

## CHAPTER 6

### POWERPLANT

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## CHAPTER 6

### POWERPLANT

#### 6.000 Powerplant and Related Systems

##### 6.001 Introduction

This section includes instructions for the removal and installation of engine, induction system, lubrication system, cooling system and exhaust system. Refer to engine and engine component manufacturers' maintenance publications for product specific inspection, repair, and maintenance procedures.

##### 6.002 Description

R44 helicopters are powered by one Textron-Lycoming O-540-F1B5 six-cylinder, horizontally opposed, overhead-valve, air-cooled, carbureted engine with a wet sump oil system normally rated at 260 horsepower and 2800 rpm for takeoff. The engine is derated to 205 maximum continuous horsepower (MCP), with a 5-minute takeoff power rating of 225 horsepower, by limiting manifold pressure (see Pilot's Operating Handbook) and RPM. At 102% tachometer indication the engine is actually turning 2718 RPM.

R44 induction air enters through a screened opening on the right side of the aircraft and passes through a flexible duct to the carburetor-mounted air box assembly. A scoop mounted to the exhaust manifold passes heated air via a duct to the air box. A cable-operated sliding valve in the air box controlled by the pilot allows either cool or warm air to flow into the box, through the radial-flow air filter and up into the carburetor. On R44 S/N 0202 and subsequent, application of carburetor heat is correlated with changes in collective setting through a friction clutch to reduce pilot workload. Lowering collective mechanically adds carb heat and raising collective reduces carb heat. The pilot may override the friction clutch and increase or decrease carb heat as desired. A latch is provided at the control knob to lock carb heat off when not required.

R44 II helicopters are powered by one Textron-Lycoming IO-540-AE1A5 six-cylinder, horizontally opposed, overhead-valve, air-cooled, wet-sump oil system, fuel-injected engine capable of 300 horsepower and normally rated at 260 horsepower and 2800 rpm for takeoff. The engine is derated to 205 horsepower MCP, with a 5-minute takeoff power rating of 245 horsepower, by limiting manifold pressure (see Pilot's Operating Handbook) and RPM. At 102% tachometer indication the engine is actually turning 2718 RPM.

R44 II induction air enters through a screened opening on the right side of the aircraft and passes through a radial-flow filter within an air box. The air then passes through a flexible duct, through the fuel control and into the engine. A spring-loaded door on top of the air box automatically opens to supply sheltered engine compartment air should filter or intake screen blockage occur.

Cooling is supplied by a direct-drive, centrifugal fanwheel enclosed by a fiberglass scroll. The scroll directs cooling air to the drive belts and, via flexible ducts, to the muffler, the main rotor gearbox, the hydraulic reservoir, and engine-mounted sheet-metal cooling panels. The cooling panels also direct cooling air to the drive belts, and further guide cooling air to the cylinders, external oil cooler (two on R44 II), alternator, magnetos, fuel flow divider (fuel injected engines), and battery cooling hose (when battery is mounted in engine compartment).

A sheave bolted to the propeller flange transfers engine power to the clutch assembly via four double v-belts engaged by a vertically mounted electric belt tension actuator.

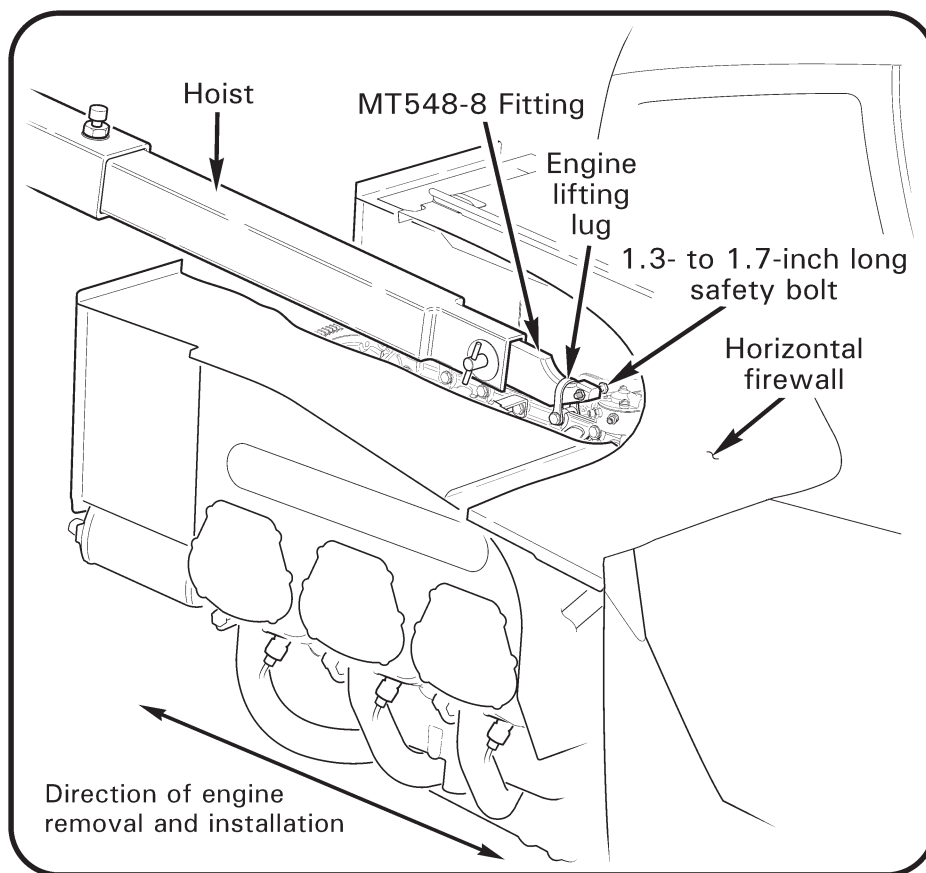


FIGURE 6-1 ENGINE HOISTING

## 6.100 Powerplant

### NOTE

Refer to the appropriate engine and ignition manufacturers' maintenance publications for specific instructions.

## 6.110 Engine Removal

1. Defuel helicopter per § 1.150.
2. Remove tailcone cowling and all engine cowling.
3. Remove tailcone per § 4.300.
4. Remove fanwheel and scroll assembly per § 6.210.
5. Remove clutch assembly, belt tension actuator, and V-belts per §§ 7.200, 7.510, & 7.281.
6. Disconnect engine breather tube or (air/oil) separator assembly at hose attached to engine by removing clamp. Cap exposed connections.
7. Remove carburetor per § 6.410 or remove fuel control per § 6.490, as applicable.

**6.110 Engine Removal (continued)**

8. Disconnect manifold pressure line from the forward left cylinder (O-540) or intake manifold (IO-540) and cap exposed connections.
9. Disconnect oil pressure hose and cap exposed connections.
10. **O-540:** If installed, disconnect primer line at T-fitting on engine and cap exposed connections.
11. Disconnect airframe and battery ground straps from engine oil sump bolts.
12. Tag for identification and disconnect alternator wiring, starter wiring, magneto-to-airframe wiring, cylinder head temperature sender wire and oil temperature sender wire.
13. Disconnect cabin heater duct from muffler shroud.
14. Support engine at bottom of lower sheave with a floor jack using a wood or rubber block between jack & sheave to protect sheave.
15. Remove (2) bolts and associated hardware securing C174-1 or -7 engine support weldment's rod ends to C020 upper frame. Remove (2) lower bolts and associated hardware at bottom of support weldment and remove weldment.

**NOTE**

Avoid disconnecting rod ends from support assembly unless required. Dimensions shown in Figure 6-2 must be maintained.

16. Refer to Figure 6-1. Verify lifting lug condition and security. Support engine at lifting lug using MT548-8 fitting with a hoist. Insert a 1.3- to 1.7-inch long bolt thru end of MT548-8 fitting for added security.
17. Disconnect and remove two forward engine-mounting bolts.
18. Remove right, aft vertical strut weldment connecting lower right frame to upper frame.
19. Remove floor jack supporting engine at sheave and pull hoist & engine aft to remove from helicopter.

**CAUTION**

To prevent damage, have a person assist on each side of engine during removal.

