Looking like it grew there, a line of O-ring material snakes its way along the case sealing surface. Pioneered by noted engine house Ly-Con, the new procedure promises to end chronic weeping of Continental and Lycoming case parting lines.

CASE CLOSED

Ly-Con makes a case for O-ringing engine crankcases leak-free.

BY TOM WILSON

Key to the O-ring procedure is Ly-Con's spanking-new Haas VF6 CNC machining center. Repeatable to 0.0002-inch and faster than Darryl Greenamyer, the 10,000-rpm, 20-horsepower Haas unit and its computer controls are the only way to handle the variables in 60 years of Continental and Lycoming production.

No one likes oil leaks, and after decades of snotty-nosed flat motors California engine shop Ly-Con is doing something about it. Taking a cue from everything from various round motor pieces to numerous flat-engine cover plates and accessory parts, Ly-Con has developed a system for O-ringing Lycoming and Continental crankcases.

Probably the most appreciative will be Ly-Con's helicopter customers. Ly-Con owner Ken Tunnell says no matter how well his shop seals the vertically mounted engines, about half of them end up leaking along the case parting line. The problem is so well-known by the chopper crowd that most commercial operators slather JB Weld or other Band-Aids around the case parting line before installing an overhauled engine in the airframe. "It's going to start leaking in 300 to 500 hours," they explain as they spread the unsightly stuff.

Fixed-wing fliers also commonly suffer from engines whose case halves perpetually weep between the starter and alternator, but at a lesser rate than the helo drivers. Still, at least 10% of the flat engines out there are busy oiling everything firewall forward—and, eventually, several items aft—and wouldn't we love to get rid of that mess? Come overhaul time, everyone would appreciate a guaranteed leak-free job, hence the new O-ring procedure.

Thread of a Chance

Both Continental and Lycoming seal their cases using a combination of Hylomar brand sealant and a length of silk thread laid between the case parting flanges. It's a time-honored system typical of pre-war powerplants, and it does keep the cases from oozing oil faster than the operator can pour it in. But it isn't forgiving of imperfections along the case parting line and definitely isn't foolproof. Furthermore, in this age of seamless perfection in airframes, even a wisping discoloration along the case parting lines isn't to be tolerated as it was back in granddad's day.

For the main runs along the crankcase top and bottom, Ly-Con uses bulk 0.070-inch diameter O-ring material cut to length. There's nothing particularly trick about the material, as O-ring rubber is designed to withstand petroleum products in the first place.

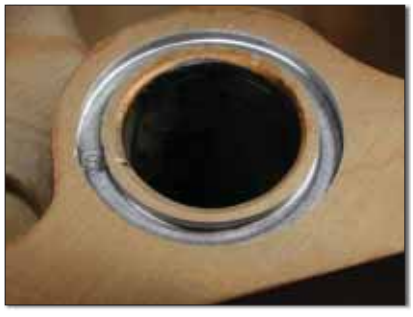
Ly-Con's Cure

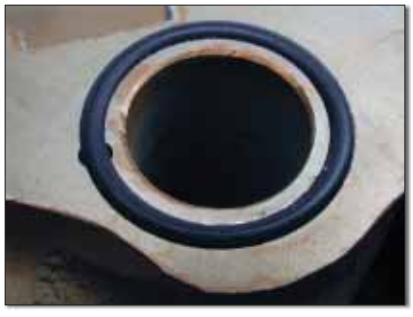
Ly-Con's solution involves grooving one of the crankcase flanges and fitting it with a length of O-ring material. The depth and shape of the O-ring groove have been carefully developed to provide the right amount of O-ring crush, along with a dovetail shape to hold the O-ring in place during engine assembly. No adhesive is used, installation is generally foolproof, and the finished engine doesn't leak.

At the time of our visit, Ly-Con had fitted several of its high-visibility airshow customers' engines with the O-ring cases and accumulated hundreds of hard-core aerobatic and ferry hours of leak-free operation. "Not a drop," Tunnell said with a smile when we asked if there had been any unwanted oil.

While a long overdue freedom from leaks, or even alleviating the fear of leaks, are the O-ring's most immediate advantages, there are others. Engine assembly is also eased, as fitting the O-ring is less demanding of the technician's skill than deciding on how much sealant to apply to the case halves, remembering if one or both sides of the case get glued and laying the thread without accidentally getting it too close to the bolt holes.

