How AVBLEND Received FAA Approval

Just what the world needs-another oil additive. But wait: This one has an unusual pedigree.
by Kas Thomas

Kas Thomas is among the best-known aviation technical writers and a world-recognized expert on piston aircraft engines. Kas is a frequent speaker at Oshkosh and AOPA Expo, and has written hundreds of articles on technical topics for Light Plane Maintenance (which he founded), The Aviation Consumer, General Aviation News & Flyer, Private Pilot, Plane & Pilot, and many others. He is also author of numerous aviation books and is the editor-in-chief of TBO Advisor magazine. Thomas holds ASMEL, instrument and rotorcraft ratings.

I must confess to being a longtime agnostic on oil additives. I've never been a big believer in them, nor, for that matter, a big disbeliever. What matters to me is what I can see and touch and measure, not a bunch of anecdotes involving lawnmowers without oil plugs. Testimonials have their place, but I'll take one page of scientific data, any day, over a file-cabinet full of handwritten hosannas from true believers who've had religious experiences because of Microlon or Slick 50 (or whatever). Anecdotal data simply has to rank lower on the totem pole of knowledge than hard numbers. The fact that thousands of people believe they've seen visitors from other planets doesn't reassure me that UFOs exist.

I've spent years looking for hard evidence that fuel and oil additives actually work. The results, with few exceptions, have been dismal. TCP Concentrate (the fuel additive from Alcor), is a prominent exception. The evidence is irrefutable, at this point, that TCP - by aiding lead scavenging - significantly improves spark plug life in engines that use leaded gasoline. As it turns out, tricresyl phosphate is also a good anti-scuff agent and therefore has a legitimate role in oil fortification. (Shell's use of TCP in 15W-50 Multi grade, and Lycoming's use of it in LW16702 oil additive, are 100% justified). The zinc dialkyl dithiophosphates (ZDDP) are also useful in preventing scuffing, although they tend to form ash.

Testimonials have their place, but I'll take scientific data any day...

Teflon, on the other hand, has no legitimate place in any fuel or oil additive. Not only do Teflon particles tend to flock together (agglomerate) and dam up around bearings and orifices, the polymer actually starts to decompose (to hydrofluoric acid) at combustion chamber temperatures. For these and other reasons, DuPont (who has more technical expertise in Teflon than anybody else in the world), has warned against the use of Teflon (polytetrafluoroethylene, or poly-TFE, for short) in oil additives since Day One.

That's not to say Teflon containing additives might not produce beneficial effects. They perhaps do, in some cases, but the effects have nothing to do with Teflon.

It's taken me almost 20 years to understand why the engine-makers have adopted such a hard-nosed attitude toward additives, but I think I am finally starting to understand (maybe I'm just getting old). By and large, all the lubrication performance that an engine needs in an oil is already in the oil when it leaves the refinery. When you look closely at the thermal and mechanical forces at work inside an operating engine, it's a miracle any lubricant can do the job at all. The fact that existing oil products let us fly our engines to 2,000 and 3,000 hours between overhauls (100,000 miles is not unusual anymore for a car engine), is nothing short of astonishing. Off-the-shelf lubricants do their job so spectacularly, one might well be prompted to ask, "What exactly anybody would hope to gain by using an oil additive in the first place?"

Unfinished Business

As it turns out, I can think of a couple of areas where lubrication science has left Lycoming and Continental Engine owners holding the bag. For example: [1] valve sticking, [2] scuff protection during cold starts, and [3] thermal breakdown (coking and carbon deposits in high-temp parts of the engine). Of these three, valve sticking is far and away the most serious, since it involves safety of flight.

