Exhaust Valve Lapping

There have been many advances in the 20 years that I have been working as a general aviation aircraft mechanic. One of the best is the digital borescope which allows me to capture photos, and even video, of exhaust valves. Frequent cylinder inspections using this imaging technology allow us to see trends develop in exhaust valve heat signatures. While it has been great to show a customer a problem before it turns into a failure it would be better to have something to reverse the trend. For most of my career we watched exhaust valves get worse and worse until they reached the subjective moment when we removed the cylinder for repair. I recently decided to try reversing the trend on a customer's exhaust valve on its way to an early death.

The customer's airplane is a Bellanca Viking with a Continental IO-550-F with approximately 1400hrs on original cylinders. His typical mission is operating at 7000-8000 feet 72% power and 70 degrees rich of peek for 1.5hr legs. The IO520's and IO 550's in Beech aircraft use the same type of cylinders and are subject to the same issues.

Initially we were inspecting cylinders in conjunction with annual inspections at approximately 150hr intervals. At the first sign of abnormal exhaust valve deposits we began inspecting affected cylinders at every oil change, approximately 30hrs. Through these inspections it became clear cylinder 2 was progressing toward a burned valve. Attempts at operational changes, as suggested by Continental, were unsuccessful. This lead us to try the more invasive intervention of lapping the exhaust valve in place.

The exhaust, intake, rocker cover, rocker arm, valve keepers, rotator cap and springs were all removed to facilitate the work. Valve lapping compound was worked into the valve seating area. The valve was pulled into contact with the seat and rotated using a drill connected to the valve stem via a rubber hose. It took several applications of valve lapping compound and the valve seat was periodically cleaned to monitor the progress of the lapping operation. The lapping process was repeated until the seating area of the valve was uniform in appearance. After carefully cleaning the valve components and other parts we reassembled the engine and returned it to service.

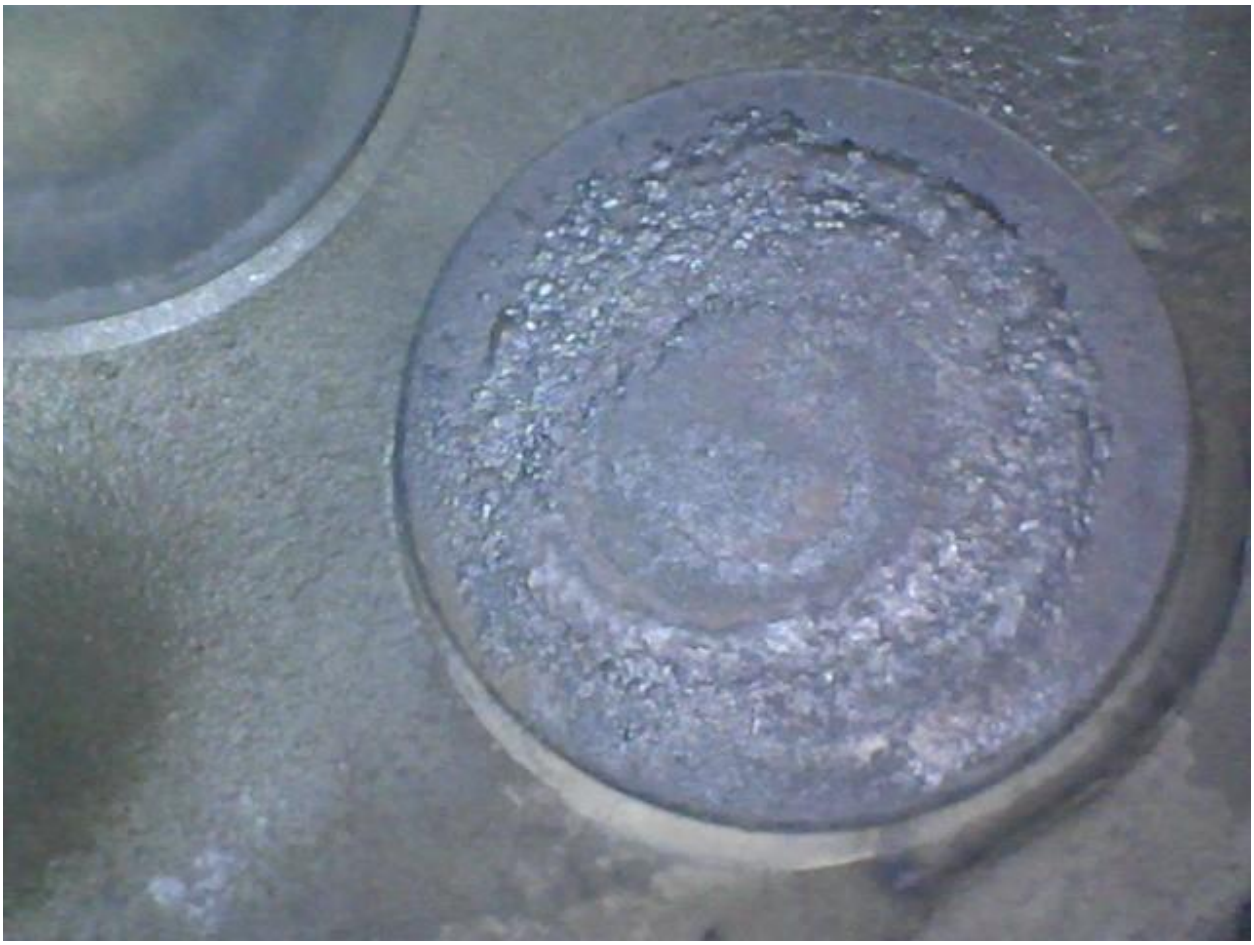
During the lapping process I found that by slowly rotating the valve and viewing the seating area it was possible to see where the valve was not contacting the seat properly. This area corresponds with the hot spot identified by the exhaust valve deposits. You can see a video of this here https://www.flickr.com/photos/136005688@N02/38393934221/in/dateposted-public/

The initial report from the owner was that the engine was using more oil than before the valve was lapped. I thought this might have been due to cleaning combustion deposits out of the exhaust valve guide. An audit of the customer's make up oil records from one year prior to the valve lapping and from the lapping to the current inspection showed there was no change to the oil consumption. For this engine, oil consumption varied from 10hrs per quart to 4hrs per quart based on the time on the oil and operational conditions. This did not change after the exhaust valve was lapped.

The following photos are a single data point. Continental does not have an approved procedure for lapping exhaust valves in place and I have found very little guidance on when to employ this technique. The evidence here certainly suggests that an uneven heat signature can be corrected, at least in the

short term, by careful lapping of the exhaust valve. This process has the potential to save considerable expense and down time for owners with problem exhaust valves.

This photo is at 162hrs prior to the valve being lapped. The appearance is almost normal with the rings being slightly shifted to the 8 O'clock position.



This photo was at photo was at 126hrs prior to lapping. The ring-shaped deposits have shifted slightly more towards the edge of the valve.

This photo was taken just prior to lapping the valve. The ring-shaped deposit has broken along the edge of the valve in the 8 O’clock position.

This photo was taken at 10.5hrs after the lapping the heat signature is not normal, but the deposits are starting to become centered on the valve again.

This photo was taken at 33.7hrs after the valve lapping. The deposits are close to normal.

The last photo taken at 91.7hrs after valve lapping. The exhaust valve deposits have returned to normal.