SECTION 11

ENGINE
(NORMALLY ASPIRATED)

WARNING

When performing any inspection or maintenance that requires turning on the master switch, installing a battery, or pulling the propeller through by hand, treat the propeller as if the ignition switch were ON. Do not stand, nor allow anyone else to stand, within the arc of the propeller, since a loose or broken wire, or a component malfunction, could cause the propeller to rotate.

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11-1. ENGINE COWLING.

11-2. DESCRIPTION. The engine cowling is divided into two major removable segments. The upper RH segment has an access door which provides access to the engine oil dipstick and remote fuel strainer drain control. The upper center cowl skin has an access door which provides access to the oil filler neck. Controllable cowl flaps are attached to the trailing edge of the lower cowl segment to aid in controlling engine temperature. Screws fasten the upper center and lower segments at the nose cap. Quick-release fasteners are used along the parting surfaces and at the aft end, allowing the removal of either segment individually. Cowl-mounted landing and taxi lights are mounted in the lower cowling nose cap.

11-3. **REMOVAL AND INSTALLATION.**

a. **Remove screws securing upper center and lower cowling segments to the nose cap.**
b. **Release the quick-release fasteners attaching the cowling to the fuselage and at the parting surfaces of the center and lower segments.**
c. **Disconnect the landing and taxi light wires at the quick-disconnects and carefully remove cowling.**
d. **Reverse the preceding steps for reinstallation. Ensure the baffle seals are turned in the correct direction to confine and direct air flow around the engine. The vertically installed seals must fold forward and the side seals must fold upwards.**

11-4. CLEANING AND INSPECTION. Wipe the inner surfaces of the cowling segments with a clean cloth saturated with cleaning solvent (Stoddard or equivalent). If the inside surface of the cowling is coated heavily with oil or dirt, allow solvent to soak until foreign material can be removed. Wash painted surfaces of the cowling with a solution of mild soap and water and rinse thoroughly. After washing, a coat of wax may be applied to the painted surfaces to prolong paint life. After cleaning, inspect cowling for dents, cracks, loose rivets and spot welds. Repair all defects to prevent spread of damage.

11-5. REPAIR. (Refer to Section 17.)

11-6. COWL FLAPS.

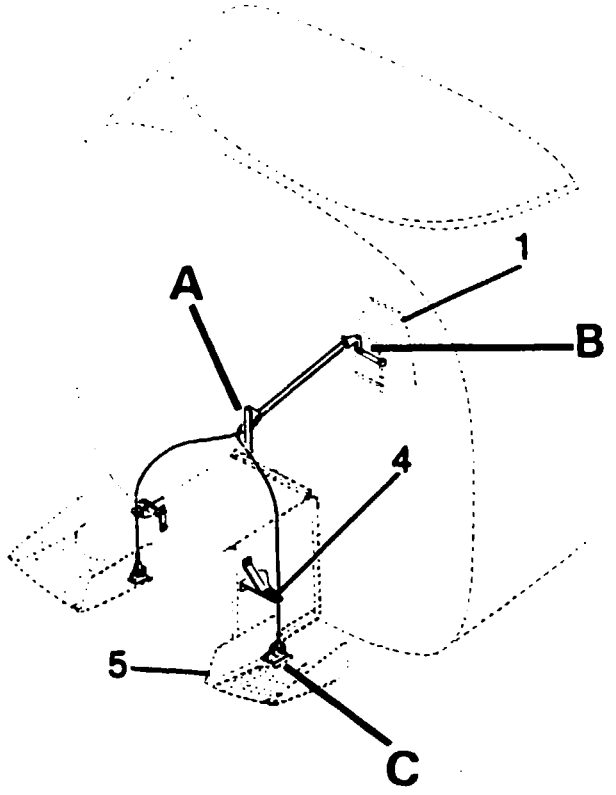
11-7. DESCRIPTION. Cowl flaps are provided to aid in controlling engine temperature. Two cowl flaps, operated by a single control in the cabin, are located at the aft edge of the lower cowl segment.

NOTE

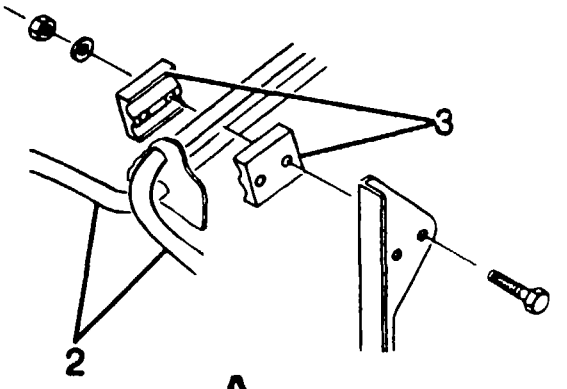
Refer to Section 2 for cowl flap hinge inspection frequency.

11-8. REMOVAL AND INSTALLATION. (See figure 11-1.)

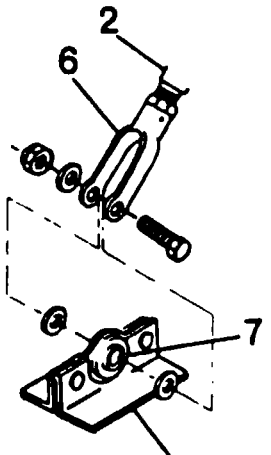
a. Place cowl flap control lever (11) in the OPEN position.
b. Disconnect cowl flap control clevises (6) from cowl flap shock-mounts (7).
c. Remove safety wire securing hinge pins to cowl flaps, pull pins and remove flaps.
d. Reverse the preceding steps for reinstallation. Rig cowl flaps, if necessary, in accordance with paragraph 11-9.



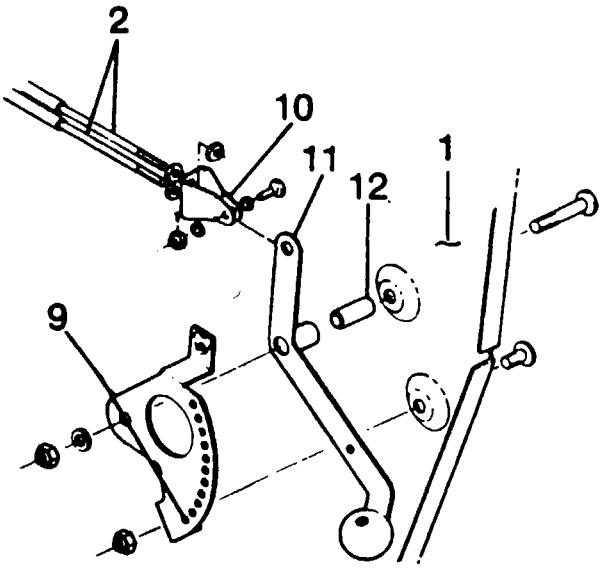
1. Pedestal
2. Cowl Flap Control
3. Clamp
4. Retainer
5. Cowl Flaps
6. Clevis
7. Shock-Mount
8. Bracket
9. Position Bracket
10. Clevis
11. Control Lever
12. Bushing



Detail A



Detail C



Detail B

Figure 11-1. Cowl Flap Installation

11-9. RIGGING. (See figure 11-1.)

a. Disconnect cowl flap control clevises (6) from cowl flap shock-mounts (7).
b. Check to make sure that the flexible controls reach their internal stops in each direction. Mark controls so that full travel can be readily checked and maintained during the remaining rigging procedures.
c. Place cowl flap control lever (11) in the CLOSED position. If the control lever cannot be placed in the closed position, adjust controls at upper clevis (10) to position control lever in bottom hole of position bracket (9).
d. With the control lever in CLOSED position, hold one cowl flap closed, streamlined with trailing edge of lower cowl. Loosen jam nut and adjust clevis (6) on the control to hold cowl flap in this position. Retighten jam nut and install bolt through clevis and shock-mount.

NOTE

Be sure threads are visible in clevis inspection holes.

e. Repeat the preceding step for the opposite cowl flap.
f. Check that all clamps and jam nuts are tight.
g. Check for ease of operation.

11-10. ENGINE.