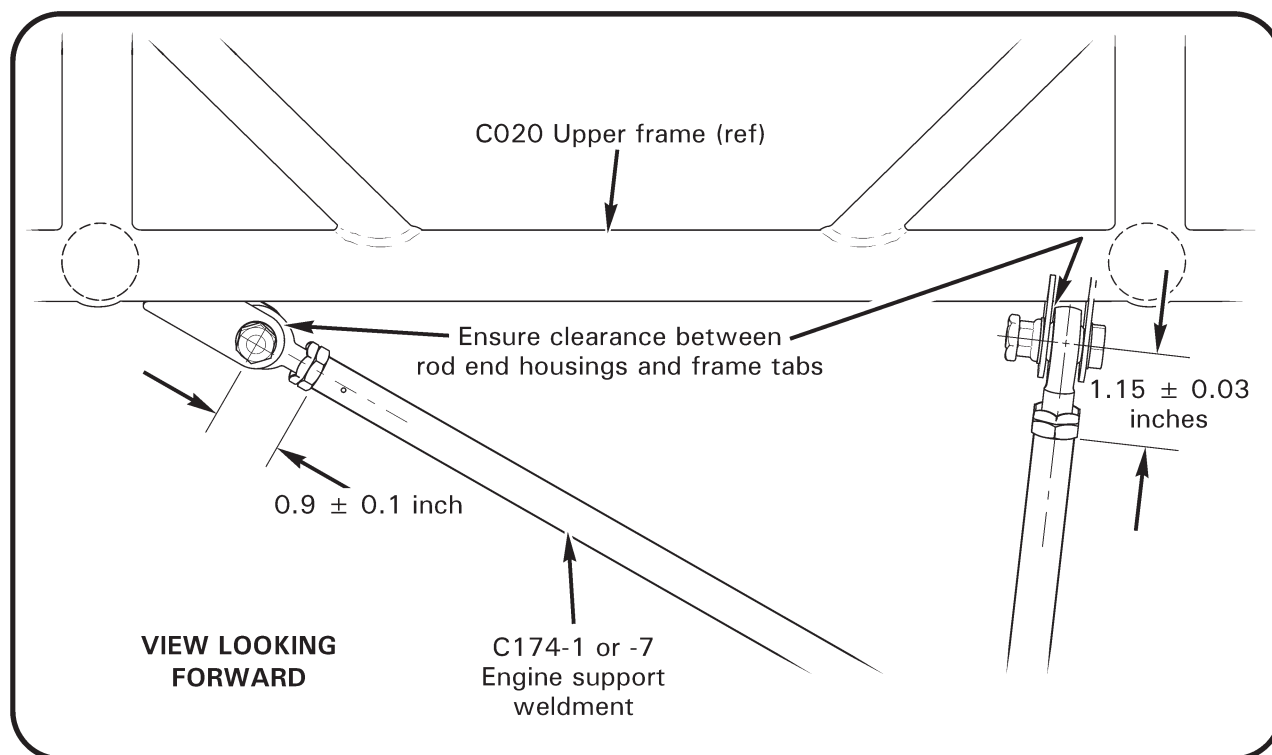


FIGURE 6-2 ENGINE SUPPORT WELDMENT

### 6.120 Engine Installation

#### NOTE

Inspect rod ends of C174-1 or -7 engine support weldment per § 2.122 prior to engine installation. Verify dimensions shown in Figure 6-2.

1. If not previously accomplished, install C592-3 mount assembly or C174-11 plate weldment and hardware on crankcase prop-governor pad. Special torque nuts per § 23-33 and torque stripe per Figure 2-1.
2. If not previously accomplished, install C593-3 (helicopter-forward) mount assemblies & hardware on crankcase. Special torque screws per § 23-33 and safety using 0.032-inch wire.
3. If applicable, install C592-4 mount assembly & hardware on C174-7 support weldment with rubber larger-diameter toward threads. Align holes in block perpendicular to flats on weldment. Special torque D210-8 nut per § 23-33 and torque stripe per Figure 2-1.
4. Refer to Figure 6-1. Connect MT548-8 fitting to engine lifting lug and insert safety bolt. Carefully hoist engine and into alignment with lower frame's mounting pads.
5. Install right, aft vertical strut weldment connecting lower right frame to upper frame. Standard torque hardware per § 23-32 and torque stripe per Figure 2-1.

**6.120 Engine Installation (continued)**

6. Install two forward engine-mounting bolts. Standard torque hardware per § 23-32 and torque stripe per Figure 2-1.
7. Support weight of engine at bottom of lower sheave with a floor jack using a wood or rubber block between jack & sheave to protect sheave. Remove hoist.
8. Install (2) bolts and associated hardware securing C174-1 or -7 aft support weldment rod ends to C020 upper frame. Install (2) lower bolts and associated hardware securing support weldment to engine. Standard torque bolts per § 23-32. Standard torque palnuts per § 23-32 and torque stripe per Figure 2-1.
9. Remove support from lower sheave.
10. **O-540:** Install carburetor per § 6.440.  
**IO-540:** Install fuel control per § 6.495.
11. Adjust throttle correlation rigging per § 10.150.
12. Connect cabin heater duct to muffler shroud.
13. Connect airframe and battery grounding straps to engine oil sump bolts and special torque per § 23-33.
14. Connect alternator wiring, starter wiring, both magneto-to-airframe wiring, cylinder head temperature sender wire and oil temperature sender wire. Ty-rap as required.
15. Connect engine breather tube or (air/oil) separator assembly at hose attached to engine.
16. **O-540:** If installed, connect D102-4 primer line to T-fitting on engine. Special torque primer line nut per § 23-33.  
**IO-540:** Connect fuel hose to engine-driven fuel pump inlet and connect fuel return hose to fuel control inlet T-fitting. Special torque per § 23-33.
17. Connect oil pressure hose.
18. Connect manifold pressure line.
19. Install fuel injection air box per § 6.480, if applicable.
20. Install V-belts, belt tension actuator, and clutch assembly per §§ 7.282, 7.520, and 7.220.
21. Install fanwheel per § 6.220.
22. Install tailcone per § 4.312.
23. Install all engine cowlings and tailcone cowlings.

### 6.130 Engine (Rubber) Mount Replacement

1. As required, remove engine per § 6.110.
2. Cut & discard safety wire and remove bolts securing forward C593-3 mount assemblies.
3. Remove bolts securing C592-4 mount assembly to C174-11 plate weldment, or remove nuts securing C592-3 mount assembly to engine, as required.
4. Press out & discard old C653-1 or -2 (rubber) mount from C592-1 mount, C592-5 block, or C593-4 block.
5. Clean C592-1 mount, C592-5 block, or C593-4 block using § 23-72 approved solvent.
6. Refer to Figure 6-2A. Apply a light coat of A257-8 rubber lubricant or clean, potable water to new C653-1 or -2 mount at rubber smaller-diameter and press into C592-1 mount, C592-5 block, or C593-4 block. Wipe off excess lubricant or water.

#### NOTE

C174-1 support weldment & C592-3 mount assembly may be replaced by C174-7 support weldment & C174-11 plate weldment & C592-4 mount assembly.

7. Remove old gasket & debris and clean mating surface of engine. Install new 72053 gasket & C592-3 mount assembly (or C174-11 plate weldment). Special torque nuts per § 23-33 and torque stripe per Figure 2-1.
8. As required, install hardware securing (aft) C592-4 mount assembly. Standard torque bolts per § 23-32 and torque stripe per Figure 2-1.
9. Install hardware securing (forward) C593-3 mount assemblies. Special torque bolts per § 23-33 and safety wire bolts using 0.032-inch diameter lockwire.
10. Install engine per § 6.120, if required.

