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Figure 7-4. Tail rotor driveshaft, damper and tail rotor transmission

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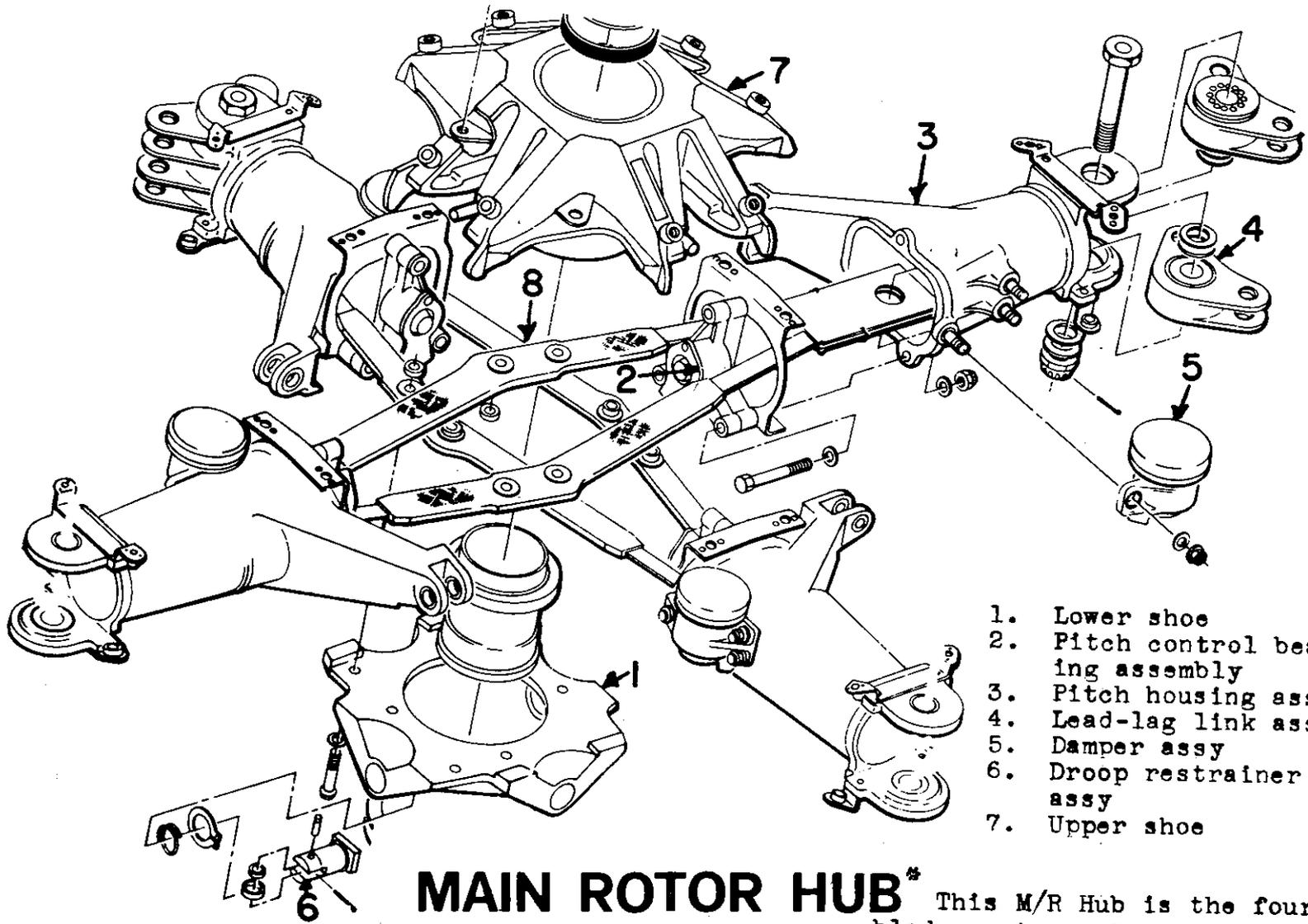
8. Tail Rotor Drive Shaft:  
CONNECTS MAIN AND TAIL ROTOR GEAR BOX  
ONE TURE HOLLOW DYNAMICALLY BALANCED  
FLEX COUPLINGS. DOES NOT SUPPORT  
ANYTHING, HAS DAMPER TO DAMPEN  
WHIPPING DURING ACCELERATIONS
9. Tail Rotor Transmission:  
RIGHT ANGLE SPEED REDUCTION (500P)  
BOONS AND STEP UP
10. Tail Rotor Transmission Lubrication:  
WET SUMP SPLASH SYSTEM  
SIGHT GAUGE + VENTED  
(500P) COMBINATION BREATHER, FILLER CAP + DIP STICK
11. Tail Rotor Transmission Cooling:  
CAM AIR  
LUBE
12. Tail Rotor Transmission Chip Detector System:  
RIGHT BOTTOM PORTION

### ROTOR SYSTEMS

1. Description: A five blade main rotor and four blade tail rotor are used to allow lower operating RPM and thus lessen rotor noise. Trapezoidally shaped tips on the main rotor and 60°/120° spacing of the tail rotors also help to reduce blade noise. The main rotor is a fully articulated system.
2. Main Rotor System
- a. Stationary Mast and Main Rotor Drive Shaft:  
MACHINED STEEL TUBE JOINED TO A FORGED  
STEEL BASE. TILTED ~~30 DEG~~ <sup>FORWARD</sup> 3 degrees forward.  
ABSORBS ALL LIFTING FORCES
- b. Main Rotor Hub Assembly:  
(1) Shoe Assembly



