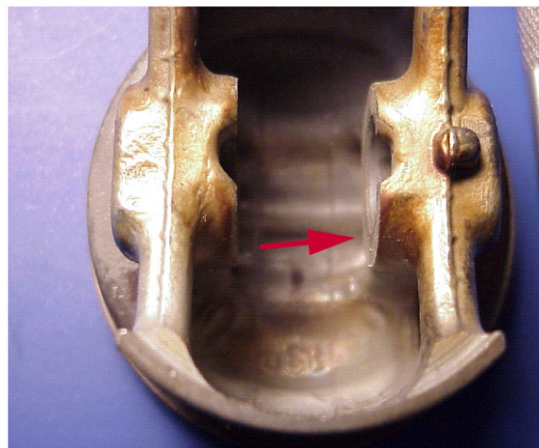


Engine Failures / Seizures and Piston Wash

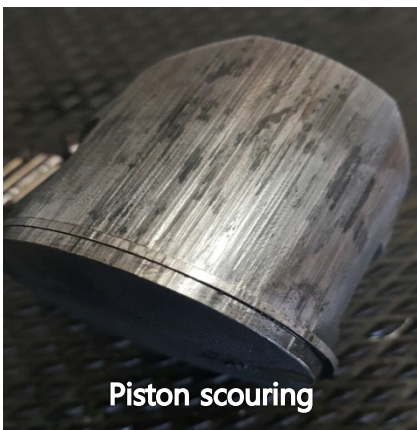
We do a lot of Gas Engine repairs and see often the varying problems so often encountered on our gas model aircraft engines. This short article is aimed at seizures and what causes them and how to determine what the cause of a failure was.

Piston seizures can happen really quickly and there are usually no warning signs. A seizure or scouring of the piston surface occurs when there is insufficient lubrication on the cylinder walls or above normal operating temperatures. This can be due to a number of reasons as follows :

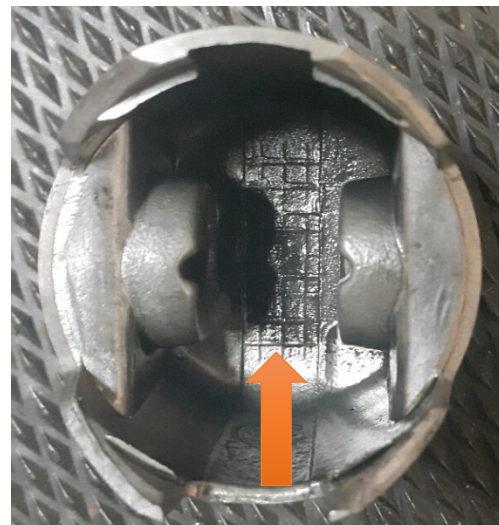
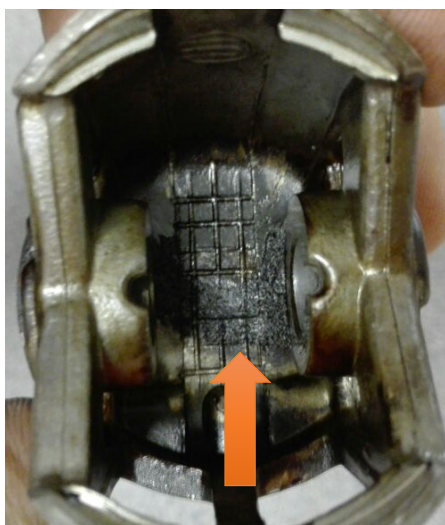
1. No oil in the fuel – yes! sometimes it can happen that NO oil is mixed into the fuel before flying, this results in a very short lifespan as there is simply not enough lubrication in petrol alone. Without lubrication temperatures will rise fast and before long the piston will scour (Left pic below) and seize up. How to tell this was a dry fuel mix is to look at the underside of the piston specifically at the edges around the Small end bearing and piston surface for scuffing marks.(right pic below)



2. Lean condition – The far most common problem - under lean running conditions again you will lack correct lubrication as well as raise the burn temperature of the higher air to fuel mix. With raised operating temps the necessary oil film strength on the cylinder walls is reduced and the piston starts to scour against the cylinder walls. So again you will see the sides of the piston scoured, most often on the exhaust side first if it hasn't hard seized as this is where the temps are the highest. (left pic below) the best way to determine a lean run is to read the piston wash pattern on top of the piston. Middle and Right pic below show poor piston wash where the entire or almost the whole surface of the piston is coated with black carbon deposits.