11-11. DESCRIPTION. An air cooled, wet-sump, six-cylinder, horizontally-opposed, direct-drive, carbureted Avco Lycoming O-540 series engine, driving a constant-speed propeller, is used to power the aircraft. The cylinders, numbered from front to rear, are staggered to permit a separate throw on the crankshaft for each connecting rod. The right front cylinder is number 1 and cylinders on the right side are identified by odd numbers 1, 3 and 5. The left front cylinder is number 2 and the cylinders on the left side are identified as number 2, 4 and 6. Refer to paragraph 11-12 for engine data. For repair and overhaul of the engine, accessories and propeller, refer to the appropriate publications issued by their manufacturers. These publications are available from Cessna Service Parts Centers.

11-12. TIME BETWEEN OVERHAUL (TBO). Avco Lycoming recommends engine overhaul at 2000 hours operating time for the O-540-J series engines. Refer to Avco Lycoming Service Instruction 1009AB, and to any superseding instructions, revisions or supplements thereto, for further recommendations. At the time of overhaul, engine accessories should be overhauled. Refer to Section 13 for propeller and governor overhaul periods.

11-13. OVERSPEED LIMITATIONS. The engine must not be operated above specified maximum continuous RPM. However, should inadvertent overspeed occur, refer to Avco Lycoming Service Bulletin 369D, and to any superseding bulletins, revisions or supplements thereto, for further recommendations.

11-14. ENGINE DATA.

AIRCRAFT Series	R182 SKYLANE
MODEL (Lycoming)	O-540-J
Rated Horsepower at RPM	235 at 2400
Number of Cylinders	6 Horizontally-Opposed
Displacement	541.5 Cubic Inches
Bore	5.125 Inches
Stroke	4.375 Inches
Compression Ratio	8.5:1
Magnetos	Bendix D6LN-2031
Right Magneto	Fires 23° BTC, Upper Left, Lower Right
Left Magneto	Fires 23° BTC, Lower Left, Upper Right
Firing Order	1-4-5-2-3-6
Spark Plugs	18mm (Refer to Avco Lycoming Service Instruction No. 1042 for factory approved spark plugs and required gap.)
Torque	330 ± 30 LB-IN.
Carburetor (Marvel)	HA-6
Tachometer	Mechanical Drive
Oil Sump Capacity	8 U.S. Quarts
With External Filter	9. U.S. Quarts
Oil Pressure (PSI)	
Normal	60-90
Minimum Idling	25
Maximum (Cold Oil Starting)	100
Oil Temperature	
Normal Operating	Within Green Arc
Maximum	Red Line (245°F)
Probe Location	Accessory Housing
Cylinder Head Temperature	
Normal Operating	Within Green Arc
Maximum	Red Line (500°F)
Probe Location	Lower side of Number 5 Cylinder
Economy Mixture Indicator (EGT)	
Probe Location	Left Hand Exhaust Collector
Direction of Crankshaft Rotation (Viewed from Rear)	Clockwise
Dry Weight-With Accessories	387 LB (Weight is approximate and will vary with optional accessories installed.)

11-15. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE WILL NOT START.	Improper use of starting procedure.	Refer to Pilot's Operating Handbook.
	Fuel cells empty.	Visually inspect cells. Fill with proper grade and quantity of gasoline.
	Mixture control in the IDLE CUT-OFF position.	Move control to the full RICH position.
	Fuel selector valve in OFF position.	Place selector valve in the ON position to a cell known to contain gasoline.
	Defective carburetor.	Repair or replace carburetor.
	Carburetor screen or fuel strainer plugged.	Remove carburetor and clean thoroughly. Refer to Section 12 for fuel strainer cleaning.
	Vaporized fuel. (Most likely to occur in hot weather with a hot engine.)	Refer to Pilot's Operating Handbook.
	Engine flooded.	Refer to Pilot's Operating Handbook.
	Water in fuel system.	Open fuel strainer drain and check for water. If water is present, drain fuel cell sumps, lines, strainer and carburetor.
	Defective aircraft fuel system.	Refer to section 12.
	Fuel contamination.	Drain all fuel and flush out fuel system. Clean all screens, fuel lines, strainer and carburetor.
	Defective ignition system.	Refer to paragraph 11-64.

11-15. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE WILL NOT START. (Cont).	Defective magneto switch or grounded magneto leads.	Check continuity. Repair or replace switch or leads.
	Spark plugs fouled.	Remove, clean and regap plugs. Test harness cables to persistently fouled plugs. Replace if defective.
ENGINE STARTS BUT DIES, OR WILL NOT IDLE.	Idle stop screw or idle mixture incorrectly adjusted.	Refer to paragraph 11-46.
	Carburetor idling jet plugged.	Clean carburetor and fuel strainer. Refer to Section 12 for fuel strainer.
	Spark plugs fouled or improperly gapped.	Remove, clean and regap plugs. Replace if defective.
	Water in fuel system.	Open fuel strainer drain and check for water. If water is present, drain fuel cell sumps, lines, strainer and carburetor.
	Defective ignition system.	Refer to paragraph 11-64.
	Vaporized fuel. (Most likely to occur in hot weather with a hot engine.)	Refer to Pilot's Operating Handbook.
	Induction air leaks.	Check visually. Correct the cause of leaks.
	Manual primer leaking.	Disconnect primer outlet line. If fuel leaks through primer, repair or replace primer.

11-15. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE STARTS BUT DIES, OR WILL NOT IDLE. (Cont).	Leaking float valve or float level set too high.	Perform an idle mixture check. Attempt to remove any rich indication with the idle mixture adjustment. If the rich indication cannot be removed, the float valve is leaking or the float level is set too high. Replace defective parts, reset float level.
	Defective carburetor.	If engine will start when primed but stops when priming is discontinued, with mixture control in full RICH position, the carburetor is defective. Repair or replace carburetor.
	Defective engine.	Check compression. Listen for unusual engine noises. Engine repair is required.
	Propeller control set in high pitch position (low RPM).	Use low pitch (high RPM) position for all ground operation.
	Defective fuel system.	Refer to Section 12.
ENGINE RUNS ROUGHLY, WILL NOT ACCELERATE PROPERLY, OR LACKS POWER.	Restriction in aircraft fuel system.	Refer to Section 12.
	Worn or improperly rigged throttle or mixture control.	Check visually. Replace worn linkage. Rig properly.
	Spark plugs fouled or improperly gapped.	Remove, clean and regap plugs. Replace if defective
	Defective ignition system.	Refer to paragraph 11-64.
	Defective or badly adjusted accelerating pump in carburetor.	Check setting of accelerating pump linkage and adjust as necessary.
	Float level set too low.	Check and reset float level.

11-15. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE RUNS ROUGHLY, WILL NOT ACCELERATE PROPERLY, OR LACKS POWER. (Cont.)	Defective carburetor.	If engine will start when primed but stops when priming is discontinued, with mixture control in full RICH position, the carburetor is defective. Repair or replace carburetor.
	Defective engine.	Check compression. Listen for unusual engine noises. Engine repair is required.
	Restricted carburetor air filter.	Check visually. Clean in accordance with Section 2.
	Cracked engine mount.	Inspect and repair or replace mount as required.
	Defective mounting bushings.	Inspect and install new bushings as required.
	Propeller control in high pitch (low RPM) position.	Use low pitch (high RPM) position for all ground operations.
	Fuel contamination.	Check all screens in fuel system. Drain all fuel and flush out system. Clean all screens, lines, strainer and carburetor.
POOR IDLE CUT-OFF.	Worn or improperly rigged mixture control.	Check that idle cut-off stop on carburetor is contacted. Replace worn linkage. Rig properly.
	Manual primer leaking.	Disconnect primer outlet line. If fuel leaks through primer, it is defective. Repair or replace primer.
	Defective carburetor.	Repair or replace carburetor.

11-16. STATIC RUN-UP PROCEDURES. In a case of suspected low engine power, a static RPM run-up should be conducted as follows:

a. Run up engine, using takeoff power and mixture settings, with the aircraft facing 90° right and then left to the wind direction.
b. Record the RPM obtained in each run-up position.

NOTE

Daily changes in atmospheric pressure, temperature and humidity will have a slight effect on static run-up.

c. Average the results of the RPM obtained, it should be within 50 RPM of 2380 RPM.
d. If the average results of the RPM obtained are lower than stated above, the following recommended checks may be performed to determine a possible deficiency.
   1. Check governor control for proper rigging. It should be determined that the governor control arm travels to the high RPM stop on the governor and that the high RPM stop screw is adjusted properly. (Refer to Section 13 for procedures.)

