

## CHAPTER 6

### POWERPLANT

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## CHAPTER 6

### POWERPLANT

#### 6.000 Powerplant and Related Systems

##### 6.001 Introduction

This section includes instructions for removal and installation of engine and support systems. Support systems include induction, cooling and exhaust systems. Refer to engine and engine component manufacturer's maintenance publications for product specific inspection, repair, and maintenance procedures.

##### 6.002 Description

R22-series helicopters are powered by one of four different Lycoming engines. O-320-A2B or O-320-A2C engines are installed in standard model R22s and are normally rated at 150 horsepower. O-320-B2C engines are installed in R22 HP, R22 Alpha, and R22 Beta models and are normally rated at 160 horsepower. Beta II/Mariner II helicopters have an O-360-J2A engine capable of 180 horsepower, derated by Lycoming to 145 horsepower. All engines are derated to 124 maximum continuous horsepower (MCP) by limitation of manifold pressure and RPM. Beta, Mariner, and Beta II/Mariner II helicopters have a 5-minute takeoff rating of 131 HP (see Pilot's Operating Handbook). Starting assist for O-320-A2B engines is provided by an impulse coupling installed on the engine-left (helicopter-right) magneto. Starting assist for O-320-A2C, O-320-B2C, and O-360-J2A engines is provided by a starter vibrator system and retard points in the engine-left magneto. Tachometer points in the engine-right magneto supply engine RPM information to the governor controller and engine tachometer. At 104% engine tachometer indication the engine is turning 2652 RPM.

Induction is through an air filter located in a carburetor-mounted air box assembly. Carburetor heat is supplied by an exhaust-pipe-mounted scoop and duct. Carburetor heat is controlled through a cable-operated guillotine valve in air box. Carburetor inlet air is filtered, even with carburetor heat on. Provision for an obstructed air filter is provided by a spring loaded bypass valve mounted on the air box cover, or by air box flexing. On Beta II/Mariner II aircraft, application of carburetor heat is correlated with changes in collective setting through a friction clutch to reduce pilot work load. Lowering collective mechanically adds carburetor heat and raising collective reduces carburetor heat. The pilot may override the friction clutch and increase or decrease carburetor heat as desired. A latch is provided at the carburetor heat control knob to lock carburetor heat off when not required.

Cooling is supplied by an engine-mounted fanwheel enclosed by a fiberglass scroll. The scroll ducts cooling air to engine-mounted panels which in turn direct air to cylinders, external oil cooler, alternator, and main rotor gearbox.

Power is transmitted through a vertically mounted sheave-and-belt system which is engaged by an electric belt tension actuator.

Battery charging and electrical power is supplied by 60-amp belt-driven alternator. A 70-amp alternator is optional.

## 6.100 Powerplant

### NOTE

Refer to engine and engine component manufacturer maintenance publications for product specific inspection, repair, and maintenance procedures.

## 6.110 Engine Removal

### NOTE

If engine is to be removed to facilitate a lower frame replacement, engine mount change, or firewall repair, fanwheel can remain installed. However, if engine is to be disassembled, remove fanwheel per § 6.210.

1. Disconnect static line from and remove aft cowl, tailcone fairing, B429-5 frame.

### NOTE

If aux tank installed, defuel helicopter. Remove aux tank.

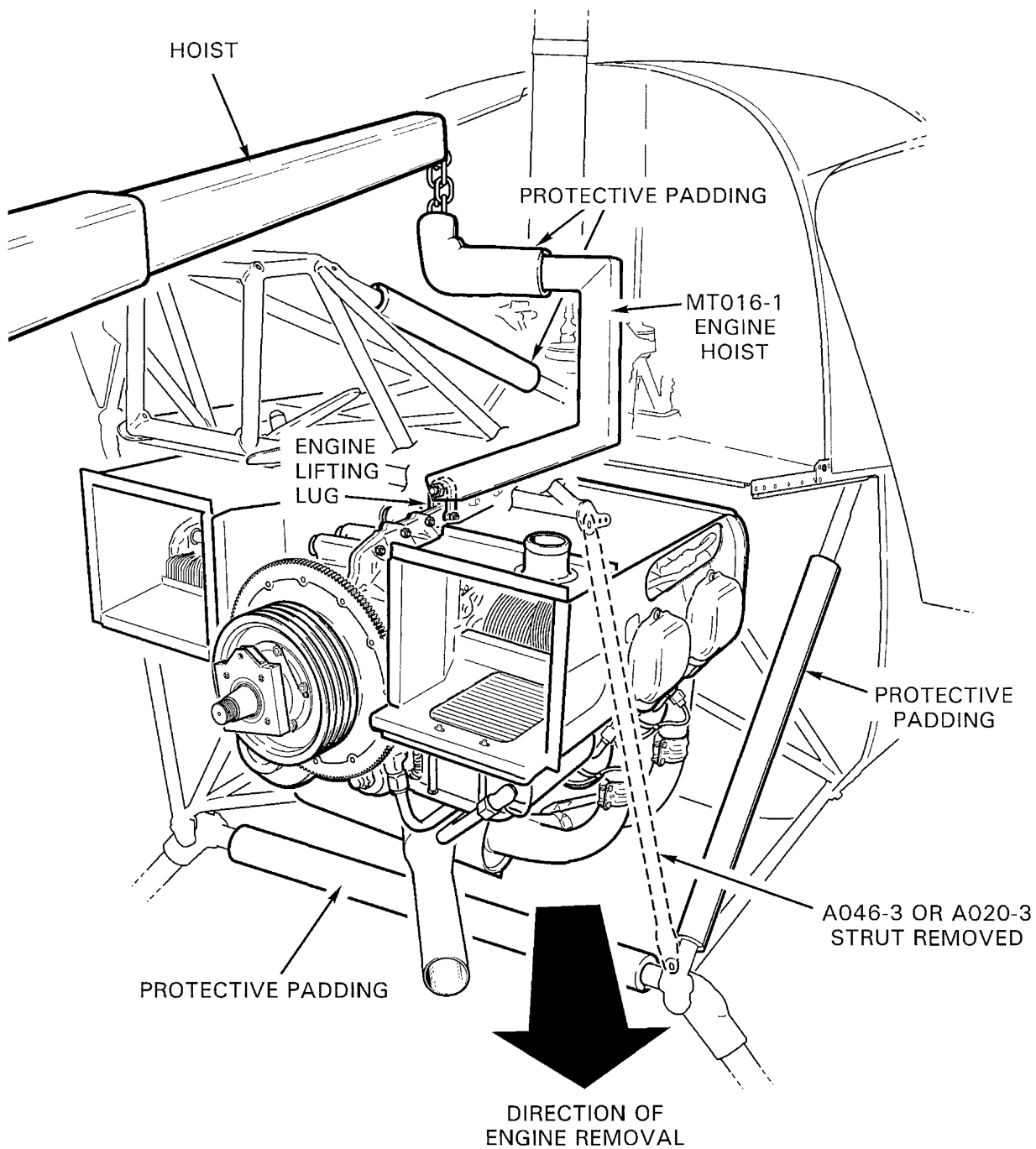
2. Disconnect main rotor gearbox cooling duct and remove horizontal firewall access panel (aft right-hand).
3. Remove clutch assembly per § 7.210.
4. Remove side skirts. Turn off fuel selector valve and disconnect fuel hose at carburetor. Cap fuel hose and carburetor inlet port.
5. Disconnect carburetor throttle linkage at carburetor bellcrank, mixture control cable at carburetor, carburetor heat control at air box, and carburetor air temperature probe at quick-disconnect, located approximately four inches from probe in a heat shrink sleeve. Remove carburetor and air box assembly.

### NOTE

Air box and carburetor may be removed as a unit.

6. Disconnect oil pressure hose from elbow on accessory housing and cap exposed connections.
7. Disconnect manifold pressure line from forward, left cylinder fitting and clamp and cap exposed connections.
8. Identify for reinstallation and disconnect engine ground straps, alternator leads, starter leads, oil pressure line, cylinder head temperature lead, and oil temperature lead. Disconnect all clamps attaching wiring to steel tubular frames. Disconnect belt tension actuator motor leads.
9. Disconnect cabin heater duct, if installed (optional equipment).
10. Disconnect primer line, if installed (optional equipment).

### 6.110 Engine Removal (cont'd)



**FIGURE 6-1 POWERPLANT REMOVAL**

### 6.110 Engine Removal (cont'd)

11. Install protective padding per Figure 6-1.
12. Connect MT016-1 "C" fitting to a minimum 500-pound capacity hoist and to engine lifting lug per Figure 6-1. Take up any slack in chain or cable of hoist. Engine mounting pads have shims placed between pads and engine mounts for proper engine alignment. Note shim stack for each mount and record for reinstallation.
13. Remove four engine mounting bolts. This will require removal of right-side (engine -left) spark plug access cover.
14. Place a support stand under tail skid or remove tailcone.
15. Remove tubular steel strut at right rear corner of steel tube structure. With a person on each side of engine, carefully remove engine. Vary height of engine as required to clear aft cross tube during removal. Swing engine clear of helicopter. Refer to Figure 6-1.

### 6.120 Engine Installation

- a) Connect MT016-1 "C" fitting to a minimum 500-pound capacity hoist and to engine lifting lug per Figure 6-1. Carefully hoist engine and swing it into alignment with engine mounting pads.
- b) Select appropriate shims as recorded during engine removal. If no record is available, install a 0.063-inch thick shim between both lower mounting pads and engine and install a 0.190-inch thick shim between both upper mounting pads and engine. Install engine mounting bolts, torque per Section 1.320. Torque stripe per Figure 2-1. Install right rear tubular strut per Section 4.222 h).

#### **WARNING**

**Damage or failure of drive line components may result from incorrect engine shimming.**

- c) Disconnect engine hoist, install horizontal firewall, right-hand spark plug access panel, and aft cowling. Reconnect main rotor gearbox cooling duct.
- d) Install carburetor using a new gasket and torque nuts per Section 1.330. Install palnuts, torque per Section 1.320, and torque stripe per Figure 2-1.

6.120 Engine Installation (cont'd)

- e) Reconnect throttle linkage to middle position of carburetor bellcrank. Refer to § 10.150 for throttle rigging. Reconnect mixture control and carburetor heat control and rig these controls for 1/16" springback at each end of the control travel (See Chapter 10 for rigging of throttle).
- f) Reconnect engine grounding strap and torque engine oil sump bolts per § 23-33. Connect oil line to oil pressure sender. Connect manifold pressure line to engine and firewall connections.
- g) Reconnect all electrical leads to oil temperature sender, cylinder head temperature sender, alternator, magnetos, etc.
- h) Install cabin heater ducting and all wire and oil line clamp connections.
- i) Connect fuel line to carburetor and inspect engine compartment for proper installation of all electrical connections, control attachment, ducting and routing.
- j) Reinstall clutch assembly. (See § 7.200).
- k) Reinstall engine access panels, compartment panels and aft cowling.
- l) Before running engine, check following components for proper alignment:
  - 1) Sheave alignment per § 7.230.
  - 2) Tail rotor drive shaft shimming per § 7.330.
  - 3) Cooling shroud-to-tailcone clearance 0.250 inch minimum.
  - 4) Intermediate flex plate to tail rotor bellcrank clearance 0.250 inch minimum with belts over 10 hours, 0.125 inch minimum with new belts.
  - 5) Clutch shaft angle per § 7.240.
  - 6) Upper sheave centering per § 7.250.

<b>NOTE</b>
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Fill engine to proper oil level.
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### 6.130 Engine Shimming

To facilitate sheave proper alignment, the engine must be shimmed to 3.55/3.75 inches, measured between ring gear top and bottom of upper frame's long cross tube with clutch engaged.

