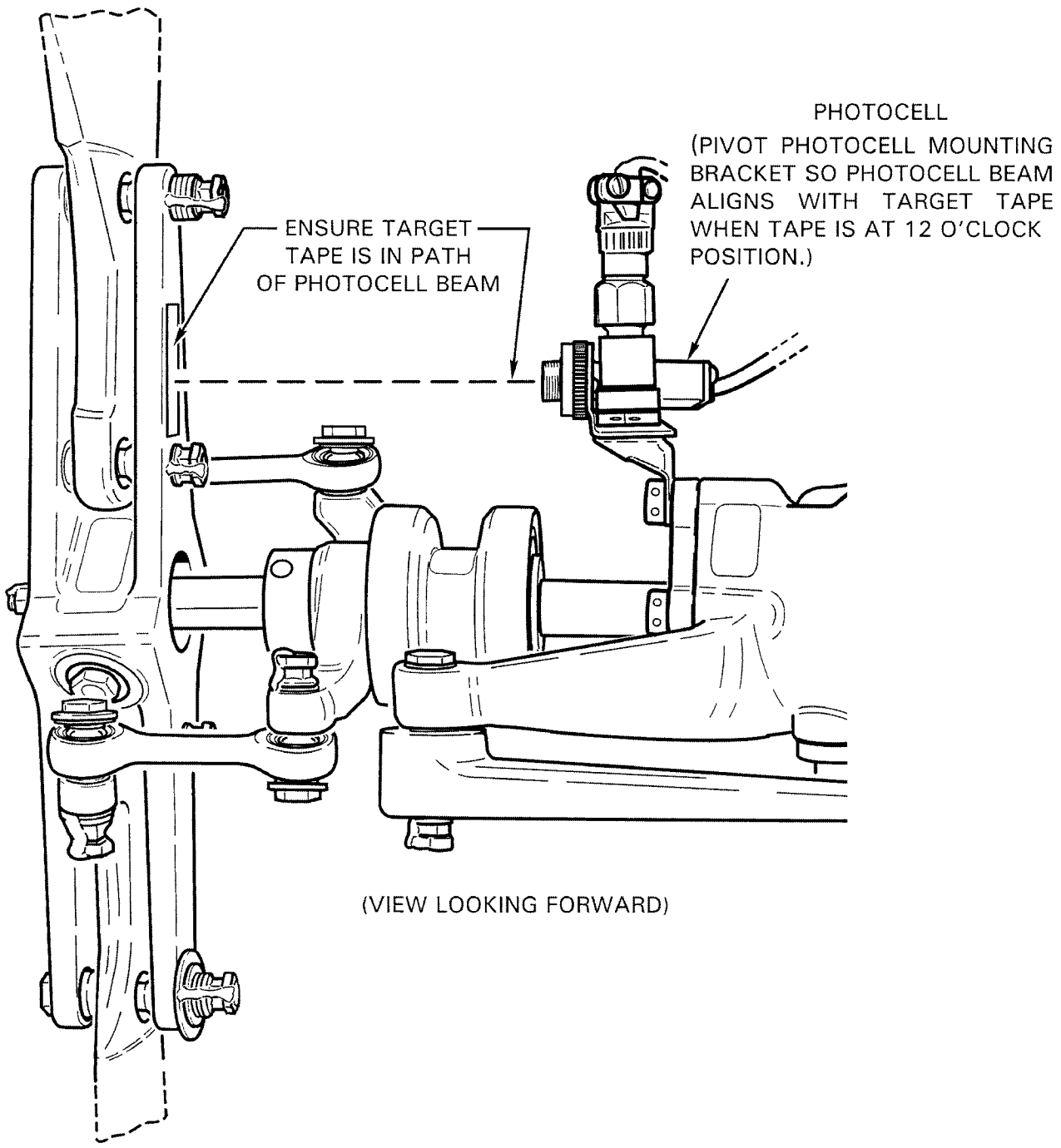


WARNING

Tail rotor balancing equipment must be removed for flight.

FIGURE 10-9C TAIL ROTOR BALANCING EQUIPMENT INSTALLATION

10.222 Tail Rotor Equipment Installation (cont'd)



WARNING

Tail rotor balancing equipment must be removed for flight.

FIGURE 10-9D TAIL ROTOR PHOTOCELL INSTALLATION

10.222 Tail Rotor Equipment Installation (continued)

c. Place a target tape on tail rotor hub inboard surface approximately 1 inch in from on blade's outboard attach bolt.

CAUTION

Ensure cables cannot become entangled in tail rotor.

d. Refer to Figures 10-9C and 10-9D. Install and secure photocell and mounting bracket to velocimeter bracket as shown. Connect extension cable to photocell and wrap cable several times around tailcone and secure with duct tape.

e. Connect cables to balancer.

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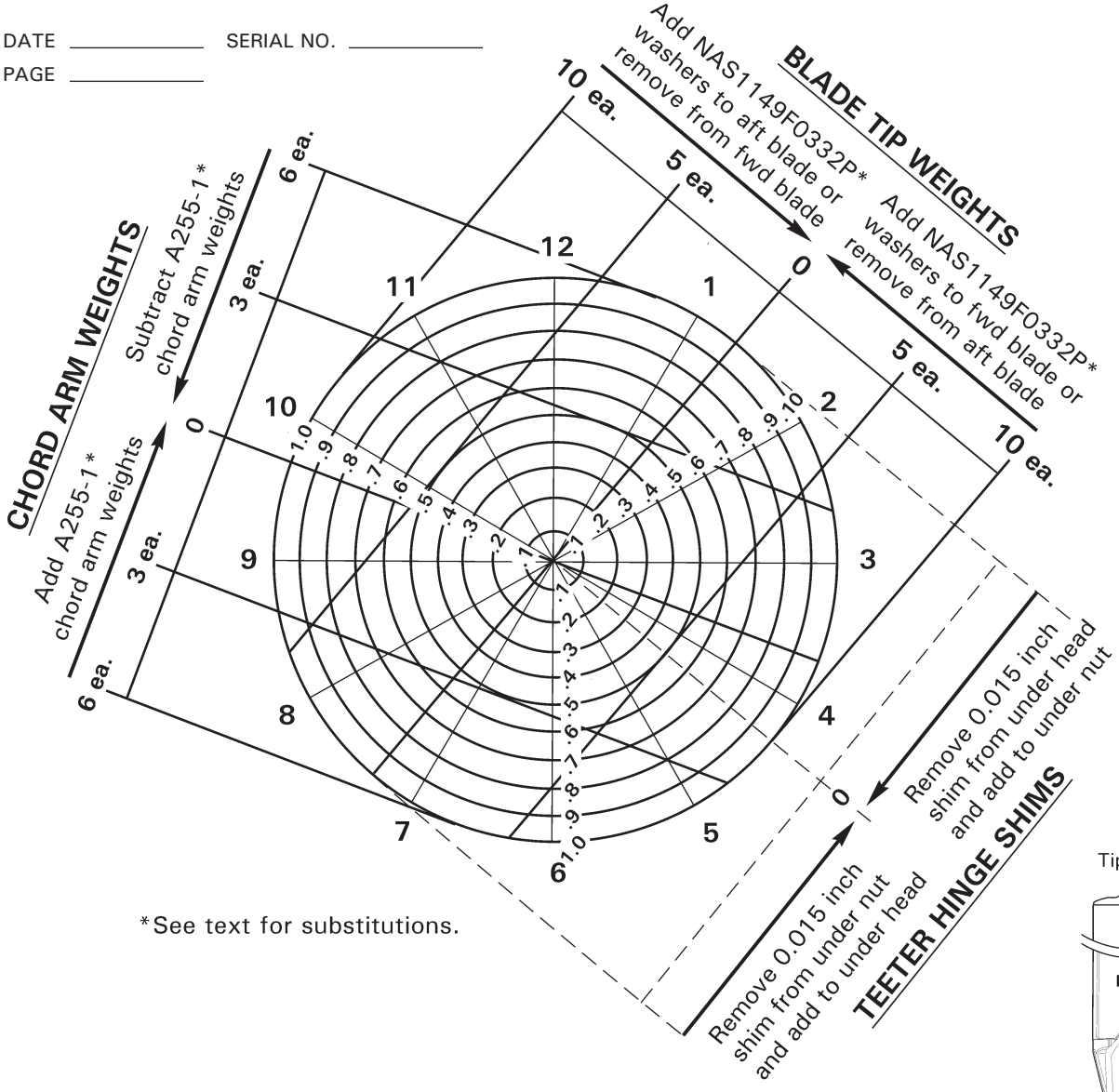

