Chapter 2
Engine Inspection

The One Minute Cylinder Inspection

You have just removed the cylinder from the engine and are getting ready to send it off for repair. What caused the problem? Will the new cylinder correct the problem? Will a replacement cylinder be exposed to the same environment that made the original cylinder go bad? Many engine and airframe problems can make a cylinder go bad. If you don't correct the problem, the problem will not go away.[1]

To diagnose the cause of failure you might spend a minute or two examining the cylinder. Here are some things to look for.

Connecting Rod Alignment

Wear to the thrust face on the piston skirt should be 180 degrees apart and 90 degrees from the piston pin boss. If this pattern has been rotated, then rod alignment is off and you should remove the rod and check for twist and bend.

Dirt and Abrasives

Look for comet tracks on the piston skirt. These are indicators of dirt or metal particles in the oil. A comet track forms when an abrasive particle scratches the aluminum surface and embeds itself into the aluminum at the end of the scratch. Look for ring wear. Sharp ring edges are most likely caused by abrasive particles in the engine.

Piston Scuffing

Scuffing of the piston skirt is usually a sign of insufficient lubricating oil on the cylinder wall caused by cold engine starts. If the piston skirts are scuffed, then you should anticipate and look for spalling of camshaft lobes and followers. Scuffing can also be caused by improper cylinder barrel size.

Combustion Chamber Inspection

Look at the combustion chamber for soot and oiliness. Soot deposits indicate excessive fuel mixture richness and oil deposits indicate the cylinder is burning excessive oil. Next, look at the coloration of the exhaust valve. An uneven coloration or uneven deposit pattern is caused by temperature differences across the valve face from leakage gas. Look for any head cracks around the spark plug bosses. Check the exhaust port for cracks. Look for oil stains on the outside of the cylinder that may indicate cracks or head-to-barrel separation.

Figure 2-1 Piston skirt showing "comet" tracks from dirt particles.

Run a plastic pen down the fins behind the exhaust port and listen to them ping. If you get a "plung" instead of a "pling," then you have a cracked cylinder or cracked fin. If this occurs, look between the fins for an oil line. If you see one, then the cylinder is cracked

through the head and is not repairable.

Continental 520 cylinders and Lycoming parallel head cylinders crack between the cooling fins located above the spark plug and between the ports. Look carefully in between the fins for a small oil line. Continental O-200 cylinders crack between the cooling fins on the exhaust port.

Place a white piece of paper on the edge of your workbench. Place the cylinder half over the white paper and half overhanging the work bench. This focuses light up through the guides. Examine the guides, especially the combustion end, for wear, build-ups, or pitting. If there are carbon deposits in the guide, then the guide usually wears 180 degrees from the deposit. Place the valves in the guides and wobble the valves back and forth, both in line with the rocker arm motion and across the rocker arm motion. Look at the valve tips for evidence of proper valve rotation and rocker contact. Look at the stem of the exhaust valve for vertical lines which indicate a previous occurrence of valve sticking. Check the face of the intake valve for pounding. This indicates the engine had been operated at excessive power settings or the hydraulic lifter needs replacing. Intake valve pounding on Lycoming O235-L2C engines indicates valve clearance has not been adjusted accurately.

Cylinder Barrel Inspection

Place a white piece of paper down in the cylinder barrel. This reflects light up on the barrel so you can examine it. Gray patches on the barrel indicate blowby of combustion gas and possible barrel warpage. Blowby is gas that flows past the piston rings into the crankcase. Gas is forced through any leakage paths afforded by the piston-bore-ring assembly in response to combustion chamber pressure. If there is good contact between the compression rings and the bore, and between the rings and the bottom of the piston ring grooves, then the leakage path of consequence is the ring gap. Gray patches on the cylinder wall are where the escaping combustion gas oxidized the oil film. "Blueing" of the steel barrel results in excessive temperatures, again caused by hot combustion gas escaping past the ring belt.

Near the cylinder flange, below ring travel, you can look at the hone pattern and get an indication of the quality of the previous workmanship. The hone pattern on steel cylinders should be crisscrossed (crosshatched). A hone pattern which goes around the cylinder barrel indicates that the previous repair was done poorly. Look for the absence of a hone pattern in the ring travel area half way down the barrel. If this area is shiny then the barrel has worn out, and most likely, excessive oil consumption is occurring.

Look for dark areas within the shiny area. These dark areas are caused by pitting which resulted from rust corrosion. Corrosion pitting combined with a shiny barrel indicates a barrel worn from corrosion deposits. Rust is abrasive.

Chrome Barrels

Look for the slightest indication of varnish or oxidized oil, each indicating ring leakage. Chrome barrels may not have any gray patches. The top of ring travel is where the greatest amount of wear occurs to the cylinder barrel. There

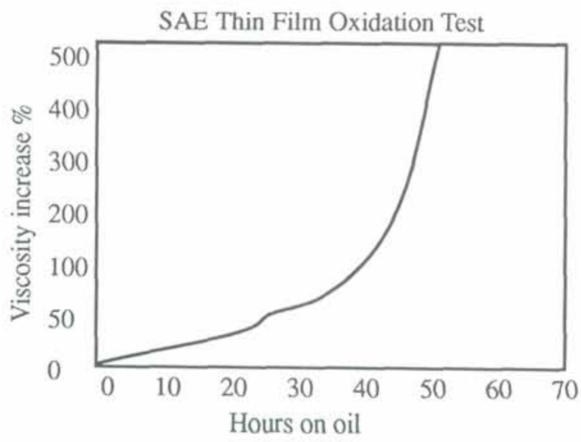

Figure 2-2 Excessive oil temperatures and time cause oil to oxidize. When the "oxidation break" occurs, there is a rapid increase in oil viscosity.

should be channeling in this area. If there is no channeling, then the cylinder requires re-chroming. Chrome channeling is the pattern of cracks that naturally occur in the chrome surface. It is the function of these cracks to retain oil, thereby providing lubrication to the ring face as it travels across the channel surfaces in the chrome. Figure 5-14 is a picture of chrome channeling.

Engine Temperature Indicators

High engine temperatures leave indicators that can be used during repair to troubleshoot the cause of failure.

Continental cylinder heads are chemically treated with a solution of "Alodine" which forms an attractive gold phosphate oxide coating. Gold Alodine changes to a yellow/green tinge when exposed to temperatures above red line. Look for this color change at the hot spots on the cylinder such as spark plug boss to exhaust port and cooling fins on the exhaust side of the cylinder.

High temperatures cause oil to

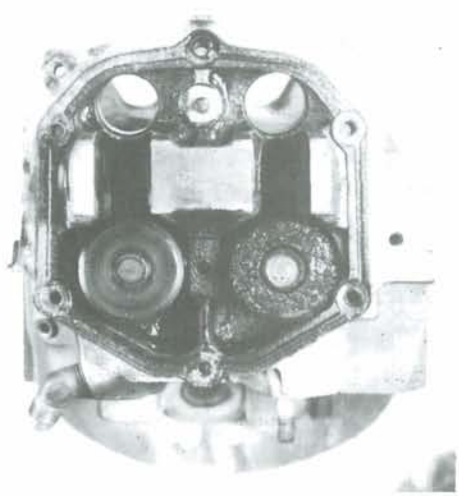

Figure 2-3 Black carbon deposits in exhaust valve area caused by excessive temperatures.

Figure 2-4 Shorter valve spring on the left has collapsed because of exposure to excessive temperature. Both valve springs were originally the same height. The darker color of the collapsed spring is from oxidized oil deposits on the spring. Springs are from a Lycoming O-320-A2B engine.