Engine Overhaul Fundamentals, Part Two: FIELD OR FACTORY?

Photo courtesy Continental Motors

An engine overhaul is a big project. Luckily, it's also work that many shops are qualified to do—ranging from local A&Ps to large FAA-certified repair stations and the engine manufacturers themselves. Find out more about the pluses and minuses of each option and which might be right for your situation.

By DENNIS WOLTER

Hopefully last month's article outlining the steps and procedures involved in an engine overhaul helps explain where all the money goes. That information should prepare a reader to decide what level of overhaul is right for you.

There are two ways you can choose to have an engine overhaul done. The first way is a field overhaul done by your local mechanic or a larger shop that specializes in overhauling and repairing engines. The second choice is to return the engine to the original manufacturer for overhaul or exchange.

Non-factory (field) overhauls

Let's first discuss the services offered by field overhaulers. Without question, there are more widely-varying levels of overhaul with field overhauls, starting with the most basic minimum-wear limits overhaul and working up to custom performance-oriented specialty overhauls.

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Minimum limits

The most basic process can be more like a condition inspection than an actual overhaul. The engine is disassembled, cleaned and inspected for adherence to minimum limits. This ensures that the reassembled engine is airworthy at the time of the inspection.

Some paint and a set of gaskets can allow the logbook to read "zero time since major overhaul." If a critical minimum limits component experiences as little as one one-thousandth of an inch of additional wear, the engine is no longer airworthy. That's not the best situation. Most mechanics I've come to know will not do a minimum-limits overhaul.

Don't overlook the little guy

Partnering with the right A&P can result in a cost-effective and predictable outcome based on your requests and their experience. It's worth the time to find a local A&P technician who is equipped to do engine overhauls—and likes it!

I believe that some of the best overhauls are done by a small one-person operations run by a technician who has developed good working relationships with various specialty shops that can recondition cylinders, crankshafts and accessories. When all these components are reassembled, you should have a safe and reliable engine.

Here are some of the reasons I think a small-shop overhaul can be a very good choice:

1. You will develop a relationship with the person who is doing this very important job for you.

2. You can be directly involved in deciding which solutions are best in addressing the many details of your overhaul.

3. If any post-overhaul issues arise, you and the mechanic are right there to jointly resolve the problem.

4. The good folks who do this work take pride in their product and have a deep interest in making sure their overhaul will safely and efficiently perform as it should, all the way to TBO.

5. Due to possible lower overhead associated with a small company structure, you may find this to be a more cost-effective choice.

6. Being more involved in the overhaul process, you will gain a more in-depth knowledge of the inner workings of your engine.

7. With a single person doing the overhaul, installation and ongoing maintenance of the engine, you avoid the finger-pointing contests that can occur when someone installs an ailing engine that they themselves didn't overhaul. One per-

Photo: PFA Archives

Overhauls of simple four-cylinder engines can often be performed by a skilled local A&P.

son, one point of contact and one cook in the kitchen can have its advantages.

8. The time and expense of shipping the engine to and from an out-of-town overhauler is eliminated.

If you have a high-horsepower, turbocharged engine, it may be difficult to find a small local shop that is equipped to overhaul an engine of this type. If this complex task is not part of their normal operation, look elsewhere. Consider one of the bigger field overhaulers for whom this task would be more routine.

FAA-approved repair station overhauls

Another great option in the field overhaul game is to have your overhaul done by a large, FAA-approved repair station which overhauls engines. Due to the larger volume of overhauls performed by these companies, they often have the ability to repair and overhaul components and accessories in-house.

The services offered by a larger field overhauler include turnkey options where a customer drops off the airplane to their facility to have the entire removal, overhaul, installation and flight test process completed there. An owner can also choose to have their local mechanic remove and ship out the engine for overhaul. Later, the local mechanic will reinstall the engine.

In either case, the overhaul facility will quote a base price for the service requested, with the customer agreeing that their crankshaft and engine case must be in good enough condition to be reused.

It's important to realize that in order for the overhaul facility to stand behind their work and offer a good warranty, they will usually prefer to undertake new-limits overhauls.

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When quoting the price for a new-limits overhaul, the facility will include a comprehensive list of all new parts, reconditioned used parts, accessory overhaul work scope details and warranty specifications.

With all of that upfront information, the final cost of the overhaul will likely still be a moving target, especially if that same shop is removing and reinstalling the engine. Old airplanes have worn stuff that often can't be evaluated until someone removes and inspects it. So, be prepared for a call from the facility letting you know that your muffler, engine baffles or engine mount will need additional repairs. *(Wolter will discuss these issues in a future article. —Ed.)*

Here are some of the advantages of having a big overhaul facility overhaul your engine:

1. These facilities are more closely regulated by the FAA to ensure that all components and processes are strictly followed, and all manufacturers specifications are adhered to.