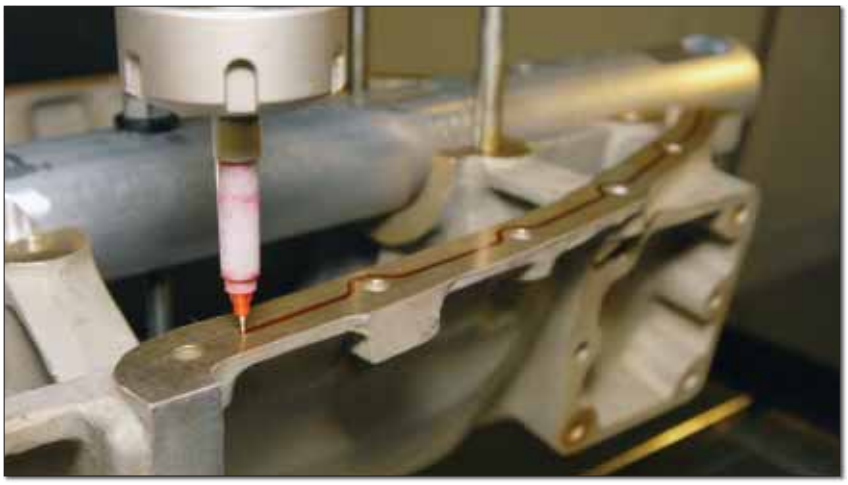
Even better, the O-ring could very well save the four-digit expense and consumption of precious case life by avoiding align boring at the next overhaul. The traditional string-sealing





Besides the parting flanges, several O-ring grooves are cut around through-bolt and stud holes. The semi-circles in the groove perimeter at 9 o'clock are where the undercutting ball-cutter enters and exits the work.

Photos: Tom Wilson



Machining a case begins by setting the case half in the Haas machine and having the pen draw the tool path. It takes only seconds to mark the line.

method demands flat, imperfection-free mating flanges—the same flanges that often lightly fret during use. Such distress to the case mating flanges, however shallow, requires case machining to restore an effective sealing area with the string method. This means milling the case flanges, which in turn typically requires align boring the crankshaft and cam bores to maintain round bearing saddles. This is a large price to pay for simply sealing the case, and can be completely avoided with the O-ring, because light fretting distress along the case parting line (not to be confused with fretting around the main bearing saddles) will not compromise the O-ring's sealing capability. The case may be re-used without milling and subsequent align boring.

Why So Long in the Making?

If O-ringing the case halves is so beneficial, and seemingly easy to execute, how come it hasn't been around for years?

While the new Haas machine offers every trick, including diagrams of the tool path, sometimes good old farm-yard expediency gives the fastest, truest information. Noting that in the old days Continental and Lycoming "must have drilled these bolt holes by hand," Ly-Con machinists have fitted one of the Haas machine's tool bays with a Pilot Razor Point pen. Running the pen before the cutter instantly shows any conflicts between the software and reality, as this trace over the edge illustrates.

At the OEM level, the answer likely involves the staggering traditionalism of the aviation world, along with the costs associated with making such a change in the certified arena.

In the rebuild aftermarket, the answer again resides in the certification paper storm, plus the need to accommodate a huge number of Lycoming and Continental case variations. After 60 years

Case Sealing: Two Choices

Just so everyone is clear on how both the stock thread and Ly-Con's O-ring methods work, we asked Ly-Con to give us a quick rundown of how the two methods are employed.

Because smooth, flat case flanges are a must when sealing with the stock string method, the parting flats of the case are machined flat and cleaned of any oil or particulates. Both case half flanges are lightly coated with aviation grade Hylomar. This is a moderately sticky blue adhesive that cleans up with acetone.

An acid brush's bristles are trimmed to about 3/8 inch to apply the Hylomar. This allows spackling the glue in a daubing motion (not brushed) without the brush bristles splaying and leaving voids in the glue. Immediately after the sealant is applied, the thread is laid down, and it is drawn around the inside of the bolt holes.

The thread ends are trimmed to extend about 1/8 inch past the case parting line. This string tail is left in place and doesn't seem to matter even when the crankshaft seal is installed. The thread can't shift out of position once the case halves are joined, so pushing in the seals doesn't upset the thread.

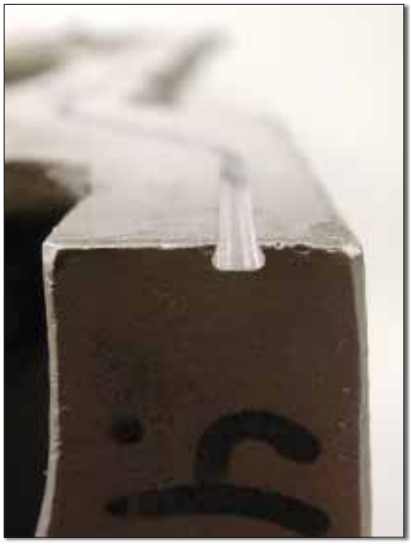
Ly-Con showed us the single-thread installation detailed in Lycoming literature. However, they often install a double thread on Experimental engines, as it seems to offer better leak protection. As for the thread, it's Grade D silk thread in 00 gauge (about 0.020 inch in diameter). Continental even has a part number for the stuff.