NOTE

If verification of governor operation is necessary, the governor may be removed from the engine and a flat plate installed over the engine pad. Run up engine to determine that governor was adjusted properly.

   2. Check carburetor heat control for proper rigging. If partially open it would cause a slight power loss.
   3. Check magneto timing, spark plugs and ignition harness for settings and condition.
   4. Check condition of induction air filter. Clean if required.
   5. Perform an engine compression check. Refer to engine manufacturer's service manual.

11-17. REMOVAL. If an engine is to be placed in storage or returned to the manufacturer for overhaul, proper preparatory steps should be taken for corrosion prevention prior to beginning the removal procedure. Refer to Section 2 for storage preparation. The following engine removal procedure is based upon the engine being removed from the aircraft with the engine mount attached to the firewall.

NOTE

Tag each item when disconnected to aid in identifying wires, hoses, lines and control linkages when engine is reinstalled. Likewise, shop notes made during removal will often clarify reinstallation. Protect openings, exposed as a result of removing or disconnecting units, against entry of foreign material by installing covers or sealing with tape.

a. Attach a tail stand of suitable capacity.
b. Place all cabin switches in the OFF position.
c. Place fuel selector valve in the OFF position.
d. Remove engine cowling in accordance with paragraph 11-3.
e. Disconnect battery cables and insulate terminals as a safety precaution.
f. Drain fuel strainer and lines with strainer drain control.

NOTE

During the following procedures, remove any clamps or lacings which secure controls, wires, hoses or lines to the engine, engine mount or attached brackets, so they will not interfere with engine removal. Some of the items listed can be disconnected at more than one place. It may be desirable to disconnect some of these items at other than the places indicated. The reason for engine removal should be the governing factor in deciding at which point to disconnect them. Omit any of the items which are not present on a particular engine installation .

g. Drain the engine oil sump and oil cooler.
h. Disconnect magneto primary lead wires at magnetos.

WARNING

The magnetos are in a SWITCH ON condition when the switch wires are disconnected. Ground the magneto points or remove the high tension wires from the magnetos or spark plugs to prevent accidental firing.

i. Remove the spinner and propeller in accordance with Section 13. Cover exposed end of crankshaft flange and propeller flange to prevent entry of foreign material.
j. Disconnect throttle and mixture controls at carburetor. Remove clamps attaching controls to engine and pull controls aft clear of engine. Use care to avoid bending controls too sharply. Note EXACT position, size and number of attaching washers and spacers for reference on reinstallation.
k. Disconnect propeller governor control at governor. Note EXACT position, size and number of attaching washers for reference on reinstallation. Remove clamps attaching control to engine and pull control aft clear of engine.
l. Disconnect all hot and cold air flexible ducts and remove.
m. Remove exhaust system in accordance with paragraph 11-83.
n. Disconnect carburetor heat control from arm on airbox. Remove clamps and pull control clear of engine.
o. Disconnect wires and cables as follows:
   1. Disconnect tachometer drive shaft at adapter.

CAUTION

When disconnecting starter cable do not permit starter terminal bolt to rotate. Rotation of the bolt could break the conductor between bolt and field coils causing the starter to be inoperative.

   2. Disconnect starter electrical cable at starter.
   3. Disconnect cylinder head temperature wire at probe.
   4. Disconnect carburetor air temperature wires at quick-disconnects.
   5. Disconnect electrical wires and wire shielding ground at alternator.
   6. Disconnect exhaust gas temperature wire at quick-disconnect.
   7. Remove all clamps and lacings attaching wires or cables to engine and pull wires and cables aft to clear engine.

p. Disconnect lines and hoses as follows:
   1. Disconnect vacuum hose at vacuum pump.
   2. Disconnect oil breather vent lines where secured to the engine.

WARNING

Residual fuel and oil draining from disconnected lines and hoses constitutes a fire hazard. Use caution to prevent accumulation of such fuel and oil when lines or hoses are disconnected.

   3. Disconnect oil temperature bulb.
   4. Disconnect primer line at engine fitting.
   5. Disconnect fuel supply hose at fuel strainer.
   6. Disconnect oil pressure line at engine fitting.
   7. Disconnect manifold pressure line at engine.

q. Carefully check the engine again to ensure ALL hoses, lines, wires, cables, clamps and lacings are disconnected or removed which would interfere with the engine removal. Ensure all wires, cables and engine controls have been pulled aft to clear the engine.

CAUTION

Place suitable stand under tail tie-down ring before removing engine. The loss of engine weight will cause the aircraft to be tail heavy.

r. Attach a hoist to the lifting lug at the top center of the engine crankcase. Lift engine just enough to relieve the weight from the engine mount pads.
s. Remove bolts attaching engine to engine mount pads and slowly hoist engine and pull it forward. Check for any items which would interfere with the engine removal. Balance the engine by hand and carefully guide the disconnected parts out as the engine is removed.
t. Remove engine shock-mount pads and bonding straps.

11-18. CLEANING. Clean engine in accordance with instructions in Section 2.

11-19. ACCESSORIES REMOVAL. Removal of engine accessories for overhaul or for engine replacement involves stripping the engine of parts, accessories and components to reduce it to the bare engine. During the removal process, removed items should be tagged for repair or replacement with new components.

NOTE

Items easily confused with similar items should be tagged to provide a means of identification when being installed on a new engine. All openings exposed by the removal of an item should be closed by installing a suitable cover or cap over the opening. This will prevent entry of foreign material. If suitable covers are not available, tape may be used to cover the openings.

11-20. INSPECTION. For specific items to be inspected, refer to the engine manufacturer's manual.

a. Visually inspect the engine for loose nuts, bolts, cracks and fin damage.
b. Inspect baffles, baffle seals and brackets for cracks, deterioration and breakage.
c. Inspect all hoses for internal swelling, chafing through protective plys, cuts, breaks, stiffness, damaged threads and loose connections. Excessive heat on hoses will cause them to become brittle and easily broken. Hoses and lines are most likely to crack or break near the end fittings and support points.
d. Inspect for color bleaching of the end fittings or severe discoloration of the hoses.

NOTE

Avoid excessive flexing and sharp bends when examining hoses for stiffness.

e. Refer to Section 2 for replacement intervals for flexible fluid carrying hoses in the engine compartment.
f. For major engine repairs, refer to the engine manufacturer's overhaul and repair manual.

11-21. BUILD-UP. Engine build-up consists of installation of parts, accessories and components to the basic engine to build up an engine unit ready for installation on the aircraft. All safety wire, lockwashers, nuts, gaskets and rubber connections should be new parts.

11-22. INSTALLATION. Before installing the engine on the aircraft, install any items which were removed from the engine or aircraft after the engine was removed.

NOTE

Remove all protective covers, plugs, caps and identification tags as each item is connected or installed. Omit any items not present on a particular engine installation.

a. Hoist the engine to a point near the engine mount.
b. Install engine shock-mount pads as illustrated in figure 11-2.
c. Carefully lower engine slowly into place on the engine mount. Route controls, lines, hoses and wires in place as the engine is positioned on the engine mount pads.

NOTE

Be sure engine shock-mount pads, spacers and washers are in place as the engine is lowered into position.

d. Install engine-to-mount bolts, then remove the hoist and support stand placed under tail tie-down fitting. Torque bolts to 450-500 lb-in.
e. Route throttle, mixture and propeller controls to their respective units and connect. Secure controls in position with clamps.
f. Route carburetor heat control to airbox and connect. Secure control in position with clamps.

