

LYCOMING

Reciprocating Engine

TROUBLE SHOOTING GUIDE

Reprint 2006
SSP-475

LYCOMING

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INTRODUCTION

TROUBLE-SHOOTING

1. Trouble-shooting is the step-by-step procedure used to determine the cause for a given problem and then selecting the best and quickest way to solve that problem. While the use of turbochargers and automatic controllers has complicated the trouble-shooting procedures, always start by discussing the problem with the pilot and the facility management. They will assist you in narrowing the problem to as few possibilities as possible. In the case of twin engine aircraft, make sure you are working on the correct engine. After a thorough discussion and verbal analysis of the problem, you are ready to go to work. If you are an experienced mechanic, you may be able to automatically eliminate some of the probable causes. If you are new on the job, you will have to go through all of the probable causes. The important thing to remember is to always start with the simple and inexpensive things first, and then work toward the more complicated, time consuming, and expensive things later.
2. After you have received all possible information from the pilot and the facility management, a quick observation of the external condition of the engine may give you an indication of the problem. Some areas to look at are the intake and exhaust pipes for leaks, the ignition harness, breather, and the engine compartment for excessive oil stains, gas stains or exhaust stains. More information may be gained rather quickly by doing a compression check to locate any low compression cylinders. Do a boroscope inspection to determine the condition of the combustion chamber. Some information that may be obtained is: the presence of excessive carbon deposits may indicate high oil consumption; the lack of carbon deposits may indicate continuous lean engine operation or detonation; and scratched or scored cylinder walls may indicate broken rings. More information may be compiled by removing the spark plugs to inspect the combustion chamber.

NOTE

Be sure to keep track of which piston pin plugs came out of which cylinder. During reassembly the piston pin plugs must be matched up with the cylinder they came out of.

Another good trouble-shooting tool is the use of spectrometric oil analysis. To be effective the engine must be in the analysis program for an extended period of time to develop a useful history of periodic samples of oil that were analyzed. The program must be carried out by experienced and reputable people in the oil analysis field.

3. The following list of problems, causes, and solutions was selected because we believe it represents the more common and recurring problems encountered by mechanics when doing trouble-shooting. It should be noted that the list is general in nature, and does apply to both normally aspirated and turbocharged engines. The sequence in which the lists are arranged is not necessarily the exact step-by-step procedure to use, but should be used as a guide to determine all of the possible causes and solutions to a problem. Always keep in mind to do the simple and inexpensive things first, then proceed with the more complicated and expensive things later.

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ENGINE WILL NOT TURN STATIC RPM (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
6. Exhaust muffler internal baffles broken and blocking exhaust outlet	6. Remove muffler for thorough inspection and replace same, if necessary.	6. NOTE: If baffles are broken and are free to move around in muffler, engine may turn static and develop power sometimes and other times it may not due to the restricted flow of exhaust gases. Strike muffler with rubber mallet or soft object and listen for rattle in muffler.
7. Excessively dirty air filter.	7. Replace at regular intervals. Time between filter changes will depend on operating conditions of individual aircraft.	7. NOTE: Sometimes new filters may have an excessive air drop through them. If this condition is suspected, remove filter and run engine to F.T. without filter installed to observe whether the engine performs better. (This test should be performed in a dust-free area and on a hard surface.)
8. Carburetor heat door not rigged properly.	8. Rig so that door goes from full open to full closed.	8. NOTE: Even though door is going from full open to full closed position when aircraft is shut down, when aircraft engine is operating vibrations and airflow may cause door to open slightly. If this condition is suspected, tape or wire the door shut for test purposes. If this solves the problem, adjust and replace parts as necessary.
9. Incorrect magneto to engine timing.	9. Check and adjust as necessary.	9. Solution is self-explanatory.
10. Fouled spark plugs.	10. Remove and clean or replace as necessary.	10. Solution is self-explanatory.
11. Tachometer reading is incorrect.	11. Have tachometer repaired or replace same.	11. Solution is self-explanatory.