*See text for substitutions.

BALANCE		TRACK (KNOTS)						
CLOCK	IPS	HOVER	50	60	70	80	90	100

Adjustment: _____

CLOCK	IPS	HOVER	50	60	70	80	90	100

Adjustment: _____

CLOCK	IPS	HOVER	50	60	70	80	90	100

Adjustment: _____

CLOCK	IPS	HOVER	50	60	70	80	90	100

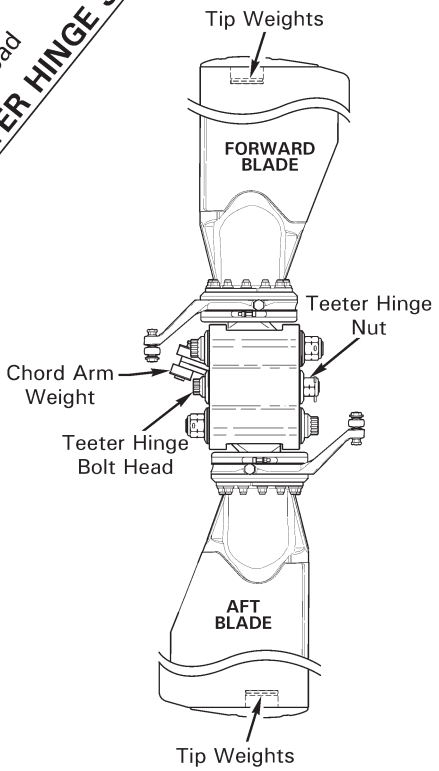

FIGURE 10-10 MAIN ROTOR TRACK AND BALANCE CHART

10.230 Main Rotor Track and Balance Procedure

NOTE

Prior to installing balancing equipment, verify blades are clean and smooth, rod ends & spherical bearings & scissors play are within limits, correct upper (rotating) scissors friction, correct swashplate tilting friction, and coning hinge frictions. Verify interrupter is opposite chord arm.

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

1. Check main rotor track in a hover and record data. Adjust track by shortening high blade pitch link per § 10.232 to bring track within 0.25 inch.
2. Check main rotor balance in a hover and record data. Adjust balance as indicated by main rotor balance chart to within 0.2 IPS (inches per second).
3. Fly helicopter at 50, 60, 70, 80, 90, and 100 knots. Check track at each airspeed and record.

WARNING

Do not exceed V_{NE} of helicopter when checking in-flight track.

4. Make slight tab adjustment to correct for a climbing blade by bending trim tab down per § 10.233.
5. Repeat steps 3 & 4 as required until track is within 3/8 inch at all airspeeds.
6. Readjust main rotor balance in a hover to no greater than 0.2 IPS.
7. Check autorotational RPM per § 10.250. Adjust as required.
8. Evaluate collective trim, longitudinal cyclic trim, and lateral cyclic trim. Adjust as required.
9. Check main rotor balance in a hover. Verify no greater than 0.2 IPS. Adjust as required.

