

## SECTION VII

# OPERATING INSTRUCTIONS

### 7-1. PROCEDURE PRELIMINARY TO STARTING

Place engine controls in following positions:

- a. Ignition Switch: "OFF".
- b. Parking Brakes: Set.
- c. Throttle: Wide open.
- d. Mixture Control: "FULL RICH".
- e. Carburetor Heat: "COLD".

Turn the propeller through four or five revolutions.

### 7-2. STARTING PROCEDURE

Perform the following operations in the order named:

- a. Close throttle, if open.
- b. Turn fuel supply valve "ON" a full tank.
- c. Unless engine is still hot, prime one to four strokes with hand primer, depending on air temperature.
- d. Open throttle slightly.
- e. Turn ignition switch to "ON".
- f. Close master switch (-12, -14, -16 and O-200 models).
- g. Start -8 models by pulling propeller through a compression stroke. Start -12, -14, -16 and O-200 models by engaging electric starter.

#### CAUTION

Never engage the electric starter while the propeller is turning. Gear teeth will be chipped if this rule is violated.

In cold weather prime the engine as it starts, and continue to prime only enough to keep the engine running until it will run smoothly on the normal mixture. If the engine cannot be started after several attempts, refer to Section VIII for possible causes.

### 7-3. WARM-UP

As soon as the engine starts, adjust throttle to obtain approximately 800 R.P.M., and observe the following precautions:

- a. Watch oil pressure gauge closely. If no pressure is indicated within 30 seconds, stop the engine, and determine the cause.
- b. Do not allow engine speed to exceed 800 R.P.M. during the first minute. Cold oil will not circulate rapidly enough for adequate lubrication at higher speeds.
- c. Leave carburetor mixture control in "RICH" position for all ground running.
- d. Open throttle gradually until the engine is running at approximately 1200 R.P.M. Do not exceed this speed until oil temperature has reached 75° F.
- e. Avoid prolonged running on the ground. Engine cylinders do not receive enough cooling air flow unless the aircraft is moving forward at high speed.

### 7-4. GROUND TEST

When ready to take-off, set parking brakes and check the following:

- a. Mixture control: "FULL RICH"
- b. Oil pressure at full throttle: 30-60 p.s.i.
- c. Oil temperature (minimum): 75 ° f.

- d. Decrease in speed when ignition switch is turned from "BOTH" to "L" or from "BOTH" to "R". Maximum 75 R.P.M.
- e. Carburetor air heat: Move control to full "HOT" position, and observe decrease in engine speed if air heater and control are operating properly. Return control to full "COLD" position.

#### NOTE

Under some conditions, ice may form in the carburetor during ground test. It must be eliminated before take-off.

- f. Fuel supply valve: "ON", full tank.
- g. Propeller pitch control (if installed): High R.P.M.

#### 7-5. TAKE-OFF

Usually the throttle will be opened wide for take-off, however, it is possible to exceed the rated take-off speed of the engine if an automatic or controllable pitch propeller is improperly adjusted or if a fixed pitch propeller of sub-standard dimensions is installed. Rated take-off speed must not be exceeded at any time. With approved propeller in proper adjustment, the take-off speed will not be realized until the aircraft is nearly airborne. If a special take-off speed is specified for the engine model, it must not be maintained longer than one minute, in order to prevent overheating. It is advisable to reduce speed to the normal rating for the engine model as quickly after take-off as immediate obstacles are cleared.

#### 7-6. CLIMBING

Except in unusual situations, it is advisable to reduce engine speed below maximum and to restrict the angle of climb so as to maintain adequate air speed to assure proper cylinder cooling. This is particularly important in warm weather.

#### 7-7. LEVEL FLIGHT

When the desired cruising altitude has been reached, adjust the throttle (and propeller pitch control, if installed) to obtain the specified cruising R.P.M. With hydraulic controllable propellers,

reduce manifold pressure first with the pitch control: then reduce R. P. M. with the throttle. During flight, observe the following procedures and precautions:

- a. If a Stromberg carburetor is installed leave mixture control in the "FULL RICH" position at altitudes less than 5000 ft. above sea level. If a Marvel-Schebler carburetor is installed the mixture control may be adjusted to obtain best rich power at any cruising altitude.
- b. To obtain best rich power, move the mixture control toward the "LEAN" position, and watch the tachometer closely to detect any change in engine speed. If speed decreases or remains unchanged return the control to the "FULL RICH" position. However, as the control is moved to lean mixture an increase in speed will ordinarily result if an automatic enrichment has occurred, due to decreased air pressure. Further control movement will cause a decrease in speed. When the position of maximum speed has been found, return the control toward "RICH" position until engine R.P.M. decreases just perceptibly. This setting produces the best power obtainable under existing atmospheric conditions with a slightly rich mixture to prevent overheating.
- c. If the mixture control is in any but "FULL RICH" position change the setting, as described in paragraph 7-7b., for each change in altitude or power setting. If a Stromberg carburetor is installed return the mixture control to the "FULL RICH" position before letting down below an altitude of 5000 feet.
- d. The carburetor air heat control should be in the "COLD" position unless icing conditions are encountered. Formation of ice in the carburetor is indicated by a loss in R.P.M. (usually progressive). To overcome ice formation, first apply full heat to melt the ice which has formed; then close the hot air valve in small steps until only enough heat is applied to prevent further ice formation.
- e. Observe engine oil temperature and pressure frequently. Unless other temperature and pressure gauges are installed, these indications

will give the first warning of trouble. If a rapid or continuous rise in oil temperature or drop in oil pressure is noticed the aircraft should be landed without delay and the cause determined.