Assembling an engine with O-ringed flanges is arguably less fuss than it is with the stock string method (Ly-Con techs make both procedures look easy). With the case ready for assembly, the O-ring material is pressed into the case groove. Slightly stretching the rubber narrows it, helping it get down into its groove as the tech runs his finger along the work. Once pressed into the groove the rubber relaxes to its larger, at-rest diameter and is captured by the tighter groove top, holding it in place. This makes handling the case a breeze, as the O-ring stays snug in its groove. And with no sealant involved there's no time rush, either.

A short tail of O-ring material is left when laying the rubber in the groove. Once the case halves are joined, the excess O-ring is razored flush, completing the job. —*T.W.*

Some of the O-ring paths are both aesthetically pleasing as well as rather long, such as with this Continental IO-520 casting.

Two cutters, both rather small, are used to form the O-ring groove. The straight cutter (top) sets the groove depth and its width at the top. The ball cutter follows, belling the bottom of the groove and giving the O-ring material a place to nest during assembly. Each cutter definitely costs more than a dime.



Viewed edge on, the O-ring groove's distinct big-bottom profile is easy to see. Ly-Con found this shape necessary to hold the O-ring rubber in place during engine assembly. Without it, the O-ring falls out before the case halves can be joined.

of production, who knows how many times the case flange shape or bolt-hole position have changed in the flat engine universe. Given manual machining, it would be impossible to develop techniques or tooling to accelerate the grooving process, thus relegating the O-ring grooving to a tedious custom process with every case.

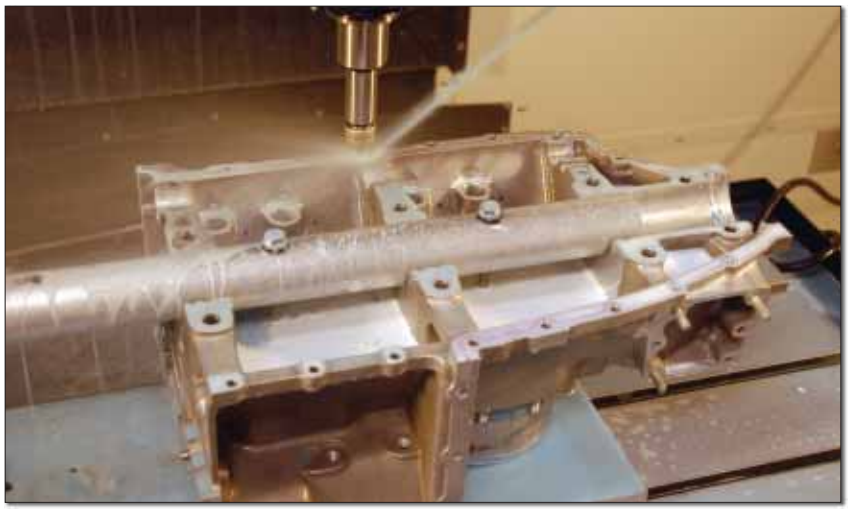
With CNC machining, however, the ability to automate the process via software, plus the incredible speed afforded by today's powerful CNC machining centers, make handling the numerous case variations possible. The trick is having the financial stones to step up to a CNC machining center. It's a big, six-figure step for aviation engine shops, but one Ly-Con recently made to compete with exclusives such as case O-ringing, along with building speed into its burgeoning cylinder porting business (of which more in a later article).

At press time the case O-ring modification was available for Experimental engines, but by the time you read this Ly-Con calculates it will have FAA approval for certificated engines via a Process Specification; that is a format available to licensed repair stations such as Ly-Con. The company is also working on an STC for the O-ring, though that will take a bit longer. In the meantime, Ly-Con already has a process patent pending on the procedure.

Ly-Con has developed the O-ringing for all of the popular Continental and Lycoming engines. Pricing was preliminarily set at $648 for a four-cylinder case and $972 for a six-cylinder case. It is worth noting that once the case has been grooved for the O-ring, the only expense at future overhauls will be the negligible cost of the new O-ring material.

Of course, the standard glue-and-string sealing method is still available at no extra charge, so we now have a choice in case sealing. We're also looking forward to other machining improvements as Ly-Con explores the capabilities of its new CNC equipment. The company is already working toward running the majority of its cylinder head porting jobs through the machine. We'll just have to wait and see what surprises they come up with after that. ✚

For more information call Ly-Con at 559/651-1070 or visit the web at www.lycon.com. Direct links can be found at www.kitplanes.com.



With the tool path verified, the coolant gushes on, and the straight cutter sirens its way through the aluminum. The straight cutter makes two trips through the case, as the tool is so small it would break if a full-depth cut were attempted. The ball cutter follows the straight cutter—it makes two passes as well—and that's it for the machining.

Once grooved, Ly-Con stamps the case with its program number. This speeds identification of the software used should the case return for a subsequent overhaul and require re-machining.

Because the cutting takes only seconds, by far the biggest time consumer of the O-ring process is setting the work in and out of the CNC machine. Gary Fisher, Ly-Con's head man in the CNC department, did the heavy lifting for the camera this time.