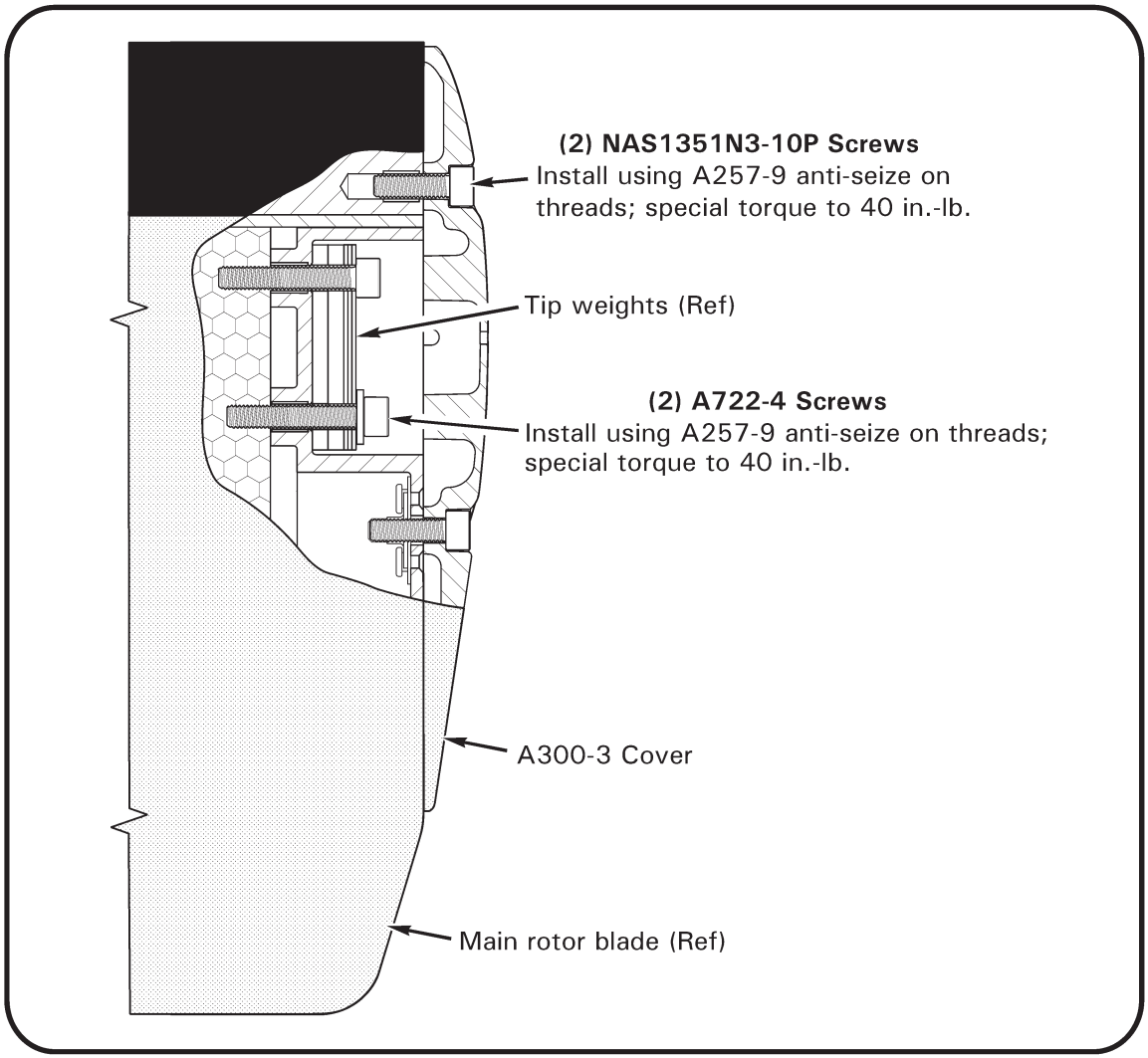

FIGURE 10-11 MAIN ROTOR BLADE TIP

10.231 Main Rotor Balance Adjustments

WARNING

A rotor which is smooth after balancing but goes out of balance within a few flights is suspect and must be examined by RHC before further flight.

A. Tip Weights (Spanwise Balance Adjustment)

1. Remove screws securing tip cover to blade. Balance rotor assembly spanwise by adjusting tip weights as required per Figure 10-10. Washers may be trimmed. Refer to Figure 10-11. Apply light coat A257-9 anti-seize to threads and install screws securing tip weights to blade; special torque screws to 40 in.-lb. Apply light coat A257-9 anti-seize to threads and install screws securing tip cover to blade; special torque screws to 40 in.-lb.

   (1) AN960-10 or NAS1149F0363P Washer = (2) AN960-10L or NAS1149F0332P Washers
   (1) A298-2 Weight = 0.034 lb
   (1) A298-3 Weight = 0.009 lb

B. Teeter Hinge Bolt Shims (Chordwise Balance Adjustment – Coarse Adjustment)

1. Remove and discard teeter hinge nut cotter pin. Remove nut, thrust washer, and any shims.
2. Have two people cone the main rotor blades. Push out teeter hinge bolt (and any shims) with another bolt.
3. Balance rotor assembly chordwise by moving (or exchanging) existing teeter hinge shims to other side of bolt (under head or under nut) as required per Figure 10-10. Install teeter hinge bolt per § 26-10.

C. Chord Arm Weight (Chordwise Balance Adjustment – Fine Adjustment)

1. Balance rotor assembly chordwise by adjusting chord arm weights or washers per Figure 10-10. Total weight not to exceed two A255-2 weights (or equivalent).

   (1) A255-1 Weight = (8) AN970-4 Washers
   (1) A255-2 Weight = (3) A255-1 Weights

