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The aluminum in the oil filter clearly came from the #1 piston, so why was Roy's shop so intent on tearing down the engine?

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Melted Piston

"Today, about 10 minutes into the the short ~20 minute flight to ferry my 1972 Beechcraft Baron 58 to its annual inspection, I noticed a very high CHT on cylinder #1 of my right engine," Roy posted to his SavvyQA ticket. "The CHT was reading about 540°F if I recall, which would be 80°F above the red line. As soon as I noticed this, I pulled back the throttle and shoved the mixture control to full rich. I didn't know if it was a real problem or a sensor malfunction, but I hadn't felt any roughness and I didn't see any oil streaks or other visible indications of trouble. So after a little consideration, I advanced the right throttle just enough to generate a little power. I could see the EGTs coming up on cylinders 2-6 but EGT #1 did not come up. At that point, I feathered the right engine and proceeded to make an uneventful one-engine landing."

...the engine...

"Very sorry to hear about your cylinder issue," replied Savvy account manager Brandon Thompson A&P/IA, "but I'm glad you made it safely. Nice job!"

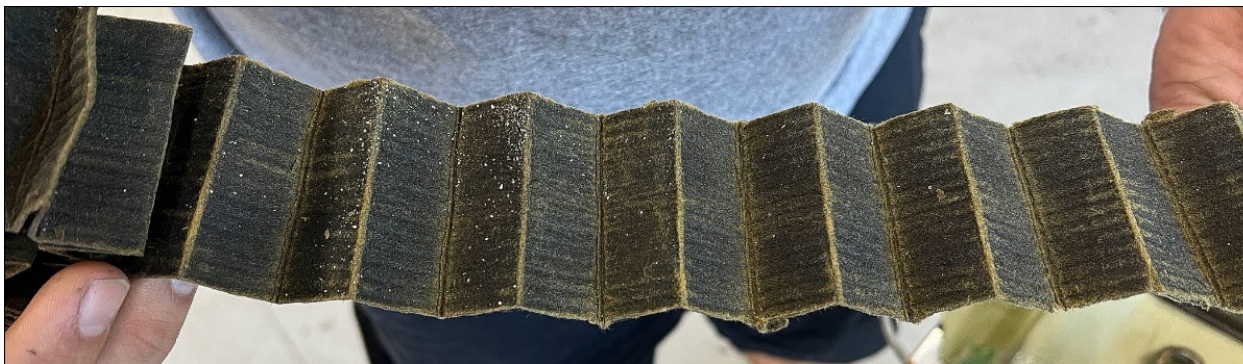


"A borescope inspection of right engine cylinder #1 revealed scoring of the cylinder walls and some corner melting of the piston," Roy continued. "The shop asked for permission to pull the cylinder, which I approved since it seemed obvious that this needed to be done."





“With the cylinder removed, the full extent of piston damage was obvious,” Roy noted. “The engine had 1,540 hours SMOH, but ironically had a top overhaul only 100 hours ago due to the ECi cylinder AD. At this point it’s obvious that the #1 cylinder needs to be addressed, and I’m thinking it should probably be scrapped and replaced due to the way-over-red-line CHT and consequent metallurgical trauma. The piston is obviously trashed, too.”



"However, given all the metal that has been found in the oil filter, I'm starting to wonder whether replacing the cylinder would just be throwing good money after bad?," Roy asked. "Is there some way to determine if the rest of the engine is okay or not? Is there metal in the oil galleries? Contamination of the bearings? Is the crankshaft okay? How can I determine the viability of this engine going forward? I don't want to overhaul this engine unnecessarily, but metal throughout the engine doesn't sound good."

"The first thing I'd suggest is to pull the propeller governor and inspect the prop governor gasket screen," said Brandon. "If any metal is found there, it means that metal got past the oil filter and made it into the oil galleries. That would be a show-stopper for me, because it would indicate the bearings are contaminated. On the other hand, if there's no metal found in the prop governor gasket screen, then that indicates that the oil filter did its job and caught all the metal."

Two days later...

"Well, the shop pulled the prop governor and didn't find any metal in the gasket screen," Roy reported.

"That's great news," Brandon said.

"They did find some metal in the oil sump," Roy continued, "and last I heard they were trying to quantify how much they retrieved and compare it to the Lycoming guidance."

"Why are they doing that?" Brandon asked. "We expect most of the melted aluminum from the piston to be in the sump, and we know where it came from."

"The question seems to really be if metal got into the oil passageways or not," said Roy. "Any thoughts on this?"

"Since the prop governor gasket screen was clean, I'm confident that the metal didn't get into the oil galleries," Brandon said.