ENGINE SURGES

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Injector nozzles dirty.	1. Remove and clean.	1. Clean by flushing in acetone or MEK and blow out with compressed air.
2. Faulty governor.	2. Replace governor.	2. Solution is self-explanatory.
3. Air in oil lines or wastegate actuator (turbocharged).	3. Bleed system.	3. Engine will usually bleed air out of actuator and control system by running. If this does not work, loosen lines and bleed system.
4. Breather plugged.	4. Remove any obstructions from breather.	4. Solution is self-explanatory.
5. Injector nozzle pressure reference system leaking (turbocharged).	5. Repair leak.	5. Check all hose connections, "O" rings, tubing and hoses for breaks or loose connections.
6. Incorrect propeller governor.	6. Replace governor.	6. NOTE: Check Part Number of governor to be sure that a worn governor was not installed.
7. Defective oil pump.	7. Repair or replace oil pump.	7. Erratic oil pressure may be traced to the fact that pump may be sucking air. On TIO and TIGO-541 engines inspect "O" rings on inlet and outlet of pump, also high pressure oil relief at pump may be defective.

ENGINE SURGES (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
7. Defective oil pump. (Cont.)	7. Repair or replace oil pump. (Cont.)	7. (Cont.) NOTE: To remove oil pump from 541 engines, the sump must be removed.
8. Propeller blades sticking in hub intermittently.	8. Remove and overhaul propeller.	8. Check for propeller blade movement and sticking. Check stops and angle on blades when against flat pitch stops.
9. Carburetor too rich.	9. Repair or replace carburetor.	9. Solution is self-explanatory.
10. Wastegate binding intermittently.	10. Free wastegate butterfly with a corrosion penetrant or replace same.	10. NOTE: Use a wrench to move butterfly from full open to full closed to determine if shaft binding is occurring.

FAILURE OF ENGINE TO DEVELOP RATED POWER

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Leaks in induction system and exhaust system (turbocharged).	1. Tighten all plugs and clamps and replace any defective parts.	1. Solution is self-explanatory. NOTE: This condition is more noticeable at altitude.
2. Improper fuel flow.	2. Check screen and gage, and replace injector, if necessary.	2. Remove screens and flush out dirt. Disconnect gage and install master to determine accuracy of aircraft instrument.
3. Restriction in air inlet or manifold.	3. Check and clean or repair as necessary.	3. NOTE: Always make sure air filters are kept clean and there are no breaks in ducting to allow foreign material or heated air from nacelle to enter induction system.
4. Improper fuel.	4. Drain tanks and refill with recommended octane fuel.	4. NOTE: Never use a lower than recommended grade of fuel. Consult latest revision of Service Instruction No. 1070.
5. Controllers out of adjustment (turbocharged).	5. Adjust same.	5. Variable absolute controller is adjusted by turning adjustment screw at cam end of controller counterclockwise to increase boost, and clockwise to decrease boost. Controllers are set to obtain a specific manifold pressure and no compensation for density and temperature is necessary. Required manifold pressure settings will be found in Operator's Manual. Adjust for full throttle setting only. Density controllers do compensate for temperature and pressure and require special equipment to adjust. The latest revision of Service Instruction No. 1187 sets forth procedures and required equipment for adjusting density controllers in the field. Differential pressure controllers are set to maintain 6 in. differential between deck and manifold pressure, special equipment is required for adjustment. NOTE: This is not normally adjustable in the field.

