

Joel Fuller opted to build the engine for his Waix from a kit.



HOMEMADE HORSEPOWER

FOR SOME EAAERS, BUILDING ENGINES IS JUST PART OF THE PLAN

STORY AND PHOTOS BY GREG LASLO

Don Saint, EAA 469785, admits he's always been competitive. He had a fast airplane—a Glasair he completed in 1997—when the 1999 AirVenture Cup Race to EAA AirVenture Oshkosh caught his eye. He looked at the race, the way the categories were set up, and found his airplane would be competitive in the 360-cubic-inch, fixed-gear airplane class.

He entered. He was right; it was competitive. Don won, and the racing bug bit him. "I was on top of the world. I've got this fast airplane, and I can go kick some butt," he says. "That's how it got started."

However, there was a hiccup. The next spring he entered the Sun 100 race at Sun 'n Fun.

"I just got waxed," he says. Suddenly his fast airplane wasn't fast enough anymore, and he had to figure out a solution to the problem.

He started tweaking the airframe, to increase its aerodynamic properties but frankly, he figured the secret lay in what was under the cowl. "The most success I've ever had with getting an airplane to go faster is all to do with power," he says.

For 2002, he decided to rebuild the engine and add a turbocharger. Now, the IO-360 is the out-of-the-box engine that the manufacturer recommended for the airframe. It doesn't come turbocharged, so the Lockheed Martin engineer decided he would build his own turbocharger. He worked with people who specialize in internal aerodynamics and other things that would, theoretically, help someone interested in fabricating a custom system. He had a need, and he had an idea. AirVenture Cup, watch out. Or rather, Don Saint, watch out.

While not all homebuilt engine builders are looking to build their own go-fast engine, some tackle amateur-aircraft construction, building not only the airframe but also the powerplant. Indeed, most builders are perfectly happy opening a crate and bolting the hunk of metal onto the engine mounts. But for those builders like Don, who believe doing this project can add to the "recreational and educational" aspects of completing an aircraft,



Don Saint took an out-of-the-box Lycoming IO-360, and then built his own turbocharger to satisfy his need for speed.



Don had to modify the cowl of his Glasair to fit the bigger 200-hp Lycoming engine he rebuilt.

engine was in someone else's possession. "The engine was literally a basket-case. I'm not kidding you," Larry says. "It was in pieces in an old barn, in baskets. The crankshaft was lying up on a bench, and it was covered in dust and dirt, and I'm thinking, 'Oh my gosh, this may be more than I want to tackle.'"

Unlike Larry, tackling a big project didn't intimidate Don. The way he figured, all he'd have to do is design an intercooler and buy a used turbo and exhaust system, then modify both to make them fit.

But there was more to it than that. First, he imported a picture of the engine compartment into Microsoft PowerPoint, and then he superimposed a circle about the size of the turbocharger. Then he had to make the mounting brackets, the exhaust plumbing, and the intercooler. This was not a weekend job.

He had haphazard success. Ultimately, the setup wouldn't produce high enough manifold pressure because of overheating, he says, and while flying to Sun 'n Fun for that target race, things came to a screeching halt—actually, it was an eerily silent halt—when he landed in a cow pasture and busted up the airplane. "You can break an engine with a turbocharger, and I learned that the hard way," Don says.

Long story short, some of his friends in EAA Chapter 983 helped him put the pieces of the airplane back together, and a year later, it was flying again. It was flying particularly well. When the winds hit just right for the Kitty Hawk to Oshkosh route for the 2003 AirVenture Cup Race, he won again. "That was a sweet victory—a comeback victory kind of thing," Don says.

Ironically, with that redemption under his belt, he lost interest in the turbocharger. He was flying formation with



the experiences of other builders offers a lot to think about. By recognizing why they built, how they learned how to do it, and the benefits they took away from the project, prospective builders may find themselves ready to jump off the fence.