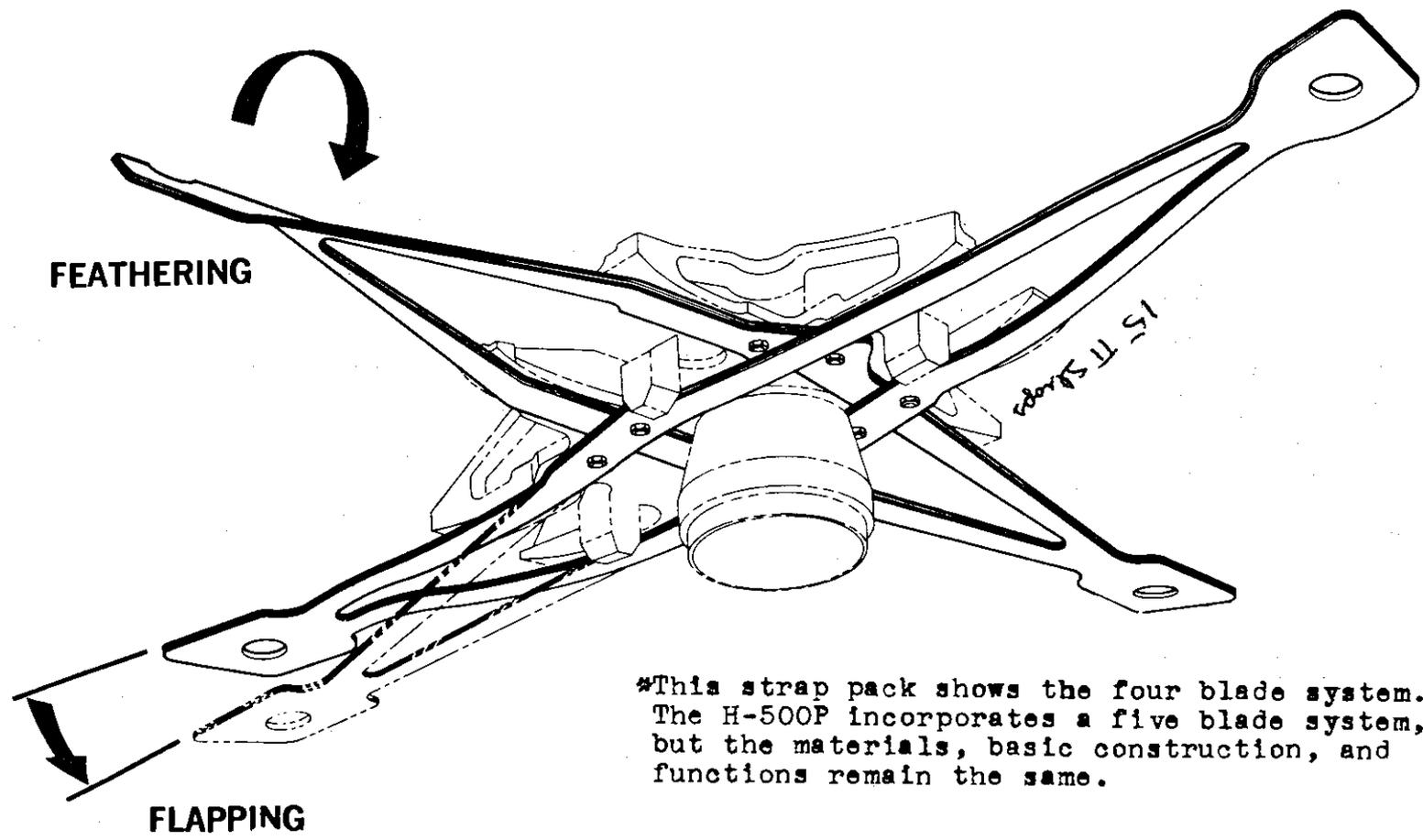
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- 1. Lower shoe
- 2. Pitch control bearing assembly
- 3. Pitch housing assy
- 4. Lead-lag link assy
- 5. Damper assy
- 6. Droop restrainer assy
- 7. Upper shoe

**MAIN ROTOR HUB\*** This M/R Hub is the four blade system. H-500P system incorporates five M/R blades.

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\*This strap pack shows the four blade system. The H-500P incorporates a five blade system, but the materials, basic construction, and functions remain the same.

# FLEX ROTOR

1/3

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(2) Strap Pack

(3) Hub Assembly

(4) Pitch Control Bearing Assembly

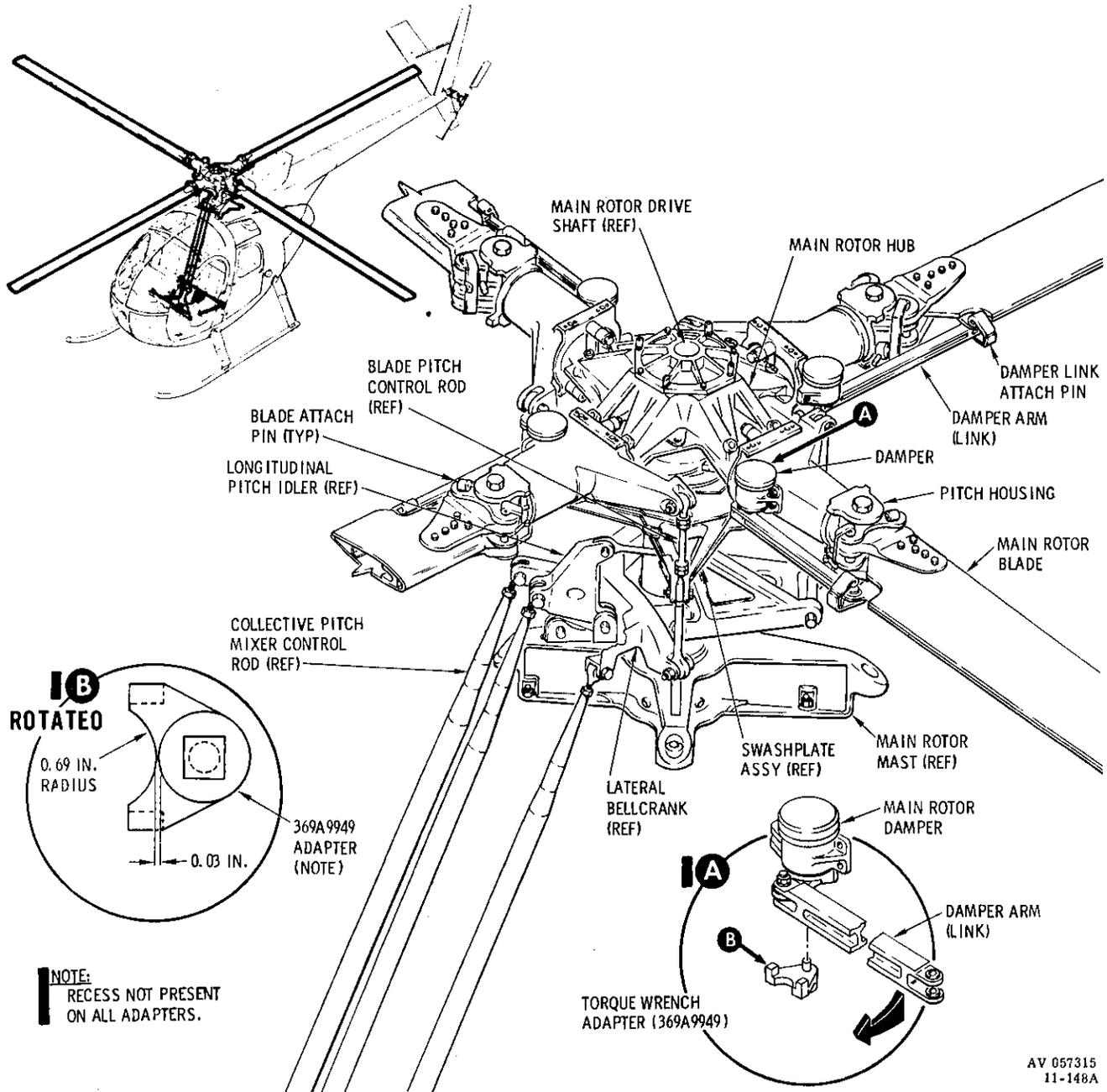
(5) Pitch Housing

(6) Link Assembly

(7) Droop Restrainers

c. Main Rotor Swashplate Assembly:

(1) Stationary Swashplate



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Figure 8-1. Main rotor hub and blades

(2) Rotating Swashplate

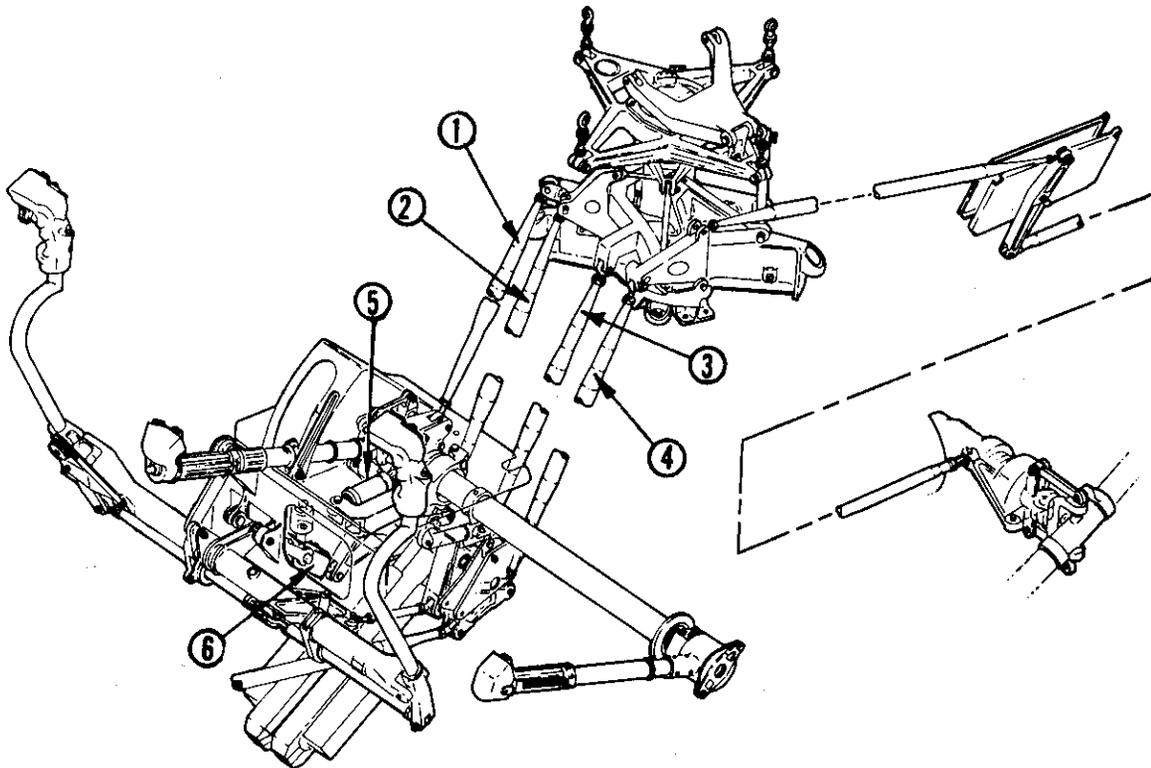
(3) Scissors Assembly

(4) Swashplate Bearing Assembly

d. Main Rotor Blades:

e. Tail Rotor Assembly:

1. Collective control tube
2. Longitudinal cyclic control tube
3. Lateral cyclic control tube
4. Tail rotor control tube
5. Collective Bungee Assembly
6. Cyclic one-way lock



## FLIGHT CONTROLS

FLIGHT CONTROL SYSTEMS

1. Fixed Stabilizers

STABILIZE DURING HI-SPEED FORWARD

FLIGHT

Middle mounted 25° up from horizontal  
Keeps punt porpoising

LOWER ALSO SERVES AS A TAIL SKID

2. Collective Control System

a. Collective Pitch Sticks:

b. Collective Bungee (over center unit):

As in Damping out main rotor feel back  
Determines force needed to move collective

c. Collective Pitch Control Rod:

d. Collective Pitch Mixer Bellcrank:

3. Cyclic Control System

a. Cyclic Control Sticks:

b. Friction Devices:

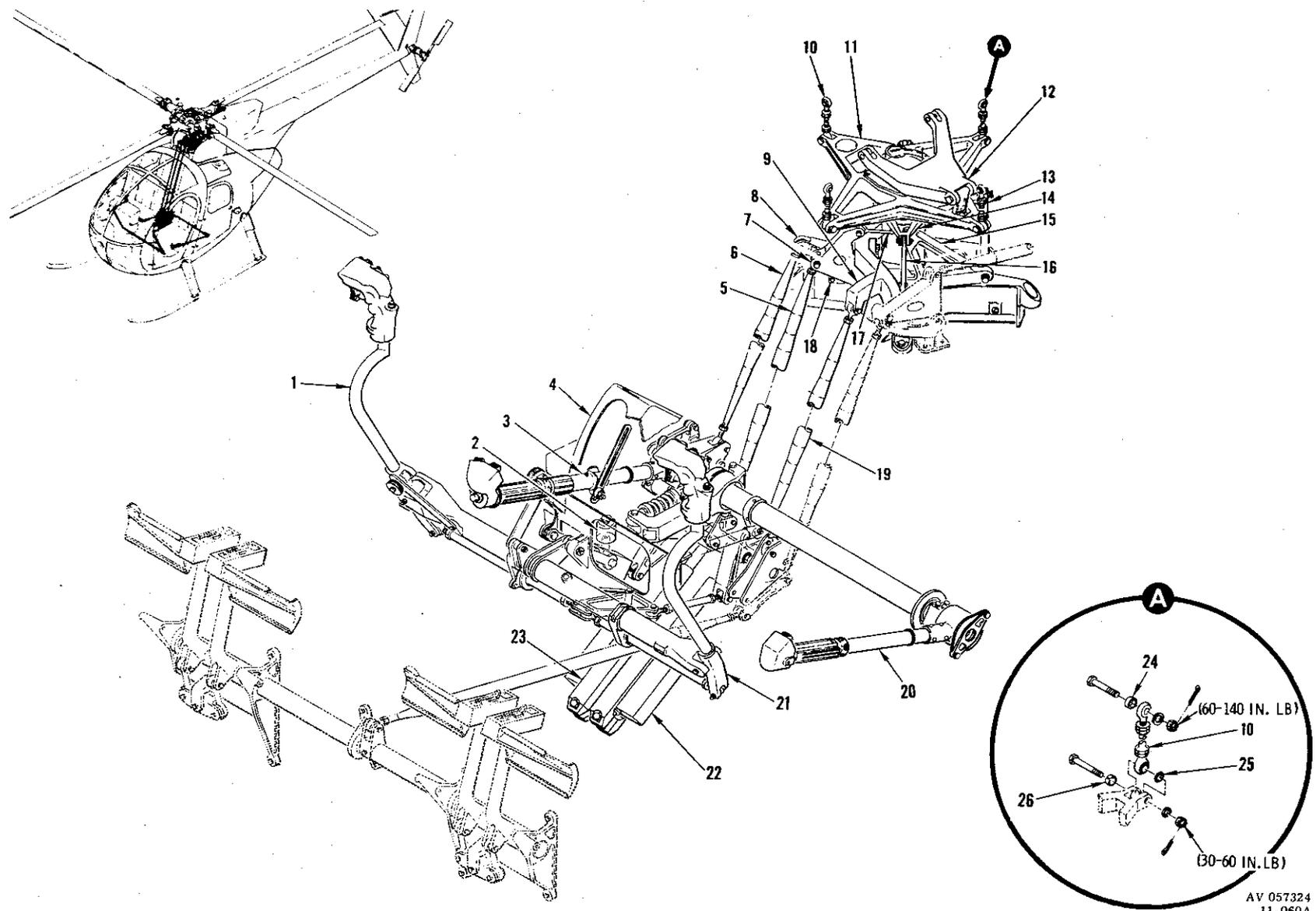


Figure 9-1. Cyclic and collective controls

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### 9-3. Swashplate and Mixer Controls.

Swashplate and mixer controls consist of a scissors assembly (12, fig. 9-1), rotating swashplate (11), stationary swashplate (14), lateral bellcrank (9), longitudinal pitch idler (7), collective pitch mixer bellcrank (8), longitudinal pitch mixer bellcrank (15), longitudinal control-mixer link (27), longitudinal link (13), two mixer links (16), and four pitch control rods (10). Movement of the collective pitch sticks (3 and 20) and cyclic control sticks (1 and 21) is sent to the mixer controls through the tunnel-routed control rods. The mixer controls transfer the required combination of collective, longitudinal, and lateral travel to the main rotor blades through the main rotor swashplate assembly and the pitch control rods. The scissors assembly is a torque link that connects the hub and swashplate.

*a. Inspection.* (See fig. 9-1.) (1) Inspect all attaching hardware for secure attachment by trying to finger turn nut and/or bolt.

### CAUTION

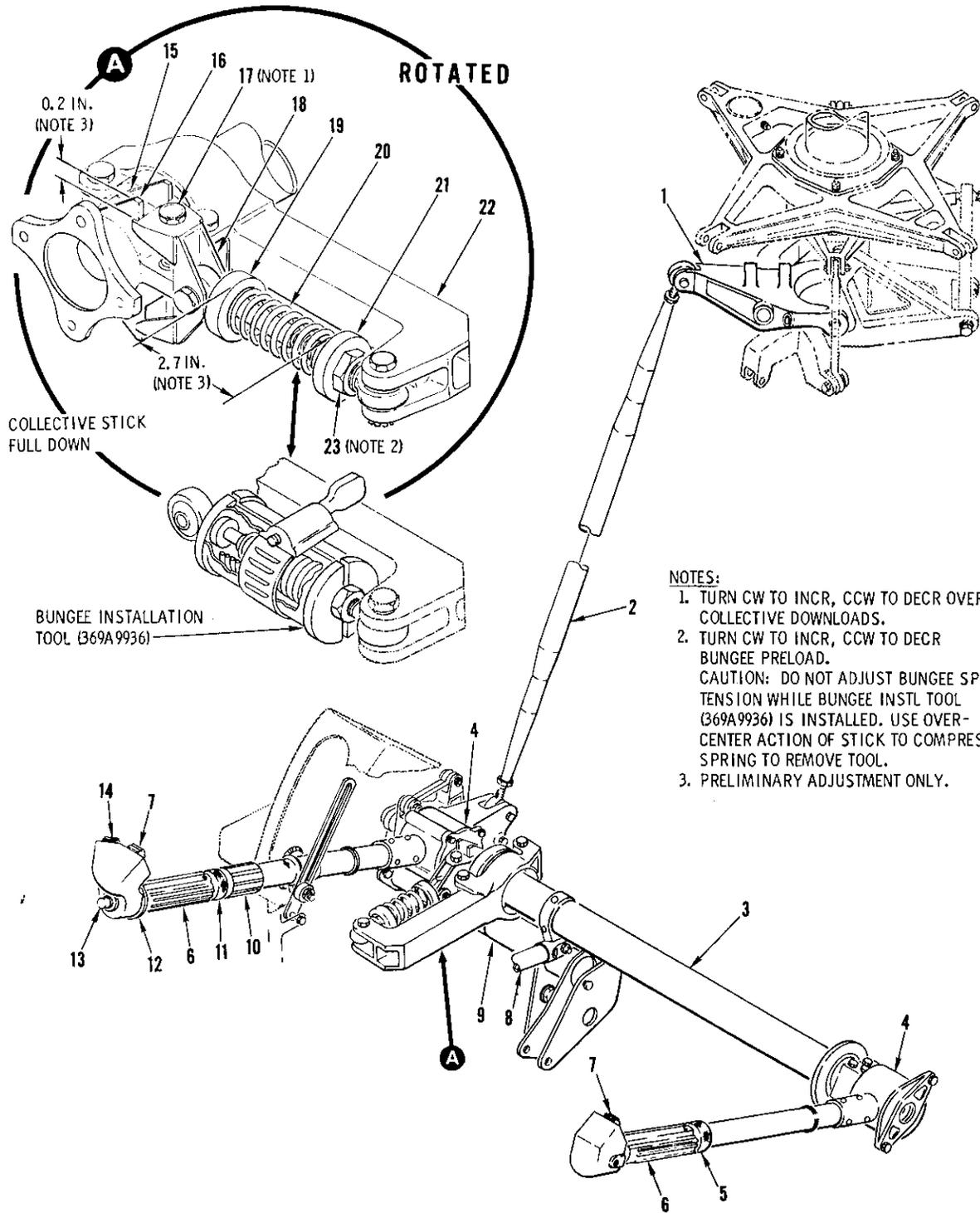
If any visible surface defects are discovered anywhere, the defective part must be replaced.

(2) Inspect all accessible areas of scissors assembly (12), rotating swashplate (11), stationary swashplate (14), lateral bellcrank (9), longitudinal pitch idler (7), collective pitch mixer bellcrank (8), longitudinal pitch mixer bellcrank (15), longitudinal control-mixer link (17), longitudinal link (13), and mixer links (16) for scratches, nicks, dents, cracks and corrosion.