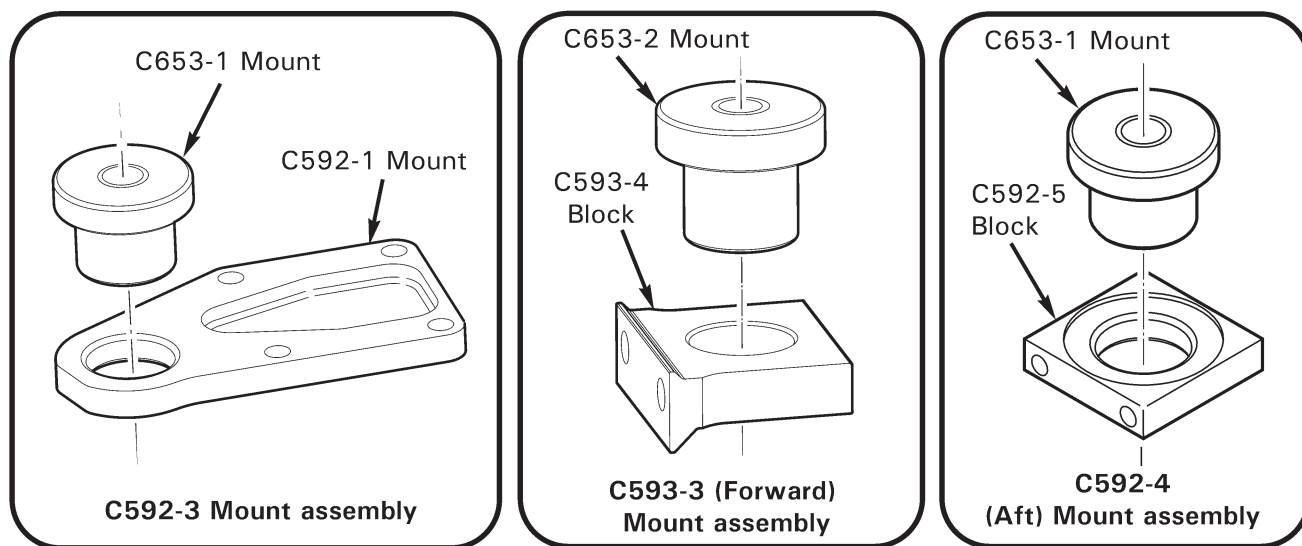


FIGURE 6-2A ENGINE MOUNT REPLACEMENT



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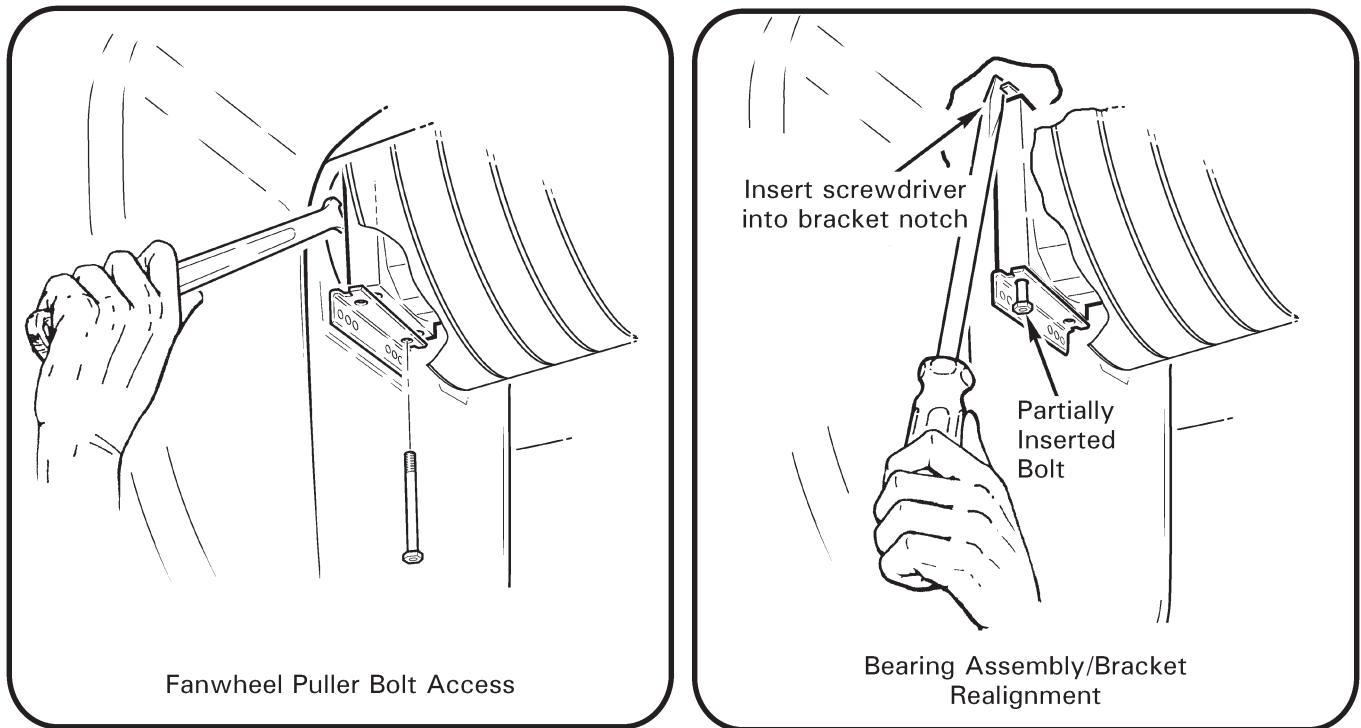


FIGURE 6-3 FANWHEEL HUB BOLT ACCESS

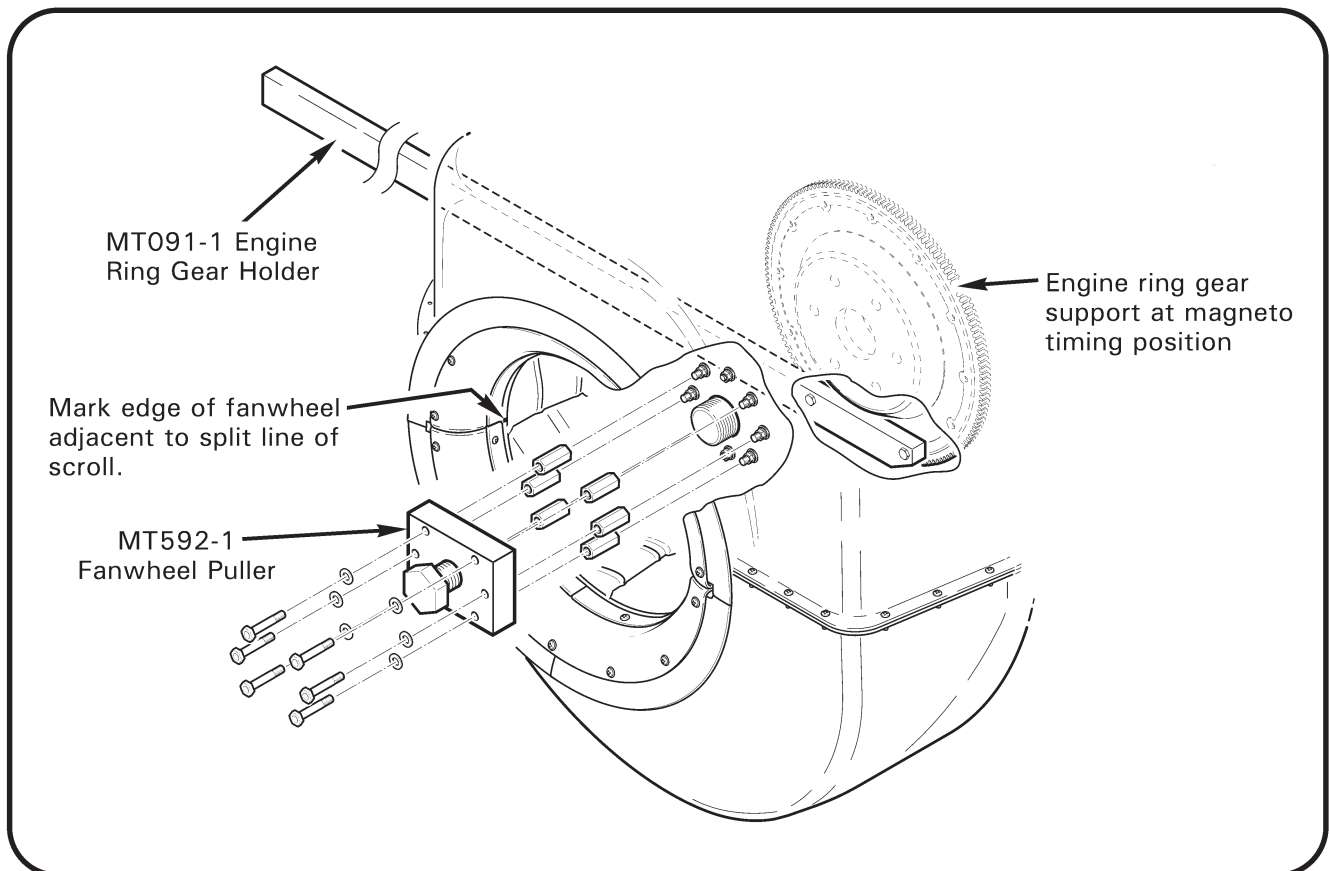


FIGURE 6-4 FANWHEEL PULLER INSTALLATION

## 6.200 Cooling System

### 6.210 Fanwheel and Scroll Removal

#### NOTE

If same fanwheel will 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 6-4.