FAILURE OF ENGINE TO DEVELOP RATED POWER (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
6. Damaged turbocharger impeller, binding or tight turbocharger wheels (turbocharged)	6. Visually inspect for damage and check for free rotation of turbocharger. Disassemble and clean, if necessary.	6. <u>NOTE:</u> If turbocharger wheel is damaged or tips of blades are missing, turbocharger must be replaced. Because this condition will cause turbocharger to become unbalanced and severely wear the bearings causing complete turbocharger failure.
7. Throttle lever not properly adjusted.	7. Check and adjust, as necessary.	7. Solution is self-explanatory.
8. Excessive dirt build-up in compressor housing or on compressor wheel (turbocharged).	8. Inspect and clean.	8. Solution is self-explanatory. <u>NOTE:</u> Excessive dirt build-up on compressor wheel may create an out-of-balance condition and accelerate bearing wear.
9. Kinked or restricted oil lines from engine to actuator, and actuator to controller.	9. Remove and inspect or replace, as necessary.	9. Solution is self-explanatory.
10. Wastegate out of adjustment (turbocharged).	10. Adjust same to correct open and closed limits.	10. The wastegate is adjusted to full closed position first, then full open. To adjust full closed, cap off outlet of actuator and apply 50 to 60 lbs. oil pressure to inlet. When oil pressure closes wastegate, measure clearance between butterfly and housing. If adjustment is improper, disconnect linkage and lengthen or shorten as required. After full closed adjustment is correct, set full open by disconnecting oil supply and allowing spring in actuator to open wastegate. Again, measure clearance between butterfly and housing. If adjustment is improper, loosen jam nut at end of cylinder and turn adjustment rod in or out as required to obtain proper full open setting, then retighten jam nut.
11. Inlet orifice in actuator plugged (turbocharged).	11. Remove inlet line at actuator and clean orifice.	11. <u>NOTE:</u> If orifice is plugged tight, it may be necessary to remove cylinder from actuator in order to be able to clean orifice.
12. Wastegate stuck open (turbocharged).	12. Remove actuator and loosen wastegate butterfly.	12. Wastegate butterfly may be freed by removing from engine, and using a wrench on the butterfly shaft. Rotate back and forth until all corrosion is removed and butterfly moves freely. This operation may be aided by using a corrosion penetrant to help loosen butterfly. One penetrant used by some people in the field is mouse milk, manufactured by Worldwide Aircraft Filter Corp., 1685 Abram Ct., San Leandro CA 94577. This penetrant could be used at each 25-hour inspection as a preventative measure. A little at each end of the shaft may help keep shaft from binding.

FAILURE OF ENGINE TO DEVELOP RATED POWER (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
13. Piston seal in wastegate actuator leaking. Noted by excess oil coming out of drain (turbocharged).	13. Disassemble, clean cylinder, and replace seal, or replace wastegate actuator assembly.	13. <u>NOTE:</u> Any time wastegate actuator is disassembled or parts are replaced, the full open and full closed positions of the butterfly should be checked and reset, if necessary. (Reset according to item #10 of this section.)
14. Oil pressure too low to close wastegate (turbocharged).	14. Adjust oil pressure to at least minimum low limit in manual.	14. Check to make sure that the proper oil pressure relief spring is in engine and that it is not broken, or that relief valve ball does not have any dirt under it causing the low oil pressure.
15. Injector and controller linkage not adjusted properly (541 series engine).	15. Adjust as per latest revision to Service Instruction No. 1211 to get full travel on both controller and injector.	15. Procedures set forth in the latest revision of Service Instruction No. 1211 include the use of two special tools, ST-318 and ST-319, to position the cross shaft and establish the clearance settings at full throttle and idle when making linkage adjustments. These step-by-step procedures should be followed to insure accurate linkage adjustment.
16. Broken baffles in muffler (normally aspirated engines).	16. Remove from engine and replace muffler system.	16. <u>NOTE:</u> If section of baffle is loose in muffler, engine may operate satisfactory at times and may be low on power at other times. This indicates baffle is moving around in muffler, blocking exhaust gases at times and at other times allowing an unrestricted flow of exhaust.
17. Poor combustion.	17. Do a differential compression check and borescope inspection to locate excessively leaking valves, valve guides or rings and to locate any broken rings.	17. Do a top overhaul to correct this problem.
18. Butterfly in wastegate is warped.	18. Replace wastegate.	18. Solution is self-explanatory.
19. Crankshaft to camshaft timing incorrect.	19. Remove accessory housing and correct timing.	19. This condition may be checked by first disconnecting starter, remove top spark plugs and rocker box cover on #2 cylinder. Turn engine to T.D.C. on compression stroke on #1 cylinder, observe that when piston in #1 cylinder goes over T.D.C. on compression the intake valve in #2 cylinder is just starting to open and the exhaust valve is just closing. If this condition does not exist, the crankshaft to camshaft timing is off. <u>NOTE:</u> On engines with fixed pitch propellers the engine probably will not turn static R.P.M. On engines with constant speed propellers the engine will probably turn up static R.P.M. but manifold pressure will be a little low.