Valve sticking has been a problem for aircraft engines since the 1930s. The problem, in a nutshell, is that high-output air-cooled engines impose huge thermal loads on exhaust valves (and seats and guides). In addition, air-cooled engines run at very rich mixtures, for cooling purposes, and they use serious amounts of lead in the fuel (for knock suppression). This combination is ideal for valve sticking, since the combustion chamber now becomes a crucible for the formation of high-melting-point lead/carbon deposits which, given the opportunity, precipitate out on valve stems during the exhaust event. When the valve retracts into its guide in preparation for the next cycle (and remember, the valve spends two-thirds of its time closed), hot stem deposits transfer to the cooler valve guide. With time, deposits build up to the point where the valve has no running clearance at all. After a hot shutdown, especially as the rapidly cooling cylinder head and guide shrink onto the still-hot valve stem, valves and guides can cement together.

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The problem is worse in engines with sodium-filled valves, because the sodium coolant carries massive amounts of heat straight up to the valve stem (the entire valve runs hot, instead of just the head).

Abnormal valve cooling only aggravates the picture. How does valve cooling become "abnormal?" Simple. When the heat-transfer path is broken, the valve overheats - that's all there is to it. For a solid -stemmed valve (which includes all Continental valves), the single most important heat-transfer path is the one formed by valve face to valve seat contact. This is where up to 75% of all heat transfer takes place (see SAE Paper 650484, May 1965, by Thompson valve engineer Cherrie). Anything that interrupts this path will cause valve temperatures to skyrocket. Bear in mind that the exhaust gases rushing past the open exhaust valve may be 1,600F to 2,000F or more, and at valve lifts less than about 0.1-inch, flow is Mach-limited. The "wind chill" is probably around 3000F. So poor valve seating, due to deposit buildups on the valve or seat, for example, can result in greatly elevated valve temperatures, and the increase shows up instantly. With sodium-cooled valves (as used on all current-day Lycoming engines), the most important heat-transfer path is via stem and guide contact. Here, valve guide wear is critical, because if guide clearances open up, not only is heat transfer impeded, but valve seating can be impaired by virtue of the fact that the valve isn't going straight up and down any more (it's wobbling around). Again, the result is skyrocketing valve temperatures.

Anything that can aid in achieving better valve seating, reduced guide wear, lower temperatures, and/or improved lubricity inside the valve guide should, in theory, help to reduce valve sticking, and maybe go a long way toward improving the overall TBO life of the engine (since valve and guide problems are often TBO-limiting).

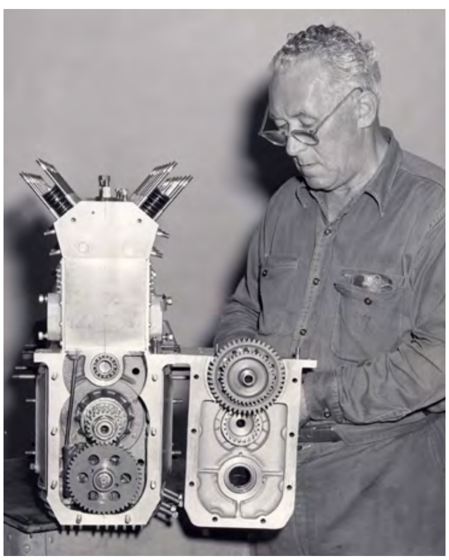
But the question is: "What can you use that's FAA-approved?" Lycoming's LW-16702 does nothing for valve sticking, and the extent to which TCP Concentrate can alleviate valve sticking is not well documented. Embry-Riddle Aeronautical University did find some evidence for this in the 1970s, but the numbers were not terribly impressive.

Marvel Mystery Oil has been used by many operators (including Braniff Airlines, back in the DC-2 and DC-.3 days) for prevention of valve sticking, but Marvel's product has never been FAA-approved, and there have been instances where valve sticking has happened in Marvel-treated engines.

Enter Lenckite

A company in Chicago Ridge, Illinois, claims to have the answer in the form of something called Lenckite AVBlend. Like Marvel oil, Lenckite is a light weight, non-Teflon-containing, non-ash-forming oil and/or fuel additive with good lubricity characteristics, designed to be added periodically to an engine (rather than just once, as with Microlon). But unlike Marvel oil, Lenckite is light blue, non-kerosenic, and (most important) FAA-approved (now called AVBLEND).