On the fence

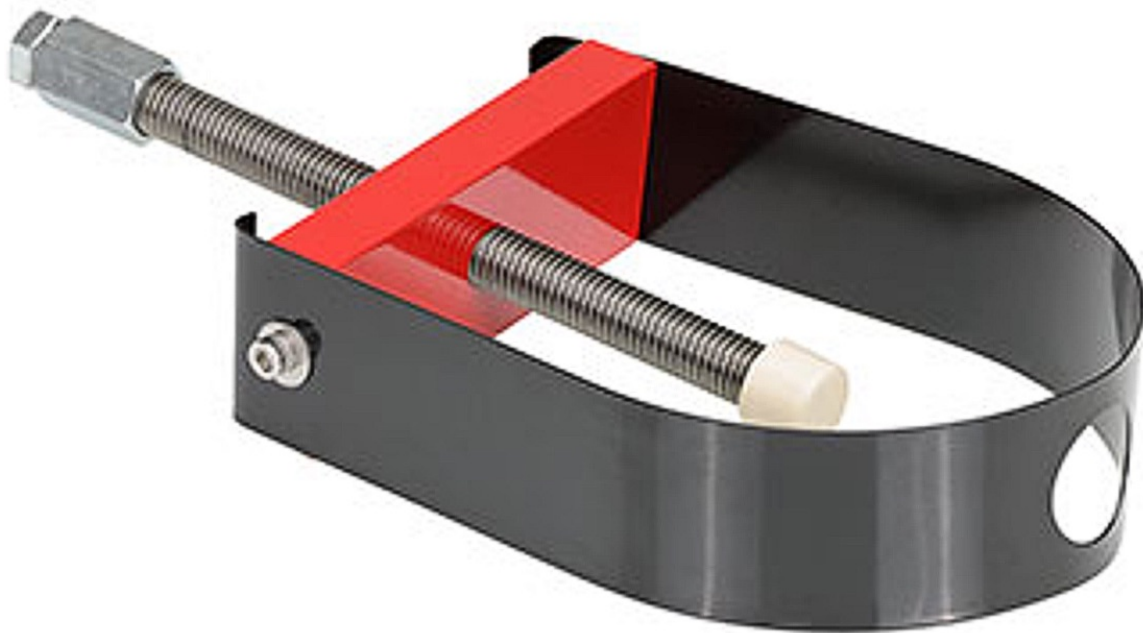
"We're really on the fence about whether to overhaul this engine since it's

"I'm really on the fence about whether to overhaul this engine since it's pretty close to its 1,600-hour TBO, or to just replace the cylinder and piston, since I know these engines are capable to going far beyond this number of hours," said Roy.

The next day...

"I visited the shop this morning," Roy posted. "They're trying to soak the piston pin in penetrating oil but so far it is frozen. The piston rotates freely on the piston pin, but they can't get it off."

"That's not surprising given how badly overheated that piston was," said Brandon. "I use [this tool](#) on a regular basis to extract stubborn piston pins..."



"Since we know the source of the metal, and it doesn't appear to have traveled through the engine," Brandon continued, "my suggestion is that you have the shop flush the oil sump with solvent, install a new piston, pin and cylinder, service the engine with clean oil and a new oil filter, then run it on the ground for about 20 minutes and cut open the oil filter. If the filter is relatively clean, install a new filter and fly the airplane for two hours in the vicinity of the airport to break-in the new cylinder, then cut open the filter again. If the filter is still relatively clean, you should be good to go. I'm guessing that'll be the case. But if it's not, then you should consider an

overhaul.”

“What do you think would have caused this to happen?” Roy asked. “Any wild guesses? If I decide to replace the cylinder, how can I be sure it won’t happen again?”

“From the piston photos,” said Brandon, “it sure looks to me like detonation or pre-ignition.”

Shop expressing hesitation

A week later...

“The shop is now expressing hesitation at signing off the engine as airworthy if the cylinder is replaced,” Roy reported. “I’ve authorized the shop to remove the oil sump and flush it out, and look up at the bottom of the engine to see what they can see as to any further damage. I’m not sure whether they’ll be able to see the cam.”

“Well, I don’t think I’d have pulled the sump,” said Brandon, “but that will certainly give them a great view of the cam. Hopefully it’ll make them feel a little more comfortable.”

“The two IAs at the shop do not feel comfortable replacing the cylinder and signing it off as airworthy just due to the amount of metal in the filter and pan and the associated liability,” Roy said. “The shop owner offered to let an outside A&P come in and do the work so they aren’t holding the plane hostage. They did pull the oil sump and found additional metal (no surprise there) but did not see any problems with the cam.”

“Oh, one more tidbit,” Roy added. “When they pulled off the sump, they found part of a shop rag wrapped around the suction screen at the bottom of the oil pickup tube. They told me it seemed like it was blocking the pickup by about 25% or so, which didn’t do anything to increase their comfort level with the engine. Of course it’s impossible to say when the rag got in there, but in the eight months I’ve owned this airplane, I’ve never seen any indication of low oil pressure.”

“Let me ask you this,” said Brandon. “If they were not comfortable with the quantity of metal contamination at the time of filter removal, why did they

remove a cylinder? Why did you spend money to remove the pan and inspect the cam if they had already concluded they were not going to approve it for return to service?"