1. Ensure clutch is fully disengaged. Pull open CLUTCH START circuit breaker and turn battery switch off.
2. Remove engine aft cowl.
3. Remove cooling hoses from lower and upper halves of scroll.
4. Disconnect tail pipe straps from lower scroll. Note shim stack on mounting screws.
5. If installed, disconnect air conditioning condenser from lower scroll and temporarily secure it to a frame.
6. Remove two vertical bolts attaching scroll to C181-3 bearing.
7. Cut safety wire and remove roll pin securing fanwheel retaining nut. Remove retaining nut. Remove washers. Install retaining nut 3 full revolutions (to prevent scroll & unseated fanwheel from dropping).

#### NOTE

An air- or electric-impact wrench may be used only to remove nut.

8. Install MT092-3 spacers directly on each of 6 long B660-1 bolts (if installed; nuts remain in place). Alternately, use a half-inch open-end wrench to hold fanwheel hub bolt heads and remove 6 of 8 nuts & washers (see Figure 6-3) and replace nuts with MT092-3 spacers.
9. Back out MT592-1 fanwheel puller's center bolt, lubricate bolt tip & threads with A257-9 anti-seize, and attach puller to the MT092-3 spacers (see Figure 6-4).

#### NOTE

Fanwheel may come off tapered shaft with a loud pop.

10. An air- or electric-impact wrench may be used to tighten fanwheel puller's center bolt & unseat fanwheel. Alternately, securely attach MT091-1 starter ring gear holding tool and immobilize tool so ring gear remains stationary (see Figure 6-4).
11. Tighten fanwheel puller's large center bolt against fanshaft until fanwheel is unseated.
12. Remove fanwheel puller. Remove fanwheel retaining nut, fanwheel, and scroll.
13. If removed, reinstall nuts & washers on fanwheel hub bolts and special torque nuts per § 23-33.

### 6.220 Fanwheel and Scroll Installation

1. Evaluate drive belts, alternator belt, and C181 bearing condition; replace as required. Clean tapered shaft and fanwheel hub mating surfaces with solvent and dry. Inspect shaft and hub for damage; replace as required.
2. As required, repair scroll per R44 Service Letter SL-61A. Place scroll upper half on fanwheel and install fanwheel on tapered shaft. Secure scroll upper half to engine cooling panels.
3. Using A257-9 anti-seize, coat threaded portion only of C007 shaft and clamping surfaces of MS20002-24 washer, NAS1149F2432P washers (use as many as will fit), and castellated nut. Install hardware with MS20002-24 washer against hub.

#### NOTE

If installing original fanwheel, ensure starter ring gear support is at magneto timing position and align marks on fanwheel with scroll split line.

4. Secure MT091-1 ring gear holding tool to engine ring gear support and hold stationary. Special torque C182-1 nut per § 23-33 until slot in castellated nut aligns with hole in fanshaft, but do not install spring pin.

#### NOTE

If slot in castellated nut does not align with hole in fanshaft throughout torque range, remove or add NAS1149F2432P washers under nut.

5. Position lower scroll and insert two AN3-41A bolts through bearing mounting bracket, actuator bearing block, and bearing mounting bracket nut plates on upper scroll. If required, align upper mount bracket nutplate by inserting a screwdriver into notch in bracket. Standard torque bolts per § 23-32 and torque stripe.
6. Install screws, washers, and nuts around scroll perimeter.
7. Verify D229 lip-to-fanwheel inlet clearance is 0.010–0.090 inch. If necessary, adjust lip clearance by elongating lip mounting holes.
8. Connect tail pipe to C173 straps. See § 6.520 for shimming requirements.
9. Connect muffler and MRGB cooling hoses to scroll. Ensure MRGB cooling hoses cross and clear tail rotor push-pull tube thru full range of travel.
10. If applicable, install air conditioning condenser and condenser heat shield on lower scroll.
11. Balance fanwheel per § 6.240.

#### CAUTION

Fanwheel balance must be checked upon installation; fanwheel imbalance can cause damage.

### 6.230 (Reserved)

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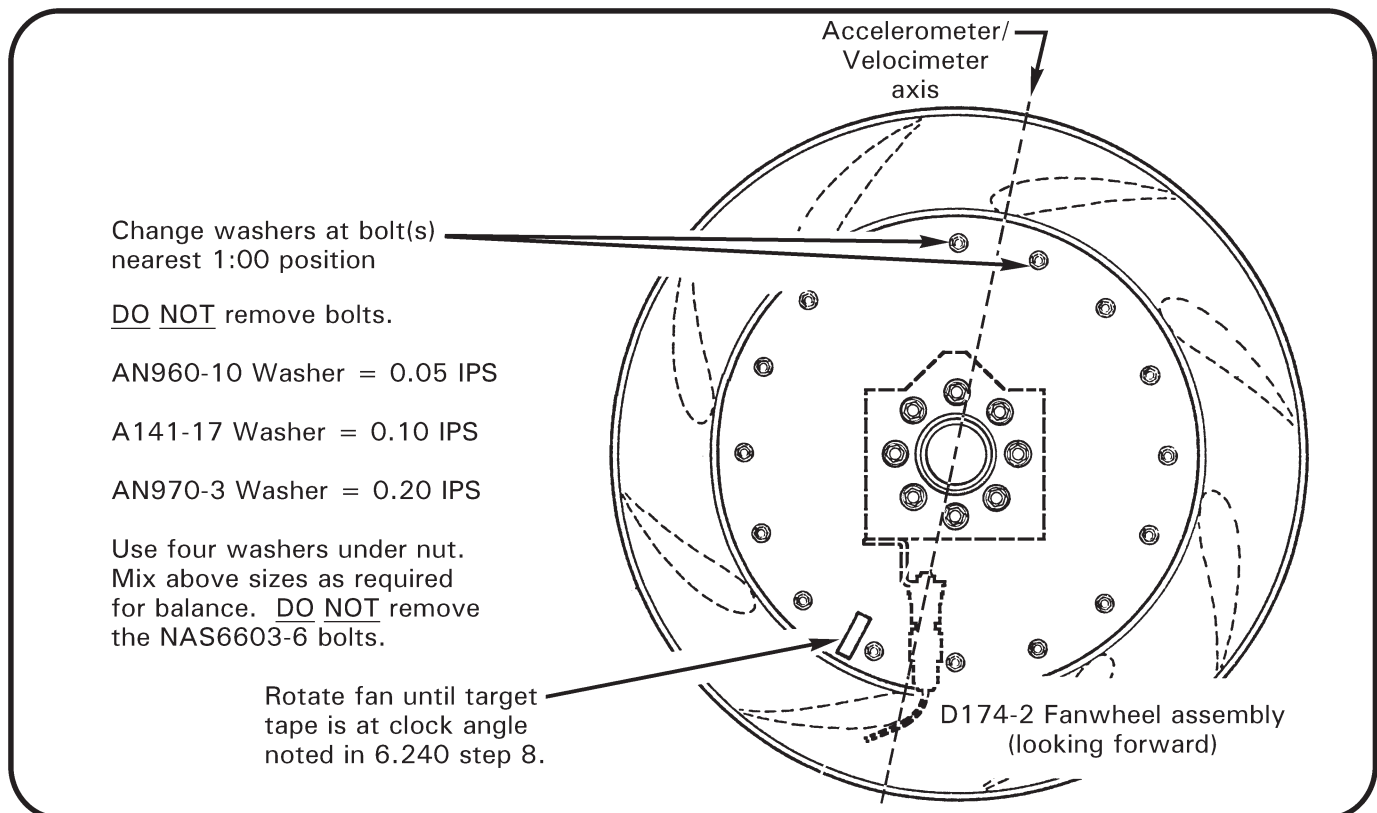
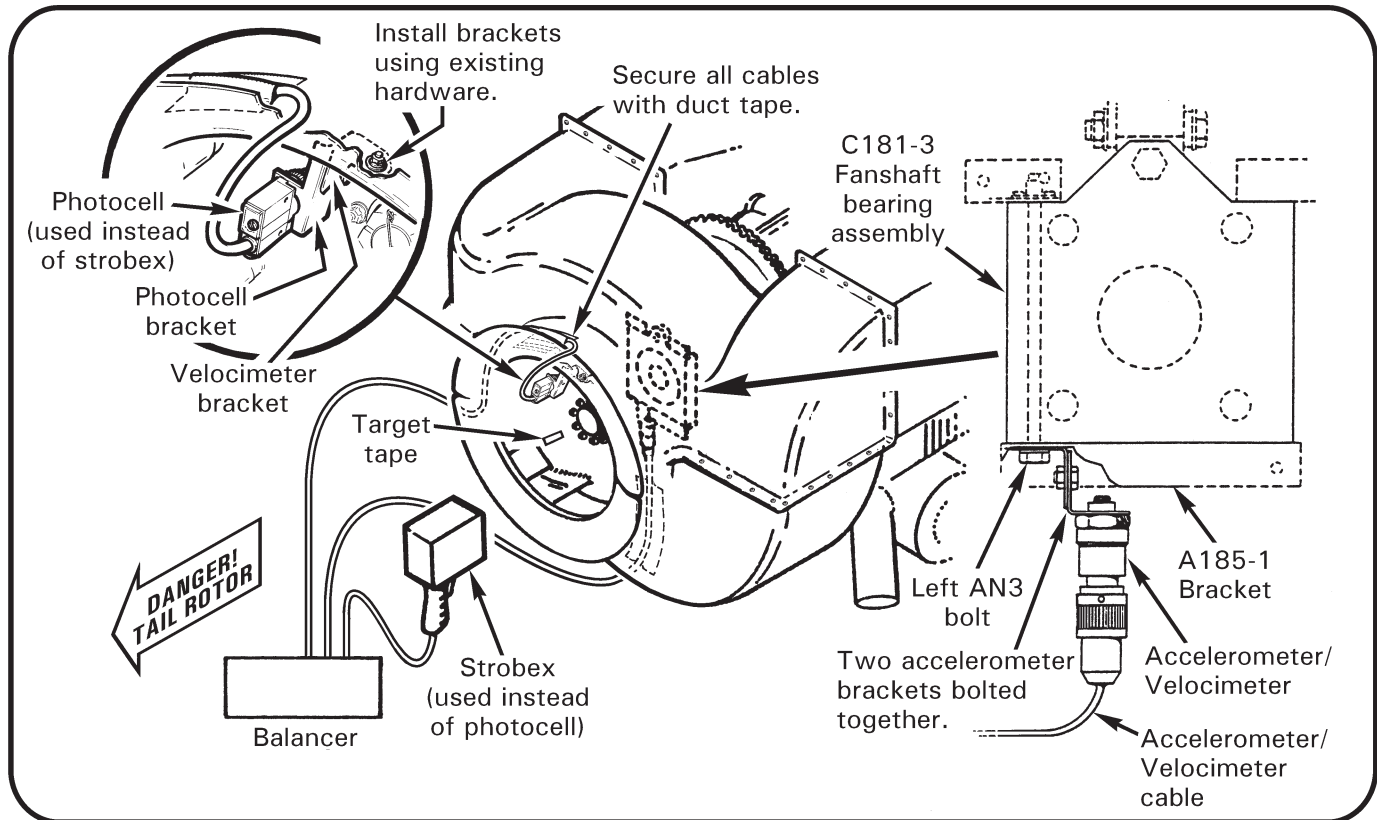