(3) Inspect the swashplate bearing assembly spherical ball for condition. Maximum radial play between the sliding surface and the stationary mast is 0.010 inch. Maximum axial play between the stationary and rotating swashplate is 0.060 inch. Nicks and dents that do not deform the ID chamfer of the hard anodized ball and that do not extend more than 0.040 inch along spherical ball surface from edge are permissible.

### Key to fig. 9-1

- |                                     |  |                                       |
|-------------------------------------|--|---------------------------------------|
| 1. Pilot's cyclic control stick     | 10. Pitch control rod                  | 19. Lateral mixer control rod         |
| 2. One-way lock                     | 11. Rotating swashplate                | 20. Copilot's collective pitch stick  |
| 3. Pilot's collective pitch stick   | 12. Mixer link                         | 21. Copilot's cyclic control stick    |
| 4. Pilot's collective stick cover   | 13. Scissor assy                       | 22. Lateral cyclic trim actuator      |
| 5. Longitudinal mixer control rod   | 14. Longitudinal link                  | 23. Longitudinal cyclic trim actuator |
| 6. Collective mixer control rod     | 15. Stationary swashplate              | 24. Bushing                           |
| 7. Longitudinal pitch idler         | 16. Longitudinal pitch mixer bellcrank | 25. O-ring                            |
| 8. Collective pitch mixer bellcrank | 17. Longitudinal control-mixer link    | 26. Slotted bushing                   |
| 9. Lateral bellcrank                | 18. Mixer support bracket              |                                       |



**NOTES:**

1. TURN CW TO INCR, CCW TO DECR OVERALL COLLECTIVE DOWNLOADS.
2. TURN CW TO INCR, CCW TO DECR BUNGEE PRELOAD.  
CAUTION: DO NOT ADJUST BUNGEE SPRING TENSION WHILE BUNGEE INSTL TOOL (369A9936) IS INSTALLED. USE OVER-CENTER ACTION OF STICK TO COMPRESS SPRING TO REMOVE TOOL.
3. PRELIMINARY ADJUSTMENT ONLY.

1. Collective pitch mixer bellcrank
2. Tunnel-routed collective mixer control rod
3. Collective interconnecting torque tube
4. Collective pitch stick housing
5. Throttle friction (fixed)
6. Throttle grip
7. N2 governor switch

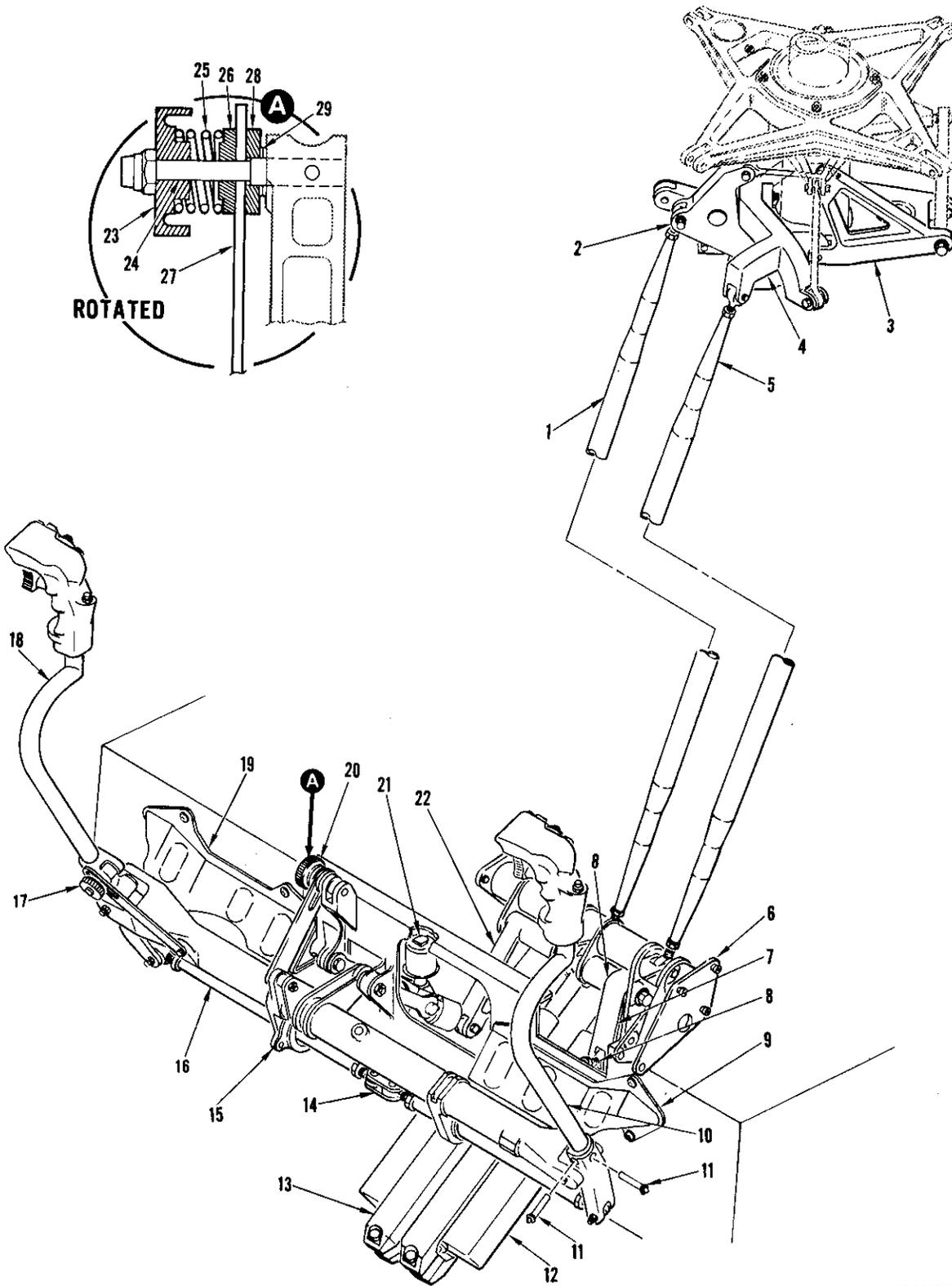
8. N2 governor (droop control) override link
9. Control support bracket
10. Stick friction
11. Throttle friction (adjustable)
12. Idle stop release ring
13. Starter switch
14. Landing light switch
15. Torque tube support bearing

16. Torque tube fitting
17. Bungee overcenter adjustment bolt
18. Bungee overcenter fitting
19. Retainer
20. Bungee spring
21. Female bearing assy
22. Bungee support bracket
23. Bearing assy adjustment retainer nut

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Figure 9-2. Collective controls and bungee system

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Figure 9-4. Cyclic controls and one-way lock

