



SNS COLLEGE OF TECHNOLOGY
(Autonomous)
DEPARTMENT OF AERONAUTICAL ENGINEERING



UNIT-5

OVERHAUL PROCEDURES



FAILURE ANALYSIS

Once the fault can be traced to a specific component or components, an attempt should be made to determine the cause of the failure. Substituting a new component into the system without analyzing the reason for the failure may just damage the new component. Sometimes many components have similar functions. In this case, all the components may need to be replaced or repaired.

To determine if there are multiple malfunctions, the technician should consider the effect of the component malfunction on engine operation. If the component is the probable cause of all the abnormal symptoms noted in earlier steps, then it can be assumed that the component is at fault.

Using the six-step procedure, we give an example of how to troubleshoot a fault on an engine that will not run consistently at idle speeds. The first step is symptom recognition.

Engine performance can be measured against several standards: The present performance of a particular engine can be compared with its past performance, provided adequate records have been kept. Engine performance can also be compared with that of other engines installed on the same type of aircraft. Type Certificate Data Sheets and the engine operator's manual can be consulted for engine performance information.



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1. Was any roughness noted? If so, under what conditions of operation?
2. How long have the engine and spark plugs been in use? How long has it been since the last inspection?
3. Were the ignition system (magneto) operational check and power check normal?
4. Did the problem change when the fuel boost pump was on?
5. When did the trouble first appear?
6. Was the full-throttle performance normal?

The next step is to list the probable faulty function. Refer to Fig. 9–15. Reasons for failure of the engine to idle could be

1. Propeller lever set to decrease rpm
2. Improperly adjusted carburetor or fuel injection system
3. Fouled spark plugs
4. Air leak in intake manifold

With a complete set of symptoms and probable causes, the technician is ready to do step 4 of troubleshooting, which includes testing various systems to localize the fault in one system. This can be done sometimes by eliminating systems that have been tested and found to be in good condition.

In most instances, assume that the trouble lies in one of the following systems:

1. Ignition system
2. Fuel metering system



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3. Induction system
4. Power or mechanical system
5. Instrumentation system

Utilizing the manufacturer's troubleshooting manuals and charts to test and eliminate the various systems makes it possible to pinpoint the induction system as the problem here.

Let's go on to the next step—narrowing the problem to a specific component. Visual inspection of the induction system reveals that one cylinder intake pipe has fuel stains and a bad gasket. This is determined to be the cause of the fault, and with a new gasket, the engine can be repaired and its operation checked.

In troubleshooting step 6 (failure analysis), the technician should determine the cause of the gasket failure and whether other engine components have been affected by the malfunction. In this case, the cause of the gasket failure appears to be normal aging.

In assessing the possible damage, the technician notes that the cylinder with the leaking intake pipe has been operating with a very lean mixture, which could have caused the cylinder to run hot. Damage to other cylinders on the engine is highly unlikely, but damage could have occurred inside the leaking cylinder. The leaking cylinder should be thoroughly inspected for damage that could have resulted from the intake leak.

In all troubleshooting cases, the knowledge and experience of the technician will be needed along with a good logical approach to perform successful fault isolation.



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TROUBLESHOOTING CHART—GENERAL ENGINE

Indication	Cause	Remedy
Engine will not start. Engine cranking. All circuit breakers and switches in correct position.	Lack of fuel. Engine overprimed. Induction system leaks. Starter slippage.	Check fuel valves. Service fuel tanks. Clear engine. Follow correct starting procedure. Correct leaks. Replace starter.
Engine will not run at idling.	Propeller lever set for DECREASE RPM. Improperly adjusted carburetor or fuel-injection system. Fouled spark plugs. Air leak in intake manifold.	Place propeller lever in HIGH RPM position for all ground operations. Readjust system as required. Change spark plugs. Tighten loose connection or replace damaged part.
Engine misses at high speed.	Broken valve spring. Plugged fuel nozzle. Warped valve. Hydraulic tappet worn or sticking. Weak breaker spring in magneto.	Replace valve spring. Clean or replace. Replace valve. Replace tappet. Repair magneto.
Engine runs too lean at cruising power.	Improper manual leaning procedure. Low fuel flow. Carburetor or fuel-injection system malfunction.	Manual lean in accordance with operator's manual. Check and clean fuel strainer. Correct malfunction.
Engine runs rough at high speed.	Loose mounting bolts or damaged mount pads. plugged fuel nozzle. Propeller out of balance. Ignition system malfunction.	Tighten or replace mountings. Clean or repair. Remove and repair propeller. Troubleshoot ignition system and repair.
Engine idles rough.	Improperly adjusted carburetor or fuel-injection system. Fouled spark plugs. Improperly adjusted fuel controls. Discharge-nozzle air vent manifold restricted or defective. Dirty or worn hydraulic lifters. Burned or warped exhaust valves, seats. Scored valve guides.	Adjust system as required. Clean or replace spark plugs. Adjust fuel controls. Clean or replace. Clean or replace. Repair or replace.
Engine runs rich at cruising power.	Restriction in air-intake passage.	Remove restriction.
Spark plugs continuously foul.	Piston rings worn or broken. Spark plugs have wrong heat range.	Overhaul engine. Install proper range spark plugs.
Sluggish engine operation and low power.	Improper rigging of controls. Leaking exhaust system to turbo. Restricted air intake. Turbo wheel rubbing. Ignition system malfunction. Carburetor or fuel-injection system malfunction. Engine valves leaking. Piston rings worn or sticking.	Rerig controls. Correct exhaust system leaks. Correct restriction. Replace turbocharger. Troubleshooting ignition system and correct malfunction. Troubleshoot and correct malfunction. Overhaul engine.
High cylinder-head temperature.	Octane rating of fuel too low. Improper manual leaning procedure. Bent or loose cylinder baffles. Dirt between cooling fins.	Drain fuel and fill with correct grade. Use leaning procedure set forth in the operator's manual. Inspect for condition and correct. Remove dirt.