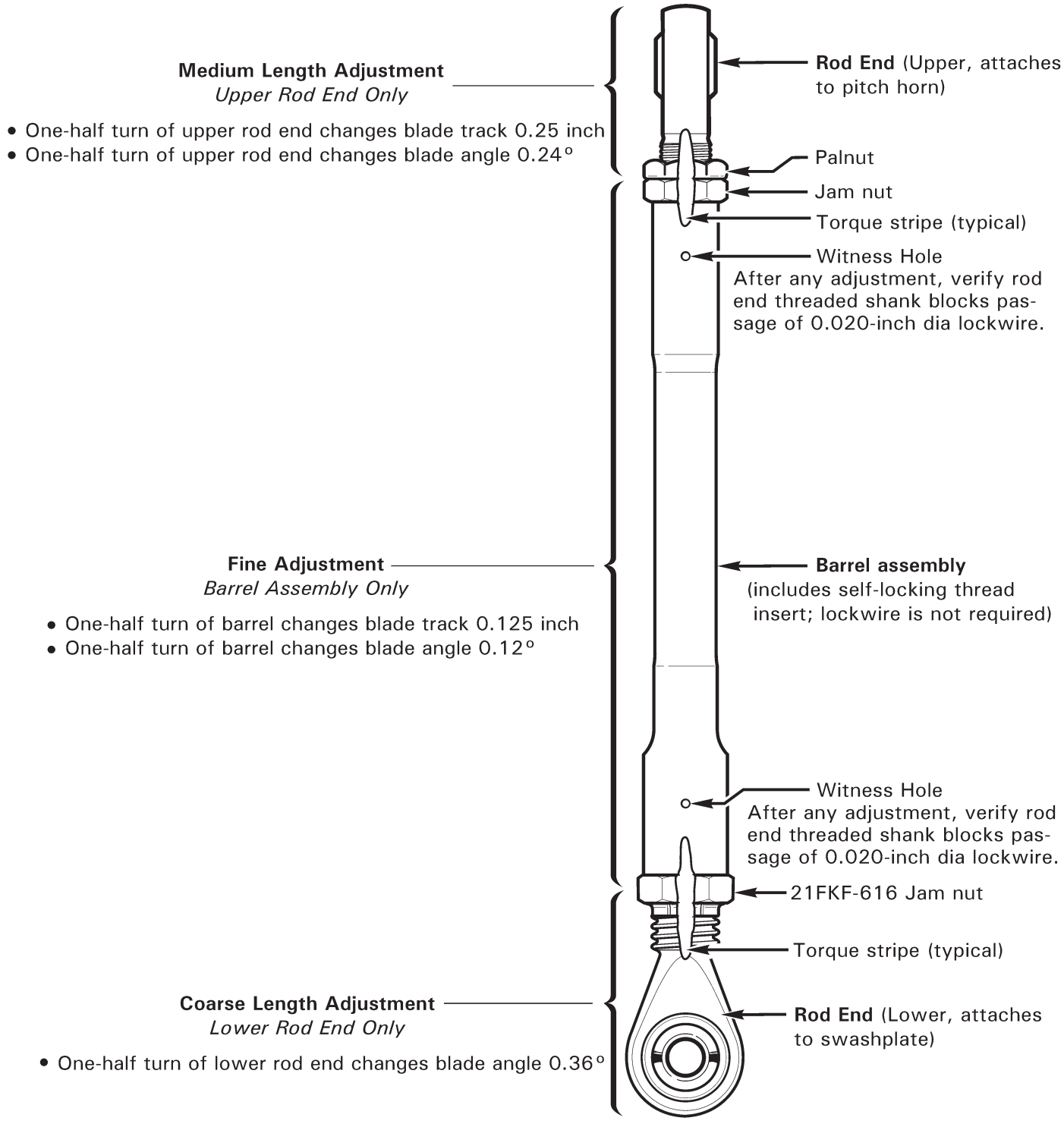

FIGURE 10-12A A258-5 MAIN ROTOR PITCH LINK

10.232 Main Rotor Pitch Link Adjustment

A. Main Rotor Blade Pitch Link

NOTE
Shorten high pitch blade when adjusting track in a hover.

NOTE
During rigging, adjust both pitch links exactly the same for collective adjustments.

1. For fine adjustment:

   a. A258-5 Pitch Link: Adjust barrel assembly only per the following steps:

      i. Refer to Figure 10-12A. Using backup wrench on barrel assembly, loosen 21FKF-616 nut at lower rod end, and upper rod end palnut and jam nut.

      ii. Rotate barrel assembly to shorten or lengthen pitch link as required. One-half turn of barrel changes blade track approximately 0.125 inch. One-half turn of barrel changes blade angle approximately 0.12°. For finer adjustment, rotate less than one-half turn as required.

      iii. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through barrel assembly witness holes.

      iv. Position rod ends to allow as much pitch link rotation as possible without binding. Using backup wrench on barrel assembly, special torque 21FKF-616 nut per § 23-33, and standard torque upper rod end jam nut and palnut per § 23-32.

      v. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.

   b. A258-1 Pitch Link: Adjust fitting only per the following:

      i. Refer to Figure 10-12B. Cut and discard pitch link assembly safety wire. Using backup wrench on link assembly, loosen 21FKF-616 nut; using backup wrench on fitting, loosen upper rod end palnut and jam nut.

      ii. Rotate fitting to shorten or lengthen pitch link as required. One-half turn of fitting changes blade track approximately 0.125 inch. One-half turn of fitting changes blade angle approximately 0.12°. For finer adjustment, rotate less than one-half turn as required.

      iii. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through pitch link witness holes.

      iv. Using backup wrench on link assembly, special torque 21FKF-616 nut per § 23-33. Using backup wrench on fitting, standard torque upper rod end jam nut and palnut per § 23-32. Safety fitting to link assembly using 0.032-inch diameter lockwire.

      v. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.

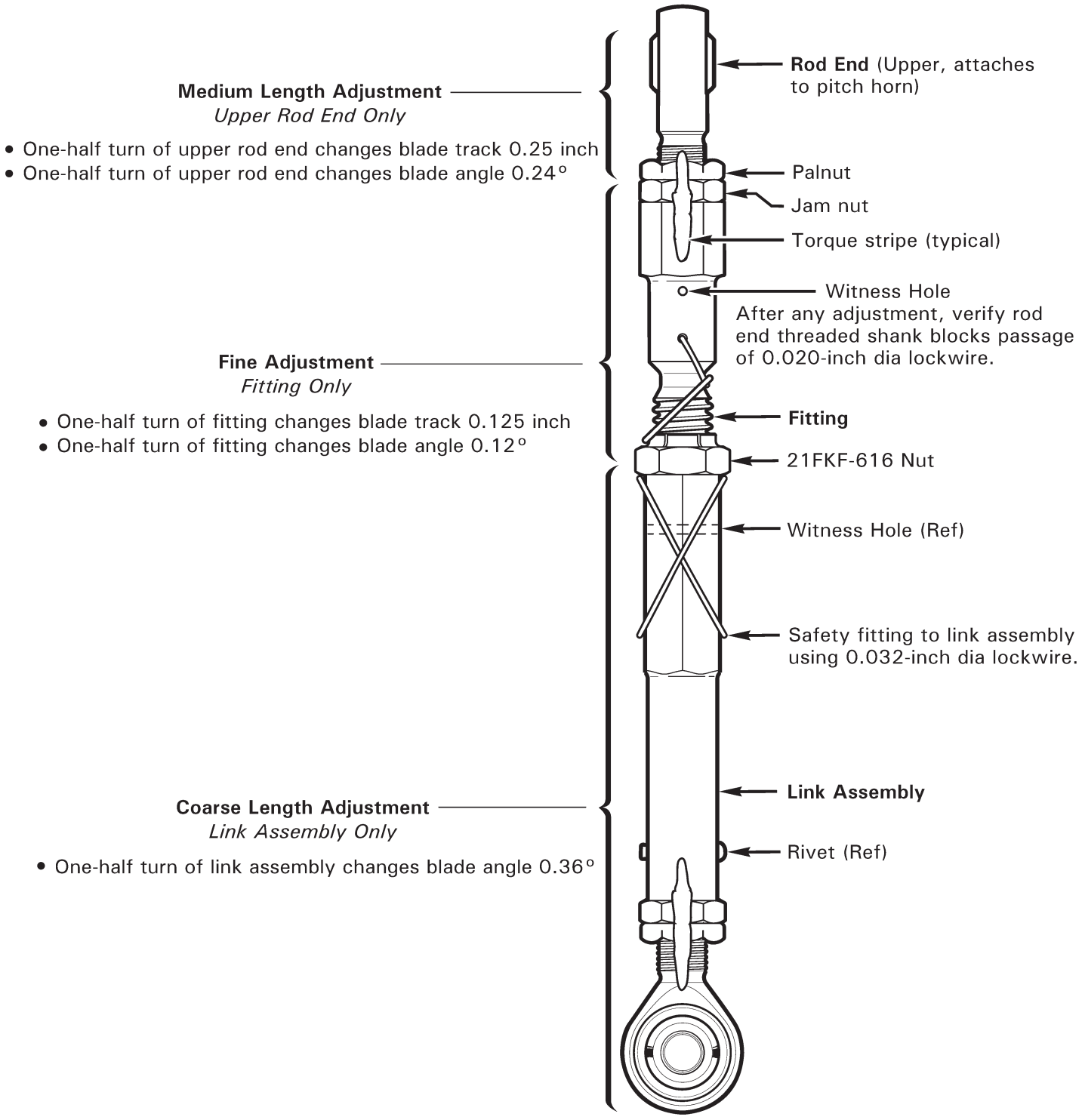

FIGURE 10-12B A258-1 MAIN ROTOR PITCH LINK

10.232 Main Rotor Pitch Link Adjustment (continued)

A. Main Rotor Blade Pitch Link (continued)

2. For medium length adjustment, adjust upper rod end per the following:

   a. Refer to Figure 10-12A or 10-12B. Using backup wrench on barrel assembly or fitting, loosen upper rod end palnut and jam nut. Remove hardware securing rod end to pitch horn.

   b. Rotate upper rod end to shorten or lengthen pitch link as required. One-half turn of upper rod end changes blade track approximately 0.25 inch. One-half turn of upper rod end changes blade angle by approximately 0.24°.

   c. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through barrel asssembly (upper), or fitting, witness hole. Install hardware securing rod end to pitch horn and standard torque fasteners per § 23-32.

   d. Position rod ends to allow as much pitch link rotation as possible without binding. Using backup wrench on barrel assembly or fitting, standard torque upper rod end jam nut and palnut per § 23-32.

   e. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.

