CHAPTER 4
UNPACKING, INSTALLATION, TESTING AND REMOVAL

Section Index

4-1 UNPACKING

Packaging Category "A" (Cardboard Container)

1. Cut steel banding straps securing the container. (Use caution as straps may spring loose when cut.)

2. Remove the staples from the base of the cardboard cover.

3. Lift cardboard cover vertically and remove.

4. Attach a hoist to the engine lifting eye, located at the top of the crankcase backbone. Take up slack on the hoist, then cut the steel banding straps holding the engine to the base.(Use caution as straps may spring loose when cut.) Lift the engine vertically and install on a transportation stand or dolly.

Packaging Category "B" (Wooden Container)

1. Remove the four (4) lag screws attaching the wooden cover to the base.

2. Lift the wooden cover vertically and remove.

3. Open the moisture proof plastic bag.

4. Attach a hoist to the engine lifting eye located at the top of the crankcase backbone.Take up slack on the hoist, prior to loosening the engine mount bolts; then remove the bolts from the shipping shock mounts.Lift the engine vertically and install on a transportation stand or dolly.

4-2 PREPARATION FOR SERVICE

If the engine is not to be installed within five (5) days after unpacking, must be represerved in accordance with procedures listed in Chapter 10.

If the engine is to be installed within five (5) days after unpacking, remove the shipping plugs installed in the lower spark plug holes and turn the crankshaft through at least two complete revolutions in order to remove the cylinder preservation oil from the cylinders. Remove the shipping plugs installed in the upper spark plug holes and inspect the cylinder bores with a borescope for rust or contamination. Contact your Teledyne Continental Motors Distributor if any abnormal condition is noted.

Install the upper spark plugs finger tight and torque the lower spark plugs to 300-360 in. lbs. Do not lubricate spark plug threads prior to installation.

NOTE...Remove exhaust port protective plugs. Service the lubrication system with mineral (non-detergent) oil or Corrosion Preventive oil corresponding to MIL-C-6529 Type II. See Chapter 3 for sump capacity.

Remove the shipping plate from the propeller governor pad forward of number 6 cylinder. Lubricate the governor shaft splines with engine oil; install a new gasket and then install the propeller governor control. Attach with plain washers, new lock washer, and torque the nuts in accordance with governor manufactures specs.

CAUTION...Align spline of governor drive gear and assure that the governor is fully seated to the crankcase prior to installing the attaching hardware. This will eliminate the possibility of misalignment forcing the drive gear off location within the crankcase.

Optional Accessories: Optional accessories such as hydraulic pumps, vacuum pumps, etc., may be installed on the magneto and accessory drive pads located on the upper rear portion of the crankcase. Remove the accessory drive covers and install new gaskets. Install accessories in accordance with the airframe manufacturer's instructions.

Install all airframe manufacturer required cooling baffles, hoses, fittings, brackets and ground straps in accordance with airframe manufacturers installation instructions.

4-3 ENGINE INSTALLATION INSTRUCTIONS

Install per airframe manufacturers instructions and the following generalized instructions. Torque bolt as recommended by the airframe manufacturer. Safety bolt per airframe manufacture's instructions.

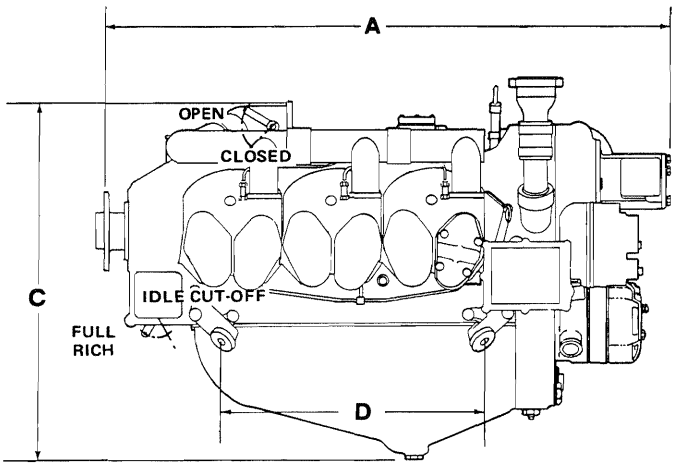
CAUTION...Remove all protective covers, plugs, caps and identification tags as each item is connected or installed.

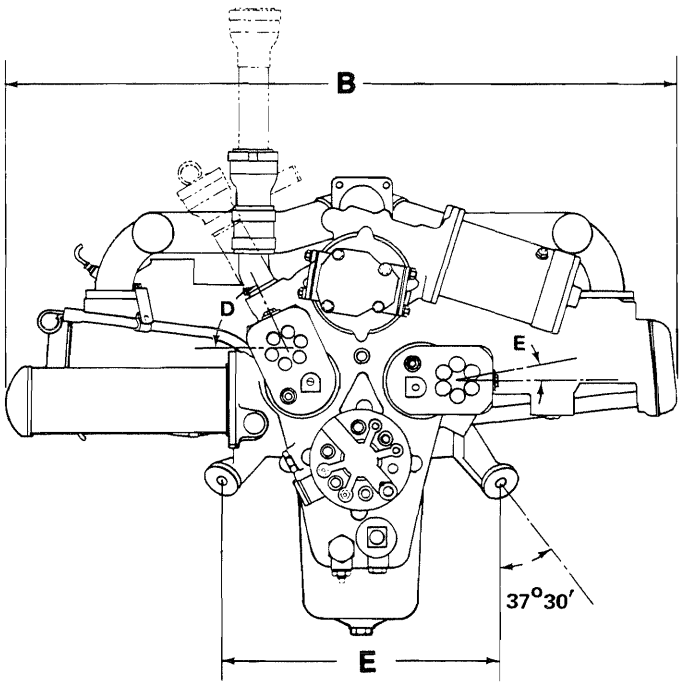
NOTE...See airframe manufacturer's instructions for engine to airframe connections.

CAUTION...The aircraft fuel tanks and lines must be purged to remove all contamination removed prior to installation in the main fuel inlet line to the fuel pump. Failure to comply can cause erratic fuel injection system operation and damage to its components.

CAUTION...Do not install the ignition harness "B" nuts on the spark plugs until the propeller installation is completed. Failure to comply could result in bodily injury when the propeller is rotated during installation.

Install the approved propeller in accordance with the airframe manufacturer's instructions.





DIMENSIONS					
MODEL	A	B	C	D	E
IO360,A,BB	34.03	31.40	22.43	16.33	13.47
C,CB	35.34	33.03	22.43	16.33	13.47
D,DB	34.03	33.03	22.43	16.33	13.47
G,GB	35.34	33.03	22.43	16.33	13.47
H,HB	35.34	33.03	22.43	16.33	13.47
J,JB	35.34	33.03	22.43	16.33	13.47
K,KB	35.34	33.03	22.43	16.33	13.47
ES	36.32	33.05	23.52	16.33	14.12

FIGURE 4-1. INSTALLATION DRAWING IO-360 SERIES

4-4 PREFLIGHT AND RUN-UP

The engine lubrication system must be pre-oiled prior to starting. This can be accomplished using a pressure oiling system installed into a main oil gallery or the oil pump. An acceptable alternate method is to use the engine starter to motor the engine with the spark plugs removed until an oil pressure indication is noted.

NOTE...Recheck the oil level in the sump if the pre-oiling method was used. Do not operate the engine with more or less than the oil sump capacity.

If the magneto attaching nuts were loosened or the magnetos rotated during engine installation, magneto to engine timing must be accomplished prior to starting.

Install and torque the upper spark plugs to 300-360 in. lbs. Install the ignition harness "B" nuts to the spark plugs in the order shown in Figure 2-2. "B" nuts are identified for position, i.e. "1T" for number one top spark plug, etc.

Start the engine in accordance with the Service Bulletin M89-7 R1 or subsequent revisions as applicable or the airframe manufacturer's operator's manual.

Unmetered and metered fuel pressures must be adjusted to specs prior to flight.

The engine has received a test cell run-in prior to leaving the factory, however, short flight test is recommended to assure that the piston rings have seated and that no induction system, exhaust system, oil or fuel system leaks exist prior to releasing the aircraft for normal service.

4-5 FLIGHT TESTING

Ambient air and engine operating temperatures are of major concern during this test flight. Accomplish a normal pre-flight run-up in accordance with the aircraft flight manual. Conduct a normal take-off with full power and monitor the fuel flow, RPM, oil pressure, cylinder head temperatures and oil temperatures. Reduce to climb power in accordance with the flight manual and maintain a shallow climb altitude to gain optimum airspeed and cooling. Rich mixture should be used for all operations except lean for field elevation, (where applicable), and lean to maintain smoothness during climb in accordance with airframe manufacturers operating instructions.

Level flight cruise should be at 75% power with best power or richer mixture for the first hour of operation. The second hour power settings should alternate between 65% and 75% power with the appropriate best power mixture settings.

The descent should be made at low cruise power settings,with careful monitoring of engine pressures and temperatures. Avoid long descents with cruise RPM and manifold pressure below 18" Hg.; if necessary decrease the RPM sufficiently to maintain manifold pressure.