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◀ Key to fig. 9-4

- |                                       |   |                                     |
|---------------------------------------|---|-------------------------------------|
| 1. Longitudinal mixer control rod     | 11. Quick-release pins  | 19. Pilot's cyclic stick guard      |
| 2. Longitudinal pitch idler           | 12. Lateral cyclic trim actuator                                  | 20. Longitudinal friction mechanism |
| 3. Longitudinal pitch mixer bellcrank | 13. Longitudinal cyclic trim actuator                             | 21. One-way lock                    |
| 4. Lateral pitch mixer bellcrank      | 14. Lateral cyclic bellcrank (sta 67)                             | 22. Longitudinal idler bellcrank    |
| 5. Lateral mixer control rod          | 15. Longitudinal cyclic control pitch interconnecting torque tube | 23. Friction knob                   |
| 6. Controls support bracket           | 16. Lateral cyclic control interconnecting rod (typ)              | 24. Friction stud                   |
| 7. Copilot's cyclic stick guard       | 17. Lateral friction device mechanism                             | 25. Friction spring                 |
| 8. Lateral idler bellcrank            | 18. Pilot's cyclic control stick                                  | 26. Retainer                        |
| 9. Lateral control rod (sta 70)       |   | 27. Guide link                      |
| 10. Copilot's cyclic control stick    |   | 28. Friction disk                   |
|                                       |   | 29. Washer stack                    |

c. Guide Links:

d. Cyclic Trim Actuators:

e. Lateral Linkage:

f. Longitudinal Linkage:

g. One-Way Lock:

*Dampens out the feed back from the main rotor blade that moves the cyclic back. Shunts it into the airframe. Failure: open; no shunting. Slotted; takes force of Bolles to move cyclic aft.*

4. Tail Rotor Control System

a. Pedals:

b. Torque Tube:

c. Bellcranks:

d. Control Rods:

VIBRATIONS AND TRACKING

1. Categories of Vibrations

- a. Normal: Rocking during starts(not to be confused with ground resonance) and vibrations due to gusty winds.
- b. Low Frequency: abnormal vibrations in the main rotor assembly at a frequency low enough to count.
- c. High Frequency: abnormal vibrations in components operating at a higher rpm than main rotor - generally, too high to count.  
NOTE: Ability to distinguish normal from abnormal vibrations is acquired through helicopter flight experience.

2. Causes of Abnormal Vibrations

a. Low Frequency - 2 Types

(1) Vertical - caused by

- (a) Main Rotor blade(s) out of track
- (b) Damper out of phase
- (c) Trim Tabs improperly adjusted

(2) Lateral - caused by

- (a) Main Rotor Blade(s) out of balance
- (b) Dampers sticking or improperly set
- (c) Binding in lead lag hinge
- (d) Damaged strap pack

b. High Frequency - normally felt as a buzzing vibration. May cause instrument needles to fuzz.

(1) Buzzing vibration felt in tail rotor pedals caused by:

- (a) Tail Rotor out of balance
- (b) Damaged Tail Rotor Blade(s)
- (c) Excessive wear in pitch control linkage

(2) Buzzing vibration felt in airframe caused by defects in:

- (a) Engine or engine components
- (b) Power Train System
- (c) Oil Cooler Blower

3. Main Rotor Blade Tracking

a. Preparation:

b. Ground Tracking:

c. Hover Track Verification:

d. Forward Flight Tracking:

e. Autorotation RPM Check:

AUXILIARY LIGHTING SYSTEM

1. Purpose: To aid in night area searches, approach, hover, and night landings.

2. Search Light:

3. Hover Light:

4. Tail Rotor Illumination Light:

## CHAPTER 8

### FLIGHT CHARACTERISTICS

#### Section I SCOPE

##### 8-1. General.

This chapter describes the flight characteristics of the aircraft.

##### 8-2. Extent of Coverage.

Appropriate coverage is provided on the vital elements of control coordination and response during various flight conditions and maneuvers.

#### Section II GENERAL FLIGHT CHARACTERISTICS

##### 8-3. General.

The aircraft is stable and responsive in all flight conditions. The flight controls have good response during maneuvering flight and a high degree of control availability. The aircraft fuselage has exceptionally low drag and autorotative glide capability is very good. During landing approaches airspeed should be reduced to approximately 60 knots on the base leg to reduce the possibility of overshooting the landing spot.

##### 8-4. Blade Stall.

*a.* Blade stall is characterized by a buildup in medium frequency vibration and feedback forces through the cyclic stick. Heavy blade stall is characterized by feedback forces through the collective pitch control. Blade stall will not normally occur when flying in smooth air within the Vne flight envelope defined in fig. 7-3, but may occur when flying in turbulence or maneuvering at high speeds. (Refer to Chapter 14 to determine maximum airspeed for blade stall.) The aircraft can be flown through light turbulence with slight cyclic corrective action. If mild turbulence is encountered, reduce collective pitch setting (and airspeed) for best comfort level. Maintaining 103 percent rotor rpm will reduce the susceptibility to blade stall.

*b.* If a sharp gust is encountered during high speed flight, control feedback forces will be encountered and the aircraft will have a tendency to pitch up. Any aft movement of the cyclic stick will aggravate the pitch up condition. When this occurs, maintain 103 percent rotor rpm and reduce collective pitch.

##### 8-5. Maneuvering Flight.

###### NOTE

Maneuvers resulting in highly accelerated banks or dives can cause a temporary uncovering of the transmission oil pressure pump inlet and a momentary loss of transmission oil pressure. Loss of pressure for 5 seconds or less is not considered detrimental to transmission operation.

During maneuvering flight, blade stall may be encountered as a function of the severity of maneuver, gross weight, and altitude. (See fig. 14-31.)

*a. Hovering in Winds.* During crosswind and downwind hovering, or landings, there is an area of instability from 8 to 15 knots. This instability is characterized by random aircraft motions, large control requirements, and a general increase in pilot workload. The steady-state control positions will provide a 10-percent control margin; however, control stops may be encountered during transient maneuvers. These conditions are aggravated by large gust spreads.

**WARNING**

**Flight involving abrupt right-hand turns should be avoided under downwind, low altitude, low airspeed conditions.**

*b. Abrupt Turn Maneuvers.* Abrupt turns to the right are more critical than those to the left. If an abrupt reversal turn is performed at low altitude and low airspeed, caution shall be exercised to prevent yawing the tail excessively into the wind during a 180 degree turn downwind or downwind approach to hover. Such a maneuver can produce lift on the horizontal stabilizer surface, which may require full aft cyclic to counteract. If excessive nose-down pitching is encountered, apply antitorque pedal to bring nose into the wind. Additional collective aggravates pitching and is not recommended. In addition, the possibility exists of running out of left pedal during turns in wind at high weight/density altitude conditions; to minimize this possibility, 103% N2 rpm should be used.