3. For coarse length adjustment:

   a. A258-5 Pitch Link: Adjust lower rod end per the following:

      i. Refer to Figure 10-12A. Using backup wrench on barrel assembly, loosen 21FKF-616 nut at lower rod end. Remove hardware securing lower rod end to swashplate.

      ii. Rotate lower rod end to shorten or lengthen pitch link as required. One-half turn of lower rod end changes blade angle by approximately 0.36°.

      iii. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through barrel asssembly (lower) witness hole. Install hardware securing rod end to swashplate and standard torque fasteners per § 23-32.

      iv. Position rod ends to allow as much pitch link rotation as possible without binding. Using backup wrench on barrel assembly, special torque 21FKF-616 nut per § 23-33.

      v. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.

10.232 Main Rotor Pitch Link Adjustment (continued)

A. Main Rotor Blade Pitch Link (continued)

3. For coarse length adjustment (continued):

b. A258-1 Pitch Link: Adjust link assembly per the following:

i. Refer to Figure 10-12B. Cut and discard pitch link assembly safety wire. Using backup wrench on link assembly, loosen 21FKF-616 nut. Remove hardware securing lower rod end to swashplate.

ii. Rotate link assembly to shorten or lengthen pitch link as required. One-half turn of link assembly changes blade angle by approximately 0.36°.

iii. Refer to Figure 2-1. Verify rod end threaded shank blocks passage of 0.020-inch diameter lockwire through link assembly witness hole. Install hardware securing rod end to swashplate and standard torque fasteners per § 23-32.

iv. Position rod ends to allow as much pitch link rotation as possible without binding. Using backup wrench on link assembly, special torque 21FKF-616 nut per § 23-33. Safety fitting to link assembly using 0.032-inch diameter lockwire.

v. Repeat steps on opposite pitch link as required; torque stripe per Figure 2-1.

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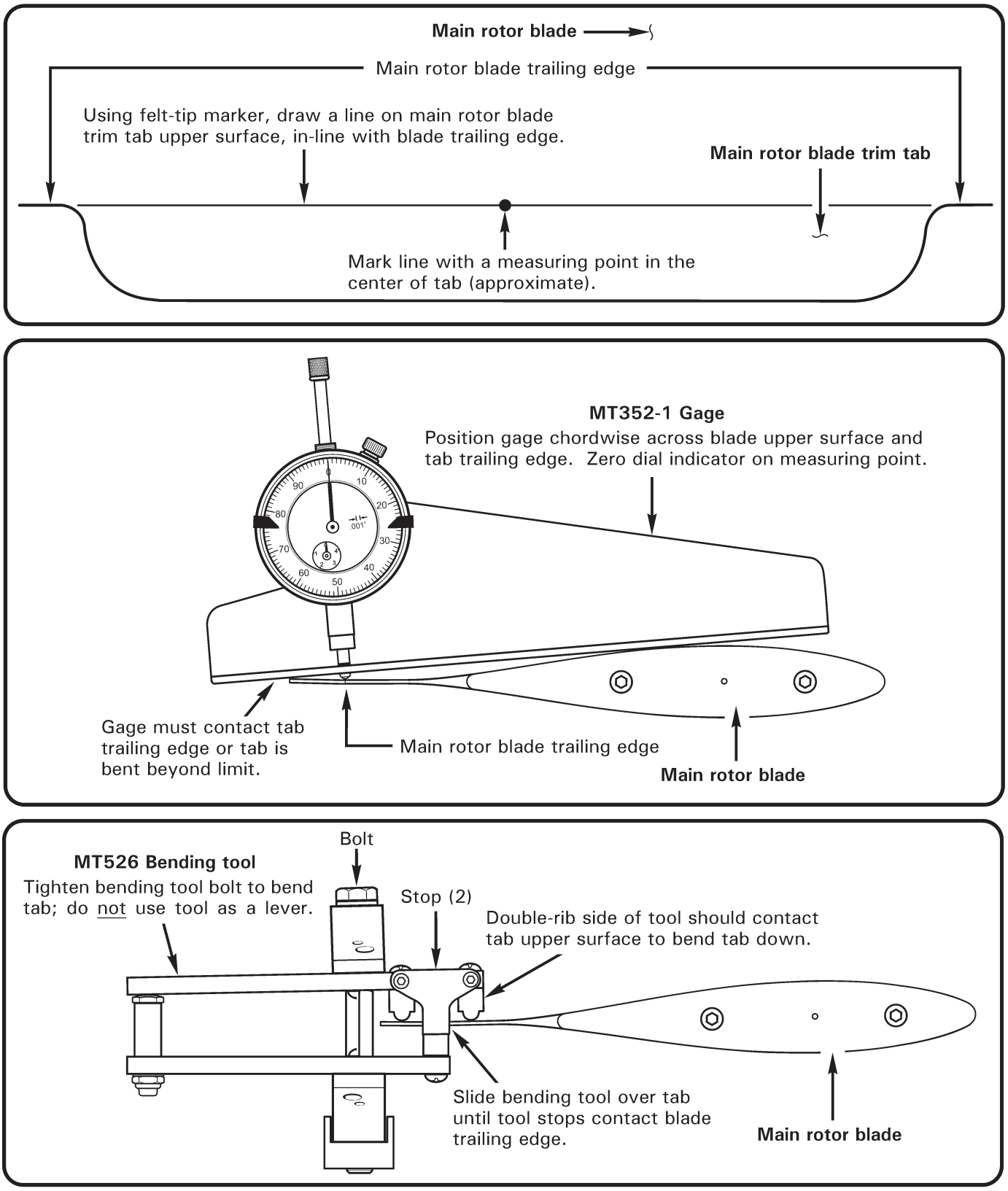

FIGURE 10-13 MAIN ROTOR BLADE TRIM TAB ADJUSTMENT

10.233 Main Rotor Blade Trim Tab Adjustment

NOTE

To correct for a "climbing" blade condition (blade spread that exceeds 3/8 inch with forward airspeed), bend high blade trim tab down.