NOTE

Throughout the aircraft fuel system, from the fuel cells to the carburator, use NS-40 (RAS-4) (Snap-On-Tools Corp., Kenosha, Wisconsin), MIL-T-5544 (Thread Compound Antiseize, Graphite Petrolatum), USP Petrolatum or engine oil as a thread lubricator or to seal a leaking connection. Apply sparingly to male threads, exercising extreme caution to avoid "stringing" sealer across the end of the fitting. Always ensure that a compound, the residue from a previously used compound, or any other foreign material cannot enter the system.

g. Connect lines and hoses as follows:
   1. Connect manifold pressure line at engine fitting.
   2. Connect oil pressure line at engine fitting.
   3. Connect fuel supply hose at fuel starter.
   4. Connect primer line at engine fitting.
   5. Connect oil temperature bulb.
   6. Connect oil breather vent line where secured to the engine.
   7. Connect vacuum hose at vacuum pump.

h. Connect wires and cables as follows:
   1. Connect electrical wires and wire shielding ground at alternator.
   2. Connect cylinder head temperature wire at probe.(Do not exceed 4 lb-in torque.)

CAUTION

When connecting starter cable, do not permit starter terminal bolt to rotate. Rotation of the bolt could break the conductor between bolt and field coils causing the starter to be inoperative.

   3. Connect starter electrical cable at starter.
   4. Connect tachometer drive shaft at adapter. Be sure drive cable engages drive in adapter. Torque housing attach nut to 100 lb-in.
   5. Connect exhaust gas temperature wire and carburetor air temperature wires at quick-disconnects.
   6. Install clamps and lacings securing wires and cables to engine, engine mount and brackets.

i. Install exhaust system in accordance with paragraph 11-83.

j. Connect all hot and cold air flexible ducts.

k. Install propeller and spinner in accordance with instructions outlined in Section 13.

l. Complete a magneto switch ground-out and continuity check, then connect primary lead wires to the magnetos. Remove the temporary ground or connect spark plug leads, whichever procedure was used during removal.

WARNING

Be sure magneto switch is in OFF position when connecting switch wires to magnetos.

m. Clean and install induction air filter in accordance with Section 2.

n. Service engine with proper grade and quantity of engine oil. Refer to Section 2 if engine is new, newly overhauled or has been in storage.

o. Check all switches are in the OFF position and connect battery cables.
p. Rig engine controls in accordance with paragraphs 11-69, 11-70, 11-71 and 11-72.
q. Inspect engine installation for security, correct routing of controls, lines, hoses and electrical wiring, proper safetying and tightness of all components.
r. Install engine cowling in accordance with paragraph 11-3. Rig cowl flaps in accordance with paragraph 11-9.
s. Perform an engine run-up and make final adjustments on the engine controls.

11-23. FLEXIBLE FLUID HOSES.

11-24. LEAK TEST. Refer to Section 2 for leak test interval. Perform leak check as follows:
a. Examine the exterior of hoses for evidence of leakage or wetness.
b. Hoses found leaking should be replaced.
c. Refer to paragraph 11-20 for detailed inspection procedures for flexible hoses.

11-25. REPLACEMENT.
a. Hoses should not be twisted on installation. Pressure applied to a twisted hose may cause failure or loosening of the nut.
b. Provide as large a bend radius as possible.
c. Hoses should have a minimum of one-half inch clearance from other lines, ducts, hoses or surrounding objects or be butterfly clamped to them.
d. Rubber hoses will take a permanent set during extended use in service. Straightening a hose with a bend having a permanent set will result in hose cracking. Care should be taken during removal so that hose is not bent excessively, and during reinstallation to assure hose is returned to its original position.
e. Refer to AC 43.13-1, Chapter 10, for additional installation procedures for flexible fluid hose assemblies.

11-26. ENGINE BAFFLES.

11-27. DESCRIPTION. The sheet metal baffles installed on the engine direct the flow of air around the cylinders and other engine components to provide optimum cooling. These baffles incorporate rubber-asbestos composition seals at points of contact with the engine cowling and other engine components to help confine and direct the airflow to the desired area. It is very important to engine cooling that the baffles and seals are in good condition and installed correctly. The vertical seals must fold forward and the side seals must fold upwards. Removal and installation of the various baffle segments is possible with the cowling removed. Be sure that any new baffles seal properly.

11-28. CLEANING AND INSPECTION. The engine baffles should be cleaned with a suitable solvent to remove oil and dirt.

NOTE

The rubber-asbestos seals are oil and grease resistant but should not be soaked in solvent for long periods.

Inspect baffles for cracks in the metal and for loose and/or torn seals. Repair or replace any defective parts.

11-29. REMOVAL AND INSTALLATION. Removal and installation of the various baffle segments are possible with the cowling removed. Be sure that any replaced baffles and seals are installed correctly and that they seal to direct the airflow in the correct direction. Various lines, hoses, wires and controls are routed through some baffles. Make sure that these parts are reinstalled correctly after installation of baffles.

11-30. REPAIR. Repair of an individual segment of engine baffle is generally impractical, since, due to the small size and formed shape of the part, replacement is usually more economical. However, small cracks may be stop-drilled and a reinforcing doubler installed. Other repairs may be made as long as strength and cooling requirements are met. Replace sealing strips if they do not seal properly.

11-31. ENGINE MOUNT. (See figure 11-2.)

11-32. DESCRIPTION. The engine mount is composed of sections of steel tubing welded together and reinforced with gussets. The mount is fastened to the fuselage at four points. The engine is attached to the engine mount with shock-mount assemblies which absorb engine vibrations. Each engine mount pad has a small hole for a locating pin which serves as a locating dowel for the engine shock-mounts.

11-33. REMOVAL AND INSTALLATION.

a. Remove engine in accordance with paragraph 11-17.
b. Remove bolts from upper and lower mount-to-fuselage structure and carefully remove engine mount.
c. Reverse the preceding steps for reinstallation. Reinstall engine in accordance with paragraph 11-22.

NOTE

Torque engine-to-mount bolts to 450-500 lb-in. Torque mount-to-firewall bolts to 160-190 lb-in.

11-34. REPAIR. (Refer to Section 17.)

11-35. PAINTING. (Refer to Section 18.)

11-36. ENGINE SHOCK-MOUNT PADS. (See figure 11-2.) The bonded rubber and metal shock-mounts are designed to reduce transmission of engine vibrations to the airframe. The rubber pads should be wiped clean with a clean dry cloth.

NOTE

Do not clean the rubber pads and dampener assembly with any type of cleaning solvent.

Inspect the metal parts for cracks and excessive wear due to aging and deterioration. Inspect the rubber pads for separation between the pad and metal backing, swelling, cracking or a pronounced set of the pad. Install new parts for all parts that show evidence of wear or damage.