Any abnormal conditions detected during test flight must be corrected and any final adjustments required must be accomplished prior to releasing the aircraft for normal service.

4-6 ENGINE REMOVAL INSTRUCTIONS

Identify each item as the item is disconnected from the engine to aid in reinstallation.

NOTE...If the engine is being removed to be placed in storage, accomplish steps listed in Chapter 10, in the section titled "Indefinite Storage" prior to removal.

1. Turn all cockpit switches and fuel selector valves OFF.
2. Disconnect the battery ground cable.
3. Disconnect the starter cable.
4. Tag and disconnect the engine wiring bundle from the following components.
    a. Magnetos
    b. Alternator
    c. Oil temperature bulb
    d. Cylinder head temperature bulb
    e. Remove all clamps attaching engine wire bundle to engine components and route clear of the engine.

Accomplish the following items:

1. Drain the engine oil from the sump. Replace drain plug and tighten.
2. Remove the propeller in accordance with airframe manufacturer's instruction.
3. Remove engine to airframe connections in accordance with airframe manufacturer's instructions.

Attach a hoist to the engine lifting eye and relieve the weight from the engine mounts.

CAUTION...Place a suitable stand under the aircraft tail cone before removing the engine. The loss of weight may cause the tail to drop.

Remove the engine mounts and engine as follows:

1. Hoist engine vertically out of the nacelle and clear of the aircraft.

   NOTE...Hoist engine slowly and make sure that all wires, lines and hoses have been disconnected.

2. Install engine on a transportation stand, dolly or on the engine shipping container base.

4-7 GROUND HANDLING

After engine is removed from aircraft or container (attached to hoist) proceed with care. Do not let engine front, rear, sides or bottom come in contact with any obstructions as the extreme weight may cause damage to the engine or components. If contact has occurred inspect for obvious or consequential damage.

4-8 CRATING AND SHIPPING

Preserve the engine in accordance with Chapter 10.

Category "A" (cardboard container). Lower engine onto container base and attach with metal banding straps. Install and attach container cover.

Category "B" (wooden container). Lower engine onto container base. Attach engine using shock mounts and bolts cover engine with plastic bag. Install and attach container cover to base.

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CHAPTER 5
NORMAL OPERATING PROCEDURES

Section Index

5-1 GENERAL

CAUTION...This section pertains to operation under standard environmental conditions. The pilot should thoroughly familiarize himself with Chapter 7, Abnormal Environmental Conditions. Whenever such abnormal conditions are encountered or anticipated, the procedures and techniques for normal operation should be tailored accordingly.

WARNING...Some model specs. are available with provisions for use with an airframe manufacturer furnished inverted flight oil system. Installation and qualification of the inverted flight oil system is the responsibility of the airframe manufacturer.

The engine received a run-in operation before leaving the factory. Therefore, no break-in schedule is required. Straight mineral oil or corrosion preventive oil MIL-C-6529 Type II per paragraph 3-3 should be used for the first oil change period (25 hours).The life of your engine is determined by the care it receives. Follow the instructions contained in this manual carefully.

The minimum grade aviation fuel for this engine is 100LL (Blue) or 100 (Green). If the minimum grade required is not available, use a higher rating. Never use a lower rated fuel.

WARNING...The use of a lower octane rated fuel can cause pre-ignition and/or detonation which can damage an engine the first time high power is applied, possibly causing engine failure. This could most likely occur on takeoff. If the aircraft is inadvertently serviced with the wrong grade of fuel, then the fuel must be completely drained and the tank properly serviced, prior to engine operation.

5-2 PRESTARTING

Before each flight the engine and propeller must be examined for damage, oil or fuel leaks, security and proper servicing.

1. Assure that fuel tanks contain proper type and quantity of fuel. (100LL-Blue, or 100 Green)
2. Drain all sumps and strainers in accordance with airframe manufacturers recommendations. If water or foreign matter is noted, continue draining until only clean fuel appears.
3. Check proper oil level in sump.

5-3 STARTING

Start engine in accordance with manufacturers instructions.

1. Fuel Selector - On proper tank.
2. Mixture - Full Rich.
3. Throttle - ¼ Open
4. Prop Control - Full Forward.
5. Master Switch - On.
6. Turn ignition switch to "BOTH".

WARNING...Overpriming can cause hydro static lock and subsequent engine failure.

7. Set auxiliary pump switch "ON" (or as instructed by aircraft manufacturer).

   CAUTION...If engine is hot, press starter button first, then turn auxiliary fuel pump switch "ON" (or as instructed by aircraft manufacturer).

8. When fuel pressure gage shows normal idle pressure (2 to 2.5 psi), engage starter.

   CAUTION...Release starter switch as soon as engine fires. never engage the starter while the propeller is still turning. If the starter has been engaged for 30 seconds, and the engine has not been started, release the starter switch and allow the starter motor to cool 3 to 5 minutes before another starting attempt is made.

9. After engine is running smoothly, turn auxiliary pump off (or as instructed by aircraft manufacturer).

10. Check oil pressure frequently. Oil pressure indication should be noted within 30 seconds in normal weather. If no pressure is noted within the specified time, stop the engine and investigate the cause.

5-4 COLD STARTS

Use the same procedure as for normal start, except that more prime will normally be necessary. After the engine begins running, it may be necessary to operate the primer intermittently for a few seconds in order to prevent the engine from stopping.

5-5 FLOODED ENGINE

1. Mixture Control - IDLE CUT-OFF.

2. Throttle - FULL OPEN.

3. Allow fuel to drain from intake tubes.

4. Magneto/Start Switch - START.

5. When engine starts, return the Magneto/Start switch to BOTH. Retard the throttle and slowly advance the mixture control to FULL RICH position.

5-6 HOT STARTS

Use the same procedure as for normal start.

5-7 GROUND WARM-UP

Teledyne Continental Motors aircraft engines are air cooled and are dependent on the forward speed of the aircraft for cooling. To prevent overheating, it is important that the following rules be observed.

1. Head the aircraft into the wind.

2. Operate the engine on the ground with the propeller in "Full Increase" RPM position.

3. Avoid prolonged idling at low RPM. Fouled spark plugs can result from this practice.

4. Leave mixture in "Full Rich". (See "Ground Operation at High Altitude Airports", Chapter 7 for exceptions.)

5. Warm-up 900-1000 RPM.

5-8 PRE-TAKEOFF CHECK

1. Maintain engine speed at approximately 900 to 1000 RPM for at least one minute in warm weather, and as required during cold weather, to prevent cavitation in the oil pump and to assure adequate lubrication.

2. Advance throttle slowly until tachometer indicates an engine speed of approximately 1200 RPM. Allow additional warm-up time at this speed depending on ambient temperature. This time may be used for taxiing to takeoff position. The minimum allowable oil temperature for run-up is 75°F.

   CAUTION...Do not operate the engine at run-up speed unless oil temperature is 75°F. minimum and oil pressure is within specified limits of 30-60 PSI.

   CAUTION...Operation of the engine at too high a speed before reaching minimum oil temperature may cause loss of oil pressure and engine damage.

3. Perform all ground operations with cowling flaps (if installed), full open, with mixture control in "FULL RICH" position, dependent on field elevation, and propeller control set for maximum RPM (except for brief testing of propeller governor).

4. Restrict ground operations to the time necessary for warm-up and testing.

5. Increase engine speed to 1700 RPM only long enough to perform the following checks:

   a. Check magnetos: Move the ignition switch first to "R" position and note engine RPM, then move switch back to "BOTH" position to clear the other set of spark plugs. Then move the switch to "L" position and note RPM. The difference between the two magnetos operated individually should not differ more than 50 RPM with a maximum drop for either magneto of 150 RPM. Observe engine for roughness during this check.

      WARNING...Absence of RPM drop when checking magnetos may indicate a malfunction in the ignition circuit. Should the propeller be moved by hand (as during preflight) the engine may start and cause injury to personnel. This type of malfunction must be corrected prior to continued operation of the engine.

      CAUTION...Do not underestimate the importance of pre-takeoff magneto check. When operating on single ignition, some RPM drop should be noted. Normal indications are 25-75 RPM drop and slight engine roughness as each magneto is switched off. An RPM drop in excess of 150 RPM may indicate a faulty magneto or fouled spark plugs.

      Minor spark plug fouling can usually be cleared as follows:

      (1) Magnetos - Both On.

      (2) Throttle - 2200 RPM

      (3) Mixture - Move toward idle cutoff until RPM peaks and hold for ten seconds. Return mixture to full rich.

      (4) Magnetos - Recheck.

      If the engine is not operating within specified limits, it must be inspected and repaired prior to continued operational service.

      Avoid prolonged single magneto operation to preclude fouling of the spark plugs.

b. Check throttle and propeller operation.

Move propeller governor control toward low RPM position and observe tachometer. Engine speed should decrease to minimum governing speed (200-300 RPM drop). Return governor control to high speed position. Repeat this procedure two or three times to circulate warm oil into the propeller hub.