LOSS OF POWER GOING TO ALTITUDE

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Leak in turbocharger system.	1. Check all clamps and bolts on induction and exhaust system. <i>NOTE:</i> Make sure alternate air door closes completely, and suck-open door is properly adjust and gasket is not damaged.	1. Observe that all clamps are tight on turbocharger induction and exhaust system. Inspect all gaskets and "O" rings on intake pipes to be sure they are in place and properly seated. Check for cracks on both intake and exhaust system. Green stain on induction system indicates induction leak. White stains on exhaust system indicates an exhaust leak. Make sure that all nuts on exhaust stacks are tight and that no exhaust gaskets are burned out.
2. Density controller does not follow curve to altitude.	2. Replace controller.	2. To check density controller, disconnect differential controller from system and block oil lines. Fly aircraft to altitude and observe that you get a steady rise in manifold pressure not to exceed airframe manufacturer's limits. If no rise is indicated, density controller must be replaced. <i>NOTE:</i> Exercise extreme caution as there will be severely staggered throttles at part throttle conditions.
3. Oil line to actuator inlet kinked or blocked.	3. Remove line. Clean or replace and eliminate kinked condition.	3. Solution is self-explanatory.
4. Actuator piston seal failed and leaking excessively.	4. Disassemble, clean cylinder, and replace seal.	4. <i>NOTE:</i> Any time wastegate actuator is disassembled you must check the full closed and full open positions of the wastegate. If adjustment is necessary, always adjust full closed first then full open. (Never plug the wastegate actuator drain as it may cause a hydraulic lock.)
5. Differential controller poppet valve leaking.	5. Replace differential controller.	5. Apply 80 psi oil to inlet port of differential controller, only minute drainage should be observed at drain port. If excessive, oil is observed at drain port, this indicates controller valve is leaking oil at all times and must be replaced.
6. Poor combustion.	6. Do a differential compression check and borescope inspection to locate excessively leaking valves, valve guides or rings and to locate any broken rings.	6. Do a top overhaul to correct this problem.
7. Binding turbocharger.	7. Overhaul or replace turbocharger.	7. Solution is self-explanatory.
8. Lean injector.	8. Replace injector or recalibrate or overhaul at approved facility.	8. Solution is self-explanatory.
9. Differential pressure controller lines hooked up improperly.	9. Attach controller sensing lines to proper locations.	9. One side of differential controller diaphragm senses deck pressure and the other side senses manifold pressure.

CANNOT REACH SPECIFIED CRITICAL ALTITUDE

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Dirty induction air filter.	1. Replace same.	1. <u>NOTE:</u> Also check for any type of blockage in induction system.
2. Damaged compressor or turbine wheel (turbocharged).	2. Replace or overhaul turbocharger. <u>NOTE:</u> Determine reason for damage and eliminate.	2. Visually inspect to see if the turbine or compressor wheels are damaged or tips of blades are missing. If this has happened, turbocharger replacement is necessary because this damage causes a severe out-of-balance condition which will rapidly wear out the turbocharger bearings.
3. Wastegate does not go to full closed position (turbocharged).	3. Adjust for full travel. If butterfly is sticking, work free and apply corrosion penetrant. If actuator seal is leaking, disassemble, clean cylinder and replace seal.	3. When setting closed and open positions, always set full closed position first, then full open. The procedure for checking full closed position is to cap off actuator discharge, apply 60-65 lbs. oil pressure to inlet. When wastegate closes, measure clearance between butterfly and housing. If adjustment is necessary, disconnect linkage and lengthen or shorten as required. To check full open, release oil pressure and allow wastegate to open full and measure clearance between butterfly and housing. If adjustment is necessary, loosen jam nut at top of cylinder and turn adjustment in or out as required. Retighten jam nut. If butterfly is sticking, loosen by manually moving back and forth until free, then lubricate with a corrosion penetrant like mouse milk, manufactured and sold by Worldwide Aircraft Filter Corporation, 1685 Abram Ct., San Leandro, CA. It may also be used as a preventative by applying to butterfly shaft at 25 hour inspections. If actuator cylinder is leaking, disassemble, clean cylinder and replace seal. If any parts are replaced, check open and closed limits as described above.
4. Bad bearings in turbocharger.	4. Replace or overhaul turbocharger. <u>NOTE:</u> Spin turbine by hand to check for free rotation	4. Check radial and axial bearing limits, as per AiResearch Turbocharger Manual.
5. Suck-open door on compressor discharge housing not fully closed or door gasket damaged (TIO-540 engines).	5. Adjust magnet so door closes properly. Replace gasket.	5. Observe that no physical damage has occurred to door and no foreign material is lodged between door and gaskets.
6. Faulty controller.	6. Repair or replace.	6. <u>Absolute Variable.</u> If engine loses power, consider leaking poppet valve or oil leaking into induction system because of broken boot bellows. Remove controller and check for oil in induction housing. In either case, controller will have to be replaced.