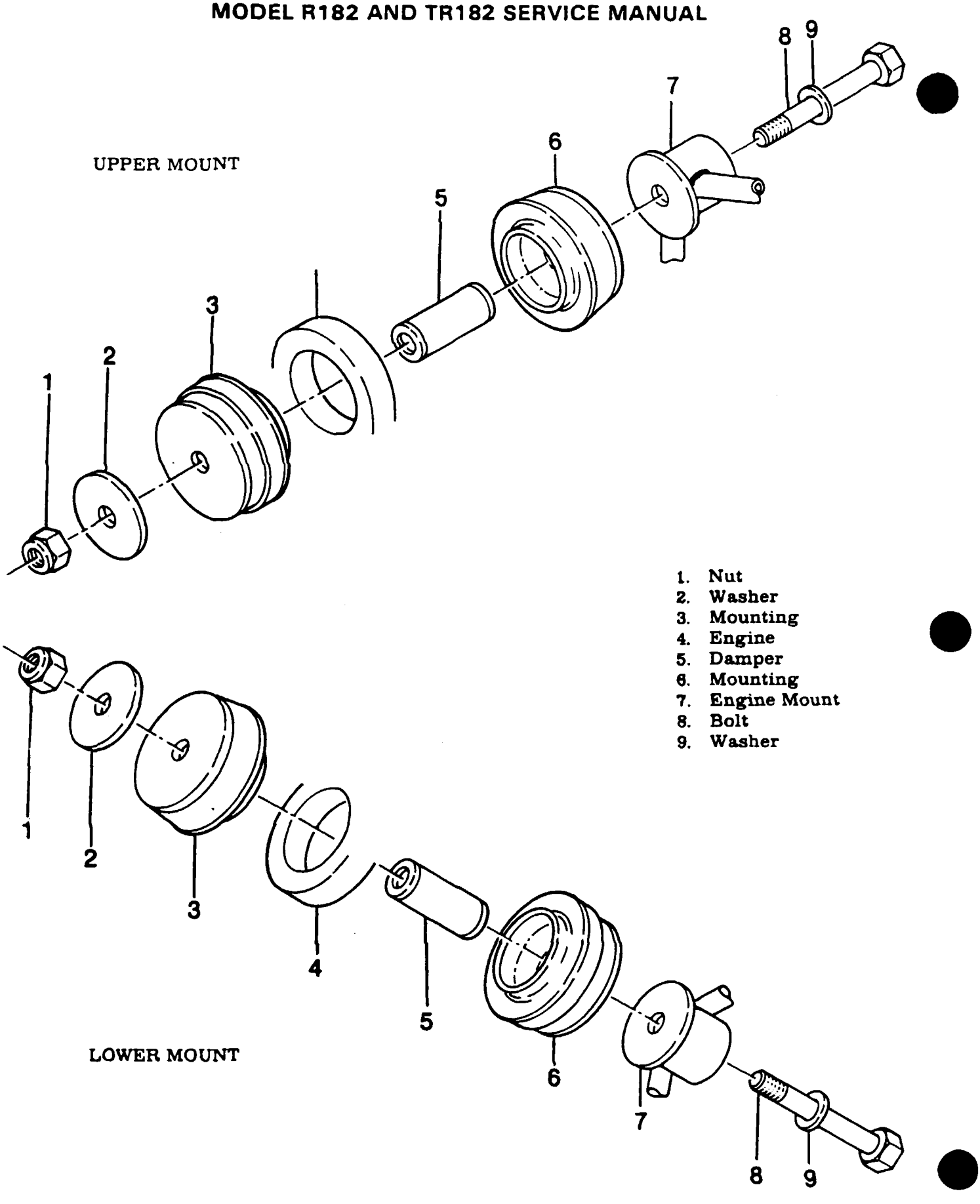
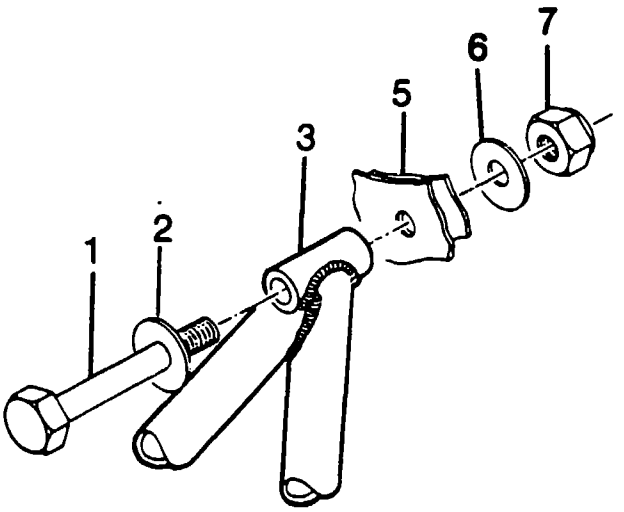
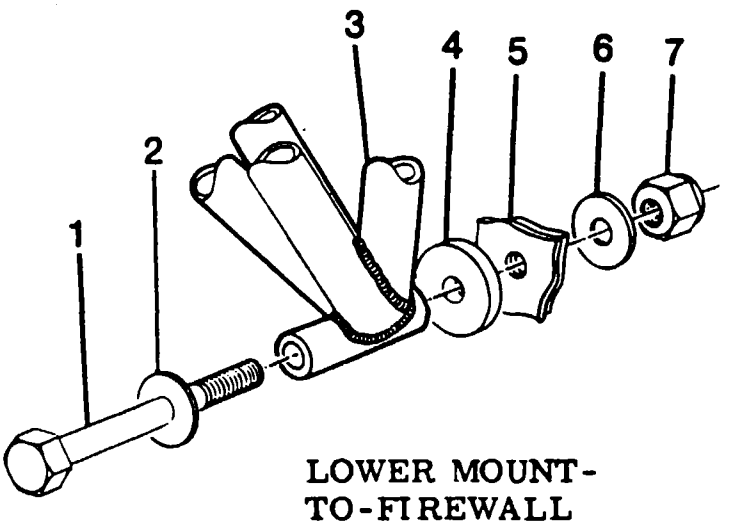


Figure 11-2. Engine Mount (Sheet 1 of 2)



UPPER MOUNT-
TO-FIREWALL



LOWER MOUNT-
TO-FIREWALL

1. Bolt
2. Washer
3. Engine Mount
4. Washer (Lower Mount Only)
5. Firewall
6. Washer
7. Nut

Figure 11-2. Engine Mount (Sheet 2 of 2)

11-37. OIL SYSTEM.

11-38. DESCRIPTION. A wet-sump, pressure-lubricating oil system is employed in the engine. An external, replaceable oil filter is standard equipment. The engine may also be equipped with a noncongealing oil cooler. Refer to applicable engine manual for specific details.

WARNING

The U.S. Environmental Protection Agency advises that mechanics and other workers who handle engine oil are advised to minimize skin contact with used oil and promptly remove used oil from the skin. In a laboratory study, mice developed skin cancer after skin was exposed to used engine oil twice a week without begin washed off, for most of their life span. Substances found to cause cancer in laboratory animals may also cause cancer in humans.

11-39. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
NO OIL PRESSURE.	No oil in sump.	Check with dipstick. Fill sump with proper grade and quantity of oil. Refer to Section 2.
	Oil pressure line broken, disconnected or pinched.	Inspect pressure lines. Replace or connect lines as required.
	Oil pump defective.	Remove and inspect. Examine engine. Metal particles from damaged pump may have entered engine oil passages.
	Defective oil pressure gage.	Check with a known good gage. If second reading is normal, replace gage.
	Oil congealed in gage line.	Disconnect line at engine and gage; flush with kerosene. Pre-fill with kerosene and install.
	Relief valve defective.	Remove and check for dirty or defective parts. Clean and install; replace valve if defective.
LOW OIL PRESSURE.	Low oil supply.	Check with dipstick. Fill sump with proper grade and quantity of oil. Refer to Section 2.

11-39. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
LOW OIL PRESSURE. (Cont).	Low viscosity oil.	Drain sump and refill with proper grade and quantity of oil.
	Oil pressure relief valve spring weak or broken.	Remove and inspect spring. Replace weak or broken spring.
	Defective oil pump.	Check oil temperature and oil level. If temperature is higher than normal and oil level is correct, internal failure is evident. Remove and inspect. Examine engine. Metal particles from damaged pump may have enteredo il passages.
	Secondary result of high oil temperature.	Observe oil temperature gage for high indication. Determine and correct reason for high oil temperature.
	Dirty oil screens.	Remove and clean oil screens.
HIGH OIL PRESSURE.	High viscosity oil.	Drain sump and refill with proper grade and quantity of oil.
	Relief valve defective.	Remove and check for dirty or defective parts. Clean and install; replace valve if defective.
	Defective oil pressure gage.	Check with a known good gage. If second reading is normal, replace gage.
LOW OIL TEMPERATURE.	Defective oil temperature gage or temperature bulb.	Check with a known good gage. If second reading is normal, replace gage. If reading is similar, the temperature bulb is defective. Replace bulb.

11-39. TROUBLE SHOOTING.(Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
LOW OIL TEMPERATURE (Cont).	Oil cooler thermostatic bypass valve defective or stuck.	Remove valve and check for proper operation. Replace valve if defective.
	Secondary effect of low oil pressure.	Observe oil pressure gage for low indication. Determine and correct reason for low oil pressure.
	Oil congealed in cooler.	This condition can occur only in extremely cold temperatures. If congealing is suspected, use an external heater or a heated hangar to warm the congealed oil.
HIGH OIL TEMPERATURE.	Oil cooler air passages clogged.	Inspect cooler core. Clean air passages.
	Oil cooler passages clogged.	Drain oil cooler and inspect for sediment. Remove cooler and flush thoroughly.
	Thermostatic bypass valve damaged or held open by solid matter.	Feel front of cooler core with hand. If core is cold, oil is bypassing cooler. Remove and clean valve and seat. If still inoperative, replace.
	Low oil supply.	Check with dipstick. Fill sump with proper grade and quantity of oil. Refer to Section 2.
	Oil viscosity too high.	Drain sump and refill with proper grade and quantity of oil.
	Prolonged high speed operation on the ground	Hold ground running above 1500 RPM to a minimum.
	Defective oil temperature gage.	Check with a known good gage. If second reading is normal, replace gage.