Where applicable move propeller control to "feather" position. Observe for 300 RPM drop below minimum governing RPM, then return control to "full increase" RPM position.

CAUTION...Do not operate the engine at a speed in excess of 2000 RPM longer than necessary to test operation and observe engine instruments. Proper engine cooling depends upon forward speed of the aircraft. Discontinue testing if temperature or pressure limits are approached.

6. Instrument Indications.

WARNING...If any discrepancies are noted in instrument indications, identification of cause and correction of problem is required before takeoff.

a. Oil Pressure: The oil pressure relief valve will maintain pressure within the specified limits if the oil temperature is within the specified limits and if the engine is not excessively worn or dirty. Fluctuating or low pressure may be due to dirt in the oil pressure relief valve or congealed oil in the system.

b. Oil Temperatures: The oil cooler and oil temperature control valve will maintain oil temperature within the specified range unless the cooler oil passages or air channels are obstructed. Oil temperature above the prescribed limit may cause a drop in oil pressure, leading to rapid wear of moving parts in the engine.

c. Cylinder Head Temperature: Any temperature in excess of the specified limit may cause cylinder or piston damage. Proper cooling of cylinders depends on cylinder baffles being properly positioned on the cylinder heads and barrels, and other joints in the pressure compartment being tight so as to force air between the cylinder fins. Fuel and air mixture ratio will affect cylinder temperature. Excessively lean mixture causes overheating even when the cooling system is in good condition. High power and low air speed, or any slow speed flight operation, may cause overheating by reducing the cooling air flow. The engine depends on the ram air flow developed by the forward motion of the aircraft for proper cooling.

d. Battery Charging: The ammeter should indicate a positive charging rate until the power used for starting has been replaced by the battery charging circuit, unless the electrical load on the generator is heavy enough to require its full output, in which event the ammeter reading should return to the positive side as soon as the load is reduced. A low charging rate is normal after the initial recharging of the battery. A zero reading or negative reading with no battery load indicates a malfunction in the generator or regulator system.

5-9 POWER CONTROL

When increasing power, first increase the RPM with the propeller control and then increase manifold pressure with throttle. When decreasing power, throttle back to desired manifold pressure and then adjust to the desired RPM. Readjust manifold pressure after final RPM setting.

5-10 TAKEOFF

1. Set mixture to "FULL RICH" setting. Where installed, cowl flaps must be in the full open position.

The "ES" engine is equipped with an altitude compensating fuel pump which automatically provides the proper full rich mixture at any given altitude.

NOTE...For operation from fields at high altitudes, operation must be conducted with the mixture control leaned for maximum performance as defined by charts in the aircraft manual. The leaner mixture is required to eliminate engine roughness. Engines with an altitude compensating fuel pump (ES Model) are automatically leaned for this condition. The mixture control should be in the full rich position for these engines.

2. Advance the throttle to the maximum take-off manifold pressure (red-line on manifold pressure gage). The recommended power setting (RPM and manifold pressure) should never be exceeded. Monitor all engine instrumentation. The A,AB, J and JB model engines have a special take-off rating limited to five minutes at maximum take-off power; then power must be reduced to maximum cruise.

3. Set auxiliary pump switch as instructed by aircraft manufacturer.

   NOTE...With high temperature at ground level, a very low fluctuation in metered fuel pressure may appear in the early flight stages, which is caused by excess vapor.

   CAUTION...Cylinder head and oil temperatures must never be allowed to exceed the limitations specified. Near-maximum temperatures should occur only when operating under adverse conditions, such as high power settings, low airspeed, extreme ambient temperature, etc. If excessive temperatures are noted, and cannot reasonably be explained, or if abnormal cowl flap and/or mixture settings are required to maintain temperatures, then an inspection should be performed to determine the cause. Possible causes of high temperatures may include broken or missing baffles, inoperative cowl flaps, sticking oil temperature control unit, or restricted fuel nozzles jets (resulting in lean-running cylinders). Faulty instruments or thermocouples may cause erroneous high (or low) temperature indications. Refer to Chapter 9 of this manual and/or the aircraft overhaul manual for troubleshooting procedures.

5-11 CLIMB (In Accordance with Aircraft Manufactures Recommendations)

1. All high power climbs must be performed at "FULL RICH" mixture setting with cowl flaps, if provided, in the full open position.

2. During climb (immediately after takeoff), observe manifold pressure and retard throttle to stay below the 28.0 inch (29.5 inch for ES) maximum manifold pressure setting (red line).

3. At reduction from take-off power for climb, follow aircraft manufacturer's recommendation for fuel pressure at power setting.

5-12 CRUISE

1. Set manifold pressure and RPM for cruise power selected. Reset mixture control for "Best Power Setting" in accordance with the applicable fuel pressure or Fuel Flow vs Brake Horsepower curve.

2. After engine temperatures have stabilized at cruise condition (usually within 5 minutes), the mixture may be reset for a "Normal Lean".

   NOTE...An excessively lean mixture can lead to high cylinder temperatures and detonation which will result in burned pistons, glazed or scored cylinders and broken or stuck piston rings.

3. When an economy setting (step 2 above) is in use and a change in power setting is to be made, it is recommended that the mixture control be returned to approximately "Best Power Setting" before changing the throttle or propeller setting.

4. If it is necessary to retard the throttles at altitudes above approximately 10,000 ft., leaning of the fuel mixture may also be necessary to maintain satisfactory engine operation. The mixture must be returned to the richer setting before the throttle is returned to the high power position.

NOTE...If an exhaust gas temperature gage is used to monitor cruise mixture setting at 75% power and below, consult Service Bulletin M89-18 or current revision as applicable.

5-13 DESCENT

1. Set mixture control at "Best Power Setting" or richer, "Full Rich" for "ES" before reducing power for descent.

2. The mixture control must be set in "FULL RICH" position before entering the airport traffic pattern.

3. Operate the auxiliary pump as instructed by aircraft manufacturer.

4. Adjust power as desired and monitor all engine instrumentation.

WARNING...Rapid descents at high RPM and idle manifold pressure or long descents below 18" hg. or manifold pressure may cause intermittent oil consumption through the induction system, excessive piston ring land wear, or unsatisfactory acceleration due to spark plug fouling or extreme cooling.

If power must be reduced for long periods, adjust propeller to minimum governing RPM and set manifold pressure no lower than necessary to obtain desired performance. Outside air temperature is a factor which affects cylinder and oil temperatures, and in those cases of very cold temperatures it may be necessary to lean the mixture and/or add drag to the aircraft, according to the airframe manufacturer's recommendations, in order to maintain engine power without gaining excess airspeed so as not to let cylinder head and oil temperatures go below operational limits listed in detailed specifications in Section 1.

Do not permit cylinder temperature to drop below 300°F. for periods exceeding five (5) minutes.

5-14 LANDING

1. In anticipation of a go around and need for high power settings, the mixture control must be set in "FULL RICH" or "BEST POWER" position, depending on field elevation, before landing.

   NOTE...Advance mixture slowly toward 'FULL RICH". If engine roughness occurs, as may happen at very low throttle settings and high RPM, it may be desirable to leave the mixture control leaner than full rich until the throttle is advanced above 15 inches of manifold pressure.

2. Operate the auxiliary pump as instructed by the aircraft manufacturer.

5-15 ENGINE SHUTDOWN

1. If auxiliary pump has been on in landing, turn "OFF".

2. Place mixture control in "IDLE CUT-OFF".

3. Turn magneto "OFF".

WARNING...Do not turn the propeller while the ignition switch is in the "BOTH", "LEFT" or "RIGHT" position, because this could start the engine and cause injury. Do not turn the propeller on a hot engine, even though the ignition switch is in the "OFF" position, because the engine could "KICK" as a result of auto-ignition of a small amount of fuel remaining in the cylinders.

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CHAPTER 6
EMERGENCY PROCEDURES

Section Index

6-1 ENGINE FIRE DURING START

If flames are observed in the induction or exhaust system during engine starting, proceed as follows:

1. Mixture Control - Move to the idle cut-off position.
2. Throttle Control - Move to the full open position.
3. Starter Switch - Hold in the cranking position until fire is extinguished.
4. Evacuate aircraft if fire is not quickly contained.

6-2 GENERAL IN-FLIGHT INFORMATION

If a malfunction should occur in flight, certain remedial actions may eliminate or reduce the problem. Some malfunctions which might conceivably occur are listed in this section. Recommended corrective action is also included: however, it should be recognized that no single procedure will necessarily be applicable to every situation.

A thorough knowledge of the aircraft and engine systems will be an invaluable asset to the pilot in assessing a given situation and dealing with it accordingly.

6-3 ENGINE ROUGHNESS

Observe engine for visible damage or evidence of smoke or flame. Extreme roughness may be indicative of a propeller blade problem. If any of these characteristics are noted, follow aircraft manufacturer's instructions.

1. Mixture - Adjust as appropriate to power setting being used. Do not arbitrarily go to Full Rich as the roughness may be caused by an over rich mixture.
2. Magnetos - Check - on both.

If engine roughness does not disappear after the above, the following steps should be taken to evaluate the ignition system.