CANNOT REACH SPECIFIED CRITICAL ALTITUDE (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
6. Faulty controller. (Cont.)	6. Repair or replace. (Cont.)	6. (Cont.) <u>Density Controller</u> . Check as per solution #2 under "Loss of Power Going to Altitude". <u>Differential Controller</u> . Apply 80 psi oil to inlet port. Observe that only minute draining occurs at drain port.
7. Improperly adjusted controllers.	7. Adjust same.	7. <u>Absolute Variable</u> . The variable absolute pressure controller is only sensitive to pressure settings so no special equipment is necessary for adjustment. To increase manifold pressure turn adjusting screw at cam end of controller counterclockwise. To decrease manifold pressure, turn adjusting screw clockwise. These adjustments to be made for full throttle power settings only. Manifold pressure settings will be found in Operator's Manual. <u>Density Controller</u> is sensitive to temperature and pressure and does require special equipment to set. Procedures for setting density controllers are set forth in latest revision of Service Instruction No. 1187. <u>Differential Controller</u> . If differential controller is leaking then critical altitude would not be reached. Check by applying 80 psi oil to inlet port and observing that only minute oil is seen at drain port. If excess oil is seen at drain port, controller is leaking at all times and must be replaced.
8. Insufficient oil pressure to close wastegate.	8. Adjust oil pressure to specifications found in Operator's Manual. Check for links or restrictions in actuator supply line.	8. Check to be sure the proper spring is in the oil pressure relief valve and is not broken or that no foreign material is under the relief ball. Eliminate restrictions in actuator supply line and route line to eliminate any kinks.
9. Damage to compressor or turbine wheel.	9. Replace turbocharger.	9. Visually inspect turbocharger wheels for damage such as bent or broken blades, rub marks on compressor or turbocharger housing. If parts of blades are missing, check for excessive bearing wear caused by severe out of balance condition.
10. Leaks in exhaust system.	10. Repair or replace as required.	10. Tighten all clamps and bolts on turbocharger system. Check gaskets for good condition and proper seating. Also inspect for any cracks (may be located by the presence of white stains on exhaust system). Make sure all nuts on exhaust stack flanges are tight and no gaskets are burned out.

CANNOT REACH SPECIFIED CRITICAL ALTITUDE (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
11. Poor combustion.	11. Do a differential compression check and borescope inspection to locate excessively leaking valves, valve guides or rings and to locate any broken rings.	11. Do a top overhaul to correct this problem.

LOW OIL PRESSURE

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Insufficient oil.	1. Fill oil sump or tank to proper level.	1. <u>NOTE</u> : Make sure you are using the correct grade and weight of oil.
2. Pressure relief out of adjustment.	2. Adjust oil pressure to proper limits.	2. On external adjustable type increase oil pressure by turning adjusting screw clockwise, and to decrease turn counterclockwise. On types with solid tower standard ¼ inch flat washers are used to control oil pressure. Add washers to increase oil pressure and remove washers to decrease oil pressure. On short tower, a maximum of three washers may be used – on a tall tower, a maximum of nine washers may be used.
3. Dirt or metal chips under oil pressure relief valve.	3. Remove, disassemble, and clean.	3. Solution is self-explanatory.
4. Damaged oil pressure relief seat.	4. Replace or repair.	4. On engines with the removable seat, seat may be pulled out and another pressed into place. On engines that have seat machined in the case, repairs must be made by repairing existing seat with Special Tools ST-243, ST-248 and ST-340 that make up the reseating tool assembly. (Refer to latest revision of Service Instruction No. 1172.)
5. High oil temperature.	5. Check all areas that involve lube system and lube oil cooling system.	5. Inspect the following areas for trouble: (a) Proper oil level. (b) Proper grade and weight of oil. (c) Thermostatic bypass valve working properly and seating squarely. (d) Plugged or partially plugged oil cooler lines or oil cooler. (e) Excessive blowby. (f) Air duct to cooler blocked or cooler partially covered. (g) Defective temperature gage.
6. Restriction at inlet side of oil pump.	6. Remove and clean oil suction screen and oil passage to inlet side of oil pump, if necessary.	6. Solution is self-explanatory.
7. Excessive internal spill off of oil.	7. Check the following areas for excessive oil flow and repair or replace. (a) Loose or missing plugs in oil galley. (b) Piston cooling squirts blocked open. <u>NOTE</u> : Low oil pressure usually occurs at low or idle RPM. (c) Excessive bearing clearance. (d) Cracked crankcase in area of oil galley.	7. Solution is self-explanatory.