11-39. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
HIGH OIL TEMPERATURE (Cont).	Defective oil temperature bulb.	Check for correct oil pressure, oil level and cylinder head temperature. If they are correct, check oil temperature gage for being defective; similar reading is observed, bulb is defective. Replace bulb.
OIL LEAK AT FRONT OF ENGINE.	Damaged crankshaft seal.	Replace. Also refer to Service Newsletter SNL85-8.
OIL LEAK AT PUSH ROD HOUSING.	Damaged pushrod housing oil seal.	Replace.

11-39A. FULL-FLOW OIL FILTER.

11-39B. DESCRIPTION. A disposable spin-on oil filter attaches to a threaded fitting on the oil pump casting. The filter contains an internal bypass valve.

11-39C. REMOVAL.

a. Remove engine cowl in accordance with paragraph 11-3.
b. Cut safety wire and turn filter counterclockwise to remove if from the adapter.

NOTE

Before discarding filter, remove filter element from can and cut off both ends. Carefully unfold the element and inspect for evidence of internal engine damage such as chips or metal from bearings. In new or newly overhauled engines chips and bearing metal may be found, and generally are of no consequence. However, particles produced by impact, abrasion, or pressure are evidence of internal engine damage and justify further examination to determine the cause.

11-39D. INSTALLATION.

a. Lightly lubricate filter gasket with engine oil or Dow-Corning compound (DC-4).
b. Turn filter clockwise until filter gasket contacts base of adapter; then tighten 3/4 to 1 turn or torque to 15/20 FT/LBS. and safety wire.
c. Start engine, check for proper oil pressure. Warm up engine and check filter for leaks.
d. Check that engine torque does not cause filter to contact adjacent parts.
e. Replace engine cowl in accordance with paragraph 11-3.
f. Check oil level and filter leakage after operating engine at high power setting, or after a flight around the field.

11-40. OIL COOLER.

11-41. DESCRIPTION. The external oil cooler is mounted on the left forward engine baffle. Flexible hoses carry the oil to and from the cooler. Ram air passes through the cooler coil and is discharged into the engine compartment. At each engine oil change, drain the oil cooler. Refer to Section 2 for servicing instructions.

11-42. FUEL SYSTEM.

11-43. DESCRIPTION. The engine is equipped with a carburetor mounted on the lower aft end of the engine. The carburetor has a manual altitude mixture control. For overhaul and repair of the carburetor, refer to the manufacturer's overhaul and repair manual.

11-44. CARBURETOR.

11-45. REMOVAL AND INSTALLATION.

a. Place fuel selector valve in the OFF position.

b. Remove engine cowling in accordance with paragraph 11-3.
c. Drain fuel from strainer and lines with strainer drain control.
d. Remove bolts attaching air box ducting to carburetor, and remove air box ducting.
e. Disconnect throttle and mixture controls at the carburetor. Note EXACT position, size and number of attaching washers and spacers for reference on reinstallation.
f. Disconnect and cap or plug fuel line at carburetor.
g. Remove safety wire, nuts and washers attaching carburetor to engine, and remove carburetor and mounting gasket.
h. Reverse the preceding steps for reinstallation. Use new gaskets when installing carburetor. Rig controls in accordance with paragraphs 11-70, 11-71 and 11-72. (Check carburetor throttle arm to idle stop arm attachment for security and proper safetying at each normal engine inspection in accordance with figure 11-3.)

11-46. IDLE SPEED AND MIXTURE ADJUSTMENTS. Idle speed and mixture adjustment should be accomplished after the engine has been warmed up. Since idle RPM may be affected by idle mixture adjustment, it may be necessary to readjust idle RPM after setting the idle mixture correctly.

a. Set the throttle stop screw (idle RPM) to obtain 600±25 RPM, with throttle control pulled full out against idle stop.

NOTE

Engine idle speed may vary among different engines. An engine should idle smoothly, without excessive vibration and the idle speed should be high enough to maintain idling oil pressure and to preclude any possibility of engine stoppage in flight when the throttle is closed.

b. Advance throttle to increase engine speed to approximately 1000 RPM.
c. Pull mixture control knob slowly and steadily toward the idle cut-off position, observing tachometer, then return control full IN (RICH) position before engine stops.
d. Adjust mixture adjusting screw at upper end of carburetor intake throat to obtain a slight and momentary gain of 25 RPM maximum at 1000 RPM engine speed as mixture control is moved from full IN (RICH) toward idle cut-off position. Return control to full IN (RICH) to prevent engine stoppage.
e. If mixture is set too LEAN, engine speed will drop immediately, thus requiring a richer mixture. Turn adjusting screw OUT (counterclockwise) for a richer mixture.
f. If mixture is set too RICH, engine speed will increase above 25 RPM, thus requiring a leaner mixture. Turn adjusting screw IN (clockwise) for a leaner mixture.

NOTE

After each adjustment to the idle mixture, run engine up to approximately 2000 RPM to clear engine of excess fuel to obtain a correct idle speed.

11-47. INDUCTION AIR SYSTEM.

11-48. DESCRIPTION. Ram air enters the induction air system through an intake port and a filter on the left aft side of the cowling, and is ducted to the airbox near the firewall. From the induction airbox the filtered air is ducted to the inlet of the carburetor mounted on the lower aft end of the engine, through the carburetor, where the fuel is mixed with the air to the intake

manifold. From the intake manifold, the fuel-air mixture is distributed to each cylinder by separate intake pipes. The intake pipes are attached to the manifold with hoses and clamps and to the cylinder with a four bolt flange sealed with a gasket. A butterfly valve, located in the airbox, may be operated manually from the cabin to permit the selection of either cold or heated air. When the induction air door is closed, heated air is drawn from a shroud on the left exhaust stack assembly.

11-48A. INSTALLATION OF INDUCTION AIR SYSTEM DUCTS. When cutting induction air system ducts to length, the support wire should be cut back far enough to bend back (minimum bend radius, 1/8 inch) under the clamp and protrude 1/4 inch. Do not break the bond between the wire and the fabric. Before tightening clamps, make sure there is no twist or torque on the duct. If the duct is supported with MIL-Y-1140 cord in place of wire, the preceding installation applies except: MIL-Y-1140 cord has no minimum bend radius requirements. The minimum installed bend radii for wire-supported ducts in plane of bend, measured from the wall of the duct, are as follows:

a. Neoprene - one ply, 1/4 diameter of the maximum duct dimension.
b. Neoprene - two ply, and silicone one ply, 1/3 diameter of the maximum duct dimension.
c. Silicone - two ply, 1/2 diameter of the maximum duct dimension.

NOTE

Duct carrying filtered induction air may not have local areas hand-formed to a different cross section.

11-49. AIRBOX.

11-50. REMOVAL AND INSTALLATION.

a. Remove upper left engine cowl in accordance with paragraph 11-3.
b. Disconnect flexible duct from forward end of airbox.
c. Disconnect flexible duct from carburetor adapter assembly.
d. Disconnect carburetor heat control arm on the forward side of the airbox and remove clamp securing control to the airbox.
e. Remove screw attaching upper airbox support to firewall stiffener.
f. Remove four screws and washers attaching airbox to the firewall and carefully remove airbox.
g. Reverse the preceding steps for reinstallation. Rig carburetor heat control in accordance with paragraph 11-72.

11-51. CLEANING AND INSPECTION. Clean metal parts of the induction airbox with Stoddard solvent or equivalent. Inspect for cracks, dents, loose rivets, etc. Minor cracks may be stop-drilled. In case of continued or severe cracking, replace airbox. Inspect gaskets and install new gaskets, if damaged. Check manually-operated air door for ease of operation and proper rigging.

11-52. INDUCTION AIR FILTER.

11-53. DESCRIPTION. An induction air filter, mounted on the induction airbox on the left aft side of the engine compartment, removes dust particles from the ram air entering the engine.

11-54. REMOVAL AND INSTALLATION.

a. Release the four quick-release fasteners securing the filter assembly to the airbox.
b. Reverse the preceding step for reinstallation.