1. Throttle - Reduce power until roughness becomes minimal.
2. Magnetos - Turn Off, one magneto at a time. If engine smoothes out while running on single ignition, adjust power as necessary and continue. Do not operate the engine in this manner any longer than absolutely necessary. The airplane should be landed as soon as practical for engine repairs.

If no improvement in engine operation is noted while operating on either magneto alone, return all magneto switches to On.

CAUTION...The engine may quit completely when one magneto is switched off, if the other magneto is faulty. If this happens, close throttle to idle and move mixture to idle cutoff before turning magnetos on. This will prevent a severe backfire. When magnetos have been turned back on, advance mixture and throttle to previous setting.

WARNING...If roughness is severe or if the cause cannot be determined, engine failure may be imminent. In this case, it is recommended that the aircraft manufacturer's emergency procedure be employed. In any event, further damage may be minimized by operating at a reduced power setting.

6-4 HIGH CYLINDER HEAD TEMPERATURE

1. Mixture - Adjust to proper fuel flow for power being used.
2. Cowl Flaps - Open.
3. Airspeed - Increase.

It temperature cannot be maintained within limits, reduce power, land as soon as practical and have the malfunction evaluated and repaired before further flight.

6-5 HIGH OIL TEMPERATURE

NOTE...Prolonged high oil temperature indications will usually be accompanied by a drop in oil pressure. If oil pressure remains normal, a high temperature indication may be caused by a faulty gage or thermocouple. If the oil pressure drops as temperature increases, proceed as follows:

1. Cowl Flaps - Open.
2. Airspeed - Increase.
3. Power - Reduce if steps 1 and 2 do not lower oil temperature.

CAUTION...If these steps do not restore oil temperature to normal, an engine failure or severe damage can result. In this case it is recommended that the aircraft manufacturer's emergency instructions be followed.

6-6 LOW OIL PRESSURE

If the oil pressure drops without apparent reason from normal indication of 30 to 60 psi, monitor temperature and pressure closely. If oil pressure drops below 30 psi, an engine failure should be anticipated and the aircraft manufacturer's instructions should be followed.

6-7 IN-FLIGHT RESTARTING

WARNING...Actual shutdown of an engine for practice or training purposes should be minimized. Whenever engine failure is to be simulated, it should be done by reducing power.

The following procedure is recommended for in-flight restarting.

1. Mixture - Advance to 3/4 FULL RICH.
2. Fuel Selector Valve - On Proper Tank.
3. Fuel Boost Pump - Off.
4. Magneto Switches - ON BOTH.
5. Throttle - NORMAL START POSITION (Open 1").
6. Propeller - Low Pitch High RPM.

6-8 ENGINE FIRE IN-FLIGHT

1. Fuel Selector - Turn to the Off Position.
2. Mixture Control - Place in the Idle Cut-Off Position.
3. Throttle Control - Place in the Closed Position.
4. Propeller Control
   a. Non-Feathering Type Propeller - Full Decrease RPM Position.
   b. Feathering Type - Feather position position.
5. Magnetos - Place Both in the "OFF" position.
6. Follow air frame manufacturer's instructions for emergency/forced landing.

CHAPTER 7
ABNORMAL ENVIRONMENTAL CONDITIONS

Section Index

7-1 GENERAL

Three areas of operation require special attention, (a) extreme cold weather, (b) extreme hot weather and (c) high density altitude ground operation.

7-2 COLD WEATHER OPERATION (Ambient Temperature Below Freezing)

NOTE...Prior to operation and/or storage in cold weather assure engine oil viscosity is SAE 30, 10W30, 15W50 or 20W50.In the event of temporary cold weather operation,not justifying an oil change to SAE 30, consideration should be given to hangaring the aircraft between flights.

Engine starting during extreme cold weather is generally more difficult than during normal temperature conditions. Cold soaking causes the oil to become thicker (more viscous), making it more difficult for the starter to crank the engine. This results in a slow cranking speed and an abnormal drain on the battery capacity. At low temperatures, gasoline does not vaporize readily, further complicating the starting procedure.

False starting (failure to continue running after starting) often results in the formation of moisture on spark plugs due to condensation. This moisture can freeze and must be eliminated either by applying heat to the engine or removing and cleaning the spark plugs.

7-3 PREHEATING

The use of preheat and auxiliary power unit (APU) will facilitate starting during cold weather and is required when the engine has been cold soaked at temperatures of 25°F, and below in excess of 2 hours.

The following procedures are recommended for preheating, starting, warm-up, run-up and takeoff.

1. Select a high volume hot air heater. Small electric heaters which are inserted into the cowling opening do not appreciably warm the oil and may result in superficial preheating.

WARNING...Superficial application of preheat to a cold-soaked engine can cause damage to the engine.

A minimum of preheat application may warm the engine enough to permit starting but will not de-congeal oil in the sump, lines, cooler, filter, etc.

Congealed oil in such lines may require considerable preheat. The engine may start and apparently run satisfactorily, but can be damaged from lack of lubrication due to congealed oil in various parts of the system. The amount of damage will vary and may not become evident for many hours. On the other hand, the engine may be severely damaged and could fail shortly following application of high power.

Proper procedures require thorough application of preheat to all parts of the engine. Hot air should be applied directly to the oil sump and external oil lines as well as the cylinders, air intake and oil cooler. Excessively hot air can damage non-metallic components such as seals, hoses and drive belts, so do not attempt to hasten the preheat process.

2. Hot air should be applied primarily to the oil sump and filter area. The oil drain plug door or panel may provide access to these areas. Continue to apply heat for 15 to 30 minutes and turn the propeller, by hand, through 6 or 8 revolutions at 5 or 10 minute intervals.

3. Periodically feel the top of the engine and when some warmth is noted apply heat directly to the upper portion of the engine for approximately five minutes. This will provide sufficient heating of the cylinders and fuel lines to promote better vaporization for starting. If enough heater hoses are available, continue heating the sump area. Otherwise, it will suffice to transfer the source of heat from the sump to the upper part of the engine.

4. Start the engine immediately after completion of the preheating process. Before starting is attempted, turn the engine by hand or starter (mixture at idle cut off) until it rotates freely. After starting, observe carefully for high or low oil pressure and continue the warm-up until the engine operates smoothly and all controls can be moved freely. Operate cowl flaps as per airframe manufacturer's instructions.

   NOTE...Since the oil in the oil pressure gage line may be congealed, as much as 60 seconds may elapse before oil pressure is indicated. If oil pressure is not indicated within one minute, shut the engine down and determine the cause.

5. Operate the engine at 1000 RPM until some oil temperature is indicated. Monitor oil pressure closely during this time and be alert for a sudden increase or decrease. Retard throttle, if necessary to maintain oil pressure below 100 psi. If oil pressure drops suddenly to less than 30 psi, shut down the engine and inspect the lubrication system. If no damage or leaks are noted, preheat the engine for an additional 10 to 15 minutes before restarting. (Refer to Section 5-8 "Pre-Takeoff Check".)

6. Before takeoff, run up the engine to 1700 RPM. If necessary approach this RPM in increments to prevent oil pressure from exceeding 100 psi.

   At 1700 RPM, adjust the propeller control to Full Decrease RPM until minimum governing RPM is observed, then return the control to Full Increase RPM. Repeat this procedure three or four times to circulate warm oil into the propeller dome.

   NOTE...Continually monitor oil pressure during run up.

7. Check magnetos in the normal manner.

8. When the oil temperature has reached 100°F and oil pressure does not exceed 70 psi at 2500 RPM, the engine has been warmed sufficiently to accept full rated power.

   NOTE...Fuel flow will probably be on the high limit; however, this is normal and desirable since the engine will be developing more horsepower at substandard ambient temperatures.

Observe oil pressure for indication and warm-up engine at 1000 RPM. Ground operation and run up require no special techniques other than warming the engine sufficiently to maintain oil temperature and oil pressure within limits when full RPM is applied.

NOTE...Before applying power for takeoff, assure that oil pressure, oil temperature and cylinder head temperature are well within the normal operating range. When full power is applied for takeoff, assure that oil pressure is within limits and steady.

Any of the following engine conditions should be cause for concern, and are justification to discontinue the takeoff.

1. Low, high or surging RPM.

2. Fuel flow excessively high or low.

3. Any oil pressure indication other than steady within limits.

4. Engine roughness.

7-4 HOT WEATHER OPERATION (Ambient Temperature in Excess of 90°F)

CAUTION...When operating in hot weather areas, be alert for higher than normal levels of dust, dirt, or sand in the air. Inspect air filters frequently and be prepared to clean or replace them if necessary. Weather conditions can lift damaging levels of dust and sand high above the ground. If the aircraft is flown through such conditions, an oil change is recommended as soon as possible. Do not intentionally operate the engine in dust and/or sand storms. The use of dust covers on the cowling will afford additional protection for a parked aircraft.

Flight operation during hot weather usually presents no problem since ambient temperatures at flight altitudes are seldom high enough to overcome the cooling system used in modern aircraft design. There are, however, three areas of hot weather operation which will require special attention on the part of the operator. These are: (1)Starting a hot engine (2)Ground operation under high ambient temperature conditions and (3)Takeoff and initial climbout.