### Section III CONTROL CHARACTERISTICS

#### 8-6. Flight Controls.

Conventional, unboosted cyclic, collective pitch and antitorque flight controls, provided in both the pilot and copilot positions, are completely effective during all normal and high speed flight operations. The antitorque pedals are adjustable and adjustment to the desired position should be accomplished when on the ground prior to flight. Adjustable friction controls are provided for the lateral cyclic, longitudinal cyclic, and collective pitch controls. The friction levels should be checked and adjusted prior to initial takeoff.

*a. Cyclic System One-way Lock.* The one-way lock incorporated in the longitudinal cyclic control system prevents rotor forces from moving the cyclic stick aft during accelerated maneuvers.

*b. Trimming Cyclic Stick Forces.* Cyclic stick forces change during transition from forward flight to hover, or vice versa. Cyclic forces should be trimmed to provide best cyclic response for continued flight in any one condition.

#### 8-7. Autorotation Characteristics.

Rapid lowering of collective pitch to establish autorotation must be accompanied by approximately 2 to 3 inches aft movement of the cyclic control stick. This coordinated action is necessary to counteract the tendency of the aircraft to nose down.

#### CAUTION

Exercise caution when lowering the collective pitch and using aft cyclic control, to avoid raising the nose of the aircraft excessively. A sudden excessive nose-up attitude will increase the angle of attack on the rotor system and possibly cause a rotor overspeed. At high gross weights the collective must be utilized to control rotor rpm within normal limits.

#### 8-8. Power-On Descent.

Sudden power losses while in a power-on (needles joined) descent will result in the nose of the aircraft pitching down, provided aft cyclic is not applied immediately.

#### WARNING

When a pitch down condition exists, it is imperative that abrupt lowering of the collective and erratic movement of the cyclic control be avoided to prevent a rotor blade strike on the tailboom.

## Section IV DESERT AND HOT WEATHER OPERATION

### 10-10. Desert Operation.

Desert operation (operating from sandy and dusty terrain) is the same as normal operation, with the following additional precautions. Provide maximum possible protection for the aircraft on the ground during blowing sand conditions by keeping protective covers installed as long as possible. Observe hot weather starting procedures (when applicable), and unless absolutely necessary do not take off during a sand or dust storm or immediately following another aircraft. Hovering should always be minimal to reduce the amount of blowing dust and restricted visibility caused by rotor downwash. Engine operation in dust and salt laden atmosphere will result in gradual engine power deterioration.

### 10-11. Hot Weather Operation.

*a.* Hot weather operations are the same as normal operations with the exception of the starting procedure. Hot weather operation requires constant monitoring of

the TOT gage. The initial start is not as critical as subsequent starts; however, during each start in hot weather the starter should be allowed to reach maximum rpm (peak out) before igniting (turning twist grip to idle stop), and the minimum light-off speed of 15% N1 should be rigidly observed. In restarting a hot engine, the TOT gage should be checked after the starter has peaked out and ignition should be delayed until the temperature has dropped to 200°C (392°F) or below.

#### NOTE

During hot weather operation, engine performance can be temperature-limited rather than torque-limited, therefore the TOT gage must be monitored as well as the torque gage to make certain neither limit is exceeded.

*b.* During operation at extreme altitudes and/or high temperatures in excess of 15,000 feet MSL and 45 degrees centigrade (113°F) OAT/fuel temperature, the electric fuel pump should be used to minimize the possibility of engine flameout.

## Section V TURBULENCE AND THUNDERSTORM OPERATION

### 10-12. General.

Flight operation in turbulence and thunderstorm should not be deliberately undertaken and, when forecasted or encountered during flight, should be avoided.

### 10-13. Operation in Turbulence.

#### WARNING

The pilot shall never intentionally encounter moderate to severe turbulence. If moderate to severe turbulence is unavoidably encountered, airspeed should be reduced and N2 increased to 103%.

When operating in light turbulence, airspeed should be reduced and N2 increased to 103% to minimize the impact effect of gusts. Flight should not be continued under marginal control response conditions and the aircraft should be landed at the first opportunity and remain on the ground until continued flight is possible.

### 10-14. Operation in Thunderstorms.

#### WARNING

The pilot shall never intentionally fly into (penetrate) thunderstorm activity but if it is inadvertently incurred, the corrective actions given in para 10-13 are applicable. The pilot should take the most immediate action feasible to exit the thunderstorm activity.

### 10-15. Stopping Rotors During Gusty or Windy Conditions.

During gusty or windy conditions, accomplish the following steps in conjunction with normal engine shutdown procedure:

- a.* Cyclic—Position as required until rotor stops turning to prevent droop stop damage.
- b.* Collective pitch—FULL DOWN.
- c.* Do not attempt to slow the rotors by application of collective pitch or anti-torque pedals.
- d.* Cyclic—NEUTRAL with friction applied.

**Section VI ICE AND RAIN****10-16. General.**

Flight procedures in ice and rain are the same as described in Chapter 3 except that the TOT indicator should be monitored more closely for indication of engine compressor icing.