CAUTION

Do not use other helicopter manufacturers' trim tab bending tools. Use of these tools will damage Robinson blades.

CAUTION

MT352-1 gage must contact trim tab trailing edge. If gage does not contact tab trailing edge, tab is bent beyond limit.

CAUTION

Tighten MT526-1 or MT526-8 trim tab bending tool bolt to bend tab; do not use tool as a lever.

CAUTION

Bend tab upward only when absolutely necessary; bending tab upward can increase rotor vibration.

CAUTION

MT526-1 trim tab bending tool (for A016-4 [stainless steel skin] blades) and MT526-8 trim tab bending tool (for A016-6 [aluminum skin] blades) are not interchangeable. Use of wrong bending tool can result in blade damage. MT090-1 trim tab bending tool (for earlier blades) is obsolete.

1. Using felt tip marker, ink mark main rotor blade trim tab per Figure 10-13. Mark line with a measuring point in the center of the tab (approximate).
2. Position MT352-1 gage chordwise across blade upper surface and tab trailing edge. Zero dial indicator on measuring point.
3. Position MT526-1 (trim tab bending tool (for A016-4 [stainless steel skin] blades) or MT526-8 trim tab bending tool (for A016-6 [aluminum skin] blades) on tab per Figure 10-12. Slide tool completely over tab until tool stops contact blade trailing edge. Double-rib side of tool should contact tab upper surface to bend tab down. Double-rib side of tool should contact tab bottom surface to bend tab up.
4. Tighten MT526 bending tool bolt to bend tab. Make slight bends and re-measure tab with MT352-1 gage. Bend trim tab 0.015 inch (down) to effect dynamic movement of main rotor blade tip approximately 0.2 inch (downward).

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10.234 Main Rotor Track and Balance Troubleshooting

The following are some of the symptoms and corrections which occur in the Track and Balance operations of the helicopter. Decide on the various causes of a given trouble and then eliminate causes one by one, beginning with the most probable.

Symptom	Probable Cause	Correction
1. Excessive Cyclic Stick Shake	Main Rotor Out of Track or Balance	Track and Balance with Chadwick-Helmuth Balancing Equipment
	Rough or Binding A205-3 Fork Assy (Upper Swashplate)	Replace or refer to Section 8.6 of Maintenance Manual
	Brinelled Spindle Bearings (rough movement)	RHC replacement of Spindle Bearings
	Blade surface rough (chipped) paint	Feather in rough edges or repaint
	Rough or Binding Pitch Links	Replace pitch link rod ends for smooth operation
	M.R. Blade Boot Misaligned	Replace boot or realign. Boot should show deformation as cyclic and collective are moved through their normal arc or travel.
	M.R. Hub Teeter or Coning Hinge Binding	RHC replacement or rework for smooth operation
	M.R. Blade Trim Tabs Bent Upward	Bend Trim Tabs down evenly
	Blade Match	RHC replacement of blade(s)
2. Excessive Ship Vibration	Main Rotor out of Track and Balance	Track and Balance with Chadwick-Helmuth Balancing Equipment
	M.R. Hub Teeter or Coning Hinge Friction Improperly Adjusted	Refer to Section 9.123 of Maintenance Manual
	Sticky Coning Hinge Bearings in M.R. Hub	RHC replacement or refer to Section 9.123

10.234 Main Rotor Track and Balance Troubleshooting (cont'd)

	Symptom	Probable Cause	Correction
2.	Excessive Ship Vibration (cont'd)	Brinelled Spindle Bearings (rough movement)	RHC replacement of Spindle Bearing
		Worn Teeter Bearing in M.R. Hub	RHC replacement of M.R. Hub Bearings
3.	Excessive Cyclic Stick Forces	Brinelled Spindle Bearings (rough movement)	RHC replacement of Spindle Bearings
		M.R. Blade Trim Tabs Bent Upward	Bend Trim Tabs down evenly
4.	Intermittent Blade Track Picture	M.R. Hub Teeter or Coning Hinge Friction Improperly Adjusted	Refer to Section 9.123
		Sticky Coning Hinge Bearings in M.R. Hub	RHC replacement or refer to Section 9.123
		Teeter Hinge not Broken-In	Adjust track to minimize error
		Brinelled Spindle Bearings (rough movement)	RHC replacement of Spindle Bearings
5.	Radical Changes to Cylic Trim	Worn Teeter Hinge Bearings in M.R. Hub	RHC replacement of M.R. Hub Bearings
		Brinelled Spindle Bearings (rough movement)	RHC replacement of Spindle Bearings
6.	Lateral Intermittent Aircraft Vibration	Engine misfiring due to malfunction in spark-plugs, ignition leads, magneto or engine not broken-in	Refer to Lycoming Maintenance Instructions

10.240 Tail Rotor Balance Procedure

Refer to specific manufacturer's installation instructions when using balancing equipment other than Chadwick-Helmuth 177- or 8350- series 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 340. 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.