1. Starting a Hot Engine. After an engine is shutdown, the temperature of its various components will begin to stabilize;that is, the hotter parts such as cylinders and oil will cool, while other parts will begin to heat up due to lack of air flow,heat conduction, and heat radiation from those parts of the engine which are cooling. At some time period following engine shutdown the entire unit will stabilize near the ambient temperature. This time period will be determined by temperature and wind conditions and may be as much as several hours. This heat soaking is generally at the extreme from 30 minutes to one hour following shutdown. During this time, the fuel system will heat up causing the fuel in the pump and lines to "boil" or vaporize.During subsequent starting attempts the fuel pump will initially be pumping some combination of fuel and fuel vapor.At the same time,the injection nozzle lines will be filled with varying amounts of fuel and vapor.Until the entire fuel system becomes filled with liquid fuel,difficult starting and unstable engine operation can normally be expected.

   Another variable affecting the fuel vapor conditions is the state of the fuel itself.Fresh fuel contains a concentration of volatile ingredients.The higher this concentration the more readily the fuel will vaporize and the more severe will be the problems associated with vapor in the fuel system.Time, heat or exposure to altitude will "age" aviation gasoline;that is, these volatile ingredients tend to dissipate.This reduces the tendency of fuel to vaporize. Starting problems may occur if the volitity is not sufficient for adequate fuel vaporization.

The operator, by being cognizant of these conditions, can take certain steps to cope with problems associated with hot weather/hot engine starting. The primary objective should be that of permitting the system to cool. Lower power settings during the landing approach when practical will allow some cooling prior to the next start attempt. Reducing ground operation to a minimum is desired to keep engine temperatures down. Cowl flaps should be opened fully while taxiing. The aircraft should be parked so as to face into the wind to take advantage of the cooling effect. Restarting attempts will be the most difficult from 30 minutes to one hour after shutdown. Following that interval fuel vapor will be less pronounced and normally will present less of a restart problem.

The starting procedure for a hot engine is the same as the normal starting procedure except that the throttle should be opened more while cranking.

If the procedure does not effect a start, proceed as follows:

a. Ignition switch off.

b. Throttle open.

c. Mixture control IN Idle Cut-Off

d. Fuel Pump on high 15 seconds

e. Normal start procedure

2. Ground Operation in High Ambient Temperature Conditions. Oil and cylinder temperatures should be monitored closely during taxiing and engine run up. Operate with cowl flaps full open. Do not operate the engine at high RPM except for necessary operational checks. If takeoff is not to be made immediately following engine run up, the aircraft should be faced into the wind with the engine idling at 900-1000 RPM. It may be desirable to operate the fuel boost pumps to assist in suppressing fuel vaporization and provide more stable fuel pressure during taxiing and engine run up.

3. Take-off Initial Climbout. Do not operate at maximum power any longer than necessary to establish the climb configuration recommended by the aircraft manufacturer. Temperatures should be closely monitored and sufficient airspeed maintained to provide cooling of the engine.

If higher than desired temperatures are experienced during the climb phase, the pilot may elect to establish a lower angle of attack or higher climb speed, consistent with safety and thereby provide increased cooling for the engine.

CAUTION...Reduced engine power will result from higher density altitude associated with high temperature.

7-5 GROUND OPERATION AT HIGH ALTITUDE AIRPORTS

Idle fuel mixture may be rich at high altitudes. Under extreme conditions, it may be necessary to manually lean the mixture in order to sustain engine operation at low RPM. When practical, operate the engines at higher idling speed.

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CHAPTER 8
SERVICING AND UNSCHEDULED MAINTENANCE

Section Index

8-1 SERVICING

The owner or operator is responsible for maintaining the engine in an airworthy condition, including compliance with all applicable Airworthiness Directives as specified in Part 39 of the Federal Aviation Regulations and "Airworthiness Limitation" of this manual per FAR A33.4. It is further the responsibility of the owner or operator to ensure that the engine is inspected in conformity with the requirements of Parts 43 and 91 of the Federal Aviation Regulations. Teledyne Continental Motors has prepared this inspection guide to assist the owner or operator in meeting the foregoing responsibilities. This inspection guide is not intended to be all-inclusive, for no such guide can replace the good judgment of a certified airframe and power plant mechanic in the performance of his duties. As the one primarily responsible for the airworthiness of the airplane, the owner or operator should select only qualified personnel to maintain the airplane.

Fuel (Min. Grade) . . . . . Aviation Grade 100 or 100 LL

WARNING...The use of a lower octane rated fuel can result in destruction of an engine the first time high power is applied. This would most likely occur on takeoff. If the aircraft is inadvertently serviced with the wrong grade of fuel, then the fuel must be completely drained and the tank properly serviced.

Oil: (First 25 hrs. operation) Mineral (non-Detergent) oil or Corrosion Preventive oil Corresponding to MIL-C-6529 Type II

Normal Service

All Temperatures 15W-50
20W-50

Below 40°F Ambient Air (Sea Level) . . . . . SAE30 or 10W-30

Above 40°F Ambient Air (Sea Level) . . . . . SAE 50

Oil Sump Capacity . . . . . 10 U.S. Quarts
(8 U.S. Quarts ES)

Oil Change Interval: . . . . . With Integral Screen 25 Hrs.
Small Full Flow Filter 50 Hrs.
Large Full Flow Filter 100 Hrs.

CAUTION...Use only oils conforming to Teledyne Continental Motors Specification MHS24 or MHS-25 after break-in period.

8-2 APPROVED PRODUCTS

The marketers of the aviation lubricating oils listed below have supplied data to Teledyne Continental Motors indicating their products conform to all requirements of TCM Specification MHS-24, Lubricating Oil, Ashless Dispersant, or MHS-25, Synthetic Lubrication Oil.

In listing the product names, TCM makes no claim or verification of marketer's statements or claims. Listing is made in alphabetical order and is provided only for the convenience of the users.

APPROVED PRODUCTS

Supplier	Brand
BP Oil Corporation	BP Aero Oil
Castrol Limited (Australia)	Castrolaero AD Oil
Chevron U.S.A Inc.	Chevron Aero Oil
Continental Oil	Conco Aero S
Delta Petroleum Company	Delta Avoil Oil
Exxon Company, U.S.A.	Exxon Aviation Oil EE
Mobil Oil Company	Mobil Aero Oil
Mobil Oil Corporation	Mobil AV-1
NYCO S.A.	Turbonycoil 3570
Pennzoil Company	Pennzoil Aircraft Engine Oil
Phillips 66 Company	Aviation Oil Type A
Phillips 66 Company	X/C Multiviscosity SAE 20W-50
Phillips 66 Company	X/C Multiviscosity SAE 25W-60
Quaker State Oil & Refining Co.	Quaker State AD Aviation Engine Oil
Red Ram Limited (Canada)	Red Ram Aviation Oil 20W-50
Shell Australia	Aeroshell (R) W
Shell Canada Limited	Aeroshell Oil W, Aeroshell Oil W 15W-50 Anti-Wear Formulation Aeroshell Oil W 15W50
Shell Oil Company	Aeroshell Oil W, Aeroshell Oil W 15W-50 Anti-Wear Formulation Aeroshell Oil W 15W50
Sinclair Oil Company	Sinclair Avoil
Texaco Inc.	Texaco Aircraft Engine Oil - Premium AD
Total France	Total Aero DW 15W50
Union Oil Company of California	Union Aircraft Engine Oil HD

NOTE...The following procedures and schedules are recommended for engines which are subjected to normal operation. If the aircraft is exposed to severe conditions, such as training, extreme weather, or infrequent operation, inspections should be more comprehensive and the hourly intervals should be decreased.

8-3 PREFLIGHT INSPECTION

Before each flight, the engine and propeller should be examined for damage, oil leaks, proper servicing and security. Refer to the aircraft manual "Preflight Check List".

WARNING...Any descrepencies detremintal to flight safety, will be cause for grounding aircraft unitl descrepencies are corrected.

8-4 50 HOUR INSPECTION

Detailed information regarding adjustments, repair and replacement of components may be found in the appropriate Overhaul Manual. The following items should be checked during normal inspections:

1.	Engine Conditions:	(Refer to Chapter 5)	a. Magneto RPM drop:	Check
			b. Full Power RPM:	Check
			c. Full Power Manifold Pressure:	Check
			d. Full Power Fuel Flow:	Check
			e. Idle RPM:	Check

Record any values not conforming to engine specifications so that necessary repair or adjustment can be accomplished before further flight.

2.	Oil Filter:	Replace filter, inspect cartridge.
3.	Oil:	Change oil, if integral screen or small filter is used.
4.	Air Filter:	Inspect and clean or replace as necessary.
5.	High Tension Leads:	Inspect for chafing and deterioration.
6.	Magnetos:	Check and adjust only if non-conformities were noted in Step 1.
7.	Visual:	Check hoses, lines, wiring, fittings, baffles, etc. for general condition.
8.	Exhaust System:	Inspect for condition and leaks.
9.	Adjustments & Repairs:	Perform service as required on any items that are not within specifications.
10.	Engine Condition:	Run up and check as necessary. Check engine for oil and fuel leaks before returning to service.