2. These facilities often employ a larger staff of both licensed mechanics and certified repair technicians who specialize in the various tasks required to overhaul an engine.

3. These facilities often have more extensive and in-depth in-house machining and component repair capabilities.

4. The ability to overhaul complex, high-horsepower engines is more likely at a larger facility.

5. Having used a big company with

Photo courtesy Lycoming

Complex engines, like the Lycoming TIO-540 shown here, are routinely overhauled by FAA-approved repair stations, as well as by the original manufacturer.

brand recognition can instill confidence in a prospective buyer at sale time.

6. These facilities often have faster turnaround and more predictable downtime estimates due to the having more available labor and control over needed repairs that can be done in-house.

7. Most large field overhaulers have accumulated a substantial stock of good used engine parts over the years. If your crankshaft is not eligible to be reused, they are likely to have a good used one on the shelf.

8. Having a large technical staff provides an extensive pool of knowledge for a technician to tap into.

9. Many larger field overhaulers have overhauled engines in stock that are ready for shipment to the customer on an exchange basis.

Note: Factoring in the higher overhead of a bigger company, the cost of using a larger field overhauler may be higher than that of a local shop.

Factory and factory service center overhauls

The third option to consider is to have your local maintenance facility remove your engine and ship it to the original manufacturer for overhaul. If you're in a hurry, you can order a factory-overhauled exchange engine that can be shipped directly to your installer. The exchange engine will be ready and waiting for installation as soon as your airplane arrives at the shop, saving some downtime.

Whether you have a Lycoming or a Continental engine, I think it is very important for an aircraft owner to call the respective factory. Discuss the various overhaul options with a technical representative as well as the manager of the facility that will be installing the reworked engine.

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Before discussing factory overhaul services, I should inform readers that the factories are no longer overhauling some of the older, out-of-production engines. It never hurts to call and ask if you're not sure if a factory overhaul is an option for your engine. However, the manufacturers do still offer robust parts support to facilitate good field overhauls.

The factories offer three levels of technical specifications the engine will be built to meet:

1. Service-limits overhaul.
2. New-limits rebuild.
3. Factory new.

An engine being overhauled to serviceable limits can be worked on at either the factory or an approved factory service center.

This all begins with a teardown, cleanup and inspection of the engine as described earlier. Components are then handled as follows:

1. All components are inspected to ensure that they meet the higher end of acceptable tolerances as published in the approved overhaul manual. Parts that are close to being out of limits will be replaced with higher-quality reconditioned or new components.

2. Factory facilities will replace a defective crankcase with a new case.

3. The same goes for the crankshaft. If either the case or crankshaft fail inspection, the customer will be

responsible for the cost of replacement.

4. New OEM cylinder assemblies including pistons, rings, valves, etc. are included.

5. All bearings, bushings and oil pump gears will be new.

6. Camshaft and lifters will be reconditioned or replaced with new.

7. Accessories for fuel injection or carburetor, magnetos, starter and, in most cases, the alternator or generator, are overhauled to new limits.

8. All gaskets, seals, ignition harness and spark plugs will be new.

9. The engine will be thoroughly test run before being crated for shipment to the customer. If the airplane was delivered to the shop for removal and installation, the engine bay components will be repaired before engine installation and test flight. The cost of needed repairs will be billed to the customer.

10. The original engine logbook and total time since new on the engine will be returned to the customer with a complete entry thoroughly describing the overhaul. A copy of the overhaul work order will also be included describing work performed and a list of all new and reconditioned components that were installed.

11. A copy of the warranty that specifies the one-year parts and labor warranty on the entire engine and a two-year warranty on the new cylinders will be provided. Any accessories that were not overhauled by the factory-approved overhaul facility will often be covered by the company who did that work.

12. The normal turnaround time for a factory overhaul with the customer providing the engine for overhaul is five to seven weeks, plus shipping time.

13. The typical warranty for both manufacturers is one year parts and labor and two years for the new cylinders. Both companies start the warranty on the date that the engine is put back into service. Make sure you get a copy of the warranty and understand what is covered and what is excluded. *(See Resources for links to each manufacturer's overhaul warranty information. —Ed.)*

14. Remember that both Lycoming and Continental will charge a customer if the crankshaft or crankcase is not reusable. If these items are reusable, both companies will overhaul the engine for the fixed price quoted.

Factory rebuilt zero-time

The factory can also fully rebuild and zero-time an engine, which offers additional value. Rebuild work is always done at the factory. The engine is built on the same assembly line as new engines. After the teardown, cleanup and inspection process is completed, the following steps are tracked to build an engine that is as close to new as possible:

1. Any component that does not meet new limits is replaced with a new factory part.

2. All accessories, magnetos, fuel system starter, starter drive, ignition leads, spark plugs, alternator, etc. are either new, or remanufactured to new condition by the original manufacturer.