WARNING

Both tail rotor blades must be same part number

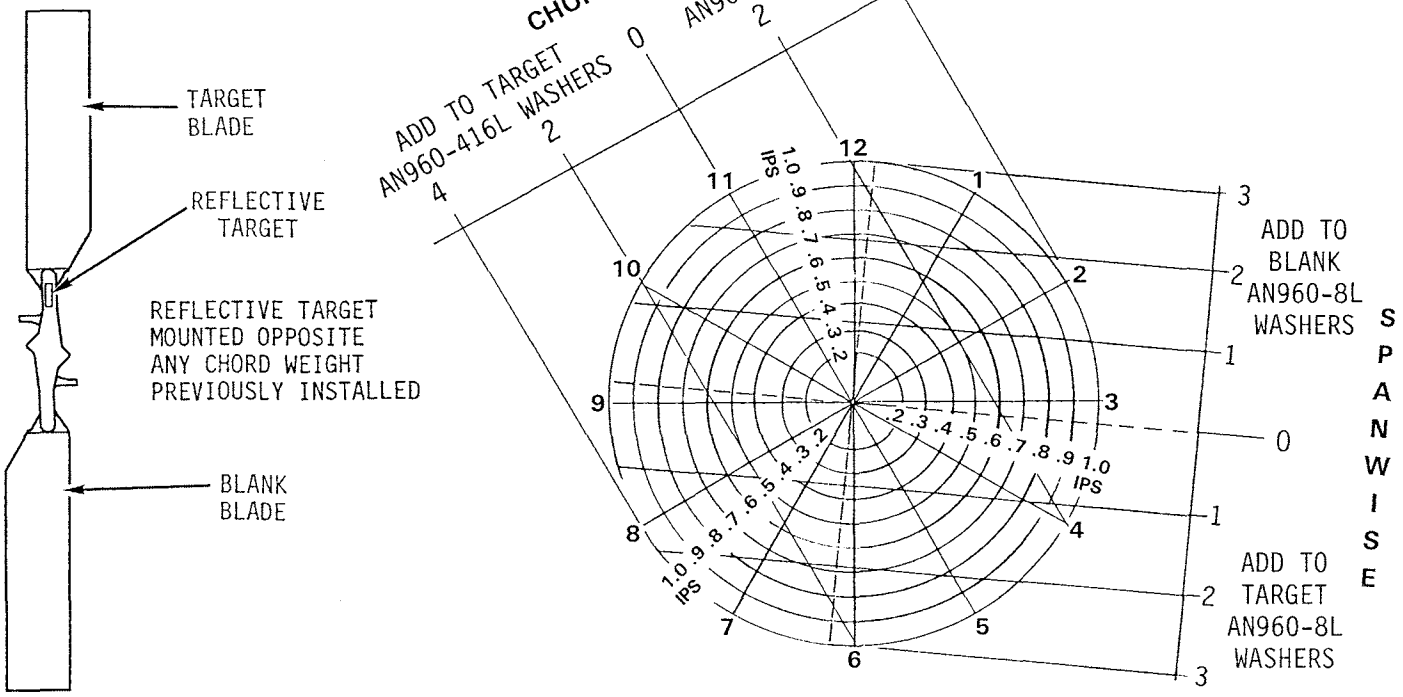
Spanwise balance adjustments for A029-1 square-tip blades made by adding, subtracting, or exchanging weights under the removable tip cover. Use A134-1 or -2 tip weights or AN960-8 or -8L washers. -8L washers may be trimmed as a very fine adjustment.

Spanwise balance for A029-2 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, AN960-416 or -416L washers under nut securing blade's pitch link attaching bolt. Change pitch link, attaching bolt length as required for proper thread engagement (see Section 1.300, refer to IPC for allowable lengths).

A008-2 TAIL ROTOR (WITH A029-1 SQUARE-TIP BLADES) TRACK AND BALANCE CHART

SHIP S/N _____
DATE _____
HOURMETER _____



CHORDWISE WEIGHTS

(2)AN960-416L WASHERS = (1)AN960-416 WASHER
(3.5)AN960-416L WASHERS = (1)A214-3 WASHER
(5)AN960-416L WASHERS = (1)A141-14 WASHER

SPANWISE WEIGHTS

(2)AN960-8L WASHERS = (1)AN960-8 WASHER
(8)AN960-8L WASHERS = (1)A134-1 WEIGHT

RUN	CLOCK	IPS	CHANGE MADE BEFORE NEXT RUN

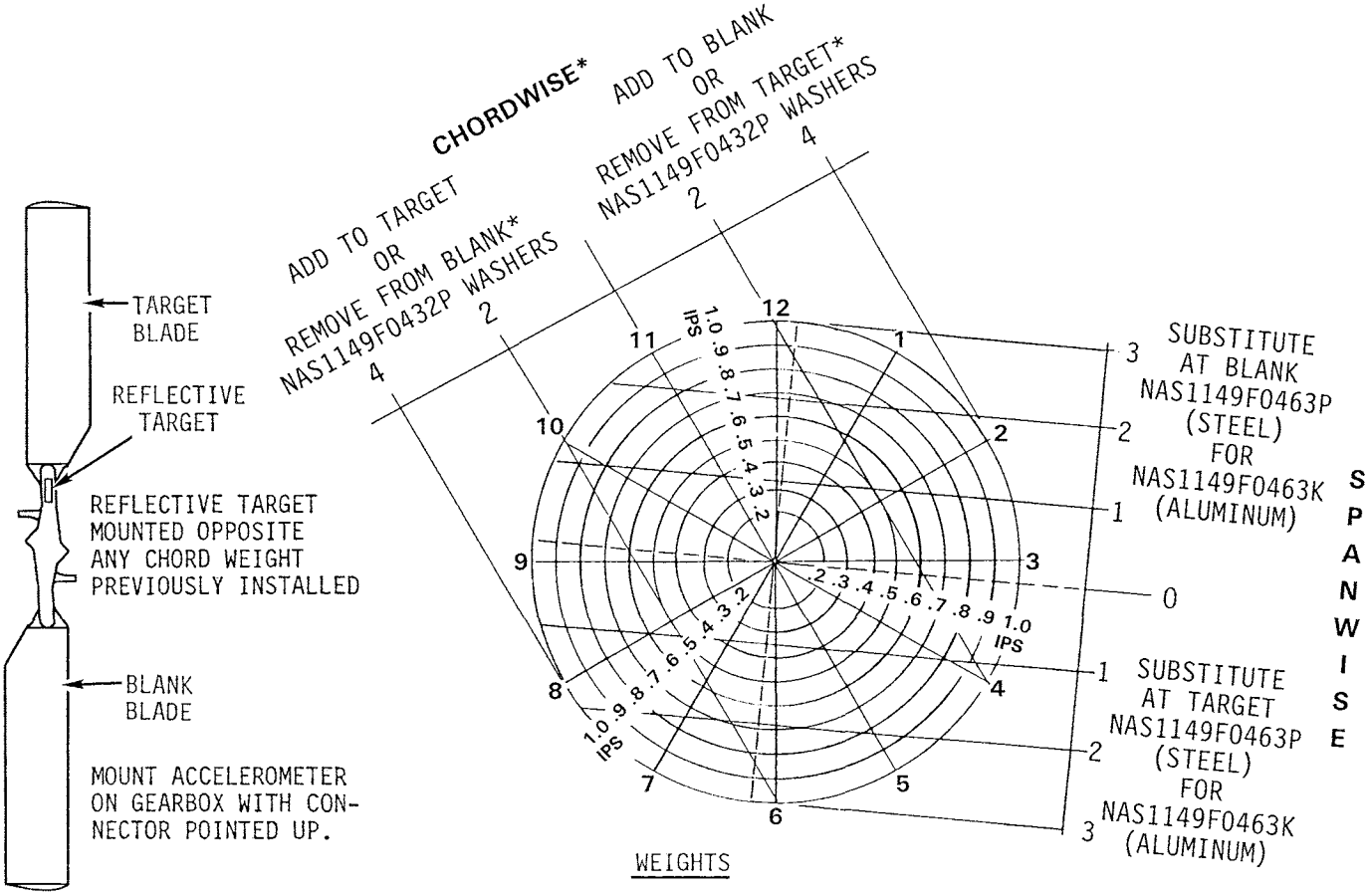
FIGURE 10-14

A008-4 TAIL ROTOR
(WITH A029-2 ROUND-TIP BLADES)
TRACK AND BALANCE CHART

SHIP S/N _____

DATE _____

HOURMETER _____



(2)NAS1149F0432P WASHERS = (1)NAS1149F0463P WASHER

(3.5)NAS1149F0432P WASHERS = (1)A214-3 WASHER

(3)NAS1149F0463P WASHERS = (1)A141-14 WASHER

(6.5)NAS1149F0463P WASHERS = (1)AN970-4 WASHER

*A MINIMUM OF ONE NAS1149F0432P WASHER MUST BE INSTALLED IN CHORDWISE LOCATION ON EACH BLADE.