FIGURE 6-5 FAN BALANCING

6.240 Fan Dynamic Balance**NOTE**

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

1. Remove engine aft cowl.
2. Install accelerometer wire on fanshaft bearing per Figure 6-5. Accelerometer should be pointed down. A suitable bracket may be assembled from two accelerometer brackets or may be fabricated.
3. Place a target tape at edge of one fan vane (see Figure 6-5).
4. Set Strobex mode to position B. Set Balance Box RPM range to X10 scale. Set Balance Box RPM dial to 270.
5. Start engine and run helicopter at 102% RPM with rotor system engaged and governor on.

**WARNING**

Use extreme care near tail rotor.

6. Point Strobex at fanshaft nut and pull trigger. Note clock angle of target tape.
7. Push Tune button on Balance Box. Note change (if any) in clock angle of target tape. While pushing Tune button, adjust RPM dial to bring the target tape back to the clock angle viewed in Step 6. Balance Box is tuned to fan RPM if there is no change in target tape clock angle when Tune button pushed and released.
8. Note clock angle of target tape when Balance Box is tuned.
9. Note vibration reading on IPS meter.
10. Shut engine down.

**CAUTION**

Ensure ignition switch is off and keys are out of switch whenever fanwheel is moved by hand.

11. After first run-up, secure MT091-1 ring gear holding tool to engine ring gear support and hold stationary. Special torque C182-1 nut per Section 1.330 until spring pin can be installed in shaft. Install spring pin and safety with 0.041-inch diameter stainless steel wire.

**NOTE**

If spring pin cannot be installed within C182-1 nut's torque range, remove or add NAS1149F2432P washers under nut. Large pliers may be used to squeeze spring pin into position.

### 6.240 Fan Dynamic Balance (continued)

12. If balance reading is over 0.2 IPS, washers must be exchanged to balance cooling fan. Rotate fanwheel until target tape is in position noted in Step 8. Change AN960-10, A141-17, or AN970-3 washers under nut nearest to the 1:00 position or split required weight change under two nearest nuts (see Figure 6-5). One AN960-10 washer will change balance reading approximately 0.05 IPS. One A141-17 washer equals two AN960-10 washers. One AN970-3 washer equals four AN960-10 washers. Four washers are required under each nut. To access bolt head, remove D229-4 cover on forward side of lower scroll and rotate fan as required. Do not remove the NAS6603-6 bolts or the NAS1149F0316P washers may be dislodged (see Figure 6-5). Torque NAS6603-6 bolt and MS21042L3 nut per Section 1.330. Install D229-4 cover on lower scroll.
13. After washers have been installed, check fan balance reading. Exchange washers until a reading of less than 0.2 IPS is obtained.
14. Remove accelerometer and attaching brackets.
15. Refer to Figure 2-11. Mark fanwheel with torque stripe directly opposite, and aligned with, each end of roll pin.
16. Install engine aft cowling.

### 6.300 Lubrication System

#### **NOTE**

See Section 1 for grade and quantity of oil required. Refer to Lycoming Operator's Manual for adjustment and maintenance of lubrication system.

### 6.310 Oil Cooler Removal

1. Remove right engine side panel and aft engine cowling.
2. Disconnect the oil lines at the cooler.
3. Remove two screws and nuts holding C636-1 support to cooling shroud.
4. Disconnect mounting bolts and remove oil cooler and support.

### 6.320 Oil Cooler Installation

1. Install MS20822-8 elbows, if required, using B270-6 sealant and torque to 110 in.-lb plus torque required to align elbows.
2. Install oil cooler and C636-1 Support to engine cooling shroud using four mounting bolts. Torque bolts per Section 1.320.
3. Install two screws and nuts that fasten support to cooling shroud. Torque nuts to 15 in.-lb plus nut drag.
4. Reconnect oil lines and torque tubing nuts per Section 1.330.
5. Install cowling.



### 6.400 Induction System

#### 6.410 Carburetor Removal

1. Remove right engine side panel.
2. Turn off fuel valve and disconnect fuel line at carburetor. Cap fuel line and carburetor inlet port.
3. Disconnect air intake and carburetor heat ducts from air box.
4. Disconnect throttle linkage from throttle arm, mixture control cable from carburetor and carburetor heat control cable from air box and slider valve.
5. Disconnect carburetor air temperature probe at quick-disconnect plug located approximately four inches from probe.
6. Remove palnuts and nuts securing carburetor to oil sump and remove carburetor and air box assembly.

#### 6.420 Carburetor Air Box Removal

1. Remove four long bolts securing air filter cover. Open cover and remove air filter.
2. Clip safety wire securing four air box-to-carburetor attach bolts and remove bolts, air box and gasket.

#### 6.430 Carburetor Air Box Installation

1. Install air box and gasket to carburetor with four attach bolts.
2. Torque four attach bolts per Section 1.330 and safety with 0.032 inch safety wire.
3. Reinstall air filter, close cover and secure with four long bolts.

#### **NOTE**

Tighten nuts on long attach bolts until 2-4 threads protrude through nut and cover is uniformly sealed. Overtightening of nuts can cause distortion of cover and leakage of air box seal.