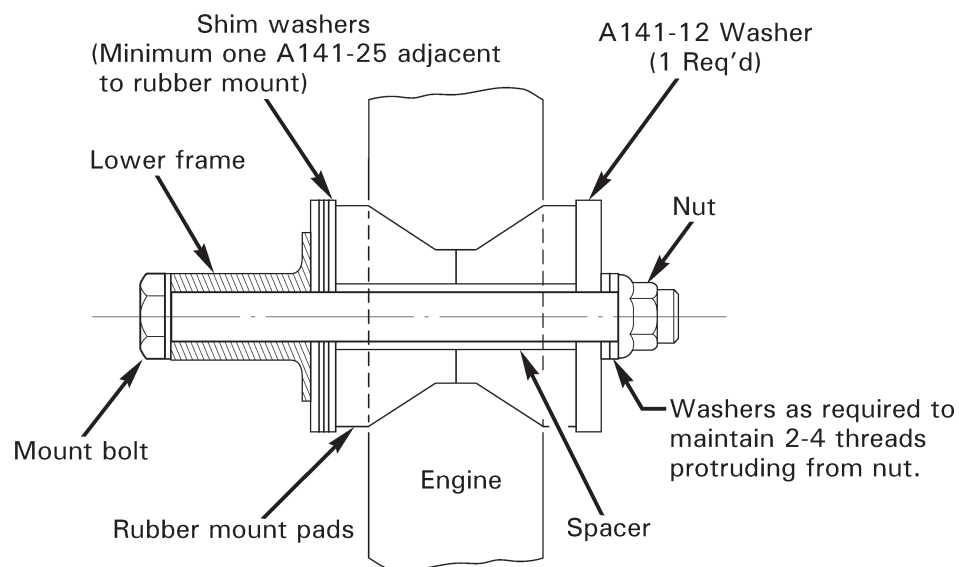
1. Engage clutch.
2. Measure ring gear-to-upper frame cross tube dimension as shown in Figure 6-2. If dimension exceeds 3.75 inches, an equal amount of shims must be added between lower frames and both the lower-left and the lower-right engine rubber mount pads. Use following formula to calculate required maximum shim thickness:

$$\frac{(\text{Measured ring gear-to-upper frame dimension}) - 3.55}{2} = \text{Calculated shim thickness}$$

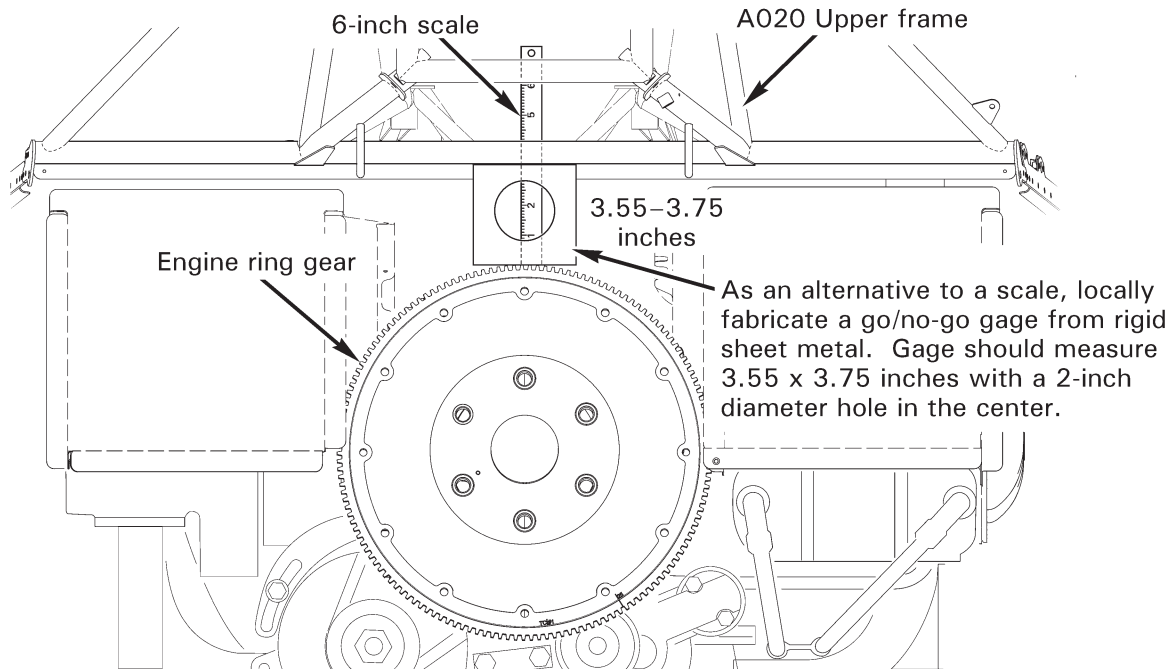
Select shim(s) as required up to, but not exceeding, calculated shim thickness. Shims are available in thicknesses of 0.032 inch, 0.063 inch, and 0.190 inch. Removing an equal amount of shims from between both lower frames and the lower-left and the lower-right engine rubber mount pads will increase ring gear-to-upper frame cross tube dimension.

3. Disengage clutch.
4. Remove side skirts.
5. Loosen upper-left and lower-left engine mount bolts. Leaving right engine mounts torqued, install selected shim(s) between lower-left frame and lower-left engine mount pad. Slotted shims, if used, may be stacked together but must be installed between unslotted shims and safetied. See Figure 6-2A.
6. Torque engine-mount bolts per § 23-32.
7. Remove right-side spark plug inspection panel. Loosen upper-right and lower-right engine mount bolts. Leaving left engine mounts torqued, install selected shim(s) between lower-right frame and lower-right engine mount pad.
8. Torque engine-mount bolts per § 23-32.
9. Engage clutch. Verify ring gear-to-upper frame cross tube dimension as shown in Figure 6-2. Adjust as required.
10. Torque stripe nuts per Figure 2-1.





Add shim washers A141-12 (0.190 inch), A141-24 (0.032 inch), B155 (0.032 inch), A141-25 (0.063 inch) as required to shim engine. B155 shims, if used, shall be between A141 washers (ref. Figure 6-2A).



**FIGURE 6-2 ENGINE INSTALLATION**

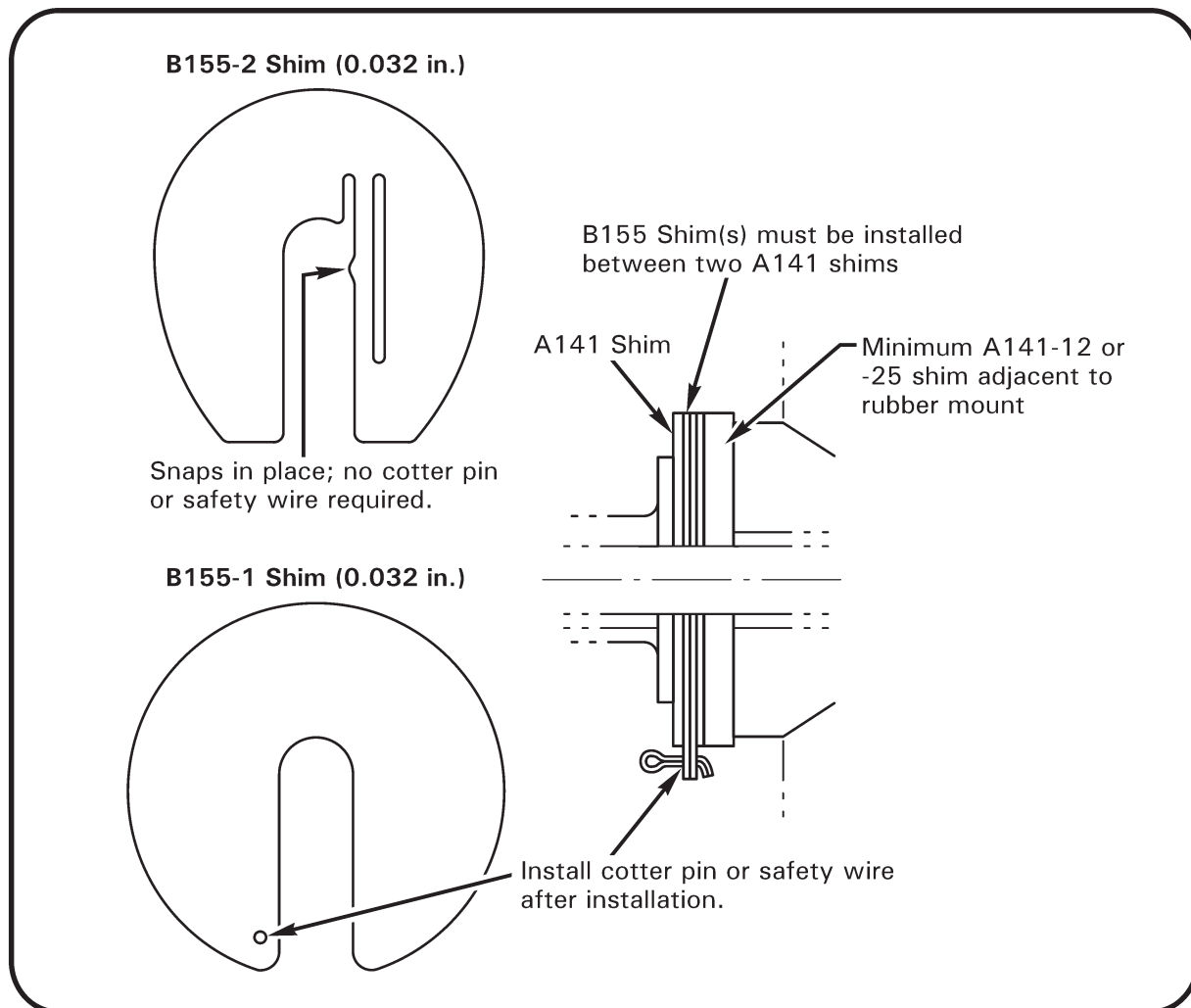


FIGURE 6-2A B155 ENGINE SHIM

**NOTE**

Engine mounting shims added or subtracted at two bottom engine mounts will change engine ring-gear-to-frame dimension by approximately twice the thickness of engine mount shim.

Example: Adding a 0.032-inch thick shim at each bottom engine mount will raise rear of engine approximately 0.064 inch.

### 6.130 Engine Shimming (continued)

**NOTE**

AN6- engine mount bolts are obsolete and must be replaced with NAS1306- or NAS6606- series bolts when shimming engine.

11. Check clutch sheave alignment per § 7.230.
12. Reinstall engine inspection covers and side skirts.
13. Adjust throttle correlation rigging per § 10.150.

### 6.200 Cooling System

#### 6.210 Fanwheel Removal

**CAUTION**

Do not engage actuator without scroll installed.

**NOTE**

If same fanwheel is to be reinstalled then orient starter ring gear support to magneto timing position and mark fanwheel at split line of scroll; this will minimize need for new balance weights. See Figure 6-3B.

- a) Remove fiberglass scroll-to-engine cooling panel perimeter screws and two bolts attaching lower scroll to lower actuator bearing block. Scroll lower half may be removed from scroll upper half at this time if desired.
- b) Remove safety wire and roll pin from fanwheel retaining nut. Refer to Figure 6-3B. Secure MT091-1 engine ring gear holding tool to ring gear support and hold ring gear stationary. Remove fanwheel retaining nut.

**CAUTION**

Failure to secure MT091-1 tool to ring gear support may result in damage to support.