The history on Lenckite goes back a long way. Its inventor, Joe Lencki, was a prominent race-car mechanic and engine designer whose cars raced at Indianapolis Motor Speedway in the 1930s. The Lencki engine, in fact, was one of the most successful race-car



Joe Lencki

engines of the 1930s. At the outbreak of WWII, speedway racing was suspended and Joe Lencki spent his war years supervising the construction of aircraft engines - first the Pratt & Whitney twin row R-1830, then (at the Dodge Chicago plant, where he was superintendent), the massive Wright R-3350.

Even before WWII, Joe Lencki realized from problems he was having getting oil to flow quickly to remote parts of his race engines' valve train after startup, that a light-lubricity oil additive would be helpful in avoiding cold-start damage in expensive race engines. By 1946, Lencki was using, (and offering to other race mechanics), his own specially reformed "pure lubricant," an additive he simply called "Speedway Cocktail."

The additive gained quick acceptance among racecar professionals, and was sold for professional use only. No mass marketing was ever attempted.

In the early 1960s, Joe Lencki (still active on the race-engine mechanics' circuit), crossed paths with ex-Air Force mechanic Ed Rachanski, who at the time, was racing funny cars for Lincoln-Mercury. Other members of the Mercury team included, "Dyno Don" Nicholson and George DeLorean, brother of the ill-famed car manufacturer. Rachanski, who built up race car engines when he was not racing his Marauder Comet, learned of Speedway Cocktail through Lencki and began experimenting with it. Later, by popular demand, Rachanski would begin building up customers' aircraft engines. He founded a shop (eventually an FAA Repair Station) called Blueprint Engines at Chicago's Midway Airport.

The Aircraft World

In 1978, Ed Rachanski was approached by Ralph Rosenbrock, vice president of a local helicopter ag-spraying and charter operation called Executive Helicopter. At that time, Executive was operating a Hiller UH12 powered by a Lycoming VO-540-B engine which was experiencing problems running on high-lead fuel. According to Rosenbrock, "One day, I received a call from the pilot stating the engine was running so rough that he could not hover the aircraft. I went to the site and determined that the exhaust valves were sticking open, so I trailered the aircraft back to our hangar at Midway Airport. I phoned Ed and asked him if he could ream the exhaust guides on our cylinders. After considerable

convincing by Mr. Rachanski, I agreed to try what he suggested, which was to run the aircraft until the engine was up to operating temperatures and then put one can of Lenckite (as the product was not being called) into the oil system and induce another can through the induction system, immediately turn off the engine, and allow it to stand several hours."

After Rosenbrock followed this odd sounding regimen, he had the company's chief pilot run the Hiller's engine up and fly it. "No evidence was found of valve sticking," Rosenbrock recalls, "and the aircraft ran beautifully, which it has continued to do ever since."

Rachanski realized FAA approval was a must. Working in conjunction with Executive Helicopter, Rachanski wrote up a test protocol and took it to the local FAA engineering office. The FAA agreed to witness the testing which would take place in an Enstrom helicopter's Lycoming HIO-360-CIA engine. In a nutshell, the test protocol involved overhauling the engine to new limits, running it to TBO with Lenckite added at each 50-hour oil change interval, then tearing it down (in FAA's presence), and documenting the condition of the parts.

The engine was, in fact, flown 1000 hours (the engine's normal TBO at that time) in the WGN-radio traffic report helicopter, under typically demanding Chicago weather conditions. A single 12-ounce can of Lenckite was added every 50 hours. The oil used was Aero shell straight-weight 50. On teardown, the engine was remarkably clean. The crank and rod bearings still had their original lead-indium overlay, the cam and lifters showed the proper functional patterns (with proper rotation of lifter bodies), and most amazingly, the engine was still within new limits on all major parts! The exhaust valves had less than a thousandth of an inch wear, and all four cylinders checked within new limits for bore, choke, and out-of-round.

I admit I was somewhat skeptical... Incredibly, the (Lenckite) cylinder barrels had flown 7786.8 hours since new, and had never been chromed or ground oversize!