LOW OIL PRESSURE (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
8. Relocating the oil pressure take-off point on the engine.	8. Use only the oil pressure take-off point approved by the engine manufacturer.	8. Solution is self-explanatory.
9. Oil pressure relief seat in crankcase cocked (could be cage type or flat type).	9. Remove and replace seat.	9. Solution is self-explanatory.

HIGH OIL CONSUMPTION

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Improper grade of oil.	1. Consult Operator's Manual for type and weight of oil.	1. <u>NOTE:</u> Consult latest revision of Service Instruction No. 1014 for information on approved lubricating oils for Lycoming engines.
2. Failure of new rings to seat properly.	2. Use correct grade of oil and proper operating procedures.	2. On new and rebuilt engines, use mineral oil until consumption stabilizes (usually from 50 to 100 hours) then if desired, change to ashless dispersant oil. On the 541 series of engines, ashless dispersant oil must be used from the beginning. <u>NOTE:</u> Consult latest revision of Service Instruction No. 1014 for recommended lubricating oils. For best ring seating, always use full throttle take-off wherever the application applies (the only exception is the gear supercharged engines where take-off power is limited by a specific manifold pressure). Also use a high cruise power setting for break in.
3. Failed or failing bearings.	3. Replace same.	3. Disassemble engine for inspection and replacement of bearings. Prior to disassembly, excessive bearing wear may be determined by the presence of metal in oil suction screen or oil filter.
4. Worn piston rings and/or cylinder barrels.	4. Remove cylinders and deglaze barrels, replace with new piston rings.	4. Prior to disassembly, the condition of the rings may be determined by doing a differential compression check. This is accomplished by rotating the cylinder to be checked to T.D.C. on compression stroke. After insuring that the propeller will not turn, introduce 80 psi air in cylinder and observe how much is retained. Air leaking by rings can be detected by listening at breather entrance for a hissing sound in crankcase indicating air escaping around the rings. For equipment required and procedures, consult latest revision of Service Instruction No. 1191.

HIGH OIL CONSUMPTION (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
5. Worn valve guides.	5. Replace same.	5. Remove cylinders from engine and take out valves. Measure guides and if worn beyond tolerances allowed in the latest revision of Table of Limits, the guides will have to be replaced. Use procedures set forth in applicable Overhaul Manual.
6. Excessive oil leaks.	6. Inspect external of engine for leaks and repair same.	6. Solution is self-explanatory.
7. Oil being siphoned from engine in flight.	7. Insure that oil filler cap is on tight and oil access door closes properly. Also be sure that the breather hose is cut properly and located so there is no change of siphoning oil from engine.	7. Solution is self-explanatory.
8. Expander in oil control ring improperly installed or lost its tension.	8. When using oil control ring with corrugated type expander, make sure ends of expander are butted together <u>not overlapped</u> . When using oil control ring with spiral wound type expander, ring design is such that improper assembly is not likely.	8. Solution is self-explanatory.
9. Oil level too high.	9. Maintain oil at manufacturer's recommended level.	9. Solution is self-explanatory.
10. Oil passing through turbocharger seals.	10. Overhaul or replace turbocharger.	10. NOTE: On engines where the lubricating oil to the turbocharger is returned to the crankcase by gravity drain, inspect the crankcase breather line to be sure it is not plugged. If it is, this will cause high crankcase pressure and not allow the oil to return to the crankcase freely and eventually push the oil past the turbocharger seals into the compressor and turbine section of the turbocharger.