#### 7-8. LET-DOWN AND LANDING

Before the throttle is retarded, place the mixture control in the "FULL RICH" position. During let-down and final approach:

- a. Retard throttle to obtain approximately 1200 R. P. M.
- b. The mixture control must be in "FULL RICH" position prior to landing. If a long glide is made, it is good practice to "gun" the engine periodically to clear the cylinders and retain engine temperatures so that the engine will remain ready for instant use.
- c. Carburetor heat is available only when engine output is well above that for idle; therefore, the carburetor heat control should be applied before closing the throttle and "off" after closing the throttle so that full power will be available if required in an emergency.

#### CAUTION

Do not open a carburetor throttle abruptly after idling in flight. To do so may cause the engine to stop. If the engine tends to stop while gliding with closed throttle, the idling mixture should be readjusted. If the engine stops when throttle is opened suddenly, return the throttle to the closed position and open slowly or operate the primer for one or two strokes.

#### 7-9. STOPPING THE ENGINE

- a. Normally the engine will have cooled sufficiently during the glide and taxiing period to permit placing the ignition switch in the off position without additional idling. If taxi time has been excessive, operate the engine at 800-100 RPM for two or three minutes before stopping.

- b. If the engine is equipped with a Stromberg NA-S3A1 carburetor, stop the engine from idling speed by turning the ignition switch to "OFF". As the engine stops open the throttle rapidly and leave it open to prevent after firing. If the carburetor is a Marvel-Schebler MA-25SPA, stop the engine by moving the mixture control to the "full lean" position, where it acts as an idle cut-off. Do not open the throttle, because it actuates the accelerator pump and rapid opening will flood the engine.

#### 7-10. LUBRICATING OIL

Teledyne Continental Aircraft Engines are certificated on straight mineral oil. Detergent oils are not a requirement. It is recognized that for engine operation in extreme ambient temperature ranges of high or low temperatures, detergent oils show advantages of coping with sludge, varnish and carbon formation in the engine, and improved performance can be obtained for aircraft operating under these adverse conditions. For obvious reasons, we do not propose to indulge in testing of any oils to ascertain whether or not they meet our specifications MHS-24B. The proof of compliance rests with the oil manufacturer. Recommendations relative to transition from a straight mineral oil to a detergent oil, as outlined in Federal Aviation Administration "Power Plant Branch Report No. 1" titled "Evaluation of Aircraft Engine Fuels and Lubricating Oils", apply to the use of Specification MHS-24B detergent oil. It is safest and simplest to begin use of this oil when the engine is new or just major overhauled. However, if an engine has been using straight mineral oil for a considerable period of time, and it is desired to change MHS-24B oil, it is generally agreed that the oil should be drained after five or ten hours of operation and the condition of the oil screen checked. If an abnormal amount of sludge is found, the oil should be changed and the screen should be checked at approximately five hour intervals, until the condition of the screen appears normal. Teledyne Continental Motors approves the use of only those detergent oils meeting oil specifications MHS-24B.

#### 7-11. VISCOSITY

Viscosity grades of oil, as listed in Table XVIII, should be used in season, according to the prevailing air temperature. In extremely cold weather it is advisable to drain the oil sump immediately after

stopping for a long period and to warm the oil to 100° F. before refilling the sump. To prevent excessive cooling of the oil sump and excessively high oil viscosity in cold weather, the sump may be covered with an oil-proof lagging.

7-12. OIL CHANGE PERIODS

Under normal operating conditions, engine sumps should be drained and refilled with fresh oil after each 30 hours of operation. Condition of oil and oil screen after this period will determine whether the operating time between oil changes should be altered to suit local conditions. Under adverse conditions of dust and humidity, the operating period may need to be reduced to 20 hours.

7-13. OIL CHANGE PROCEDURE

Always drain engine oil immediately after warming up the engine to obtain an oil temperature of 100° F. Place a clean container under the sump. Remove the drain plug, and allow the old oil to drain

completely. When it is reinstalled, use a new copper-asbestos gasket and safety with lockwire. Remove and inspect the oil screen. If the screen contains heavy sludge deposits or if the drained oil is highly diluted, more frequent oil changes will be advisable. If many or large metallic particles are found on the screen or in the drained oil (except machinings in new engines) the engine is in need of overhaul. Clean the screen in unleaded gasoline. Replace it with a serviceable gasket; tighten the cap securely, and install lockwire. Replace the oil temperature capillary. Refill the sump with fresh oil to the gauge "FULL" mark.

7-14. ENGINE FUEL

These engines are designed to operate efficiently on gasoline of aviation quality with octane ratings at least equal to those specified in Table XIII. Tetraethyl lead content should not exceed 1/2 cc. per gallon. The fuel should be free from water and as free as possible from solid particles.

TABLE XVIII RECOMMENDED OIL VISCOSITY GRADES

|                         |               |               |
|-------------------------|---------------|---------------|
| AMBIENT AIR TEMPERATURE | Below 40° F.  | Above 40° F   |
| OIL VISCOSITY GRADE     | S.A.E. No. 20 | S.A.E. No. 40 |

When average ambient air temperature is approximately at the dividing line of the above temperature ranges, use the lighter oil.