The WGN traffic helicopter's engine was overhauled and put in service (with the original nitrated cylinders) for another TBO run, this time to 1150 hours. A second teardown was witnessed by the FAA. The same results were seen.

FAA approval of Lenckite was granted for all piston aircraft engines.

The 7700 – Hour Cylinders

Blueprint Engines overhauled the Enstrom's engine a second time and put it back in service, again with the original cylinders. This time, the engine was run to 1464 hours. At the third teardown, the factory nitrated cylinders were still within limits for bore, choke and out-of-round. The jugs were lightly honed, then put back together with new parts in accordance with Lycoming Service Bulletin No. 240. The freshly rebuilt HIO-360 was put back in Executive's Enstrom for another run.
This time, the engine was flown to 1508 hours SMOH (5122 hours TTSN). Again, at teardown, the engine was free from excessive wear and the cylinders were still within limits. The engine was overhauled and put back in service.

After another 1100 hours, the Lycoming was torn down again. And again, the cylinders were within limits.

Some 400 hours later, a head crack was found in one cylinder. All cylinders were removed from service (and retained by Blueprint Engines as hardware exhibits). Incredibly, the cylinder barrels had flown 7786.8 hours since new, and had never been chromed or ground oversize! Through five overhauls, they got nothing more than light honing to remove glaze left by Aero shell 100 W (treated with Lenckite). At 7786 TTSN, the barrels were just beginning to reach the 5130 hour in-service limit.

All of this would be pretty hard to believe, quite frankly, if I didn't see it myself. I confess I was somewhat skeptical the first time Ed Rachanski, Jr., called me on the phone and told me about the Enstrom engine. "You ought to come down here and see the cylinders," he piped. "Yeah, right," I thought. My father operated an Enstrom once and knew plenty of other Enstrom operators and none of those guys got 7000 hours out of their cylinders! But curiosity eventually go the better of me, and in January 1994, in the midst of one of the coldest cold waves in years, yours truly trekked to Chicago to inspect the work orders for WGN's traffic helicopter and examine the legendary Lenckite-treated HIO-360 cylinders in person. I also personally miked two of the exhaust valves, and can report that the stem wear was indeed only four to five ten thousandths. The valve faces were also mirror-smooth and clean all the way around.

Everything Ed Rachanski had told me appeared to be true. The Enstrom's cylinders looked to be Oberdorfer castings and they were in excellent condition. The barrels were dark and very smooth, with no significant wear steps, and with some hone-marks still present below the bottom limit of ring travel.

The cleanliness of the rocker area was impressive too. Rachanski agreed and pulled out a box of slides (color transparencies), showing what other Lenckite treated engines he's worked on looked like (for the past 18 years, all engines overhauled by Blueprint Engines have been treated with Lenckite). Valve springs, spring seats, and rocker box crevices on untreated engines are usually quite carbonaceous after a full TBO run, but on a Lenckite-treated engine, there are no deposit accumulations, just a light glaze (what Blueprint's guys call the "turkey glaze" appearance).

Mode of Action

I asked Ed Rachanski, Sr., what Lenckite's mode of action was. He explained that there are no metallic salts (no zinc, for instance), no polymers, no solids, nor any ash-forming components in Lenckite, just highly reformed oil products, in a very light, very pure parrafinic base stock. The exact formula, of course, is proprietary. The essential point is that only mineral oil derivatives are used.

Without AVBLEND   With AVBLEND

There are no coal tar constituents for example, nor any inorganic salts. Smelling an open container, I remarked on the presence of ether. "Yes, there is ether in it," Rachanski admitted. "It's there as a tracer. Some manufacturers put perfume in their additives. We put a small amount of ether."