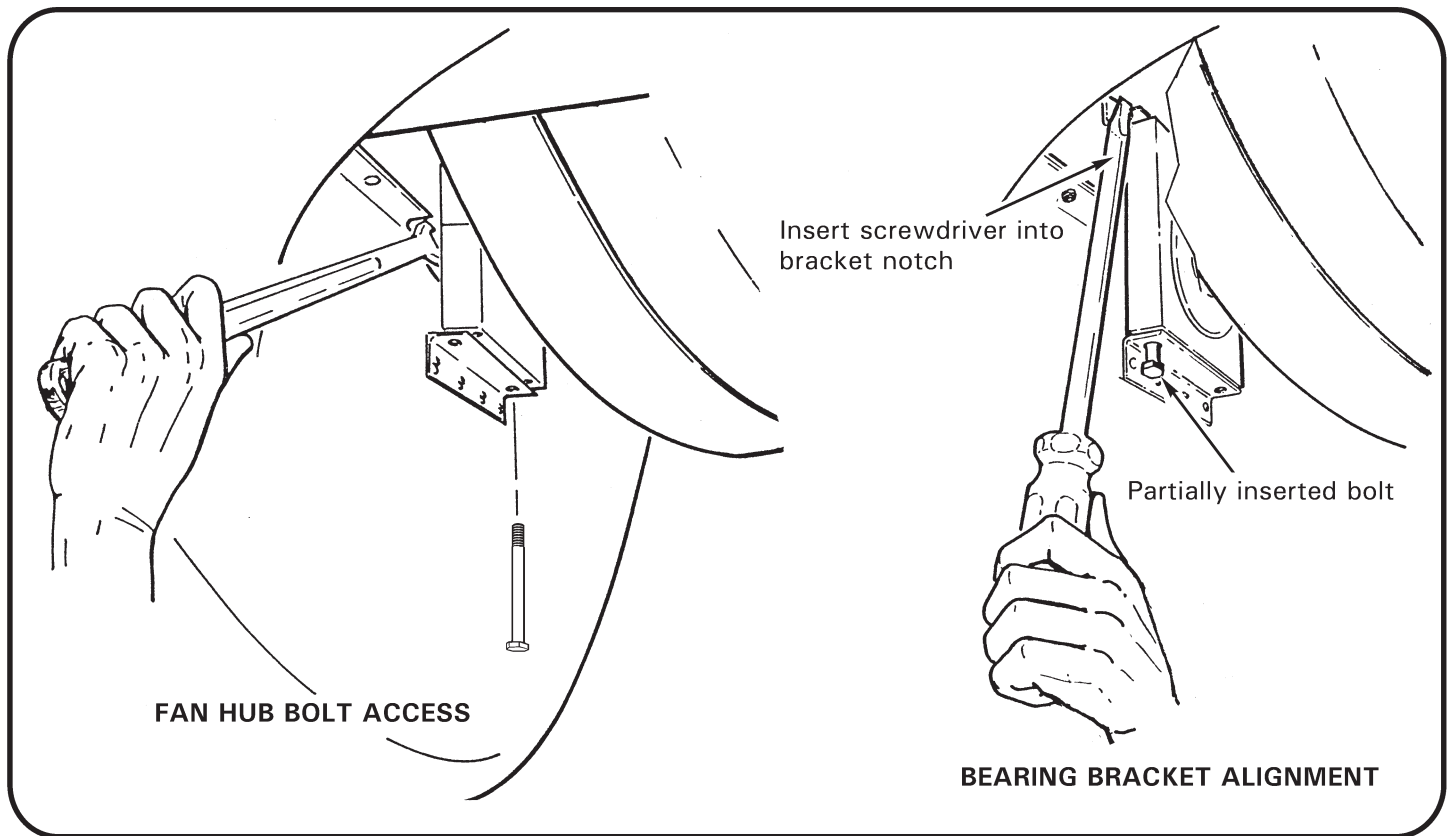


FIGURE 6-3A FAN HUB ACCESS AND LOWER BEARING BRACKET ALIGNMENT

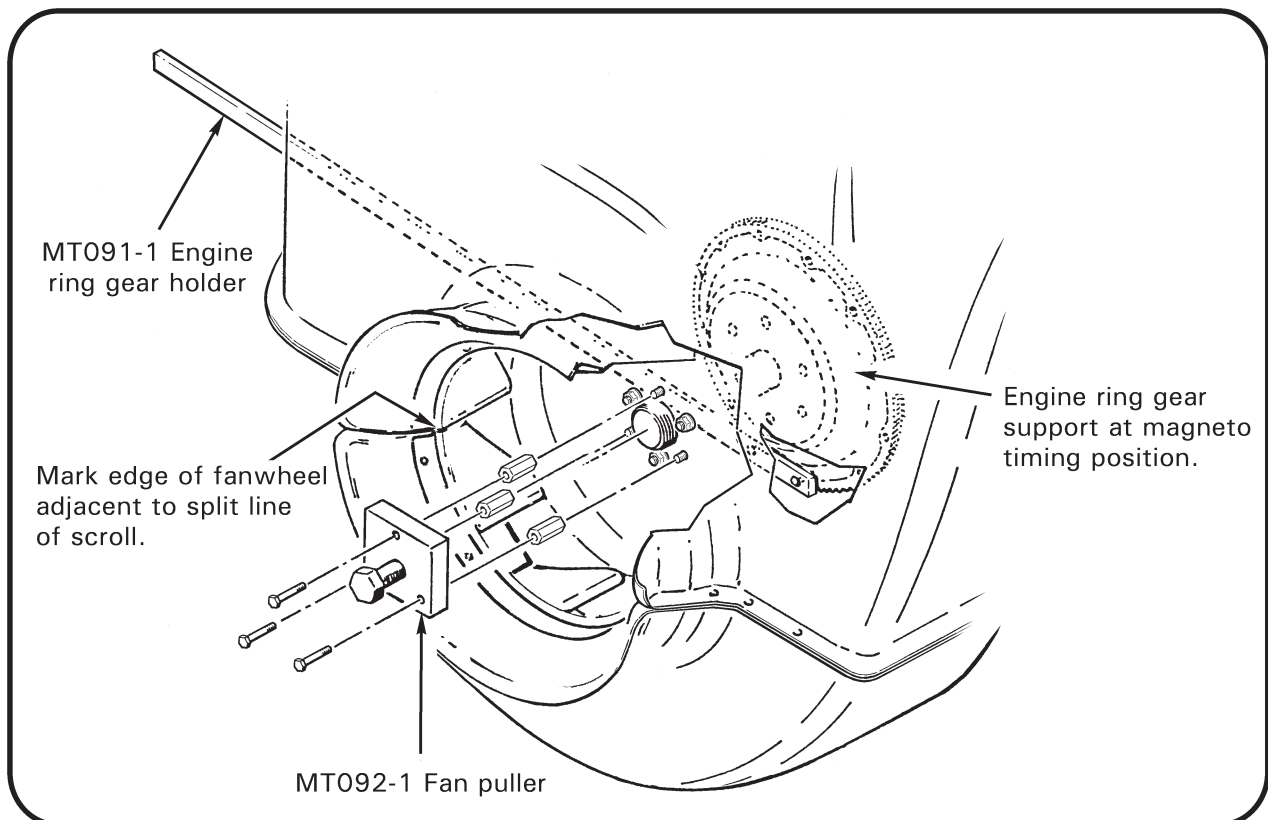


FIGURE 6-3B PULLING FANWHEEL

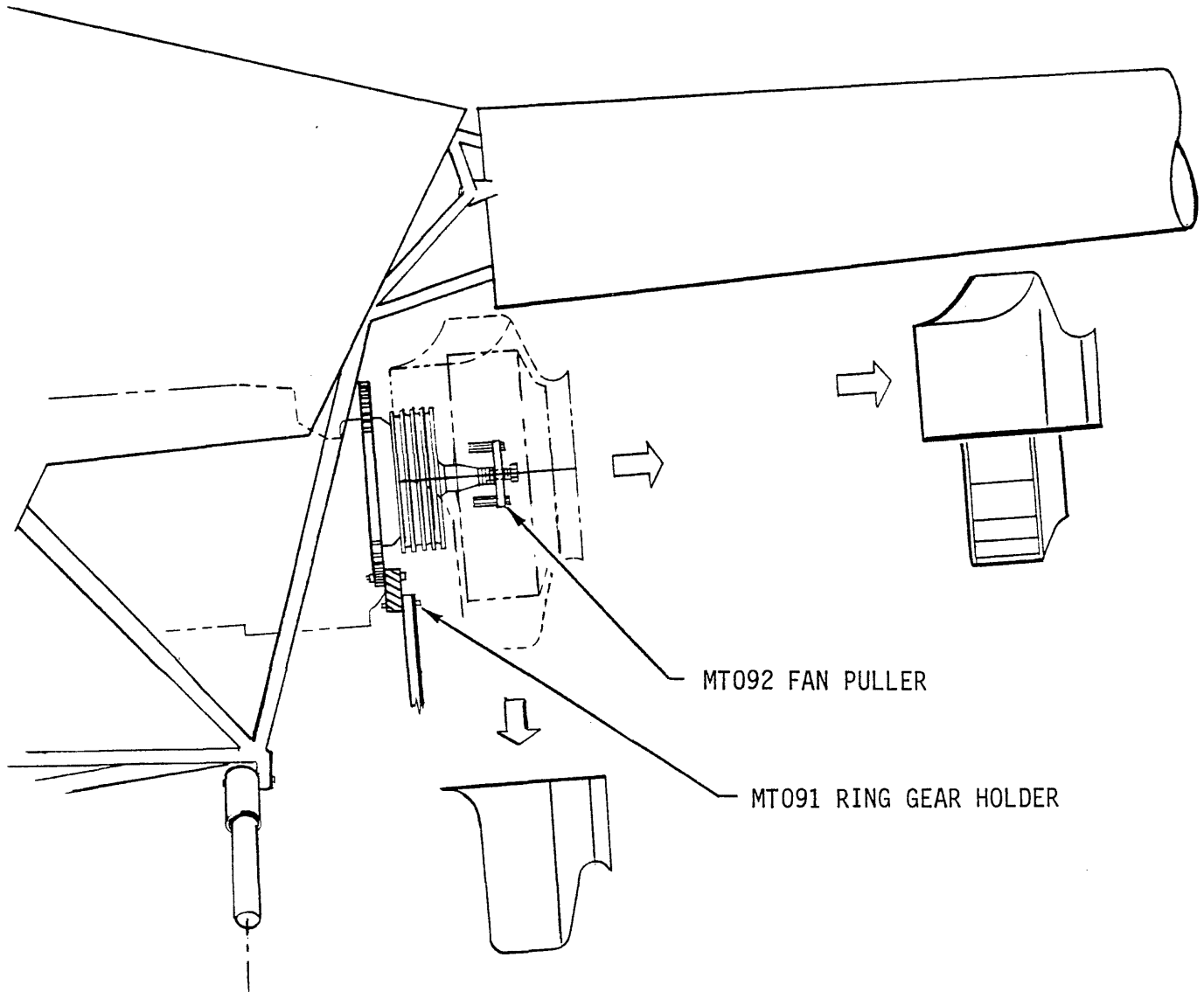


FIGURE 6-3C FANWHEEL AND SCROLL REMOVAL

**6.210 Fanwheel Removal (cont'd)**

- c) Refer to Figure 6-3A. Using an open-end wrench to hold bolt heads, remove every other nut on center hub bolts and replace them with MT092-3 spacer nuts.
- d) See Figure 6-3B. Ensure MT092-1 fanwheel puller tool's large center bolt is unscrewed sufficiently so it will not contact fan shaft. Attach fanwheel puller to MT092-3 spacer nuts.
- e) While holding ring gear stationary with MT091-1 tool, tighten fanwheel puller tool's large center bolt against fan shaft until fanwheel hub is unseated.

**CAUTION**

Support fanwheel assembly to prevent dropping it. Fanwheel may come off tapered shaft suddenly and with a loud noise.

- f) Remove MT092 fanwheel puller and install fan hub nuts on fan hub bolts. Torque nuts per Section 1.330.

**6.220 Fanwheel Installation****CAUTION**

Beta II/Mariner II helicopters must use B174-1 Rev F (12 NAS6603-6 cone-to-fanwheel attach bolts) or subsequent fanwheels and A007-5 (1 11/16 inch nut) or subsequent shaft assemblies.

- a) Clean tapered shaft and fanwheel hub with solvent. Verify no damage to shaft and hub. Thoroughly inspect A181 bearing; verify no roughness or dryness.
- b) Place upper half of fiberglass cooling scroll on fanwheel and install fanwheel on tapered shaft.

**NOTE**

Upper half of cooling scroll must be installed with fanwheel as it will not clear tailcone or upper frame with fanwheel installed first.

**NOTE**

If installing original fanwheel ensure starter ring gear support is at magneto timing position and orient fanwheel to align with marks noted in Section 6.210(a).

- c) Coat threaded portion of tapered shaft and castellated nut face with A257-9 anti-seize compound (thread lubricant). For A007-5 fan shaft, install MS20002 washer against hub. Install AN960-series washers and nut. Exercise care so no lubricant gets on tapered shaft.

**6.220 Fanwheel Installation (cont'd)**

- d) Secure MT091-1 ring gear holding tool to ring gear support and hold ring gear stationary. Torque nut per Section 1.330 until roll pin can be installed in fan shaft. Safety roll pin with 0.041 inch diameter stainless steel wire (number of AN960-series washers may be adjusted to facilitate roll pin installation).

**CAUTION**

Failure to secure MT091-1 tool to ring gear support may result in damage to support.