11-55. CLEANING AND INSPECTION. Clean and inspect filter in accordance with instructions in Section 2.

NOTE

If air filter gasket becomes loose, bond with EC-1300L or equivalent.

11-56. IGNITION SYSTEM.

11-57. DESCRIPTION. The ignition system is comprised of dual magnetos in one housing, two spark plugs in each cylinder, an ignition wiring harness, an ignition switch mounted on the instrument panel and required wiring between the ignition switch and magnetos.

11-58. TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE FAILS TO START.	Defective ignition switch.	Check switch continuity. Replace if defective.
	Spark plugs defective, improperly gapped or fouled by moisture or deposits.	Clean, regap and test plugs. Replace if defective.
	Defective ignition harness.	If no defects are found by a visual inspection, check with a harness tester. Replace defective parts.
	Magneto "P" lead grounded.	Check continuity. "P" lead should not be grounded in the ON position, but should be grounded in OFF position. Repair or replace "P" lead.
	Failure of impulse coupling.	Impulse coupling pawls should engage at cranking speeds. Listen for loud clicks as impulse couplings operate. Remove magnetos and determine cause. Replace defective magneto.
	Defective magneto.	Refer to paragraph 11-64.
	Broken drive gear.	Remove magneto and check magneto and engine gears. Replace defective parts. Make sure no pieces of damaged parts remain in engine or engine disassembly will be required.

11-58. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE WILL NOT IDLE OR RUN PROPERLY:	Spark plugs defective, improperly gapped or fouled by moisture or deposits.	Clean, regap and test plugs. Replace if defective.
	Defective ignition harness.	If no defects are found by a visual inspection, check with a harness tester. Replace defective parts.
	Defective magneto.	Refer to paragraph 11-64.
	Impulse coupling pauls remain engaged.	Listen for loud clicks as impulse coupling operates. Remove magneto and determine cause. Replace defective magneto.
	Spark plugs loose.	Check and install properly.

11-59. MAGNETOS.

11-60. DESCRIPTION. The Bendix D-2000 series magneto consists of two electrically independent ignition circuits in one housing. A single four pole rotor provides the magnetic energy for both circuits. The magneto uses an impulse coupling to provide reliable ignition at engine cranking speed. Suppression of breaker contact point arcing is accomplished by feed-thru type capacitors mounted in the magneto cover which forms a part of the magneto harness assembly.

11-61. REMOVAL AND INSTALLATION.

WARNING

The magneto is in a SWITCH ON condition when the switch wire is disconnected. Therefore, ground the breaker contact points or disconnect the high-tension wires from magneto to spark plugs.

a. Remove engine cowling in accordance with paragraph 11-3.
b. Remove the eight screws securing the high-tension outlet cover to the magneto. The "P" leads may be disconnected for additional clearance if necessary.

NOTE

It is a good practice to position No. 1 cylinder at its approximate advanced firing position before removing the magneto.

c. Remove nuts, washers and clamps attaching the magneto to the engine accessory housing. Note the approximate angular position at which the magneto is installed, then remove the magneto.
d. Reverse the preceding steps for reinstallation and time magneto-to-engine in accordance with paragraph 11-63.

11-62. INTERNAL TIMING. (MAGNETO REMOVED FROM ENGINE.)

NOTE

A magneto, correctly timed internally, will have the red painted tooth of the large distributor gears approximately centered in the timing windows, the L ("E" gap) mark on the rotor shaft in alignment with the pointer and both sets of breaker contacts opening, all at the same time.

a. Remove breaker contact point assembly cover, if installed, by removing the cover screws, pulling cover directly aft away from housing and disconnecting both capacitor leads from breaker contact assemblies.
b. Remove timing inspection hole plugs from magneto.
c. Slowly turn the rotor shaft until the red painted tooth of the large distributor gear for each side is approximately centered in the inspection windows with the L("E" gap) mark on the rotor aligned with the pointer. Lock the rotor in this EXACT position using Bendix Rotor Holding Tool, Part No. 11-8465 or equivalent.

NOTE

Position the 11-8465 Rotor Holding Tool on drive end of rotor shaft in the 4 o'clock position so that any shaft deflection caused by clamping action will be in a plane parallel to the breaker contacts.

d. Connect the timing light (Bendix Part No. 11-9110 or equivalent) black lead to any unpainted surface of the magneto. Connect the red lead to the left breaker contact terminal and the green lead to the right breaker contact terminal.
e. Carefully adjust the LEFT breaker contacts to just begin to open (light will go out) with the timing pointer within the width of the L ("E" gap) mark.
f. Repeat step "e" for the RIGHT breaker contacts.
g. Loosen the rotor holding tool and turn rotor shaft in normal direction of rotation until cam followers of contact assemblies are on the high point of cam lobes. Contact point clearance should be 0.016±0.002 inch and 0.016±0.004 inch on LEFT and RIGHT contacts respectively. If dimensions do not fall within limits, readjust contact points and recheck to be sure the points just begin to open when the timing pointer is within the width of the L ("E" gap) mark.

NOTES

Wire feeler gages are recommended when checking contact point clearance.

No attempt should be made to stone or dress contact points.

If the above conditions are met and within the tolerance, the magneto is timed internally and ready for installation. If the above conditions are not within tolerance, proceed to step "h".

h. While holding the rotor shaft, loosen the screw securing breaker contact cam to rotor shaft and back screw out approximately half way. Place the end of a broad bladed screwdriver between the bottom of the cam and housing. Strike the screwdriver handle with a sharp downward blow to "pop" the cam loose from taper of shaft.
i. Rotate cam until breaker contact cam followers are on the high point of cam lobes. Adjust breaker points to obtain a clearance of 0.016±0.004 inch on LEFT and RIGHT contacts respectively. Tighten breaker contact securing screws to 20-25 lb-in.
j. Repeat step "c."
k. While holding rotor shaft in this EXACT position, rotate the breaker contact cam in the opposite direction of rotation a few degrees BEYOND where the breaker contacts close, then rotate cam in the normal direction of rotation until the breaker contacts just begin to open. Point opening should be determined by the use of a timing light. (Bendix Part No. 11-9110 or equivalent.)
l. While holding cam in this EXACT POSITION, push cam on rotor shaft as far as possible with the fingers. Tighten cam securing screw thereby drawing the cam down evenly and tightly. Torque cam securing screw to 16-20 lb-in.

NOTE

Extreme care must be exercised in this operation. If cam adjustment is changed in the slightest degree, the timing of the magneto will be thrown off. Do not drive cam on rotor shaft with a mallet or other instrument.

m. Recheck timing to make sure both sets of breaker contacts begin to open within the width of the L ("E" gap) mark and that the contact point clearance is in accordance with dimensions in step "g".

NOTE

When reinstalling the inspection hole plugs, make sure the ventilated plugs are installed in the ends of the magneto. Torque plugs to 12-15 lb-in.

11-63. MAGNETO-TO-ENGINE-TIMING. The magneto must be installed with its timing marks carefully aligned, with number one cylinder on its compression stroke and with the number one position at its advanced firing position. Refer to paragraph 11-14 for the advanced firing position of number one piston. To locate the compression stroke of the number one cylinder, remove the lower spark plug from number 2, 3, 4, 5, and 6 cylinders. Remove the upper spark

plug from number 1 cylinder. Place the thumb of one hand over the spark plug hole of number one cylinder and rotate crankshaft in the direction of normal rotation until the compression stroke is indicated by positive pressure inside the cylinder lifting the thumb off the spark plug hole. After the compression stroke is attained, locate number one piston at its advanced firing position. Locating the advanced firing position of number one piston may be obtained by rotating the crankshaft opposite to its normal direction of rotation until it is approximately 30 degrees before top dead center (BTC) on the compression stroke of number one cylinder. Rotate crankshaft in a normal direction to align the timing mark on the front face of the starter ring gear support with the drilled hole in the starter, making sure the final motion of the ring gear is in the direction of normal rotation.

NOTE

An accurate top center indicator which screws into a spark plug mounting hole, and a pendulum pointer mounted on a 360-degree timing disc may also be used to locate the advanced firing position. The timing disc should be adapted to fit over the end of the propeller spinner in such a manner that it may be rotated as necessary. In all cases, it must be definitely determined that the number one cylinder is at the correct firing position and on the compression stroke when the engine is turned in its normal direction of rotation.