The mode of action, Rachanski told me, involves Lenckite penetrating deep into the metal (like penetrating oil). The more porous the metal, the deeper the penetration. Thus, cast-aluminum parts soak up Lenckite very readily. Naturally, it helps if parts are warm, Lenckite penetrates best when the metal's pores are open widest. When the metal cools down, some Lenckite is retained in the pore structure of the surface, forming a tenacious coating. No covalent bonding occurs, and there is no permanent chemical modification of the base metal. You do have to replenish the stuff every 50 hours or so, after all, but Lenckite is tenacious. It's like oil you can't fully wipe off no matter how hard you try! From the description of Lenckite's mode of action, I could see a direct parallel in how an oilite bushing works. It's the same principle: You heat the metal to 150 or 200 degrees F and brush light oil on the part, then hold the piece at that temperature for anywhere from 10 minutes to a couple of hours. During that "soak time," the oil seeps into the metal's pores by capillary action. It comes out, little by little, in actual service over a period of many hours.

Rachanski explained that the "seeping out" of Lenckite occurs exactly when you need it most. "Don't forget," he emphasized, "Joe Lencki developed the product originally to cut down on cam scuffing during cold-starts of his race engines. With Lenckite, you always have lubrication on startup, because you always have that wetting action. Your oil drains off the parts with time, but Lenckite doesn't. You never get bare metal against bare metal."

The same wetting action explains the inability of Lenckite treated parts to hold carbon deposits. Quite simply, coke and lead deposits won't stick to a surface that "weeps" oil. That's all there is to it. No rocket science here.

Likewise, rust and corrosion are slow to occur on a Lenckite-treated steel part, because of the fact that Lenckite (which forms a physical barrier, protecting parts from oxygen) doesn't drain off.

The Hot Seat

In the combustion chamber, Lenckite helps moderate surface temperatures (according to Rachanski), by flashing out of the metal's pores on an as-needed basis. But the most important role that Lenckite plays, Rachanski believes, is its role in preventing deposit buildups on valves and seats. By keeping the valve contact area clean, heat transfer between valve seats is optimal. Valve and stem temperatures stay in the designed operating range, reducing the potential for valve sticking. In addition, because there are drastically fewer deposit buildups on the seats and valves, there is less combustion leakage, which means cleaner combustion.

"In an engine with leaky valves," Ed Rachanski, Sr., points out, "you aren't getting the design peak pressure for that cylinder. Some of the pressure is leaking out during the compression stroke, and some leaks out during combustion. As a result, peak pressure is less and you start to get incompletely burned by-products from the fuel. Some of those by-products stay in the cylinder from cycle to cycle. They're what give rise to combustion chamber deposits."

The elder Rachanski (who, since handing over management of Blueprint Engines to his sons), spends much of his time as an independent aircraft accident investigator and expert witness and feels there is a definite connection between the incompletely burned by-products of combustion and valve sticking. He's not alone in this opinion either. Gary Greenwood, formerly of Engine Components Inc., wrote an article in a recent issue of the EC Flyer stating that valve sticking is more likely in engines with fouled spark plugs, in part because single-spark flame initiation takes longer and is less likely to produce complete combustion. That is, partially burned fuel by-products accumulate, only to precipitate out on pistons, valves, etc. According to Rachanski, any time cylinder compression sags (for whatever reason), the chemistry of combustion is severely altered in such a way as to favor harmful byproducts. Keeping valves free of deposits (of the kind that can cause compression loss) is therefore extremely important. It may be the key to preventing a host of problems, including not only valve sticking, valve guide wear and valve breakage, but ring sticking and ring breakage as well.

Your oil drains off with time, but Lenckite doesn't. You never get bare metal against bare metal... No rocket science here.

Fleet Experience

Nothing speaks as loudly as experience, however. This is why I made sure to ask Rachanski if any large fleet operators had amassed any experience with Lenckite. I was given a UPS shippers manifest book documenting shipments of Lenckite to various customers around the U.S. One name that came up numerous times was American Flyers (the famous flight-training operation), with bases in Illinois, Florida, Michigan, Texas, California, New York and New Jersey. I thought it might be interesting to talk with someone at American Flyers. I ended up speaking with Herman Krunfus, director of maintenance for the Palwaukee/DuPage fleet.