- e) Install lower cooling scroll half (if removed) and insert two long bolts through lower bracket and actuator bearing block until they enter upper bracket nut plates. Align upper bracket nutplate by inserting screw driver in bracket notch (see Figure 6-3A). Torque bolts per Section 1.320.

**NOTE**

When replacing Revision I and prior fanwheels with Revision J and subsequent fanwheels (ref Figure 6-4B), relocate D339-4 cover to coincide with different fanwheel bolt pattern using KI-124 Kit.

- f) Install screws, nuts and washers around perimeter. Torque nuts to 15 in.-lb plus nut drag.
- g) Refer to Figure 2-9. Mark fanwheel with torque seal directly opposite each end of fanwheel nut roll pin to allow detection of movement between fanwheel and fan shaft.
- h) Check B229 lip to fanwheel inlet clearance per Figure 6-5C. If necessary, lip clearance may be adjusted by elongating lip mounting holes.
- i) Dynamic balance per Section 6.240 is required after fanwheel installation.

**6.230 Reserved****6.240 Balancing Fanwheel****NOTE**

The following instructions pertain to Chadwick-Helmuth Model 8350 and 177-series (Vibrex) equipment. When using Chadwick-Helmuth Model 192- or 8500- series, MicroVib or equivalent balancing equipment consult the equipment's specific operating instructions.

6.240 Balancing Fanwheel (cont'd)

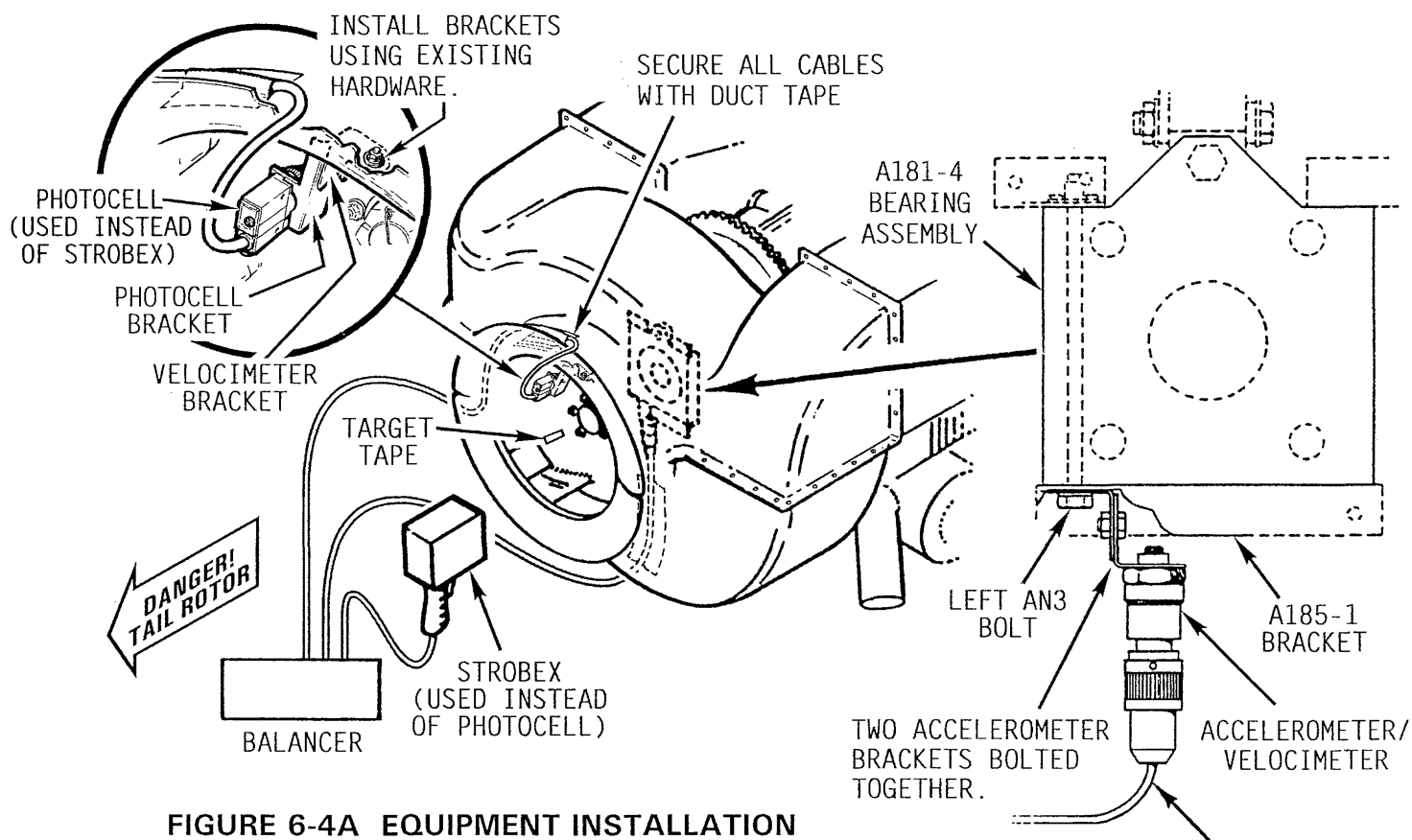
- a) Install accelerometer on lower actuator bearing left bolt per Figure 6-4A. Accelerometer wire should be pointed down. A suitable bracket may be assembled from two accelerometer brackets or may be fabricated.
- b) Place 4270 target tape at one fan vane edge per Figure 6-4A.
- c) Set Strobex mode to position B. Set Balancer RPM range to X10 scale. Set the Balancer RPM dial to 265.
- d) Start engine and run helicopter at 104% with rotor system engaged.

**WARNING**

Use extreme care near tail rotor.

- e) Point Strobex at fanwheel nut and pull trigger. Note target tape clock angle (position).
- f) Push Tune button on Balancer. Note change (if any) in target tape clock angle. While pushing Tune button, adjust RPM dial to bring target tape back to clock angle viewed in Step e). Release Tune button.
- g) Repeat steps e) and f) as required until there is no change in target tape clock angle when Tune Button is pushed and released (i.e. Balancer is tuned).
- h) Note target tape clock angle after Balancer is tuned.
- i) Note vibration reading on Balancer IPS meter.
- j) Shut down engine.
- k) If IPS exceeds 0.2, balance weights must be changed. Rotate fanwheel until target tape is in position noted in step h). Increase balance weight by changing washers under nut closest to 1:00 position or by splitting required weight change among two nearest nuts per Figure 6-4B. Alternatively, weight may be decreased under nut closest to 7:00 position. Total washers under each nut must result in two-four threads protruding past nut to ensure proper clamp-up. Access balance weight bolt heads thru hole under D229-4 cover (if installed; cover may be retrofitted using P/N KI-111 Kit) on forward side of lower scroll or thru oil cooler access door (with a crowfoot on a flex handle) and rotating fanwheel as required. Ensure NAS1149F0316P washers (if installed, see Figure 6-5) are not dislodged if NAS6603-6 bolts are removed. Torque NAS6603 bolts per Section 1.330. Install D229-4 cover.
- l) Recheck fanwheel balance and adjust as required to obtain less than 0.2 IPS.
- m) Remove accelerometer.





**FIGURE 6-4A EQUIPMENT INSTALLATION**

ADD WEIGHT BY INCREASING WASHER SIZE OPPOSITE ACCELEROMETER/VELOCIMETER. ALTERNATIVELY, REMOVE WEIGHT BY DECREASING WASHER SIZE ADJACENT TO ACCELEROMETER/VELOCIMETER. DO NOT REMOVE NAS6603-6 BOLTS.

AN960-10 WASHER = 0.05 IPS CHANGE

A141-17 WASHER = 0.10 IPS CHANGE

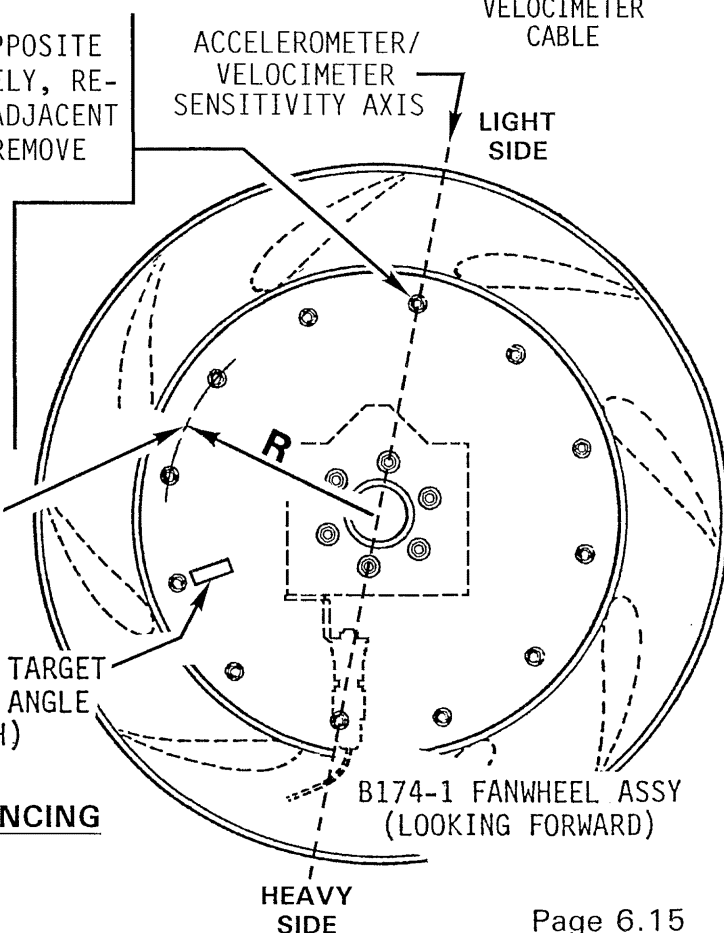
AN970-3 WASHER = 0.20 IPS CHANGE

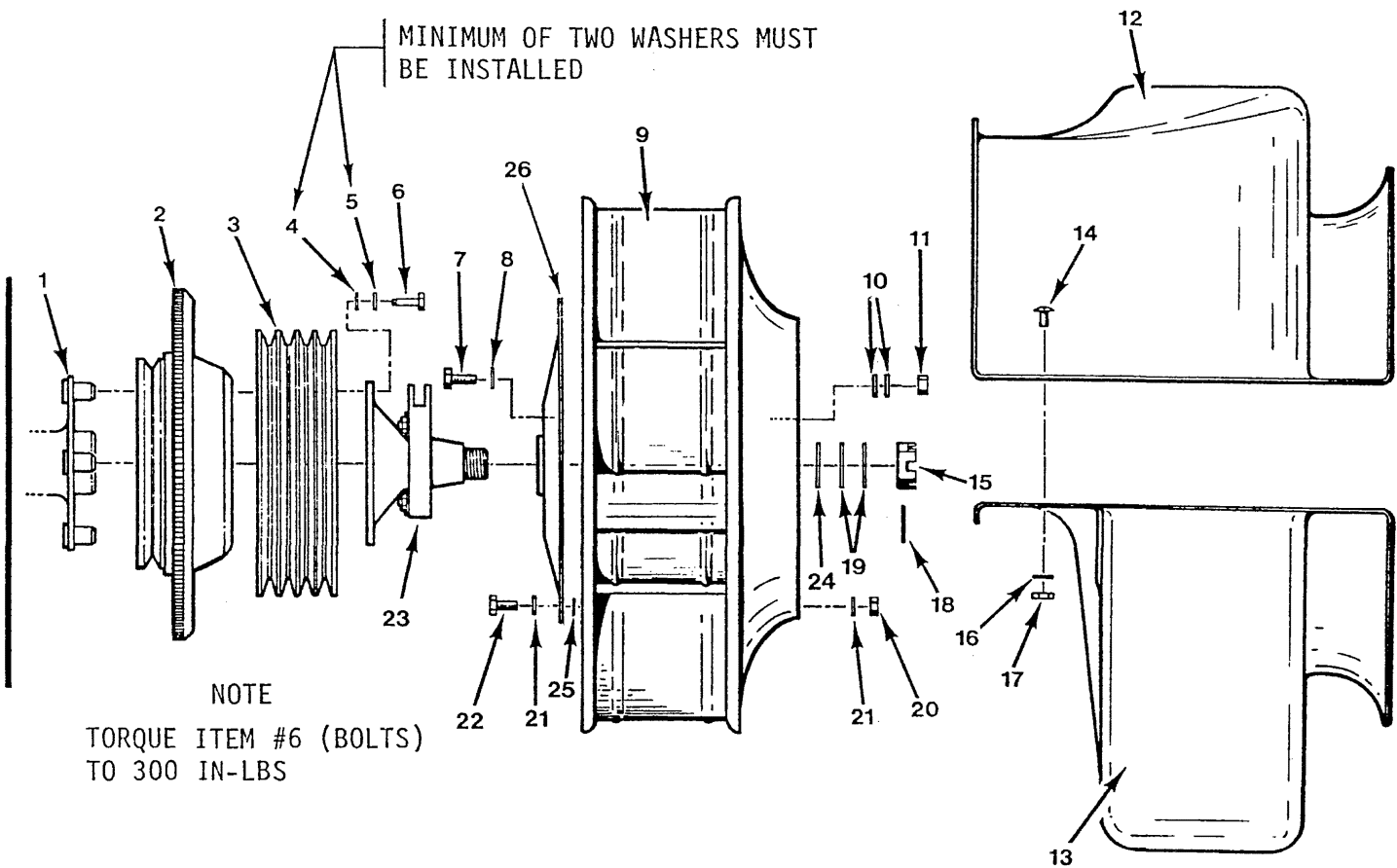
MIX ABOVE SIZES AS REQUIRED FOR BALANCE. ENSURE 2-4 THREADS EXPOSED BEYOND NUT.