8-5 100 HOUR INSPECTION

Detailed information regarding adjustments, repair and replacement of components may be found in the appropriate Overhaul Manual. The following items should be checked during normal inspections:

1.	Engine Conditions:	(Refer to Chapter 5)	a. Magneto RPM drop:	Check
			b. Full Power RPM:	Check
			c. Full Power Manifold Pressure:	Check
			d. Full Power Fuel Flow:	Check
			e. Idle RPM:	Check

Record any values not conforming to engine specifications so that necessary repair or adjustment can be accomplished before further flight.

2.	Oil Filter:	Replace, inspect cartridge.
3.	Oil:	Drain while engine is warm. Refill sump.
4.	Valves/Cylinders:	Check compression (Refer to Service Bulletin M84-1 or subsequent revisions as applicable).

5.	Cylinders,Fins, Baffles	Inspect.
6.	Spark Plugs:	Inspect, clean, regap (if necessary), reinstall. Rotate plugs from upper to lower positions and vice versa to lengthen plug life.
7.	High Tension Leads:	Inspect for chafing and deterioration.
8.	Magnetos:	Check. Adjust points and timing if necessary.

NOTE...Minor changes in magneto timing can be expected during normal engine service. The time and effort required to check and adjust the magnetos to specifications is slight and the operator will be rewarded with longer contact point and spark plug life, smoother engine operation and less corrective maintenance between routine inspections.

WARNING...At each 500 hours, the magnetos are required to be disassembled and inspected according to Magneto Service Manual.

9.	Air Filter:	Inspect and clean or replace as necessary.
10.	Alternate Air Door:	Check operation.
11.	Throttle Shaft and Linkage:	Inspect for wear and lubricate.
12.	Fuel Nozzles:	Inspect nozzles and vent manifold for leaks or damage.
13.	Fuel & Oil Hoses & Lines:	Inspect for deterioration, leaks, chafing.
14.	High & Low Fuel Pump Outlet Pressure	Check. Adjust if necessary. (Refer to TCM Bulletin M89-10 or current revision as applicable for Procedure)
15.	Control Connections:	Inspect and lubricate.
16.	Oil Pressure Relief Valve:	Inspect and clean.
17.	Oil Temp. Control Unit:	Inspect and clean.
18.	Exhaust:	Check all joints for condition and leaks.
19.	Adjustment & Repairs:	Perform service as required on any items that are not within specifications.
20.	Engine Condition:	Perform complete run up. Check engine for fuel or oil leaks before returning to service.

Fuel Injection Service and Maintenance: When attempting to determine whether a problem exists in the engine fuel injection system it is advisable to confirm that other engine systems, (particularly the aircraft fuel system and the ignition system) are functioning correctly before concluding that the trouble lies in the fuel injection system. Any trouble in the fuel injection system will likely be associated with dirt or foreign matter. For this reason, the filter screens at the fuel manifold valve and the main filter in the aircraft supply line must be kept clean and unrestricted.

Adjustments: The idle speed adjustment is a conventional spring loaded screw, located in the air throttle lever. (See Figure 8-1.) Set idling speed for 600 RPM. the idler mixture adjustments is a screw on the metering valve directly above the lead seal. (See Figure 8-1.) Tightening the screw will provide a leaner mixture. A richer mixture is obtained by backing off the screw. Tap fuel control unit slightly when enrichening to stabilize fuel control cam. Adjust to obtain a slight and momentary gain in idle speed as the mixture control is slowly moved toward "IDLE CUT-OFF". (If set too lean, idle speed will drop under the same conditions.) See service Bulletin M89-10 or subsequent revisions as applicable.

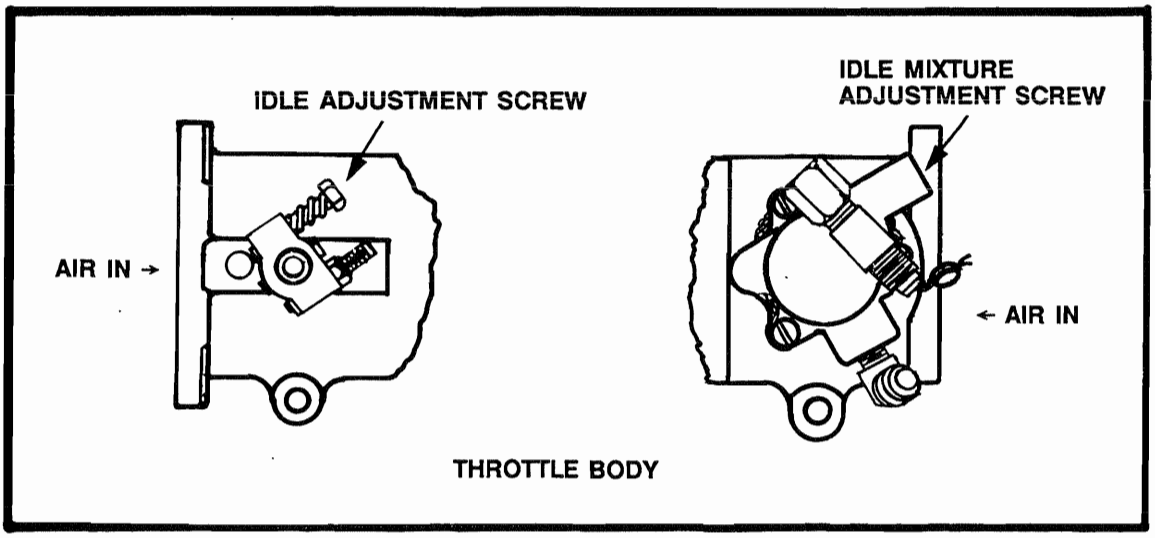


FIGURE 8-1. IDLE ADJUSTMENT POINTS

8-6 UNSCHEDULED MAINTENANCE

Detailed information required for component part replacement, system adjustments, accessory replacement/repair, top overhaul etc., can be found in the "Related Publications" listed in Chapter 1.

No unscheduled maintenance of the categories listed above should be attempted without consulting the applicable related publications.

The Time Between Overhaul (TBO) for the IO-360 Series is 1500 hours, (2000 for KB). Those accessories supplied with this engine by TCM are considered to have the same TBO as the engine with the criteria for service and longevity as outlined in the most current TCM TBO service bulletin M89-13 or subsequent revision as applicable.

8-7 CYLINDER COMPRESSION (Leakage) CHECK

The differential pressure test is an accepted method of determining cylinder condition by measuring air pressure loss past the pistons, rings and valves. The operation of the equipment is based on the principle that, for any given airflow through a fixed orifice, a constant pressure drop across that orifice will result. On many engines it is now a regular part of the 100 hour or annual inspection.

We have received reports of incorrect cylinder leakage check results caused by improper use of test equipment and/or by the use of faulty test equipment.

To help you accurately accomplish a leakage check, we submit the following information on leakage and use of the Master Orifice Tool (Ref. Figure 8-2) to calibrate the leakage checking equipment used on Teledyne Continental engines.

LEAKAGE CHECKS

Cylinder leakage is broken down into two areas of concern, the "Static Seal" and the "Dynamic Seal".

Static Seal

The static seal consists of the valve to valve seat seals, spark plug to spark plug port seals and cylinder head to barrel seal (Ref. Figure 8-3). No leakage of the static seal is permissible.

Dynamic Seal

The dynamic seal consists of the piston rings to the cylinder wall seal (Ref. Figure 8-3). This seal leakage can vary from engine to engine by the cylinder displacement, cylinder choke, ring end gap and piston design.