After the engine has been placed in the correct firing position, install the magneto to the engine in the following manner:

a. Remove the timing window plug from the most convenient side of the magneto housing.
b. Remove the rotor viewing location plug from the top center of the housing.
c. Turn the rotating magnet drive shaft in the normal direction of magneto rotation until the red painted tooth of the large distributor gear is centered in the timing hole (hole at each side of magneto).
d. Also observe at this time that the built in pointer just ahead of the rotor viewing window aligns with the L ("E" gap) mark on the rotor.
e. Install the magneto-to-engine gasket on the magneto flange.

WARNING

Do not attach harness spark plug leads to the spark plugs until all magneto-to-engine timing procedures are completed and the switch leads ("P" leads) are connected.

f. Remove the engine-to-magneto drive gear train backlash by turning magneto drive opposite to normal rotation as far as possible.
g. With the No. 1 cylinder at its correct firing position and on the compression stroke, hold the magneto as close to its No. 1 firing position as possible (red tooth in center of window and pointer over L("E" gap) mark on rotor and install magneto to the engine. Loosely tighten magneto in position.

NOTE

To facilitate connection of a timing light to the switch lead ("P" lead) terminals, short adapter leads may be fabricated. These can be made by using two switch lead terminals and two short pieces of insulated wire. Install the fabricated adapter leads in the switch lead outlet terminals of the cover.

h. Attach the red lead of the timing light (Bendix Part No. 11-9110 or equivalent) to the left switch lead adapter, the green lead of the timing light to the right switch lead adapter and the black lead of the timing light to the magneto housing (common ground).

NOTE

An internal timing tolerance is allowed when adjusting the two main breakers. Therefore, one of the main breakers may open slightly before the other. Magneto-to-engine timing should be accomplished using the first main breaker to open as the reference point when the engine is in the firing position for No. 1 cylinder. This will ensure that ignition created by either spark plug will not occur prior to the desired engine firing point.

i. Turn the entire magneto in direction of rotor rotation until the timing lights are on.
j. Turn magneto in direction of rotor rotation, right-hand rotation to right and left-hand rotation to left, until one of the timing lights just goes off. Then tighten the magneto mounting clamps evenly in this position.
k. Back the engine up approximately 10° and then carefully "bump" the engine forward while observing the timing lights.
l. At the No. 1 cylinder firing position, one of the timing lights should go off. Continue turning the engine in its normal direction of rotation until the other timing light goes off. This should be not more than 3 engine degrees later than the first light. If not. repeat steps "i" thru "k" until these conditions are obtained.
m. Make sure the magneto clamps are tightened securely, recheck timing once more and remove timing equipment.
n. Reinstall inspection plugs and torque plugs to 12-15 lb-in.

11-64. MAINTENANCE. At the first 25-hour inspection, first 50-hour inspection, first 100-hour inspection and thereafter at each 100-hour inspection, the contact breaker point compartment and magneto-to-engine timing should be inspected and checked. If magneto-to-engine timing is correct within plus zero and minus two degree, internal timing need not be checked. If timing is out of tolerance, remove magneto and set internal timing (paragraph 11-62), then install and time to engine.

NOTE

If engine operating troubles develop which appear to be caused by the ignition system, it is advisable to check the spark plugs and ignition harness first before working on the magnetos. If the trouble appears definitely associated with a magneto, the following may be used to help disclose the source of trouble without overhauling the magneto.

a. Moisture check.
   1. Remove contact breaker point assembly cover and inspect cover, cables and capacitor for moisture in the area.
   2. Inspect distributor block high tension outlets for moisture.
   3. If any moisture is evident, lightly wipe with a soft, dry, clean, lint-free cloth.

CAUTION

Do not use gasoline or any other solvent, as these will remove the wax coating on some parts and cause an electrical leak.

b. Breaker contact compartment check.
   1. Check all parts of the contact breaker assembly for security. Check distributor block high-tension outlet springs for evidence of spark erosion and proper height. The end of spring should not be more than 0.422 inch from top of tower.
   2. Check breaker contact assembly points for excessive wear, burning, deep pits and carbon deposits. Breaker points may be cleaned with a hard finish paper. If breaker points are found defective, install a new assembly. Make no attempts to stone or dress breaker points. Clean new breaker points with clean unleaded gasoline and hard finish paper before installing.
   3. Check condition of the cam follower felt. Squeeze felt between thumb and finger. If fingers are not moistened with oil, re-oil using 2 or 3 drops of lubricant (Bendix Part No. 10-86527 or equivalent). Allow approximately 30 minutes for felt to absorb the lubricant. Blot off excess lubricant with a clean, lint-free cloth. Too much lubricant could foul breaker points and cause excessive burning.
   4. Check capacitors for looseness in the magneto cover of the harness assembly and for any physical damage. If equipment is available, check the capacitors for leakage, series resistance and capacitance. The capacitance should be 0.34 to 0.41 microfarads.

NOTE

Spring in capacitor outlet may cause an indication of a short to ground if an adapter lead is not used.

c. If the trouble has not been corrected after accomplishing the moisture and breaker contact compartment check, check magneto-to-engine timing in accordance with paragraph 11-63. If timing is incorrect, remove magneto and adjust internal timing in accordance with paragraph 11-62.
d. Reinstall magneto and time to engine in accordance with paragraph 11-63.
e. If the trouble has not been corrected, magneto overhaul or replacement is indicated.

11-65. MAGNETO CHECK.
   a. Start and run engine until the oil and cylinder head temperatures are in the normal operating ranges.
   b. Advance engine speed to 1700 RPM.
   c. Turn the ignition switch to the "R" position and note the RPM drop, then return the switch to the "BOTH" position to clear the opposite set of plugs.
   d. Turn the switch to the "L" position and note the RPM drop, then return the switch to the "BOTH" position.

e. The RPM drop should not exceed 175 RPM on either magneto setting or show greater than 50 RPM differential between magneto settings. A smooth RPM drop-off past normal is usually a sign of a too lean or too rich mixture. A sharp RPM drop-off past normal is usually a sign of a fouled plug, a defective harness lead or a magneto out of time. If there is doubt concerning operation of the ignition system, RPM checks at a leaner mixture setting or at higher engine speeds will usually confirm whether a deficiency exists.

NOTE

An absence of RPM drop may be an indication of faulty grounding of one side of the ignition system, a disconnected ground lead at magneto or possibly the magneto timing is set too far in advance.

11-66. SPARK PLUGS. Two 18-mm spark plugs are installed in each cylinder and screw into helicoil type thread inserts. The spark plugs are shielded to prevent spark plug noise in the radios and have an internal resistor to provide longer terminal life. Spark plug life will vary with operating conditions. A spark plug that is kept clean and properly gapped will give better and longer service than one that is allowed to collect lead deposits and is improperly gapped.

NOTE

Refer to Section 2 for inspection interval. Remove, clean, inspect and regap all spark plugs at each inspection. Install lower spark plugs in upper portion of cylinders and install upper spark plugs in lower portion of cylinders. Since deterioration of lower spark plugs is usually more rapid than that of the upper spark plugs, rotating helps prolong spark plug life.

11-67. ENGINE CONTROLS.

11-68. DESCRIPTION. The throttle, mixture and carburetor heat controls are of the push-pull type. The mixture control is equipped to lock in any position desired. To move the control, the spring-loaded button, located in the end of the control knob, must be depressed. When the button is released, the control is locked. The mixture control also has a vernier adjustment. Turning the knob in either direction will change the control setting. The vernier is primarily for precision control setting. The throttle control has neither a locking button nor a vernier adjustment, but contains a knurled friction knob which is rotated for more or less friction as desired. The friction knob prevents vibration induced "creeping" of the control. The carburetor heat control has no locking device.

11-69. RIGGING. When adjusting any engine control, it is important to check that the control slides smoothly throughout its full range of travel, that it locks securely if equipped with a locking device and the arm or lever it operates moves through its full arc of travel.

CAUTION

Whenever engine controls are being disconnected, pay particular attention to the EXACT position, size and number of attaching washers and spacers. Be sure to install attaching parts as noted when connecting controls.