**10-17. Engine Ice After Starting.**

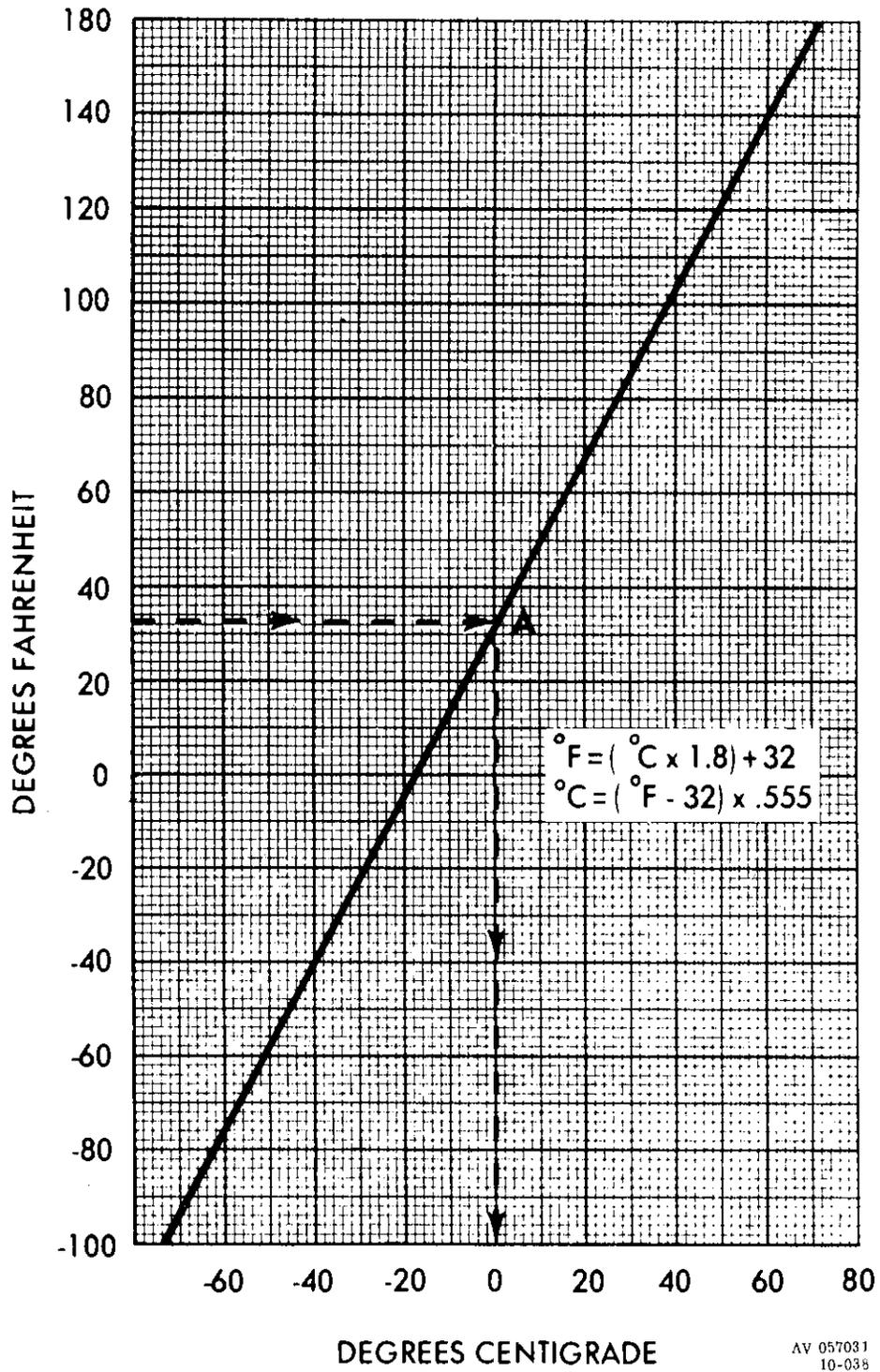
After starting the engine (during idle), should ambient conditions cause engine compressor icing to occur, the first engine reaction will be one of air starvation indicated by a gradual but constant increase in TOT, with corresponding decreases in N1 rpm. The immedi-

ate application of engine anti-ice air will eliminate any ice accumulations and restore normal engine operation.

**10-18. Engine Ice During Flight.****CAUTION**

Engine anti-icer should be used when flying in visible moisture at OAT 5°C (41°F) or below.

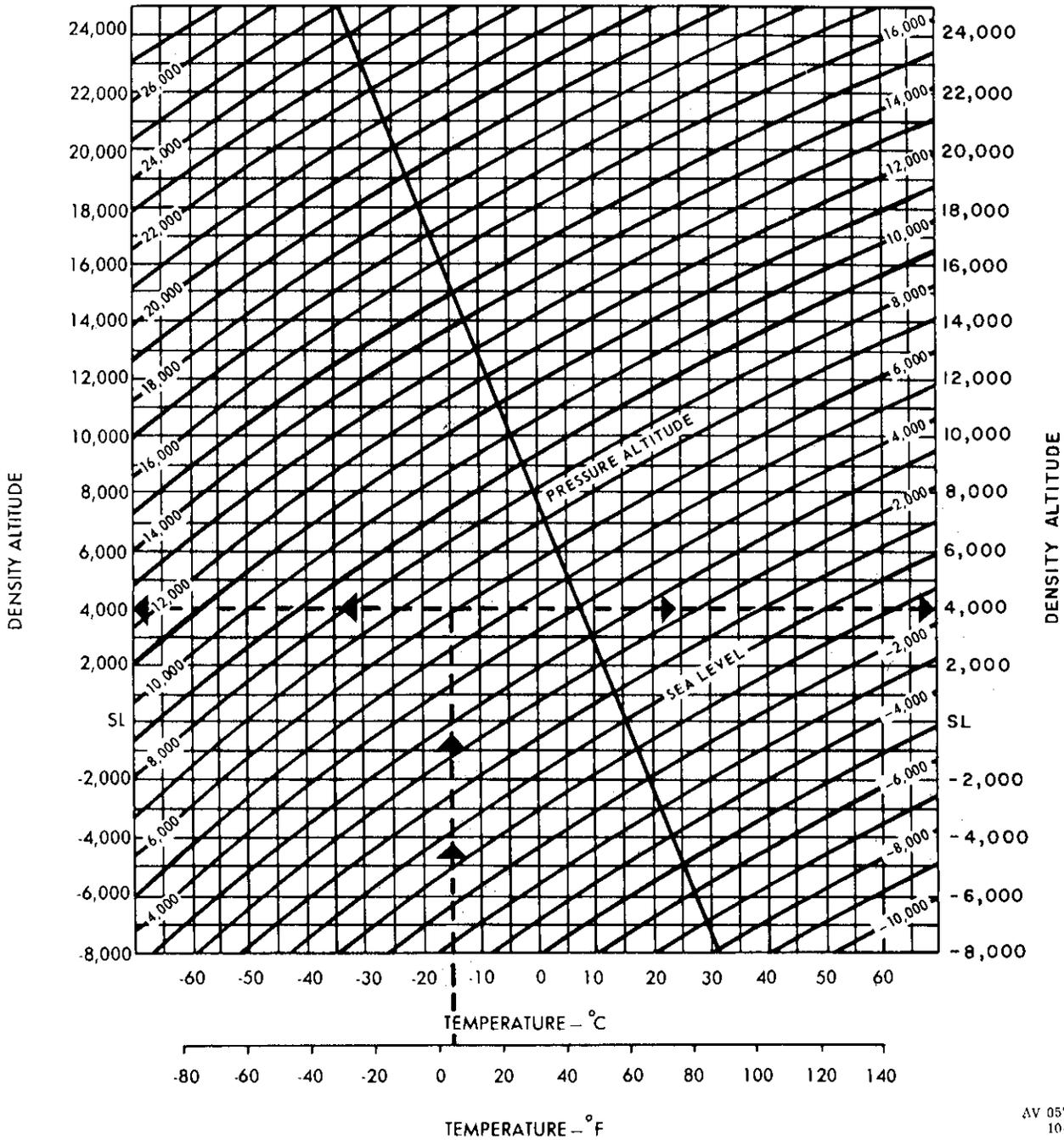
During flight operation, the only indication of icing will be gradual increase in TOT. Immediate application of engine anti-icing air will eliminate compressor ice and restore TOT to the normal operating range.



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Figure 14-1. Temperature conversion chart

EXAMPLE: IF AMBIENT TEMP IS  $-15^{\circ}\text{C}$  AND  
 PRESSURE ALT. IS 6,000 FEET, THE DENSITY  
 ALT. IS 4,000 FEET



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Figure 14-2. Density altitude chart