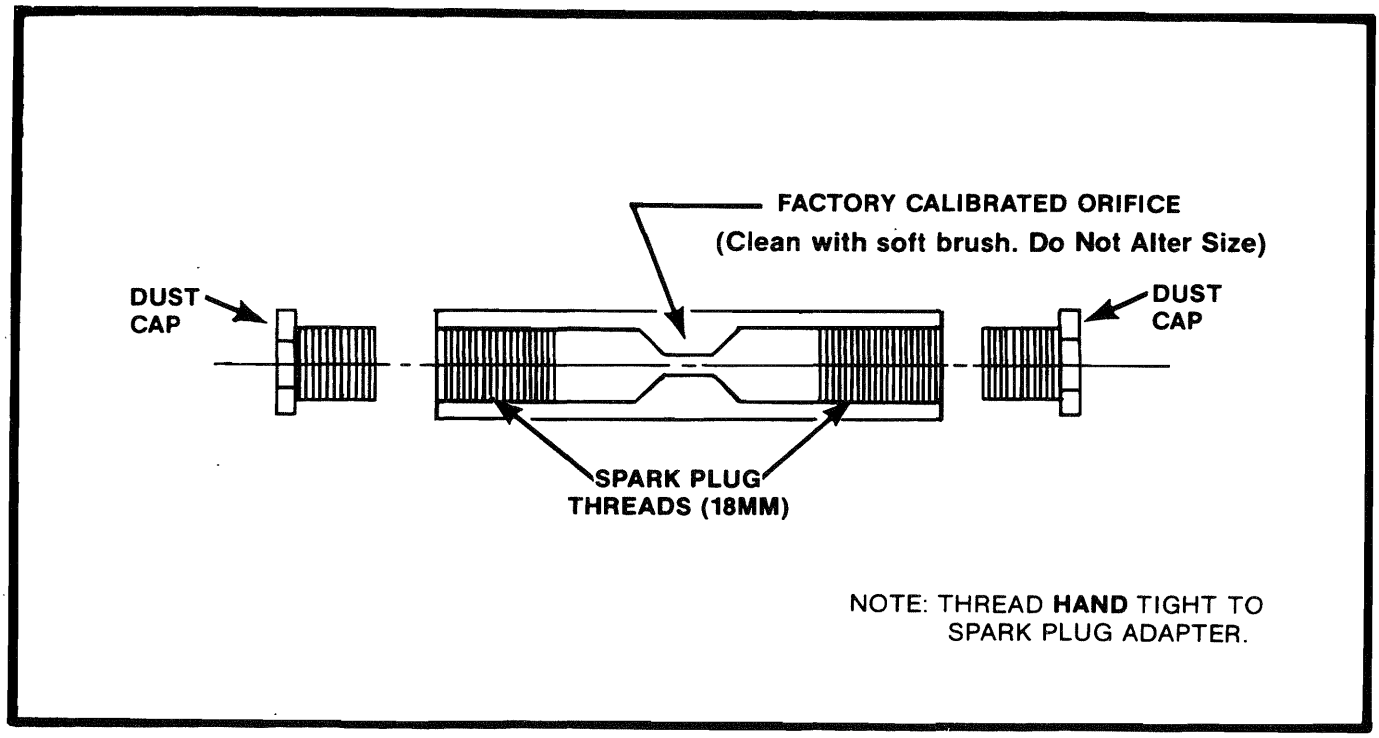
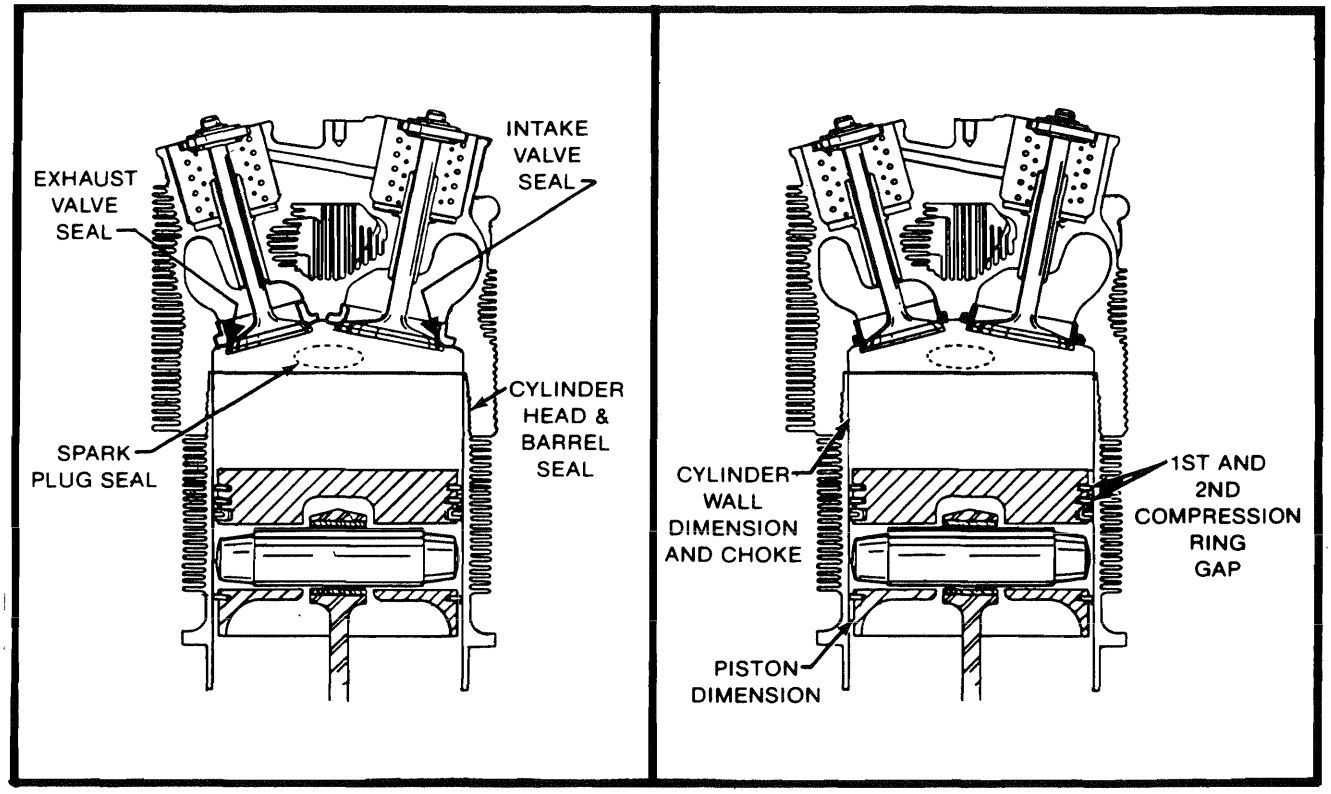


FIGURE 8-2. MASTER ORIFICE ASSEMBLY TOOL BORROUGHS P/N 646953.

Borroughs Tool & Equpiment Co.
2429 N. Burdick St.
Kalamazoo, MI 49007
Tel. 616/345-2700



STATIC SEAL **DYNAMIC SEAL**

FIGURE 8-3.

EQUIPMENT

Testing equipment must be kept clean and checked periodically for accuracy as follows: Using a line pressure of 100 to 120 p.s.i., close the cylinder pressure valve, then set the regulator pressure valve to 80 p.s.i.. The pressure in both gages should stabilize with no leakage.

The restrictor orifice dimension in the differential pressure tester (Fig. 8-4) for Teledyne Continental aircraft engines must be 0.040 inch orifice diameter, 0.250 inch long with 60° approach angle, and must flow 120 ± 5 cubic feet per hour at 30 p.s.i. differential pressure.

Master Orifice Tool

For conformity in tester equipment, a Master Orifice Tool has been developed to calibrate equipment and determine the low indicated leakage limit prior to the engine leakage check. Connect compressed air at 100-120 p.s.i. to the tester with cylinder pressure valve closed. Turn the regulator pressure valve on, adjusting pressure to indicate 80 p.s.i.. Remove the dust caps from both ends of the Master Orifice Tool and install onto your cylinder spark plug adapter. Turn the cylinder pressure valve on and readjust regulator pressure gage to read 80 p.s.i.. At this time the cylinder pressure gage indication will be the low allowable limit for cylinder leak checks. The low allowable limit is referred to as the master orifice calibrated pressure reading. After the master orifice calibrated pressure reading has been recorded, close regulator pressure valve and remove Master Orifice Tool from your cylinder adapter.

A schematic diagram of a typical differential pressure tester is shown in Figure 8-4.

Performing The Check

The following procedures are listed to outline the principles involved, and are intended to supplement the manufacturer's instructions for the particular tester being utilized.

CAUTION...Magnetos and fuel must be shut off prior to test to make certain that the engine combustion cannot accidently occur.

1. Perform the test as soon as possible after the engine is shut down to ensure that the piston rings, cylinder walls, and other engine parts are well lubricated and at running tolerance.

2. Remove the most accessible spark plug from each cylinder.

3. Turn the crankshaft by hand in the direction of rotation until the piston (in the cylinder being checked) is coming up on its compression stroke.

4. Install an adapter in the spark plug hole and connect the differential pressure tester to the adapter (NOTE: Cylinder pressure valve is in the Closed position). Slowly open the cylinder pressure valve and pressurize the cylinder not to exceed 20 p.s.i. Continue rotating the engine against this pressure until the piston reaches top dead center (TDC). Reaching TDC is indicated by a flat spot or sudden decrease in force required to turn the crankshaft. If the crankshaft is rotated too far, back up at least one-half revolution and start over again to eliminate the effect of backlash in the valve operating mechanism and to keep the piston rings seated on the lower ring lands. This is critical because the slightest movement breaks this piston ring sealing and allows the pressure to drop.

   CAUTION ... Care must be exercised in opening the cylinder pressure valve, since sufficient air pressure will be built up in the cylinder to cause it to rotate the crankshaft if the piston is not at TDC. It is recommended that someone hold the propeller during check to prevent possible rotation.

5. Open the cylinder pressure valve completely. Check the regulator pressure gage and adjust, if necessary to 80 p.s.i..

6. Observe the pressure indication on the cylinder pressure gage. The difference between this pressure and the pressure shown by the regulator pressure gage is the amount of leakage through the cylinder. If the cylinder pressure gage reading is higher than the previously determined master orifice calibrated pressure reading, proceed to the next cylinder leak check. If the cylinder pressure gage reading is lower, proceed with the following.