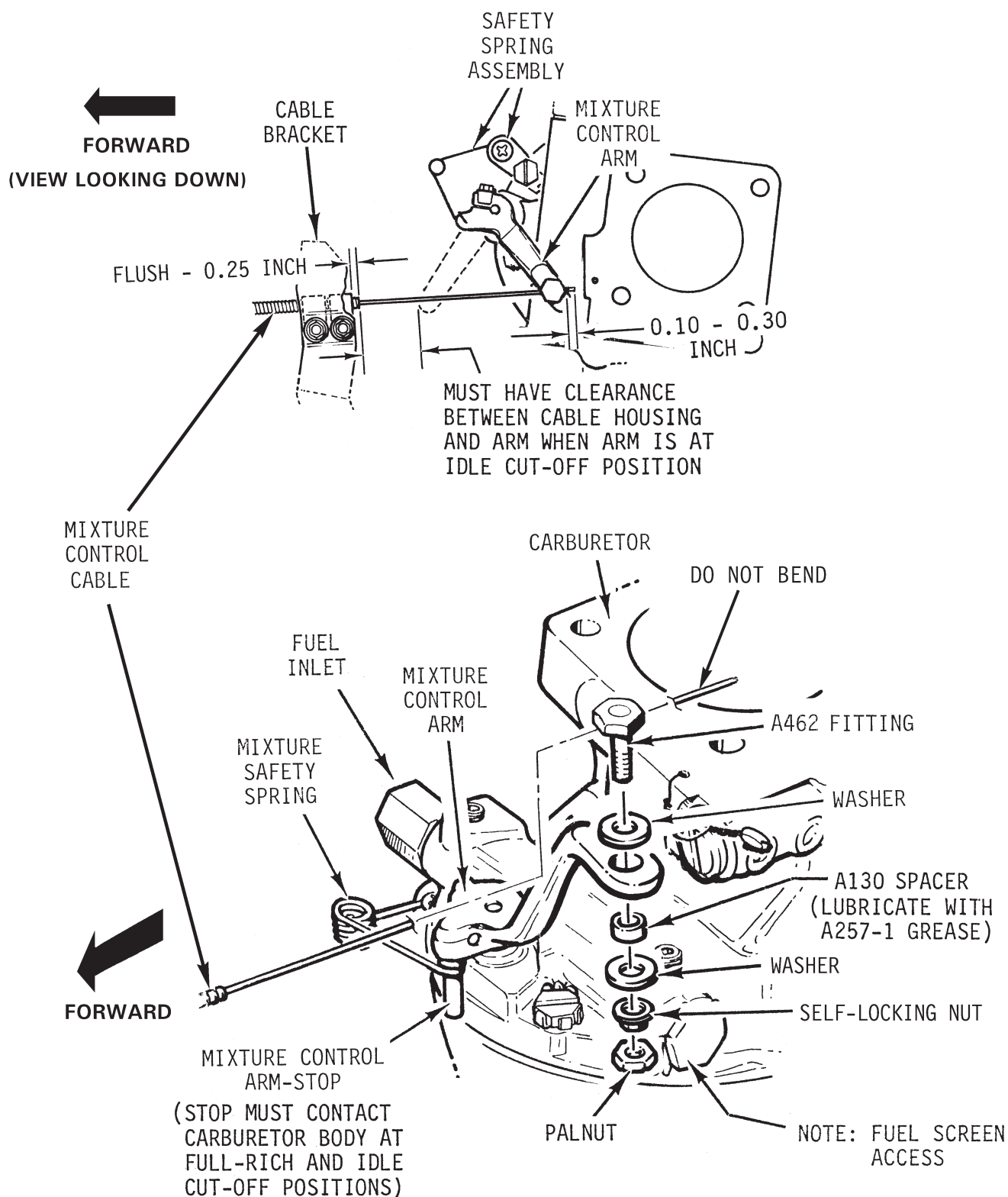


FIGURE 6-6 O-540 MIXTURE CONTROL INSTALLATION

#### 6.440 Carburetor Installation

1. Install air box per Section 6.430.
2. Using new gasket, install carburetor on oil sump mounting studs with throttle arm to ship's left. Torque mounting nuts per Section 1.330 and install palnuts.
3. Connect throttle linkage to throttle arm. Adjust throttle correlation rigging per Section 10.150 and torque per Section 1.320.
4. Connect mixture control cable to carburetor (see Figure 6-6) and carb heat control to air box slider valve. Rig each control for 0.03-0.10 inch clearance under knobs when fully depressed. Verify full travel of mixture arm and carburetor heat slider valve.
5. Connect carburetor air temperature probe and secure connector to carburetor with ty-rap.
6. Connect fuel hose to carburetor and torque per Section 1.330.
7. Connect air intake and carburetor heat hoses to air box.
8. Install engine cowling(s).
9. Comply with Section 2.210, steps 15 & 16.

#### 6.450 Carburetor Heat Scoop Removal

1. Remove engine right cowling.
2. Disconnect hose from air box to carb heat scoop.
3. Loosen clamps and remove scoop.

#### 6.460 Carburetor Heat Scoop Installation

1. Position scoop on exhaust manifold and tighten mounting clamps.
2. Connect hose from air box to scoop.
3. Inspect scoop for 0.1-inch minimum clearance in all directions; adjust as required. Torque mounting clamp screws per Section 1.320.
4. Install engine cowling.

#### 6.470 Fuel Injection Air Box Removal

1. Remove engine right cowling.
2. Remove air intake hose.
3. Cover fuel control air intake.
4. Remove four screws and large area washers atop of, and securing air box to, horizontal firewall.
5. Remove air box.