Krunfus told me the school's planes (which are predominantly Lycoming powered, but also include some Continental-powered Barons), are on a continuous inspection program with checks every 75 hours. "They get an oil change at the 75-hour inspection, and also one halfway between each inspection." he explained. Four-cylinder planes get one 12-ounce can of Lenckite at each oil change and six-cylinder engines get two 12-ounce cans.

Krunfus confirmed that American Flyers had been using Lenckite in a test program since 1991. "In two years," he told me, "we've seen our incidence of valve sticking drop by 75 to 80 percent. We were having a real problem before. Now it's gotten to the point where we just use the Lenckite additive at every oil change, in every airplane, and we almost never see any valve sticking."

American Flyers is currently the largest fleet user of Lenckite AVBlend, with 78 aircraft flying some 6600 hours per month. In the past two years, Krunfus estimates that the school's training aircraft have amassed well over 100,000 hours on Lenckite-treated oil, with consistently positive results.

The Outlook

"We feel the time is right for this product," Ed Rachanski, Sr., explains. "We've spent a long time using the product, testing it, getting it approved, and gathering support. With the history this product has, we think there's no reason plane-owners and mechanics everywhere shouldn't know about it and use it. It does a wonderful job of protecting engines. It's done a fantastic job for our customers."

Ed Jr., agrees, "When customers bring their engines back in at the end of a TBO round, they look extremely clean. You can tell immediately if an engine's been using Lenckite."

"We think the product's time has come," Ed Sr., sums up.

Conclusion

Although (as I stated at the beginning), I tend to take a dim, if not disdainful view of additives, some additives are clearly worth looking into. Lenckite strikes me as such an additive. After inspecting parts from Lenckite-treated engines, talking with operators who've used the product (including a maintenance manager from one of the country's largest flight schools), and reviewing the history of the product, I am forced to the conclusion that Lenckite is definitely worth looking into if you have the slightest concern about valve sticking, cam spalling or dry-start damage. It certainly can't hurt anything. It is notable for its wetting action, its sheer tenacity (failure to run off parts), and its apparent ability to all but eliminate deposit buildups (especially on valves, seats and guides and in rocker boxes). The fact that an Enstrom helicopter's cylinders went 7000+ hours without being out-of-round or beyond limits for barrel wear (using straight Shell 50-weight oil treated with Lenckite) is also impressive, to say the least. That's not to say, of course, you'll get 7000 hours out of your cylinders. You might, of course (if you fly as often as a WGN traffic helicopter), but Lenckite is not sold as a TBO-extending additive. Nor should it be. To their credit, the Rachanskis never spoke in terms of doubling your TBO, cutting friction in half or slashing wear, the kind of oil-additive claims that always have me batting myself on the ears at two in the morning, trying to get the steady hum of bullshit out of my head.

If you're using (or had been planning to use) Marvel Mystery Oil in your engine, you should definitely switch over to Lenckite, for its FAA approval, if nothing else. And be sure to drop the TBO Advisor a line, if and when you do make the switch. Let us know your experiences, good, bad, or otherwise. We intend to follow the progress of Lenckite, and Lenckite's users very closely as time goes oni

I've come to the conclusion that Lenckite (AVBLEND) is definitely worth looking into.

U.S. Department of Transportation
Federal Aviation Administration

Small Airplane Directorate
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2300 East Devon Avenue
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MAR 0 7 1997

Mr. Ed Rachanski
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Bedford Park, IL 60638-6024

Dear Mr. Rachanski:

This is in response to your January 14, February 19, and March 7, 1997, letters concerning your company's reorganization and new address. Additionally, this is in regards to your request for approval of AvBlend as an engine oil additive for aircraft piston engines.

We have reviewed your request and hereby approve AvBlend as an engine oil [illegible] both Textron Lycoming and Teledyne Continental engines [illegible] engines. We are enclosing copies of Tecni Fl[illegible] January 14, 1997, and [illegible] 1997, both [illegible]

Sin[illegible]

FOR Thad[illegible] Krolicki, [illegible]
Pro[illegible] Branch Manager,
Chicago Aircraft Certification Office

Enclosures