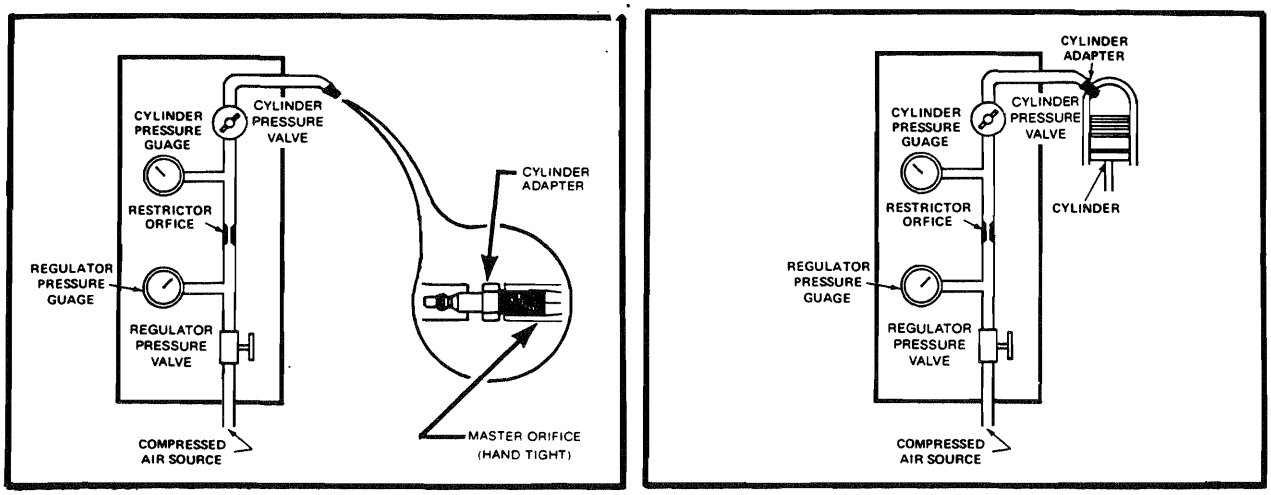


FIGURE 8-4. DIFFERENTIAL PRESSURE TESTER

Static Seal Check (Table 1)

7. The source of air leakage should first be checked for the static seal. Positive identification of static seal leakage is possible by listening for air flow sound at the exhaust or induction system cylinder port. When checking for cylinder head to barrel leakage, use a soapy solution between the fins and watch for bubbles. Use a soapy solution also around both spark plug seals for leakage. NO LEAKAGE IS ALLOWED IN STATIC SEALS.

8. If leakage is occurring in the intake or exhaust valve areas, it may be possible to correct a low reading by staking the valves. This is accomplished by placing a fiber drift on the rocker arm directly over the valve stem and tapping the drift several times with a hammer to dislodge any foreign material that may be between the valve face and seat.

   NOTE...Striking rotocoil may dislodge valve keepers.

   CAUTION...When correcting a low reading in this manner, rotate the propeller so the piston will not be at TDC. This is necessary to prevent the valve from striking the top of the piston in some engines. Rotate the propeller again before rechecking leakage to reset the valves in the normal manner.

   NOTE...When the rocker cover is removed, inspect valve springs, valve retainers and valve stem for wear. This may have contributed to the valve leakage.

9. If leakage is noted between the cylinder head and barrel, REPLACE THE CYLINDER. If leakage cannot be corrected at the valves by "staking", the cylinder must be removed and repaired before a Dynamic Seal Check.

   NOTE... When the cylinder is removed, with the spark plugs installed, inspection can be accomplished by filling the inverted cylinder bore with nonflammable solvent and then inspected for leaks at the static seal areas.

10. If the cylinderr was removed for static leakage, replacement or repair, inspect piston ring gap and cylinder wall for tolerance (Ref. Dynamic Seal, Figure 8-3). Once the piston and the cylinder have been cleaned, inspected, and ring gap tolerances have been met, reassemble to the engine.

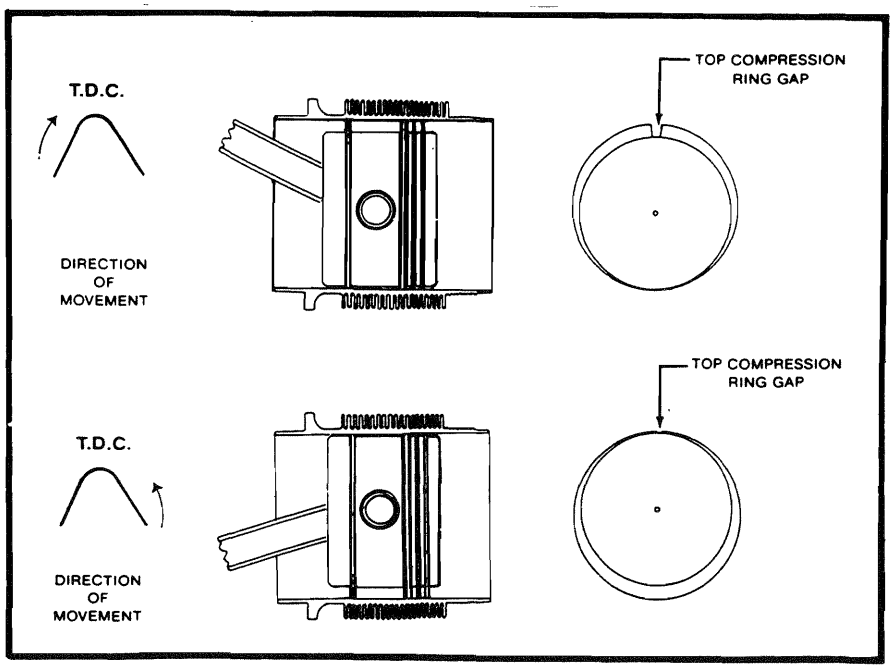


FIGURE 8-5.

Dynamic Seal Check (Table 1)

11. To check the dynamic seal of a cylinder, proceed with the leakage test and observe the pressure indication of the cylinder pressure gage. The difference between this pressure and the pressure shown by the regulator gage is the amount of leakage at the dynamic seal.

12. If the leakage is below the previously determined low cylinder gage reading, loss past the dynamic seal may be due to piston ring end gap alignment or by the piston and piston rings' angular direction in the cylinder bore (Figure 8-5). First assure that the piston and piston rings are centered. This may be accomplished by reducing regulator pressure to 20 p.s.i. and working piston through TDC several times, bringing the piston to TDC in the normal direction of engine rotation. Adjust regulated pressure to 80 p.s.i. and determine amount of loss. If the gage reading is higher than the previously determined master orifice calibrated reading, proceed to next cylinder to be tested.

    NOTE...Piston ring rotation within the ring land is a normal design characteristic. As illustrated in Figure 8-5, the compression ring location may have a direct bearing on the dynamic seal pressure check. Therefore, we suggest you complete the test in the opposite direction if readings are below prescribed limits.

13. If recheck of cylinder pressure gage reading indication remains below allowable loss, engine may be run-up to operating temperature and rechecked prior to cylinder being removed and repaired. Rework of cylinders should be accomplished as outlined in the engine overhaul manual and service bulletins.

FIRST CHECK	CHECK FOR	METHOD	1. DISCREPANCY	2. CORRECTIVE ACTION	3. CORRECTIVE ACTION
STATIC SEAL (NO LEAKAGE PERMISSIBLE)	Intake Valve to Seat Seal	Listen for Air Flow in Intake Port	Carbon	Stake Valve	
			(Cracked Cylinder)	Replace Cylinder	
			Seat Worn or Burned	Grind or Replace	Reinspect
			Valve Worn or Burned	Grind or Replace	
	Exhaust Valve to Seat Seal	Listen for Air Flow in Exhaust Port	Carbon	Stake Valve	
			(Cracked Cylinder)	Replace Cylinder	
			Seat Worn or Burned	Grind or Replace	Reinspect
			Valve Worn or Burned	Replace	
	Spark Plug (2) to Port Seal	Apply Soapy Solution Around Spark Plug	Loose Heli-coil	Replace Heli-coil	Reinspect
			Cracked Cylinder	Replace Cylinder	
	Cylinder Head to Barrel Seal	Apply Soapy Solution Between Head and Barrel	Bubbles	Replace Cylinder	
	Cylinder Head Cracks	Apply Soapy Solution Around Fins	Bubbles	Replace Cylinder	
SECOND CHECK	**CHECK FOR**	**METHOD**	**1. DISCREPANCY**	**2. CORRECTIVE ACTION**	**3. CORRECTIVE ACTION**
DYNAMIC SEAL	Leakage by Piston Rings	Test Gauge below Tolerance	Piston cracked or out of limits	Replace Piston	
			Worn Rings	Replace Rings	
			Cylinder wall dimentions out of limits	Replace Cylinder	
		Test Gauge above Tolerance	None	None	

TABLE 1
SEAL CHECK

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