RADIUS R = 5.10 IN. ON REVISION "J" AND SUBSEQUENT FANWHEELS;  
R = 4.10 IN. ON REVISION "I" AND PRIOR FANWHEELS.

ROTATE FAN UNTIL TARGET TAPE IS AT CLOCK ANGLE NOTED IN 6.240 (H)

**FIGURE 6-4B FANWHEEL BALANCING**





NUMBER	PART NO.	DESCRIPTION	NUMBER	PART NO.	DESCRIPTION
1	-	Engine Flange	17	NAS679A08	Nut
2	-	Engine Ring Gear	18	B350-2	Spring Pin
3	A493-1	Lower Sheave	19	AN960-1616L (As req'd)	Washer (For A007-3)
4	AN960-616L	Washer		AN960-1818L (As req'd)	Washer (For A007-5)
5	AN960-616	Washer	20	NAS679A3	Nut
6	NAS1306-24H	Bolt	21	AN960-10	Washer
7	NAS1305-11	Bolt	22	NAS1303-3	Bolt
8	AN960-516L	Washer		NAS1303-6***	Bolt (on B174 Rev F and subsequent)
9	B174-1	Fanwheel Assy	23	A007-3	Shaft Assy
10	AN960-516	Washer		A007-5	Shaft Assy (Must use in Beta II and Mariner II)
11	NAS679A5	Nut	24	MS20002-18	Washer (For use with A007-5)
12	A236-1	Scroll (Upper)	25	NAS1149F0316P***	Washer
13	A236-2* or A236-3**	Scroll (Lower)	26	A187	Cone (Ref)
14	AN525-832R6	Screw			
15	AN320-15	Nut (For use on A007-3)			
	AN320-18	Nut (For use on A007-5)			
16	AN960-8L	Washer			

\*Ship 0001 thru 0500  
 \*\*Ship S/N 0500 and on  
 \*\*\*Used on B174-1 Rev "F" and subsequent.

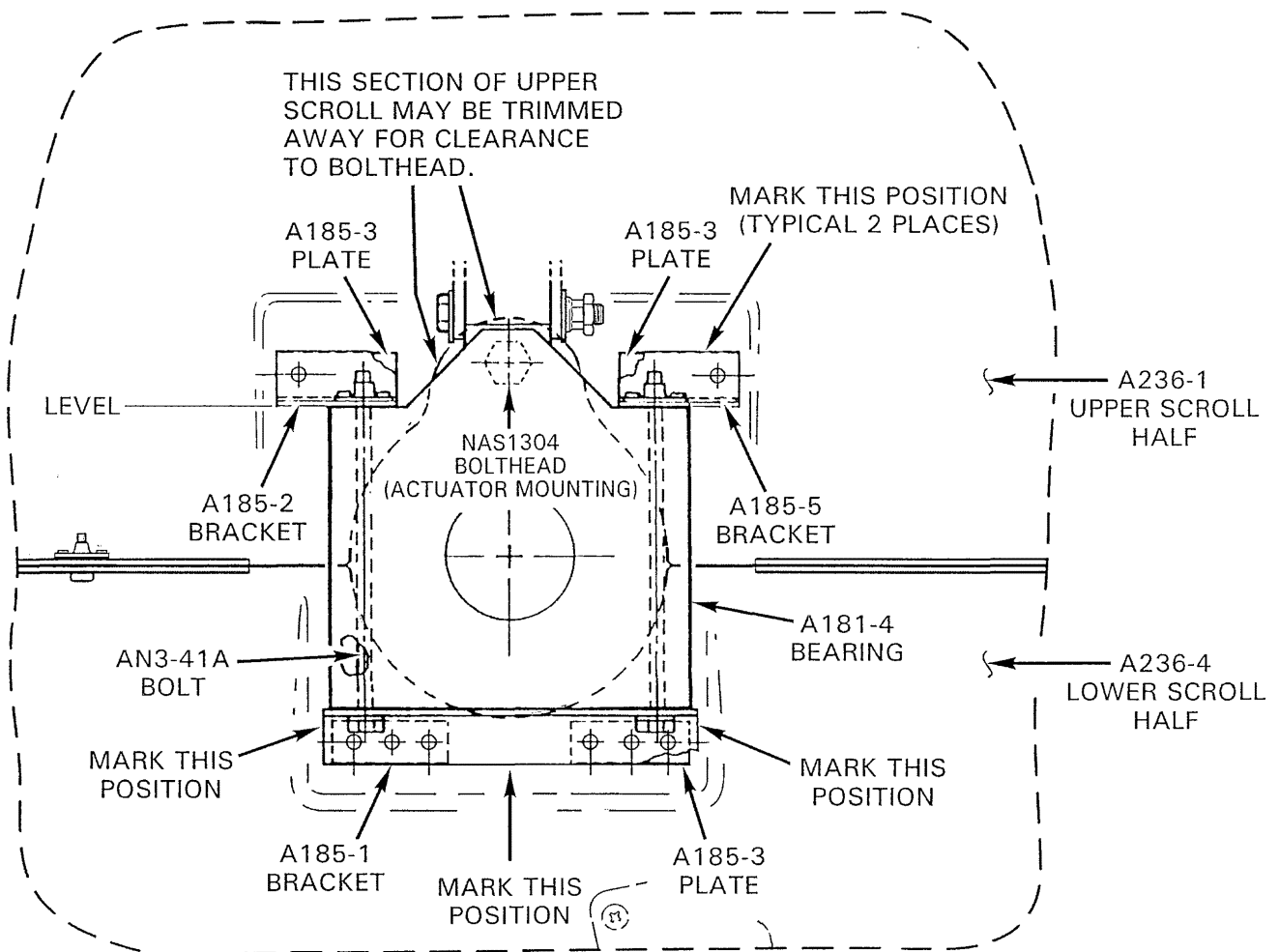
FIGURE 6-5 CENTRIFUGAL BLOWER INSTALLATION

### 6.250 Cooling Scroll Replacement

- a) Remove the old scroll halves and actuator assembly, if installed.
- b) Level the airframe laterally per Section 1.210. Assemble the A185-1 bracket on the bottom of the bearing housing with the A185-2 on the upper left and the A185-5 on the upper right. Use two AN3-41A bolts to secure the brackets (See Figure 6-5A). Place a bubble level across the top surface of the lower actuator bearing. Rotate the housing to level the bearing.
- c) Place the upper scroll half (A236-1) and the engine cooling fan on the fanshaft. Do not disturb the position of the lower actuator bearing. Finger tighten the fanshaft nut. On Beta and Mariner ships with the larger oil coolers, the right-hand side of the upper scroll sits on the oil cooler ledge. Adjust the upper half laterally to center the lip of the fan and the edge of the inlet scoop, then clamp to the sheet metal shrouds (See Figure 6-5B).
- d) Install the lower scroll half (A236-3) to the upper. Check the clearance between the lip of the fan and the edge of the inlet scoop. The clearance should be concentric all the way around the lip of the fan. Adjust both the halves as required and clamp into position (See Figure 6-5B).
- e) Carefully mark the position of the lower actuator bearing and brackets on the scroll halves. Mark the mounting holes on the scroll halves through the sheet metal shrouds. Mark the top and sides of the scroll at the edge of the sheet metal shrouds. Using a 90 degree angle drill, with a #18 drill bit, match drill as many mounting holes as possible. Cleco clamp or install AN525-832 screws to secure the scroll as the holes are drilled. Match drill the two vertical mounting holes through the oil cooler ledge.
- f) Position the upper and lower B229-2 lips at the inlet of the scroll. Adjust the clearance to the edge of the cooling fan to 0.030-0.070 inch. Clamp into position and match drill the lips to the scroll.
- g) Remove the scroll and fan. Drill the remaining marked mounting holes, with a #18 drill bit. Assemble the A185 brackets on the drill fixture. Position the brackets on their alignment marks on the scroll. Drill through the brackets and scroll with a #40 drill bit. Position the reinforcing plates on the inside of the scroll. Enlarge the holes in the brackets, scroll and reinforcing plates with a #30 drill bit. Disassemble and deburr the holes. Reassemble and rivet the brackets and reinforcing plates using MS20470AD4 rivets.

### 6.250 Cooling Scroll Replacement (cont'd)

- h) Position one NAS679A08 nutplate on upper scroll half at vertical mounting hole on inboard right hand side. Drill and rivet nutplate in position with flush head rivets.
- i) Trim top and side edges of scroll upper half parallel with sheet metal cool panel flanges as required to maintain an edge distance of 0.01-0.02 inch
- j) Trim upper scroll at lower actuator mounting bolt as necessary. No contact with bolthead is permitted.
- k) Epoxy prime and paint grey.
- l) Install fanwheel per Section 6.220.