3. All rotating components are manufactured to very precise, new-engine standards in order to achieve good balance specifications, ensuring a smooth-running engine.

4. Both Lycoming and Continental will rebuild run-out engines. You shouldn't have any worries about the condition of the crankshaft or crankcase as long as the run-out engine is in operating condition.

5. Bottom line—these engines are as close to new as possible. Specific warranty details for rebuilt engines are available at the manufacturers' websites. *(See Resources for more information. —Ed.)*

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6. A new logbook is supplied with the rebuild, and the engine total time is reset to zero hours. All Service Bulletins and AD notes are complied with and the appropriate logbook entries are made.

Brand-new from the factory

A third factory option is to purchase a new engine that includes all new accessories and can be shipped directly from the factory to the customer.

Both Continental and Lycoming offer a new engine exchange program as well. Lycoming and Continental new engines come with a full 24-month warranty on the complete engine. Not much to decide on or worry about, but of course it comes at a price!

Specialty performance overhauls

One final, non-factory option is to select a specialty or boutique overhauler. These firms offer performance-enhancing options not available from the original engine manufacturer. A lot of these processes have roots in the car and motorcycle racing worlds.

Many of these shops are able to create a more powerful, fuel-efficient and capable engine without compromising reliability. That said, it is very important to research these options carefully. Look for a firm that has a long and positive track record.

I believe best place to start your research for specialty overhaulers is to contact Piper Flyer Association and Piper type clubs. These groups are central collection points and can help direct you to the source you need for an informed decision.

The following is a list of the most common processes performed by boutique overhaulers. It's important to note that not all of these services are done by one company, nor can all of them be done to any one engine.

1. Cylinder conversions that can increase the displacement of the engine.

2. Precision dynamic balancing of rotating components.

3. Exchanging crankcases to later and stronger designs.

4. Installing higher-compression pistons.

5. Machining intake and exhaust ports to increase the flow of gases in and out of the engine.

6. Redesigned exhaust pipes and mufflers that remove exhaust more efficiently.

7. Balanced fuel injection nozzles that ensure each cylinder gets a precise fuel-air mixture.

8. Various turbocharging systems to facilitate full-horsepower performance at high altitude.

9. Camshaft modifications that increase the amount of fuel-air mixture that can be delivered to the cylinders.

10. Improved engine baffles that will ensure more efficient and balanced engine cooling.

11. Friction-reducing roller lifters with small wheels that roll on the surfaces instead of rubbing (which can induce wear on rotating cam surfaces).

12. Higher-capacity alternators.

13. More efficient and lighter starters.

14. Two-, three- and four-blade propeller choices.

15. Electronic or pressurized ignition systems to enhance fuel efficiency or ensure more reliable high-altitude performance.

16. Conversion of carbureted engines to fuel injection, increasing power and fuel efficiency, and eliminating carburetor ice issues.

This list doesn't cover all the mods that boutique overhaulers can offer. The idea is to select the best combination of these

enhancements that will add new performance parameters to your specific engine and airplane.

Many of these boutique overhaulers buy kits and STCs from other companies to install on their engines. *(Engine conversions for Piper aircraft are outside the scope of this article. —Ed.)*

As with any work on your airplane, when it comes to FAA approvals, it's important to confirm that the chosen facility has the appropriate STCs and documentation before committing to having the work done.

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Also remember that these boutique shops offer custom work that can take additional time to complete and be aware that exchange programs may be more limited.

Finally, as these are often smaller companies doing the work, there may not be an extensive network of people who can take care of future repairs on some of these custom installations. Bear in mind too that your chosen boutique overhauler may be some distance away.

In closing, I would like to stress that no matter what level of overhaul one chooses, all Service Bulletins and Airworthiness Directives will be complied with and documented with appropriate paperwork.

So, that's all for engine overhauls. Next month, we will discuss everything that must be done to prepare the engine bay to receive the shiny new engine. Until then, fly safe! PF

Industrial designer and aviation enthusiast Dennis Wolter is well-known for giving countless seminars and contributing his expertise about all phases of aircraft renovation in various publications. Wolter founded Air Mod in 1973 in order to offer private aircraft owners the same professional, high-quality work then only offered to corporate jet operators. Send questions or comments to editor@piperflyer.org.

RESOURCES >>>>>

ENGINE MANUFACTURER WARRANTY INFORMATION – PFA SUPPORTERS

Avco Corporation (Lycoming)
lycoming.com/warranty

Continental Motors Group
continentalmotors.aero/Factory_Services/Product_Warranty

FIELD AND SPECIALTY/BOUTIQUE OVERHAULERS – PFA SUPPORTERS

Piper Flyer Association Yellow Pages
https://www.piperflyer.org/piper-yellow-pages.html