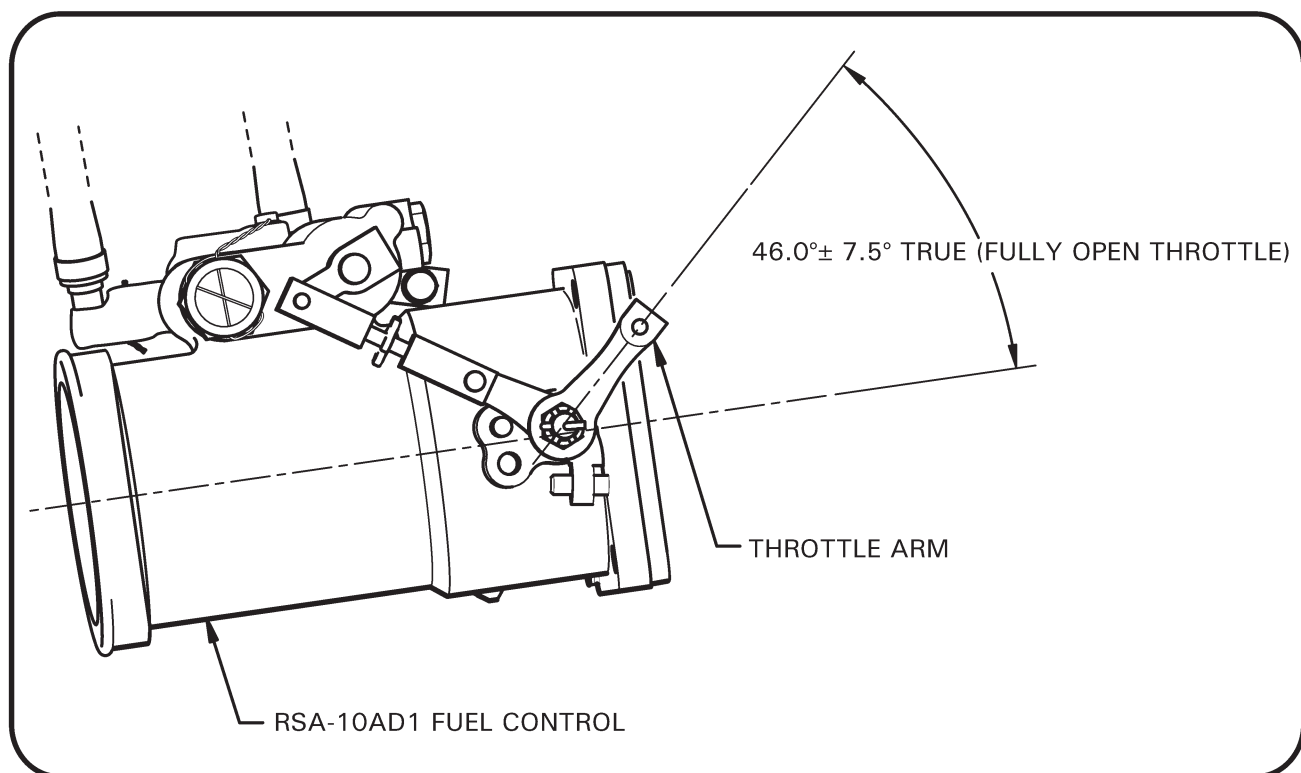


FIGURE 6-7 IO-540 THROTTLE ARM ADJUSTMENT

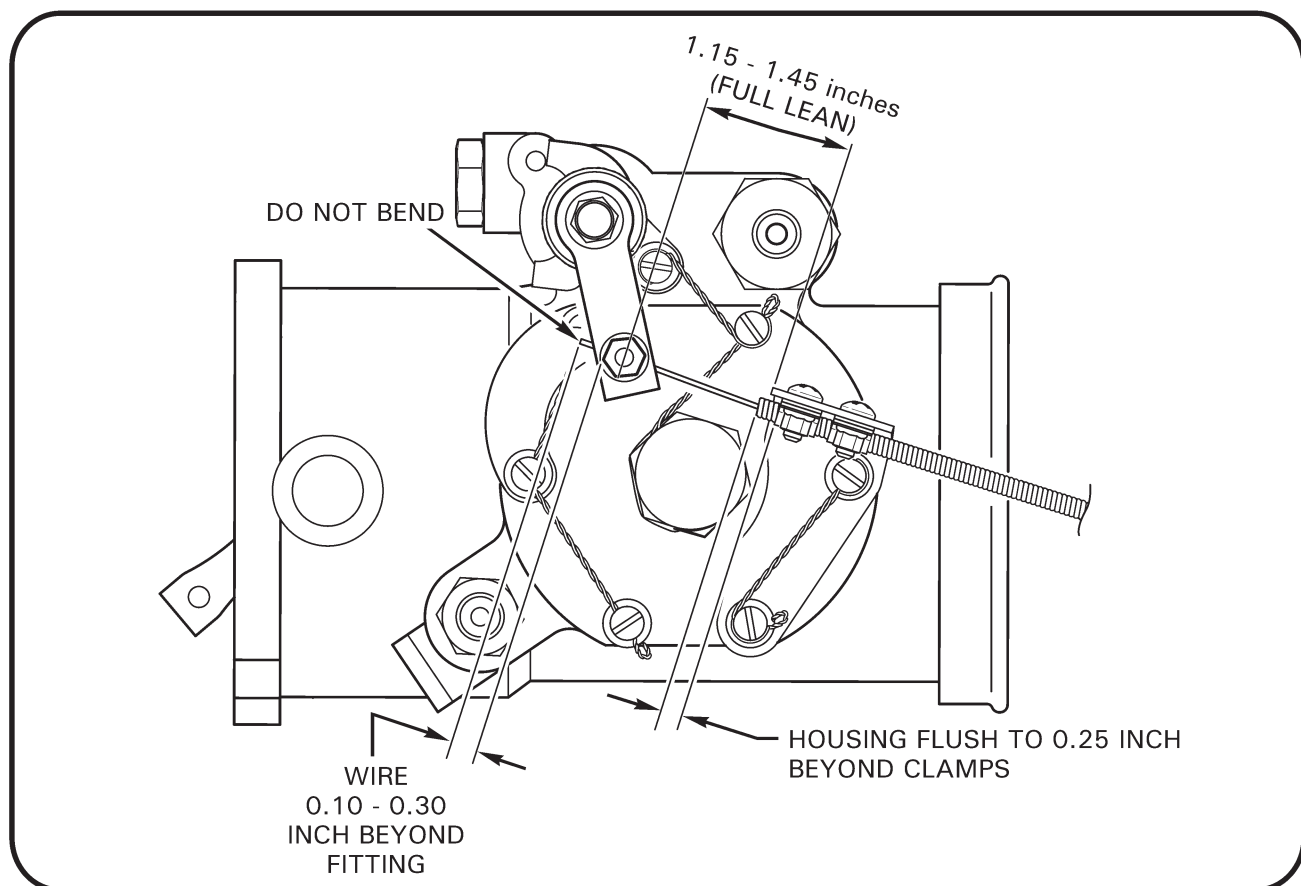


FIGURE 6-8 IO-540 MIXTURE CABLE INSTALLATION

#### 6.480 Fuel Injection Air Box Installation

1. With intake pointing outboard, position air box below forward, right side of horizontal firewall and secure to firewall with four screws.
2. Remove fuel control air intake protective cover, if installed, and install air intake hose between air box and fuel control.
3. Verify clearance between air box, intake hose and adjacent components; adjust component position as required for clearance.
4. Install engine cowling.

#### 6.490 Fuel Control Removal

1. Turn fuel shut-off valve off.
2. Remove right cowling.
3. Remove A785-31 air intake hose.
4. Disconnect A457-9 tee from 2577202 fitting and cap fuel openings.
5. Disconnect B283-7 hose from fuel control outlet and cap fuel openings.
6. Remove NAS6603-13 bolt and associated hardware securing A336-6 or -9 push-pull tube to D731-9 bellcrank assembly.
7. Loosen (2) MS27039C1-07 screws and A462-4 fitting securing A522-13 mixture control cable to fuel control.
8. Loosen lower, aft bolt securing fuel control to intake manifold. Remove three remaining bolts and associated hardware securing D731-9 bellcrank assembly & fuel control to D730-1 intake manifold and remove fuel control.
9. Remove old gasket from intake manifold inlet. Cover inlet if not immediately replacing fuel control.
10. If replacing fuel control, compare fittings on removed fuel control with replacement fuel control. Transfer fittings as required and special torque per § 23-33.

#### 6.495 Fuel Control Installation

1. Compare hardware on removed fuel control with replacement fuel control. Transfer hardware as required.
2. Remove temporary shipping safety wire from mixture and throttle arms.
3. Verify correct full-open throttle arm angle per Figure 6-7 and full-lean mixture arm distance per Figure 6-8; adjust as required. Install D930-1 mixture safety spring.
4. Remove protective caps from fuel inlet and outlet. Drain all fluid.

6.495 Fuel Control Installation (continued)

5. Inspect D730-1 intake weldment; verify no cracks and no obstructions. Using new gasket and with fuel inlet pointing aft, install fuel control and D731-9 bellcrank assembly on flange of intake manifold weldment.
6. Connect fuel inlet tee to fuel control inlet. Special torque per § 23-33 and torque stripe per Figure 2-1.
7. Connect throttle push-pull tube. Verify full travel (collective must be raised slightly to achieve full-open throttle).
8. Refer to Figure 6-8. Connect mixture cable housing to bracket with housing flush-to-0.25 inch extended beyond clamps. Lubricate A130 spacer with A257-1 grease and connect mixture control cable inner wire to mixture control arm. Verify full travel and 0.03-0.10 inch clearance under mixture control knob when full rich. Mixture control inner wire should protrude 0.10-0.30 inch beyond A462 fitting securing wire to mixture control arm. If wire cannot rotate relative to mixture arm the A130 spacer in fitting may be missing or damaged; replace as required.
9. Install air intake hose between air box and fuel control.
10. Electrically ground the helicopter.
11. Place a clean container beneath fuel control outlet and connect a ground wire between container and helicopter.
12. Pull CLUTCH-START circuit breaker.
13. Turn fuel shut-off valve on.
14. Turn battery switch on. Open throttle. Turn ignition key to PRIME position and hold until fluid exiting fuel control is the same color as avgas (fuel control is typically shipped with non-flammable oily preservative). Continue flushing fuel control until avgas exiting fuel control no longer exhibits oily smell and feel.
15. Close throttle and turn battery switch off.
16. Connect fuel control outlet hose. Special torque per § 23-33 and torque stripe per Figure 2-1.
17. Turn battery switch on. Turn ignition key to PRIME position and hold until AUX FUEL PUMP light extinguishes. Turn ignition key off. Inspect fuel control and attached fuel connections and verify no leakage.
18. Remove grounding wire(s).
19. Perform preflight, start engine, and run up using R44 POH checklist.
20. Set idle rpm to 58-62% rpm with engine warm and clutch engaged.
21. Shut down engine using R44 POH checklist.

6.495 Fuel Control Installation (continued)

22. Disconnect fuel control outlet hose, connect test hose if desired, and measure fuel flow rate at fuel control outlet with mixture full rich, throttle at idle, and electric fuel pump on (ignition key at PRIME position).
23. Adjust idle mixture as required to obtain 16–18 pounds/hour fuel flow (170–190 cc/minute). Clockwise rotation of idle mixture adjustment wheel (viewed from aircraft right side) enriches mixture. Re-check idle rpm after mixture adjustment and repeat as required until both rpm and mixture are within limits. With rpm and mixture set, verify smooth acceleration from idle to 102% rpm with no engine hesitation or smoke from tailpipe. Also verify smooth needle split from 102% to idle with no engine roughness or erratic rpm indications and acceptable idle quality. Note that 16–18 pounds/hour fuel flow should produce acceptable idle quality and off-idle throttle performance under sea-level standard conditions. Richer mixtures may be required for cold temperature operation and leaner mixtures may be required for hot/high altitude operation. Deviate from 16–18 pounds/hour recommendation as required for acceptable idle quality and off-idle throttle performance (smooth accelerations and needle splits).
24. Adjust throttle correlation rigging per § 10.150.
25. Install right cowling.