The second feature noticeable on a lean run is the underside of the piston surface (Remember “Black Spot Hot” – see pics below) when the piston temp is higher than it should be, the unburnt fuel from the crankcase will actually also burn a black spot onto the underside of the piston.





See pic on the Left for a set of pistons showing good piston wash, Piston wash (clear areas on a pistons surface) is created by the incoming unburnt fuel mixture cooling the piston surface as it enters via the transfer ports. The carbon deposits are only burnt on to the top of a piston where it is the

hottest and not receiving any cooling. When a piston shows no signs of cooling it indicates lean running / overly high temps and seizures are imminent. Remember a piston seizure can only occur when something burns or scrapes away the oil film that exists between the piston and the cylinder wall. Understanding this, it's not hard to see why oils with exceptionally high film strengths are desirable. Good quality oils can provide a film that stands up to the most intense heat and the pressure loads of a modern model engine.

The important thing to realize is that the top of the piston is not a uniform temperature. The area in front of the exhaust port that is exposed to all of the hot gases exiting the cylinder is naturally the hottest. The area in front of the transfer ports that is cooled by the fresh air and fuel entering the cylinder is obviously going to be the coolest. And, the center of the piston will be somewhere in between. The second important thing is that there is some small range of temperatures where the piston is hot enough to char the oil that comes in contact with it, but cool enough not to melt the piston. Putting those together, you have "piston wash"

Lastly another indicator of very hot running temps is the conrod small end, small end bearing and piston pin itself, any Blue discoloration on these parts shows there has been very high running temps. See pics below.



The important thing with diagnosing a lean run is why was it lean? Of course the needles could be simply closed too far meaning there is not enough fuel OR and very importantly is there could be an air leak. Remember the Air / Fuel ratio needs to be correct, so even with the correct needle settings you can experience a lean run if you have an air leak. thirdly don't forget to check all inline filters and the main filter screen in the carb for dirt, restricting fuel flow.

3. Retarded timing – this can also cause overheating and seizures, simply because the burn of the air / fuel mix is after TDC meaning that the piston has already started travelling downwards and the oil residue left on the cylinder walls is burnt off by this burn when the ignition fires late. This means that when the piston travels back upwards there is not enough lubrication on the cylinder walls causing metal to metal contact, scouring and even more heat build-up.

Piston damage from Excess heat / Lack of proper cooling

Believe it or not this is more uncommon, diagnosis can be tricky but there are a few indicators of this.

1. When the lower and mid-section of the piston skirt is scoured and the top area around the ring land is still ok. This means you can rule out combustion related heat problems as the area nearest the combustion chamber is unmarked.
2. Sometimes the entire side of the piston can be scoured as the extended period of high heat has destroyed the oil film strength and lubrication is destroyed, resulting in metal to metal contact and scouring. Often then the ring is trapped in the ring land and compression is completely lost. Piston wash may look fairly normal once again showing its not combustion related.
3. When the rear of the piston is scoured first, this can happen due to the rear of the cylinder being in a cooling air "shadow" area as the air tends to hit the front of the cylinder, pass by the sides, and then separate from the cylinder walls.



Not always, and not the only reason for this - but this video in the link below is typical of scuffed pistons, as material has been removed from the piston sides there is a poor piston / cylinder fit and as the engine is rocked at TDC the pistons rock from side to side in the cylinder causing this sound. read more here about Engine failures and how this happens - <http://cmchobbies.co.za/shop/cmc-arti...> (Engine Failures / seizures)

<https://youtu.be/l-ZNvayT42c>

Lastly to finish off – one of the most important things here is learning about piston wash, it's a great way for determining how your engine is running and making sure you are not too lean, giving you hours of good engine runs on your plane!