**FIGURE 6-5A LOWER ACTUATOR BEARING INSTALLATION**  
(VIEW LOOKING AFT)

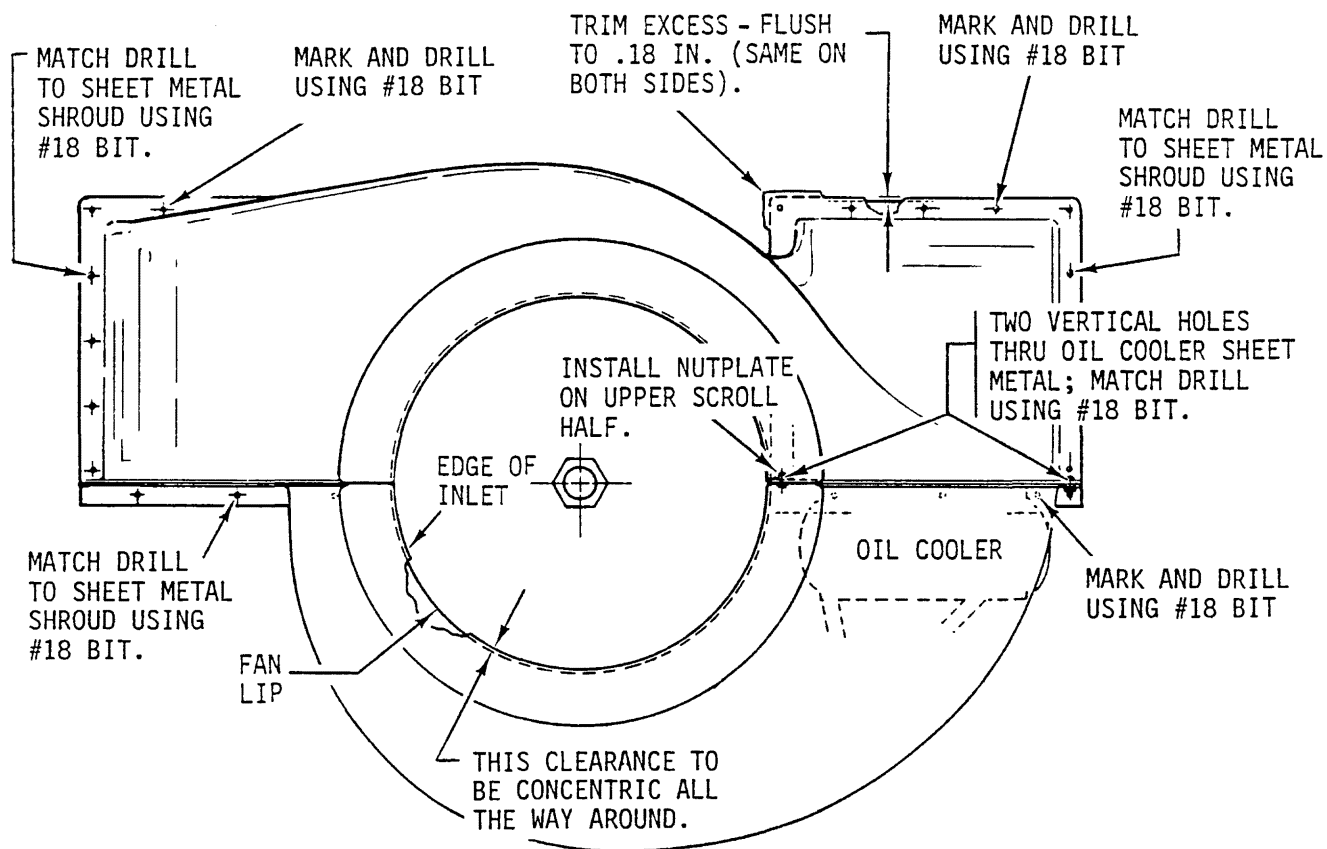


FIGURE 6-5B COOLING SCROLL REPLACEMENT

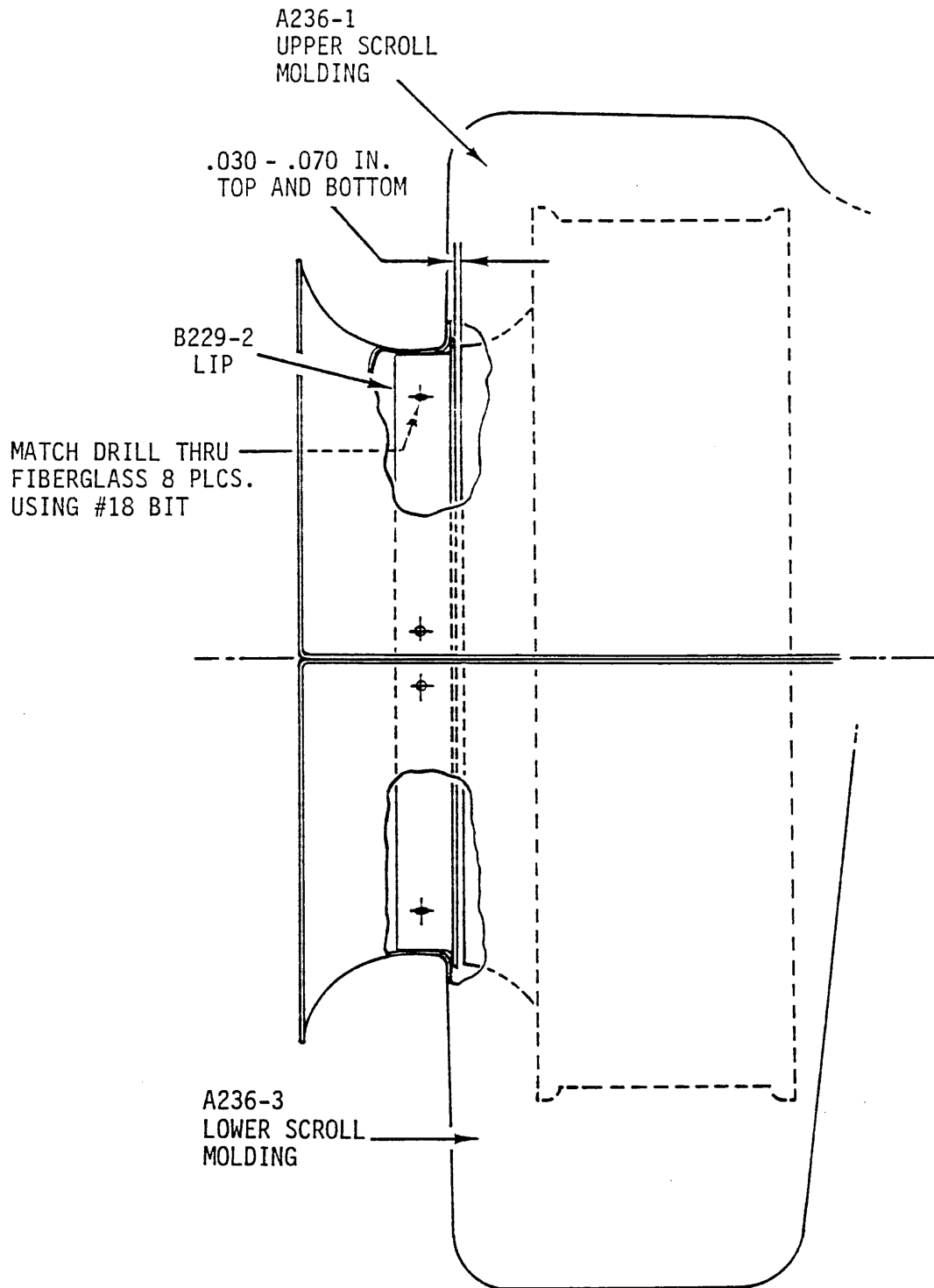
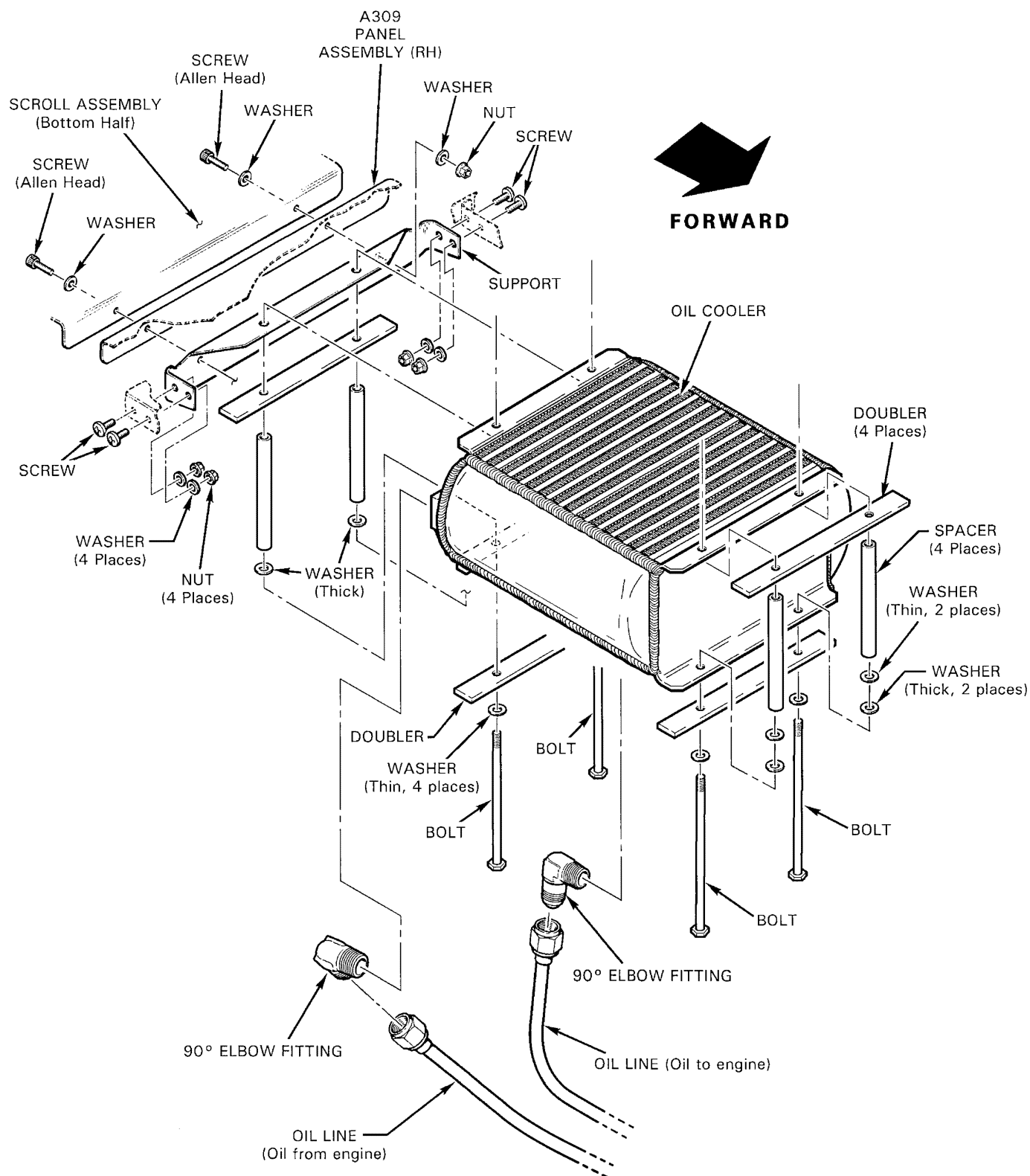


FIGURE 6-5C COOLING SCROLL REPLACEMENT  
(FAN LIP POSITIONING)



**FIGURE 6-6 OIL COOLER INSTALLATION**

## 6.300 LUBRICATION SYSTEM

### **NOTE**

Refer to Pilot's Operating Handbook for grade and quantity of oil required. Refer to the Textron-Lycoming Operator's Manual for adjustment and maintenance of the lubrication system.

### 6.310 Oil Cooler Removal

1. Disconnect oil lines at cooler.
2. Remove four screws and nuts connecting support to panels.
3. Disconnect four mounting bolts and remove oil cooler and attached support. If replacing cooler do NOT attempt to remove and transfer blue-anodized 90 degree elbow fittings (steel fittings may be removed).

### 6.320 Oil Cooler Installation

### **NOTE**

Seal elbows' pipe threads with B270-6 sealant prior to installing in oil cooler. Torque elbows per Section 1.320.

### **CAUTION**

Hold threaded fittings on oil cooler with wrench to react torque when tightening elbows.

1. Install oil cooler and attached support to engine cooling panels using four mounting bolts. Torque AN3 bolts per Section 1.320 and torque stripe per Figure 2-1.
2. Install four screws and nuts connecting support to cooling panels (See Figure 6-6).
3. Connect oil lines, torque nuts per Section 1.330, and and torque stripe per Figure 2-1.

## 6.400 INDUCTION SYSTEM

### 6.410 Carburetor Removal

1. Disconnect air intake and carburetor heat hoses from air box.
2. Disconnect throttle linkage from carburetor bellcrank, mixture control cable from carburetor and carburetor heat control cable from air box slider valve.
3. Disconnect carburetor air temperature probe wiring.
4. Remove palnuts and nuts securing carburetor to intake manifold and remove carburetor and attached air box assembly.