General engine troubleshooting chart.
Operation, Inspection, Maintenance, and Troubleshooting of Reciprocating Engines



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TROUBLESHOOTING CHART—GENERAL ENGINE (Continued)

Indication	Cause	Remedy
	Exhaust system leakage. Excessive carbon deposits in combustion chambers.	Correct leakage. Overhaul engine.
Oil pressure gage fluctuates.	Low oil supply.	Determine cause of low oil supply and replenish.
Engine oil leaks.	Damaged seals, gaskets, O rings, and packings.	Repair or replace as necessary to correct leaks.
Low compression.	Excessively worn piston rings and valves.	Overhaul engine.
Engine will not accelerate properly.	Unmetered fuel pressure too high. Turbocharger waste gate not closing properly. Leak in turbocharger discharge pressure.	Adjust engine fuel pressure according to specifications. Refer to turbocharger and controls manual. Repair or replace as necessary.
Slow engine acceleration on a hot day.	Mixture too rich.	Lean mixture until acceleration picks up. Then return control to FULL RICH.
Engine will not stop at IDLE CUTOFF.	Manifold valve not seating tightly.	Repair or replace manifold valve.
Manifold pressure overshoot on engine acceleration.	Throttle moved forward too rapidly.	Open throttle about half way. Let manifold pressure peak, then advance throttle to full open.
Slow engine acceleration at airfields with ground elevation above 3500 ft [1066.80 m].	Mixture too rich.	Lean mixture with manual mixture control until operation is satisfactory.
When climbing to 12,000 ft [3657.60 m], engine quits when power reduced.	Fuel vaporization.	Operate boost pump when climbing to high altitudes. Keep boost pump on until danger of vapor is eliminated.



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TROUBLESHOOTING CHART—FUEL SYSTEM TROUBLES

Indication	Cause	Remedy
Engine will not start.	No fuel in tank. Fuel valves turned off. Fuel line plugged. Defective or stuck mixture control. Pressure discharge-nozzle-valve diaphragm ruptured. Primer system inoperative.	Fill fuel tank. Turn on fuel valves. Starting at carburetor, check fuel line back to tank. Clear obstruction. Check carburetor for operation of mixture control. Replace discharge-nozzle valve. Repair primer system.
Engine starts, runs briefly, then stops.	Fuel tank vent clogged. Fuel strainer clogged. Water in the fuel system. Engine fuel pump inoperative or defective.	Clear the vent line. Clean fuel strainer. Drain sump and carburetor float chamber. Replace engine-driven fuel pump.
Black smoke issues from exhaust. Red or orange flame at night.	Engine mixture setting too rich. Primer system leaking. At idling speed, idle mixture too rich. Float level too high. Defective diaphragm in pressure carburetor.	Correct the fuel-air mixture adjustment. Replace or repair primer valve. Adjust idle mixture. Reset carburetor float level. Replace pressure carburetor.



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TROUBLESHOOTING CHART—FUEL INJECTION

Indication	Cause	Remedy
Engine will not start. No fuel flow indication.	Fuel-selector-valve in wrong position. Dirty metering unit screen. Improperly rigged mixture control.	Position fuel-selector-valve handle to main tank. Clean screen. Correct rigging of mixture control.
Engine acceleration is poor.	Idle mixture incorrect.	Adjust fuel-air control unit.
Engine will not start. Fuel flow gage shows fuel flow.	Engine flooded. No fuel to engine.	Clear engine of excessive fuel. Loosen one line at fuel manifold nozzle; if no fuel shows, replace fuel manifold.
Engine idles rough.	Restricted fuel nozzle. Improper idle mixture.	Clean nozzle. Adjust fuel-air control unit.
Very high idle and full-throttle fuel pressure present.	Relief valve stuck closed.	Repair or replace injector pump.
Engine runs rough.	Restricted fuel nozzle. Improper pressure.	Clean nozzle. Replace pump.
Low fuel pressure at high power.	Leaking turbocharger discharge pressure. Check valve stuck open.	Repair leaking lines and fittings. Repair or replace injector pump.
Low fuel flow gage indication.	Restricted flow to metering valve. Inadequate flow from fuel pump.	Clean fuel filters and/or adjust mixture control for full travel. Adjust fuel pump.
Fluctuating or erroneous fuel flow gage indication.	Vapor in system. Clogged ejector jet in vapor-separator cover. Air in fuel flow gage line.	Clear with auxiliary fuel pump. Clean jet. Repair leak and purge line.
High fuel flow gage indication.	Altitude compensator stuck. Restricted nozzle or fuel manifold valve. Recirculation passage in pump restricted.	Replace fuel pump. Clean or replace as required. Replace fuel pump.
Fuel discharging into engine compartment. Relief valve probably not operating.	Leaking diaphragm.	Repair or replace injector pump.
No fuel pressure.	Check valve stuck open.	Repair or replace injector pump.
Unmetered fuel pressure.	If high, internal orifices are plugged. If low, relief valve stuck open.	Clean internal orifices in injector pump. Repair or replace injector pump.