HIGH CYLINDER HEAD TEMPERATURE

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Spark plugs of improper heat rating installed in engine.	1. Use only approved spark plugs for your engine.	1. NOTE: Consult latest revision of Service Instruction No. 1042 for approved spark plugs.
2. Cooling baffles missing, broken or improperly installed.	2. Insure that all baffles are installed properly and not broken.	2. NOTE: Never attempt to modify, relocate or eliminate any cooling baffles.
3. Partially plugged fuel nozzles.	3. Clean in methyl-ethyl-ketone or acetone and blow out with compressed air.	3. Solution is self-explanatory.
4. Fuel lines of improper I.D. being used.	4. Fuel line I.D. should be .085-.090 in.	4. NOTE: Primer lines have same threaded connections as fuel lines but are of much smaller I.D. NOTE: The only exception to this rule is the IO-540-E1B5 used in the Aero Commander 500S. This engine uses primer lines for fuel lines and they are .060 in. I.D.

HIGH CYLINDER HEAD TEMPERATURE (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
5. Engine improperly timed.	5. Check magneto to engine timing and insure that engine is timed to the correct number of degrees B.T.C.	5. <i>NOTE:</i> Even though magneto synchronization is correct, if engine is timed at 25° BTC when it should be 20° BTC, engine will run hotter.
6. Engine being operated excessively lean.	6. Check Operator's Manual for minimum fuel flow for various power settings and never go below them.	6. <i>NOTE:</i> If this condition is suspected, check combustion chamber for carbon deposits. If there are none, this is sufficient reason to be suspicious of a continuous lean engine operation.
7. Mix control improperly rigged.	7. Rig for complete travel.	7. <i>NOTE:</i> Even though mix control lever at pilot seat appears to have full travel, be sure to check at carburetor or injector to insure that mix lever is going against the F.R. (full rich) and I.C.O. (idle cut-off) stops.

SPLIT IN MANIFOLD PRESSURE (Twin Engine)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Propeller blade angle not adjusted properly.	1. Adjust propellers for correct blade angle when against flat pitch stops.	1. Solution is self-explanatory.
2. Controllers out of adjustment (turbocharged).	2. Adjust to proper limits.	2. Variable absolute pressure controller is adjusted to a specific manifold pressure as found in Operator's Manual with no compensation for temperature. Density controllers are adjusted as per latest revision of Service Instruction No. 1187. Where procedures and equipment requirements are set forth on density controlled engines, some split in manifold pressure may have to be accepted because of variations in turbocharger efficiency. <i>NOTE:</i> Both controllers are adjusted for full throttle setting condition only.
3. Excessively dirty air filter.	3. Replace with new filter.	3. <i>NOTE:</i> Problem may be more noticeable when aircraft is flown to altitude because of the decrease in air density.
4. Alternate air door leaking.	4. Replace door or adjust for complete closing	4. <i>NOTE:</i> Although door may appear to close completely on the ground, it may be opening slightly in flight due to vibration or air currents. To determine if this is happening, tape alternate air door shut and fly aircraft to altitude and observe manifold pressure.
5. Incorrect hydraulic lifters or hydraulic lifters bleeding down too rapidly.	5. Replace hydraulic lifters.	5. <i>NOTE:</i> On turbocharged engines manifold pressures will come back together when manifold pressure gets above 30 in.

SPLIT IN MANIFOLD PRESSURE (Twin Engine) (CONT.)

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
6. Restriction in airframe or engine induction system.	6. Inspect and remove restriction.	6. Solution is self-explanatory.
7. Leaks in airframe or engine induction system.	7. Inspect and repair leaks.	7. Solution is self-explanatory.