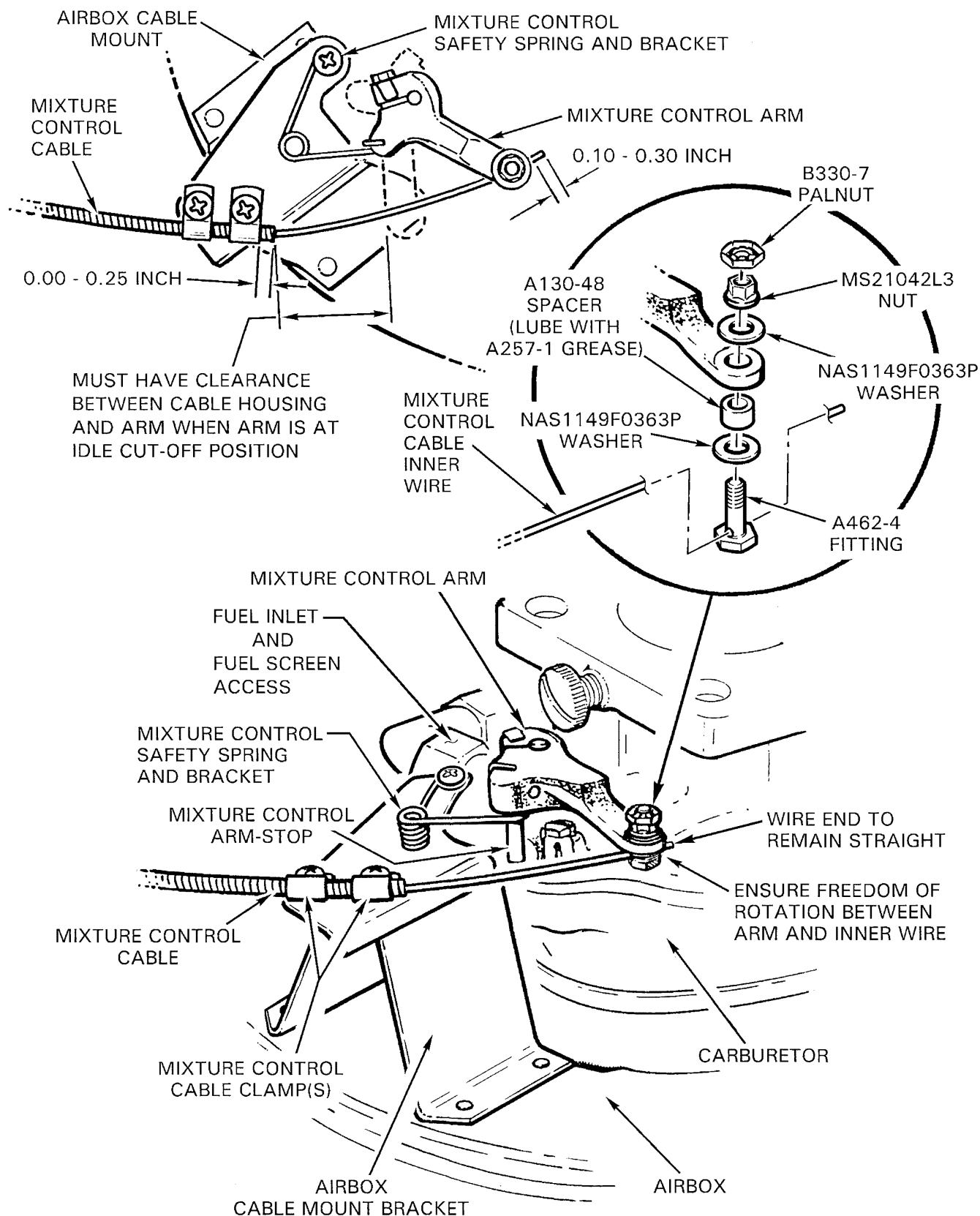


### 6.420 Air Box Removal

1. Disconnect air intake hoses from air box.
2. Disconnect mixture control cable clamp(s) from air box.
3. Disconnect mixture safety spring from carburetor mixture control arm.
4. Open air box cover and remove air filter.
5. Disconnect carburetor heat control cable from air box and slider valve.
6. Cut safety wire and remove four bolts (or cap screws) securing air box to carburetor and remove air box and rubber gasket.

### 6.430 Air Box Installation

1. With air inlets on right, install air box and rubber gasket on carburetor and secure with bolts and washers (or cap screws and spacers on R22 S/Ns 2571-2664 with C057 air box). Torque fasteners per Section 1.330 and safety with 0.032 inch diameter safety wire.
2. Connect mixture control safety spring to carburetor mixture control arm. Verify spring moves arm to full rich position.
3. See Figure 6-7. Connect mixture control cable housing to air box. Push and pull on cable housing and verify it does not slip in clamp(s).
4. See Figure 6-7. Connect mixture control cable inner wire to mixture control arm. Verify mixture control moves carburetor mixture control arm stop to stop. Verify 0.03/0.10 inch clearance (spring-back) under knob at full-rich position. If required, adjust position of inner wire in A462 fitting. Torque A462 fitting per Section 1.330. Install palnut, torque per Section 1.320, and torque stripe.
5. Connect carburetor heat control cable to air box. Connect carburetor heat control cable inner wire to slider valve and torque A462 fitting per Section 1.330. Verify carburetor heat control fully opens and closes slider valve. Bend free end of inner wire ninety degrees where it exits A462 fitting, then cut wire as required to leave 0.25/0.50 inch remaining. Install palnut, torque per Section 1.320, and torque stripe.
6. Install air filter, close cover, and secure. Tighten four long bolts only enough to secure cover and eliminate looseness, then torque stripe. On R22 Mariners, seal air box cover perimeter with aluminum tape. If installed, verify spring-loaded alternate air door fully closes when released.
7. Connect air intake hoses to air box.



**FIGURE 6-7 MIXTURE SAFETY SPRING INSTALLATION**

### 6.435 Air Filter Cleaning

**NOTE**

Replace B771-1 air filters after 5 years or 600 flight hours, whichever occurs first.

1. Remove B771-1 air filter from airbox. Visually inspect filter and verify no obvious damage. Inspect filter's pleated media for cleanliness. If the media contains only dust, clean media using compressed air or water. Clean heavily soiled media using a mild soap & water solution.
  - a. Compressed air: Maintain at least one-inch distance between air nozzle and pleated media and apply less than 40 psi compressed air thru media opposite the normal direction of airflow.
  - b. Water: Apply less than 40 psi water stream thru media opposite the normal direction of airflow. Dry filter thoroughly using less than 160°F warm air.
  - c. Mild soap & water solution: Apply less than 40 psi water stream thru media opposite the normal direction of airflow. Soak filter in a mild soap and water solution for more than 15 minutes but less than 4 hours. Gently agitate filter in soap solution to help remove dirt. Apply less than 40 psi water stream thru media in both directions. Dry filter thoroughly using less than 160°F warm air.
2. Using a bright light, examine pleated media and verify no holes or tears.
3. Verify filter sealing surfaces are a smooth, continuous circle and flat.

**NOTE**

Do not install a wet air filter. Do not apply oil to filter media.

4. Install filter in airbox.

#### 6.440 Carburetor Installation

1. With carburetor butterfly bellcrank on left, install carburetor and new gasket on mounting studs of engine sump and secure with washers and nuts. Special torque nuts per § 23-33. Install palnuts, standard torque per § 23-32, and torque stripe.
2. Connect throttle push-pull tube to middle hole of carburetor butterfly bellcrank. Standard torque bolt per § 23-32. Install palnut, torque per § 23-32, and torque stripe.
3. See Figure 6-7. Connect mixture control cable inner wire to carburetor mixture control arm. Lightly tighten A462 fitting, but do not torque; fitting will be torqued in following step.
4. Install air box per § 6.430.
5. Verify idle RPM and idle mixture per § 2.210.
6. Check throttle correlation rigging per § 10.150.

#### 6.450 Carburetor Heat Scoop Removal

1. Disconnect hose from carburetor heat scoop.
2. 0-320 engine: Remove six screws securing curved sheet metal and remove sheet.  
0-360 engine: Remove two B277 clamps securing scoop assembly to exhaust manifold and remove scoop.
3. 0-320 engine: Remove four bolts securing scoop assembly to bead clamp on exhaust riser and remove scoop assembly. Remove additional clamp from exhaust riser above bead clamp.

#### 6.460 Carburetor Heat Scoop Installation

1. 0-320 engine: Install A694 clamp and angle on #4 cylinder exhaust riser and lightly tighten. Attach scoop assembly on bead clamp and lightly tighten.  
0-360 engine: Install scoop assembly, secure with B277 clamps, and lightly tighten.
2. Connect air inlet hose to scoop assembly.
3. 0-320 engine: Position sheet on mounts. Move A694 clamp and rotate bead clamp (with attached scoop assembly) as required to minimize preload and ensure clearance from surrounding structure. Tighten A694 clamp. Standard torque bolts per § 23-32. Install sheet with six screws.  
0-360 engine: Move scoop assembly as required to minimize preload and ensure clearance with surrounding structure. Special torque scoop attach clamps to 30 in.-lb.

## 6.500 Exhaust System

### 6.510 Exhaust System Removal

1. Remove carburetor heat hose and, if installed, disconnect heater hoses from muffler shroud.
2. Protect landing gear aft cross tube with suitable covering. Disconnect exhaust flanges at cylinder heads and remove exhaust system and gaskets.

### 6.520 Exhaust System Installation

<p style="text-align: center;"><b>NOTE</b></p> <p>Do not use stainless tape beneath exhaust bead clamps which incorporate integral barriers.</p>
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1. Position a gasket on each exhaust port.
2. Protect landing gear aft cross tube with suitable covering. Position exhaust system on engine and connect riser exhaust flanges to cylinder heads with washers and nuts. Remove protective cover from cross tube.
3. Loosen bead clamp on each riser. If required, remove curved metal sheet from carb heat scoop assembly.
4. Special torque exhaust flange nuts per § 23-33. Install palnuts and standard torque per § 23-32.
5. Install carburetor heat hose and connect heater hoses, if installed.
6. Standard torque bead clamp AN3 bolts per § 23-32. If removed, install curved metal sheet on carburetor heat scoop assembly and reposition clamps as required to minimize preload and ensure clearance from surrounding structure.

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6.610 LOW-POWER CHECKLIST

When low engine power output is suspected, use the following checklist to verify:

1. Aircraft gross weight is not exceeded. Weigh aircraft if it was not weighed at last overhaul.
2. Engine oil pressure, oil temperature, and CHT are within limits.
3. MAP gage indicates ambient pressure (engine off).
4. Proper grade of fuel per Pilot's Operating Handbook.
5. Main rotor blades are clean and smooth (no rough paint).
6. Exhaust is unobstructed.
7. Main rotor blade trim tabs are not excessively bent.
8. Carburetor heat valve closes fully in OFF position.
9. Induction system is unobstructed. Air filter and both inlet hoses (ambient and carburetor heat) are clean, undamaged, unobstructed, and do not collapse in flight. Carburetor-to-engine gasket is correct size.
10. Engine tachometer indication is correct. Verify with digital tachometer (such as found in newer dynamic balancing equipment) or similar equipment.
11. Oil screens or filter do not exhibit metallic debris consistent with internal engine damage.
12. Proper cylinder compression (both leakage and direct) per Lycoming recommendations.
13. Mixture neither excessively lean nor rich. Compare fuel flow. Verify fuel filter cleanliness, check spark plug indications, check carburetor throttle body-to-float bowl screw security per Lycoming SB 366.
14. Proper spark plug type and condition.
15. Proper magneto-to-engine timing. Verify engine-left (helicopter-right) magneto is not operating in retard mode when ignition switch is in BOTH position (disconnect retard terminal after starting engine and compare hover MAP indications; lesser hover MAP with retard terminal disconnected indicates magneto was operating retarded).
16. Proper fuel flow and unobstructed carburetor fuel inlet screen. Perform fuel-flow check per Section 12.
17. If primer-equipped, verify fuel is not leaking past primer pump (ensure primer pump is locked) and air is not leaking past fittings in cylinder head.

## | 6.610 LOW-POWER CHECKLIST (cont'd)

18. Carburetor or fuel control throttle lever contacts full-throttle stop (collective must be raised slightly).
19. Carburetor or fuel control mixture arm contacts stop when mixture control is in full-rich position and mixture arm does not exhibit springback at extremes of travel when disconnected from control cable/safety spring (due to internal binding).
20. No induction/MAP system leaks. To check MAP system, disconnect MAP line at cylinder head fitting and apply suction with syringe until MAP gage indicates 10 inches Hg. Monitor gage for one minute; indication should rise no more than 1 inch Hg. Verify carburetor throttle shaft bushings are not worn; check both axial and radial clearances. Intake leaks can also occur due to loose intake pipe connections in oil sump and/or cracked sump runner tubes. For O-320-B2C engines only, incorrect thin-flanged intake pipes P/Ns 61363, 61364, or 61365 used in place of correct P/Ns LW-16728, LS-16729, and LW-16730 can cause leaks in conjunction with deep-counterbore flange P/N 74360.
21. Proper exhaust valve guide clearance per Lycoming SB388B.
22. Proper dry-tappet clearance per Lycoming Overhaul Manual.
23. With lifters pumped up (valve lash removed), each intake valve should exhibit equal travel during opening when measured with a dial indicator. Similarly, each exhaust valve should exhibit equal travel during opening. Unequal travel indicates damaged cam lobe(s).
24. Proper magneto internal timing.
25. Carburetor float bowl fuel level correct.
26. Cylinder head intake port has radiused edge where inlet airflow turns 90 degrees toward valve. If no radius exists, contact Lycoming Technical Support.
27. Proper crankshaft-to-camshaft timing: As #1 piston passes TDC on compression stroke, the #2 intake valve should open while the #2 exhaust valve closes (valve overlap position).
28. If O-320/O-360/O-540 engine exhibits low-power immediately after overhaul, verify correct 8.5:1 compression ratio piston P/N 75089 has been installed (instead of 7.0:1 low compression piston P/N 75413).