RUN	CLOCK	IPS	CHANGE MADE BEFORE NEXT RUN

FIGURE 10-14A

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.

1. Perform autorotation RPM check at minimum practical weight. Calculate the takeoff gross weight of the helicopter. Record the time on the hour meter.

   Take-Off gross weight _____

   Take-Off hourmeter reading _____

2. 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 over-speeding 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)

3. After each flight, refer to figure 10-15 and determine the following:

Test #	Elapsed Time (in-flight hourmeter reading minus take-off hourmeter reading)	Pounds of Fuel Consumed (elapsed time x 45 lbs/hr)	Test Gross Weight (take-off gross weight minus fuel consumed	Chart % RPM	Test % RPM (from in-flight data)	RPM Correction (chart % RPM minus Test % RPM)
1						
2						
3						
4						
5						

4. Adjust the pitch links based on the average RPM correction required. Lengthen both pitch links to decrease RPM if the test RPM is greater than the chart RPM (lengthening the pitch links one full rod end turn will reduce RPM 3%). Shorten both pitch links to increase RPM. Be sure to adjust both pitch links exactly the same so track will not be affected.

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

   a. Start at outside air temperature, and draw a vertical line up to the pressure altitude.

   b. Draw a horizontal line from the pressure altitude to the rotorcraft gross weight at time of autorotation.

   c. Draw a vertical line down from the gross weight to the required autorotation RPM.

   d. Make adjustment to the main rotor pitch links as required to obtain test autorotation RPM within ± 1% of chart RPM (see Figure 10-15).

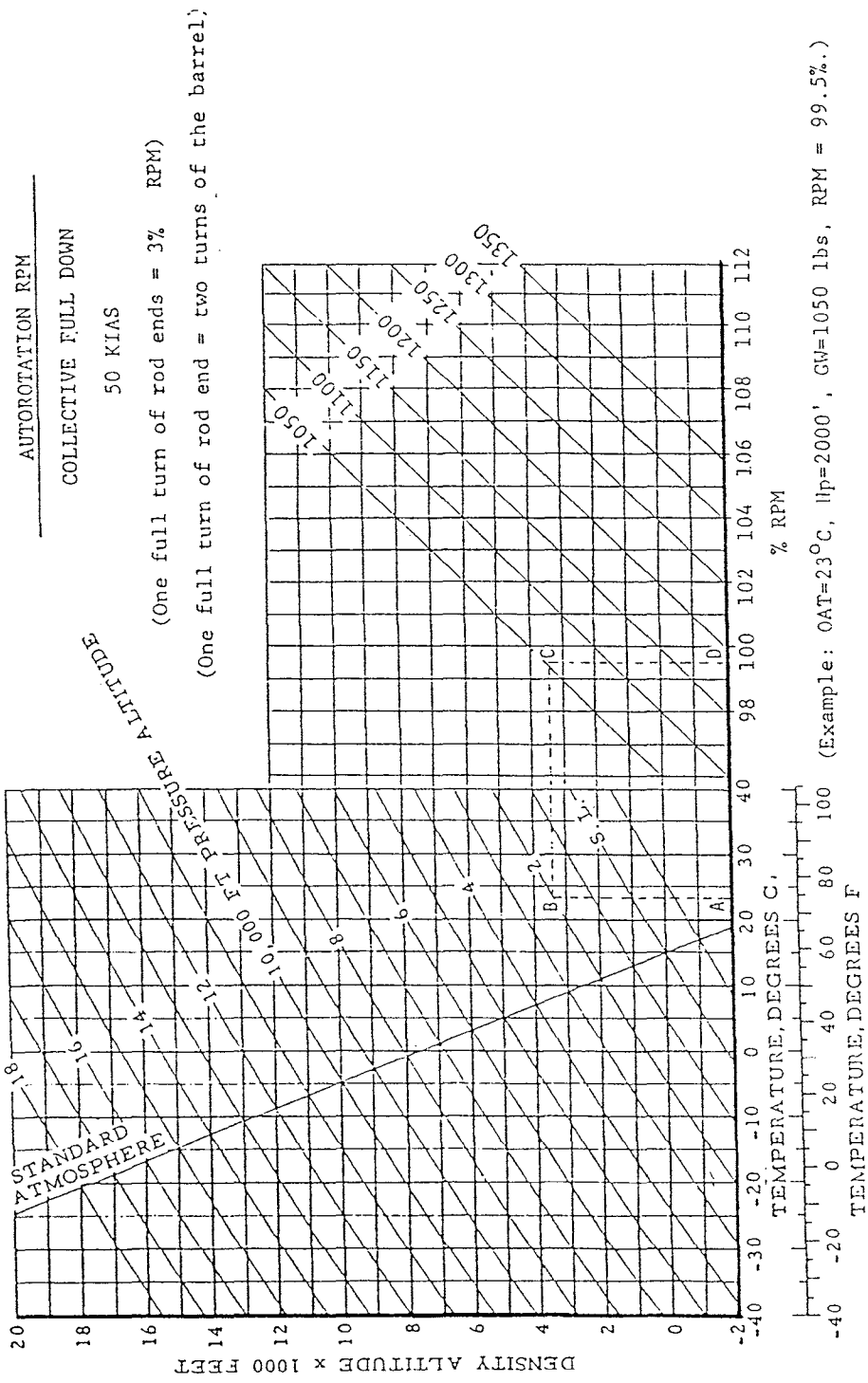

AUTOROTATION RPM
COLLECTIVE FULL DOWN
50 KIAS
(One full turn of rod ends = 3% RPM)
(One full turn of rod end = two turns of the barrel)
1050
1100
1150
1200
1250
1300
1350
% RPM
98 100 102 104 106 108 110 112
(Example: OAT=23°C, Hp=2000', GW=1050 lbs, RPM = 99.5%.)
PRESSURE ALTITUDE
1,000 FT
STANDARD ATMOSPHERE
DENSITY ALTITUDE x 1000 FEET
20 18 16 14 12 10 8 6 4 2 0 -2
TEMPERATURE, DEGREES C
-40 -30 -20 -10 0 10 20 30 40
TEMPERATURE, DEGREES F
-40 -20 0 20 40 60 80 100
A
B
C
D

FIGURE 10-15