HIGH OIL TEMPERATURE

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Insufficient oil supply.	1. Check oil at regular intervals and maintain proper level.	1. Solution is self-explanatory.
2. Insufficient cooling air.	2. Check air inlet and outlet to cooler and replace or repair parts and ducting as required.	2. Solution is self-explanatory.
3. Improper grade of oil.	3. Use only grade and weight of oil specified for engine.	3. <i>NOTE:</i> Consult latest revision of Service Instruction No. 1014 for proper grades and weight of oils used in Lycoming engines.
4. Oil cooler or lines plugged or partially plugged.	4. Remove cooler and lines and flush out.	4. Solution is self-explanatory.
5. Thermostatic bypass valve not operating properly or seating squarely.	5. Replace thermostatic bypass valve.	5. <i>NOTE:</i> If valve is not seating properly, the filter base may have to be replaced.
6. Excessive blow by.	6. (Do a top overhaul.) This condition usually caused by worn or stuck rings.	6. <i>NOTE:</i> To locate exactly where the blow by is originating from, do a differential compression check as described in latest revision of Service Instruction No. 1191.
7. Defective temperature gage.	7. Replace same.	7. Solution is self-explanatory.

HIGH MANIFOLD PRESSURE AT IDLE

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Improperly adjusted fuel injector or carburetor.	1. Adjust idle mixture to get a 25 to 50 RPM rise when moving mixture control from full rich to idle cut-off.	1. <i>NOTE:</i> Speed may have to be adjusted also.
2. Incorrect hydraulic lifters installed.	2. Replace with correct part number lifters.	2. Solution is self-explanatory.
3. Hydraulic lifters bleeding down too rapidly.	3. Replace with new hydraulic lifters.	3. <i>NOTE:</i> Any time hydraulic lifters are removed from an engine for cleaning and inspection be <u>sure</u> to keep the cylinder and plunger together as an assembly. If they become separated, do not just arbitrarily assemble any body and plunger together because you may change the leak-down rate. On twin engine installations, a split in manifold pressure will be noticed during acceleration.
4. Air leak in induction system.	4. Check induction system and repair leak.	4. <i>NOTE:</i> Engine will be rough at idle.

HIGH OIL PRESSURE

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Oil pressure improperly adjusted.	1. Adjust to within minimum and maximum range as found in Operator's Manual.	1. On external adjustable type oil pressure relief adjustment, turn adjustment counterclockwise to decrease oil pressure. On engines using the pressure relief that is not externally adjustable, remove the pressure relief valve from the engine and take out washers from behind spring.
2. Improper weight of oil.	2. Use the suggested weight of oil for the ambient temperature in which the engine is being operated.	2. Consult latest revision of Service Instruction No. 1014 for lubricating oil recommendations.
3. Oil passage from pressure relief valve to sump plugged.	3. Remove blockage from oil passage.	3. Remove pressure relief from engine and run a soft copper wire down through oil passage to sump; if blockage is found, remove same. <i>NOTE:</i> If blockage persists, sump may have to be removed to clear passage.
4. Incorrect pressure relief spring being used.	4. Replace with correct pressure relief spring.	4. Solution is self-explanatory.
5. Relocating the oil pressure take-off point on the engine.	5. Use only the oil pressure take-off point on engine approved by manufacturer.	5. <i>NOTE:</i> If the oil pressure take-off point on the engine is moved closer to oil pump discharge, a rise in oil pressure will be noted.
6. Oil temperature too cold.	6. Allow oil temperature to increase before increasing throttle.	6. Solution is self-explanatory.

MANIFOLD PRESSURE FLUCTUATES

CAUSE	SOLUTION	PROCEDURE FOR SOLUTION
1. Wastegate sticks intermittently.	1. Free wastegate by turning it with a wrench at the butterfly and apply a corrosion penetrant. (Replace wastegate if necessary.)	1. Solution is self-explanatory.
2. Oil sump baffle modification required. Models affected, TIO-540-A, -S1AD, -T2AD, -AA1B5, -AE2A; (L)TIO-540-F2BD, -J, -N2BD, -R2AD, -U2A.	2. For information concerning this problem, consult latest revision of Service Instruction No. 1279.	2. Step-by-step procedures found in latest revision of Service Instruction No. 1279.
3. Oil in fitting on differential pressure controller not restricted. Models affected, TIO-540-A, -F, -J; LTIO-540-F, -J	3. Replace with oil in fitting having .075 in. restriction.	3. Solution is self-explanatory.
4. Linkage from fuel injector to controller not rigged properly. (TIO and TIGO-541 series engines only.)	4. Procedures for properly rigging linkage is found in latest revision of Service Instruction No. 1211.	4. Solution is self-explanatory.