6.620 High Cylinder Head Temperature (CHT) Indication

1. For any helicopter indicating unusually high CHTs, verify:
  - a. Proper fuel grade.
  - b. Cooling scroll inlet metal lips-to-fanwheel clearance is within 0.020–0.100 inch.
  - c. Mixture control at carburetor is at full-rich position when mixture knob is fully in.
  - d. Integrity of engine baffles and cooling panels.
  - e. Cooling hoses are properly routed, secured, and in good condition.
  - f. Correct spark plugs (Lycoming Service Instruction 1042 refers).
  - g. Magnetos are properly timed.
  - h. No excessive leakage from exhaust riser-to-cylinder head gaskets.

**NOTE**

Cylinder head temperatures may be higher during engine break-in until oil change and switch from mineral to ashless dispersant oil.

2. If preceding steps and corrective actions do not improve CHT indications, the CHT gage may be indicating erroneously high. Refer to § 33-131-2 Part E.

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## 6.700 THROTTLE CONTROL AND CARBURETOR HEAT ASSIST

The throttle control consists of a twist grip integral with the collective control, an overtravel spring, throttle bellcrank, throttle push-pull tube, a carburetor throttle lever, and carburetor heat assist factory installed on S/N 2571 and subsequent.

### 6.710 Overtravel Spring (Refer to Figures 8-6 and 10-8)

#### 6.711 Overtravel Spring Removal

1. Remove belly panel and vertical panel between seat backs.
2. Disconnect A327-1 overtravel spring's upper rod end from collective throttle arm.
3. Disconnect A327-1 overtravel spring's lower rod end from bellcrank.
4. Remove overtravel spring.

#### 6.712 Overtravel Spring Installation

1. Connect overtravel spring's lower rod end to bellcrank and torque per Section 1.32. Install palnut, torque per Section 1.320, and torque stripe per Figure 2-1.
2. Connect overtravel spring's upper rod end to collective throttle arm. Raise collective fully, and with throttle twist grip rotated full closed, verify dimension shown in Figure 10-8; adjust upper rod position as required. Torque screw per Section 1.330. Install palnut, torque per Section 1.320, and torque stripe per Figure 2-1.
3. Install belly panel and vertical panel between seatbacks.

### 6.720 (Reserved)

### 6.730 Throttle Push-Pull Tube Assembly

#### 6.731 Throttle Push-Pull Tube Assembly Removal

1. Remove cover enclosing bellcrank beneath left seat baggage compartment. Disconnect throttle push-pull tube assembly from bellcrank.
2. Disconnect throttle push-pull tube assembly from carburetor and remove.

#### 6.732 Throttle Push-Pull Tube Assembly Installation (Refer to Figure 10-8)

1. Insert throttle push-pull tube assembly forward thru firewall seal. Attach aft end to middle hole of carburetor throttle lever and tighten bolt.
2. Attach throttle push-pull tube assembly to bellcrank and tighten bolt.
3. Adjust throttle correlation rigging per section 10.150. Torque push-pull tube jam nuts(s) and palnut(s) (if installed), per Section 1.320 and torque stripe per Figure 2-1.

### 6.740 Carburetor Heat Assist

A carburetor heat assist device is installed on R22s with O-360 engines. The carb heat assist correlates application of carburetor heat with changes in collective setting to reduce pilot work load. Lowering the collective mechanically adds heat and raising the collective reduces heat. Collective input is transmitted through a friction clutch which allows the pilot to override the system and increase or decrease heat as required. A latch is provided at the control knob to lock carburetor heat off when not required.

#### 6.741 Carburetor Heat Control Removal

1. Open air box.
2. Remove horizontal cover between seats.
3. Drive out spring pin on cyclic friction knob using a pin punch. Remove cyclic friction knob. Unscrew knob and collar from carb heat assist stem.
4. Raise cyclic cover and secure out of the way.
5. Remove and discard palnuts from carburetor heat slider valve fittings. Discard palnuts.
6. Loosen nut(s) securing carburetor heat control inner wire to valve.
7. Remove cotter pin and washer securing forward end of control to D334 bellcrank assembly.
8. Pull center wire out of conduit.
9. Remove B270-5 sealant surrounding conduit at vertical firewall. Remove screws securing conduit to keel panel and airbox.
10. Remove outer conduit.

**6.740 Carburetor Heat Assist (Cont'd)****6.742 Carburetor Heat Control Cable Installation**

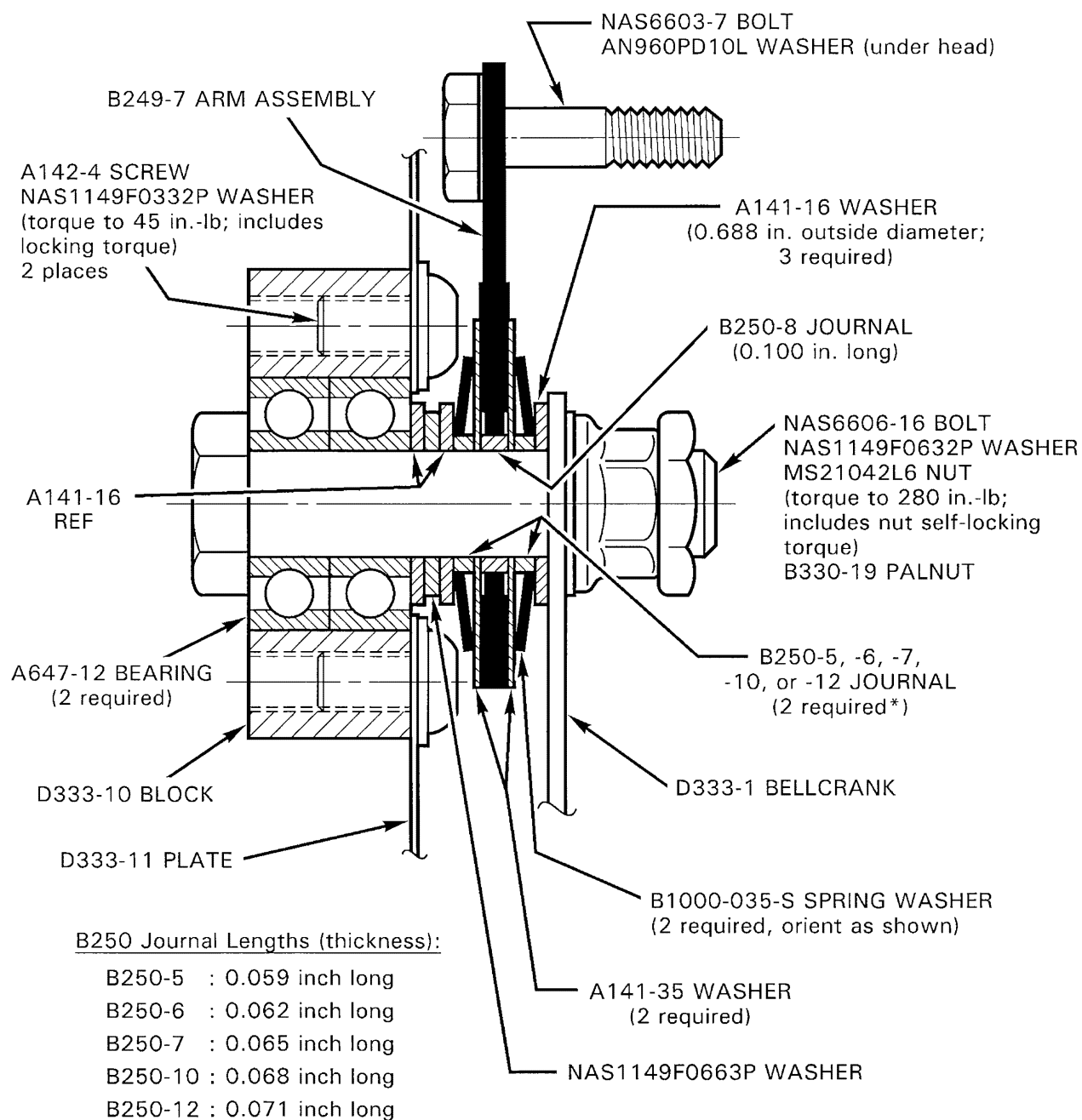
1. Pull inner wire from new control. Route and secure conduit along keel panel, thru vertical firewall, and into air box with retained hardware.
2. Replace B270-5 sealant around cable at firewall pass-through.
3. Lubricate inner wire with A257-1 grease, insert into conduit. Connect forward end to bellcrank, install washer, and temporarily install cotter pin.
4. Secure cyclic cover in place, install collar and knob on stem. Verify 0.10 to 0.25 inch clearance between fitting on inner wire and forward end of conduit with control knob fully down. Reposition conduit as required.
5. Verify aft end of conduit has 0.00 to 0.15 inch protrusion into air box. As required, remove inner wire and trim conduit. Install inner wire, connect forward end to D334 bellcrank, install washer and secure with cotter pin.
6. Connect inner wire thru fitting(s) in carb heat slider valve. With knob fully down and slider valve fully aft, trim inner wire 0.10 to 0.03 inch beyond aft edge of fitting. Torque nuts on fittings per Section 1.330. Torque stripe per Figure 2-1.
7. Install air filter, close cover, and secure. Tighten four long bolts only enough to secure cover and eliminate looseness, then torque stripe. On R22 Mariners, seal air box cover perimeter with aluminum tape. If installed, verify spring-loaded alternate air door fully closes when released.

**6.743 D334-5 Carburetor Heat Assist Bellcrank Assembly Removal**

1. Remove belly panel and horizontal panel between seats.
2. Disconnect carburetor heat assist control inner wire from bellcrank.
3. Disconnect carb heat assist push-pull tube from B249 arm assembly. Remove six screws securing bellcrank assembly to keel panel and B368 stiffener.
4. Remove bellcrank assembly.

**6.744 D334-5 Carburetor Heat Assist Bellcrank Assembly Installation**

1. Position bellcrank assembly against, and with bearing block protruding thru, right keel panel.
2. Secure plate to keel panel with screws.
3. Install A142 screws thru stiffener into bearing block. Torque to 45 in.-lb and torque stripe.
4. Attach A336 push-pull tube to B249 arm assembly and torque bolt per Section 1.320. Install palnut, torque per Section 1.320 and torque stripe per Figure 2-1.
5. Lubricate D333-3 fitting at forward end of carb heat control with A257-1 grease and secure to bellcrank with washer and cotter pin.



\*Install B250-5, -6, -7, -10, or -12 journals as required to produce a rotational friction of 10-12 inch-pounds. Journal dash numbers may be mixed. Measure rotational friction by clamping long side of D333-11 plate in padded vise w/B249-7 arm assembly against vice jaws and rotating bolt head with dial-indicating torque wrench.

**FIGURE 6-8 D334 BELLCRANK ASSEMBLY**  
**CARB HEAT ASSIST FRICTION ADJUSTMENT**  
(View looking aft)

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6.745 D334-5 Bellcrank Friction Adjustment (Refer to Figure 6-8)

NOTE
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Verify bolt head between arm and plate.
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1. Measure rotational friction per Figure 6-8.
2. Adjust friction as required by exchanging B250 journals per Figure 6-8 (dash numbers may be mixed). Decreasing journal thickness increases friction. Torque NAS6606 bolt per Figure 6-8.
3. Install palnut, torque per Section 1.320, and torque stripe per Figure 2-1.

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