## 6.500 Exhaust System

### 6.510 Exhaust System Removal

1. Remove left and right side cowlings, and remove aft cowling assembly.
2. As required, loosen clamps securing shields to inlets and tail pipe and remove shields.
3. **O-540 engine:** Loosen clamps securing carburetor heat scoop to riser/collector.
4. Remove hardware securing C173 straps to tail pipe.
5. Loosen clamps securing hoses to muffler shroud.
6. Supporting C169 muffler assembly, remove nuts and washers securing risers to cylinders and remove muffler. Discard gaskets.
7. As required, remove hardware securing bead clamps to risers/collectors, remove clamps, and remove and discard A701-10 stainless-steel tape if installed.

### 6.520 Exhaust System Installation

1. Install new gaskets and install hardware securing C169 muffler assembly or exhaust risers/collectors (if disassembled from C169 muffler assembly) to cylinders. Draw up (12) 21FKF-518 nuts evenly prior to torquing; special torque nuts per § 23-33.
2. If exhaust risers/collectors were disassembled from C169 muffler assembly, position muffler on risers/collectors installed in step 1. Wrap joint under bead clamps with a single layer of new A701-10 stainless-steel tape with 0.25–0.75 inch overlap, and install hardware securing bead clamps. Standard torque bead clamp bolts per § 23-32. Verify security.

#### CAUTION

Ensure bead clamp bolt flanges are oriented so any leakage is directed away from ignition components and structure.

3. Install clamps securing hoses to muffler shroud. Verify security.
4. **O-540 engine:** Tighten clamps securing carburetor heat scoop to riser/collector. Verify security.
5. If removed, tighten clamps securing heat shields to inlets and tail pipe. Verify security.
6. Install hardware securing C173 straps to tail pipe. Shim between tail pipe ears and straps using NAS1149F0332P washers (1 minimum, 3 maximum at each fastener) to create a 0.02–0.08 inch forward preload. Verify security.
7. Install aft cowling assembly, and install left and right side cowlings.
8. Revise Weight and Balance Record in applicable Pilot's Operating Handbook (POH) Section 6 to incorporate the following data as required:

	Weight	Long. Arm	Long. Moment	Lat. Arm	Lat. Moment
C169-1 Muffler Assembly	17.6 lb	124.4 in.	2189.4 in.-lb	–1.0 in.	–17.6 in.-lb
C169-31 Muffler Assembly	17.6 lb	124.2 in.	2185.9 in.-lb	–1.2 in.	–21.1 in.-lb
C169-35 Muffler Assembly	18.6 lb	124.6 in.	2317.6 in.-lb	–0.9 in.	–16.7 in.-lb
C169-37 Muffler Assembly	18.6 lb	124.4 in.	2313.8 in.-lb	–1.1 in.	–20.5 in.-lb

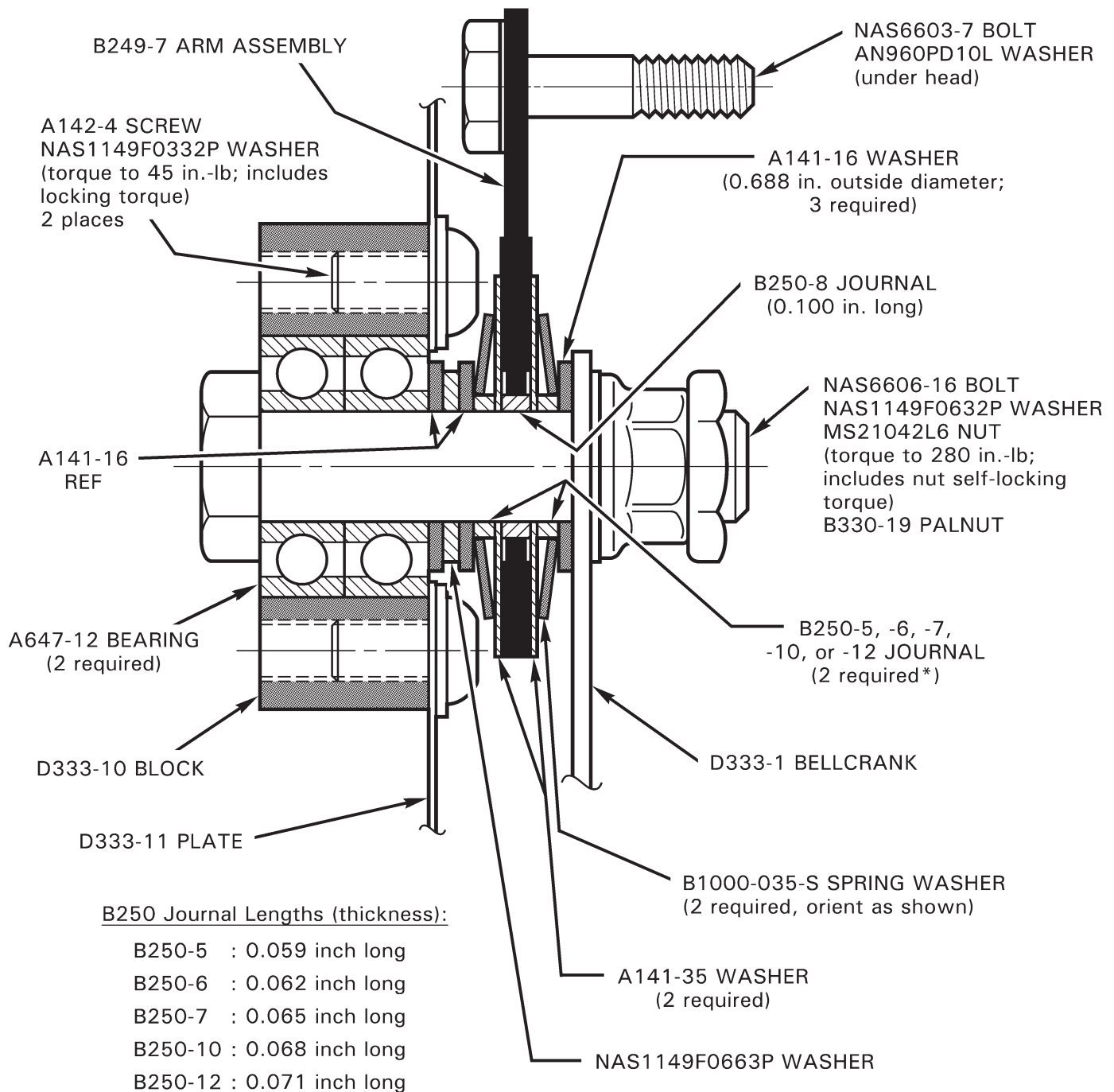


## 6.600 Troubleshooting

### 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. If equipped, verify 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. Fuel injector nozzles are unobstructed (IO-540 only). Clean nozzles per Lycoming Service Instruction 1275C.
11. Engine tachometer indication is correct. Verify with digital tachometer (such as found in newer dynamic balancing equipment) or similar equipment.
12. Oil screens or filter do not exhibit metallic debris consistent with internal engine damage.
13. Proper cylinder compression (both leakage and direct) per Lycoming recommendations.
14. 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.
15. Proper spark plug type and condition.
16. 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).
17. Proper fuel flow and unobstructed carburetor/fuel control inlet screen. Perform fuel-flow check per Section 12.
18. If primer-equipped carbureted engine, verify fuel is not leaking past primer pump (ensure primer pump is locked) and air is not leaking past fittings in cylinder head.



\*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. After adjustment, clamp long side of D333-11 plate in padded vise with B249-7 arm assembly contacting vise jaws while providing rotational clearance for D333-1 bellcrank; measure rotational friction by rotating bolt head with dial-indicating torque wrench.

**FIGURE 6-9 D334 BELLCRANK - CARB HEAT ASSIST FRICTION ADJUSTMENT**

6.610 Low-Power Checklist (continued)

19. Carburetor or fuel control throttle lever contacts full-throttle stop (collective must be raised slightly).
20. 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).
21. 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. On fuel-injected engines, verify intake manifold drain ("sniffle") valve does not leak ambient air into intake manifold.
22. Proper exhaust valve guide clearance per Lycoming SB388 (latest revision).
23. Proper dry-tappet clearance per Lycoming Overhaul Manual.
24. 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).
25. Proper magneto internal timing.
26. Carburetor float bowl fuel level correct.
27. Cylinder head intake port has radiused edge where inlet airflow turns 90 degrees toward valve. If no radius exists, contact Lycoming Technical Support.
28. 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).
29. If 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).

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