Honest assessment

"Given the photos and other information we have at this point, if YOU were the IA doing this annual inspection, would you feel comfortable replacing the #1 cylinder assembly and signing off the engine, or would you rather see the engine sent off for a teardown?" Roy asked Brandon. "That's probably not a fair question, but I'd really appreciate your honest assessment."

"I feel like you've accounted for the metal contamination, and verified that it has not traveled through the engine," said Brandon. "They found the source of the metal, and you've allowed them to do a great deal of disassembly and during that work they have not found any evidence of metal contamination. If this were in my shop, I'd put the engine back together with a new or overhauled/exchange cylinder, run it on the ground for 20 minutes and pull the filter. If the filter looked okay, I'd suggest you fly it for two hours and check the filter again."

"Ultimately it's your call," Brandon continued. "Sending the engine out will put your airplane down for many months. Lead times at engine shops and for engine parts is crazy right now. This is the worst time to get an engine overhauled that I can remember. Times are tough! But at the end of the day, you have to do whatever will allow you to sleep well at night. That's my honest assessment."

The next day...

"For what it's worth, I spoke to two other IAs today (both of whom I have personally used in the past) and they both agree with you and are somewhat mystified at the shop's position," said Roy. "Unfortunately, neither are interested in actually doing a cylinder replacement."

"I also talked to the engine shop I'd probably use for overhaul," Roy continued. "The COO there took an interest after I requested an overhaul quote. He looked at the photos and reviewed the shop's findings, and seemed perplexed at the suggestion to overhaul. He said I should simply

seemed perplexed at the suggestion to overhaul. He said I should simply change out the cylinder, flush the sump, and monitor the filter at more frequent intervals. In other words, pretty much what you said."

"Great minds..." quipped Brandon.

"Next question," Roy posted. "The mechanic suggested sending out the propeller and the prop governor to be flushed. Does this sound reasonable and prudent to you, or unnecessary?"

"Roy, I'm going to add Mike Busch to this ticket," said Brandon. "Perhaps he has thoughts as to how you can persuade the shop to come around."

Mike's take

"Based on the photos, the #1 cylinder clearly experienced a pre-ignition event, which is the only thing we know of that can cause such a rapid and profound CHT rise," Mike posted to Roy's ticket. "The pre-ignition event caused corner melting of the piston, which caused molten aluminum to get into the sump and also cause the #1 compression ring to become locked in its groove, resulting in scoring of the cylinder barrel by the immobilized compression ring."

"Given that no metal was found in the prop governor gasket screen, there's absolutely no reason to believe that any of the liberated metal got into the oil galleries and contaminated the bearings," Mike said. "So in my mind, there's no justification for an engine teardown."

"The #1 cylinder and piston are clearly trash," Mike continued. "The piston pin is stuck because the piston experienced severe overheating and warping, and may need to be extracted forcefully to remove the piston. Once the piston has been removed, it might be prudent to remove the #1 connecting rod. This will accomplish two things. First, it will provide assurance that the #1 connecting rod was not bent or otherwise damaged either by the violent pre-ignition event or by the forceful piston pin extraction procedure. Second, it will provide a good opportunity to inspect the #1 connecting rod big-end bearing and the #1 crankpin. If the bearing is not contaminated and the crankpin is not scored, you can be quite certain that none of the other rod or main bearings are contaminated or damaged and you can relax that there's no further collateral damage."

If the prop governor gasket screen was metal-free, then there's nothing to be accomplished by flushing the prop governor or the propeller hub," Mike said. "All the liberated metal was caught by the suction screen and oil filter (as designed), and none got any further."

"So many mechanics seem to have a knee-jerk reaction that any event that causes metal to be liberated warrants tearing down the engine and sending off the prop and governor," Mike observed. "This makes zero sense from an engineering standpoint, but it makes perfect sense for a mechanic who is paranoid about liability and would like to pass the liability off to an engine shop and prop shop. There's way too much of this 'defensive maintenance' in the piston GA industry for my taste."

Epilog

Roy didn't post to the ticket for about two weeks. Finally, Brandon couldn't stand it any more.

"Hey Roy, checking in, what's the latest?" posted Brandon.

"I shared Mike's analysis with the shop," Roy responded, "and after a little radio silence they finally relented and agreed to the plan Brandon outlined earlier on this ticket: ground run for 20 minutes, cut the filter, fly for two hours, cut the filter. My fingers are crossed that all goes well. 😊"

"I'm pretty confident it will," said Brandon. "Keep us posted."

"Ah, my work is done!" said Mike. "I will sleep soundly tonight."





Roy's experience offers an important lesson for all aircraft owners: If your shop or mechanic takes a position that makes you feel uncomfortable, seek out an expert second opinion...and perhaps a third or fourth if necessary. **Just because an A&P tells you something doesn't mean it's right or reasonable or optimal.** It's important to trust your A&P, but it's equally important to trust "your little voice." At the end of the day, it's your airplane and your decision.

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