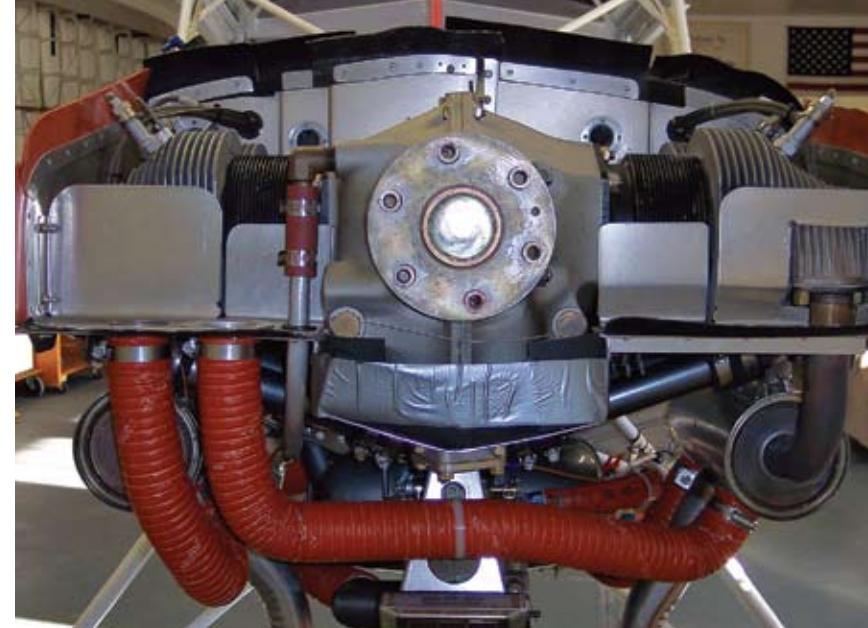
PURPOSE-BUILT

There are as many reasons for building an engine as there are engine builders, but most fall within the broad categories of saving money, building an engine to meet the owner's special needs, and building an engine to learn more about how airplanes work.

"The first thing was cost," says Larry Wimsatt, EAA 103112, who rebuilt a Continental O-200 for his Pegasair. "The second thing was the Continental O-200 engine. There were no new ones, so if you wanted to put it on your airplane, that was the way you had to go."

The aircraft itself was built around that engine, and while the O-200 is now available as an engine for light-sport aircraft, it wasn't in 2003 when Larry was completing his airplane. As a result, a rebuilt version ran between \$12,000 and \$14,000. By trading time for money, he managed to build the engine for about half that and roughly another six months of work. That is, six months of work beyond finding the right engine to rebuild.

Larry almost bit off more than he could chew. He found an engine advertised on a sign at a local airport, but by the time he called, the owner had died. The disassembled



Larry Wimsatt, opposite page, found this Continental engine in pieces, covered in dust and dirt, but six months later, it was providing power for his Pegasair.

on his own. Because the prop wasn't turning during the landing, the engine didn't initially look like there was much wrong with it. In fact, it had escaped relatively unscathed, to Jim's benefit.

In the meantime, Jim retired and moved to north-central Arkansas. He found a local pilot, Ken Edens, EAA 766782, who was also an aircraft mechanic who rebuilt engines as a side

other chapter members, and the lag between pushing in power and getting it back out of the engine wasn't much fun. He soon went back to flying the engine as a normally aspirated model. That is, until he heard about a guy who made a gear-up landing in a twin, and ended up with two dinged engines. He found the airplane in the same salvage yard where he'd found his first engine—and the salvage yard was looking to part with it for the right price. He ended up with a 200-hp Lycoming that had had a prop strike and needed a teardown. He bought the engine and thought he might have fun rebuilding it. And he did—he installed high-compression pistons and electronic ignition. Then he sat on it for a few months until he figured out what to do with it.

No surprise, he put it on the Glasair. At 220 hp, it climbs with the best of the local RVs. "Now I've got all kinds of power, compared to the RVs anyway," Don says. "Once I level off, of course, I can just walk away from them."

As I was saying, he is competitive.

The engine build really wasn't much of a modification; the hardest work was making the bigger engine fit under the smaller cowl. Don spent a lot of time redoing fiberglass work. And that was nothing compared to fabricating a turbocharger system.

BUILDING POWER

Whatever their reasons for building an engine in the first place, members say they wouldn't break into the magic box without guidance. In fact, rebuilding the engine wasn't taken lightly by any of the builders. They say there's too much to know without having some kind of help—whether it's from a generous and experienced chapter member, or from professional training, or just from solid study—and a handful of experience—on their own.

Jim Oberst, EAA 397954, purchased an engine for his Glasair II, waited a while, and then decided to do something with it. An unfortunate victim of a fuel-out landing, the engine was doubly cursed when its owner decided to fix it

gig and was willing to lend a hand. They found the engine had been tinkered with. There were bolts that weren't safety-wired, and some other parts weren't installed correctly. "We started breaking it down, and we immediately saw things that didn't look very good," Jim says. "We just made a



decision to rebuild it."

Jim Oberst, above, recruited fellow EAAer Ken Edens to help him rebuild the engine for his Glasair II.

The pair took all the things that could be overhauled or checked to an engine shop in Tulsa, Oklahoma, had the cylinders redone at another company, replaced valves and springs, and overhauled everything that should be overhauled, including the carburetor. They bought a new fuel pump and generator, got a new drive shaft, new bearings, new seals, and then reassembled the whole thing. For Jim, this was the first time he'd ever seen the inside of an engine.

"It was an interesting process, because Ken insisted that we buy a lot of the parts new and redo other things that,



Jim and Ken had the cylinders redone elsewhere, but replaced the valves and springs themselves and bought a new fuel pump and generator, got a new drive shaft, and new bearings for Jim's engine.

used *Trade-A-Plane* to identify the companies that sold rebuild kits. When it came to checking the parts, he used an old book from Continental to determine what was in spec or not. "If it's out of these limits here, it's a throwaway and you need to replace it," Larry says.

After he completed the engine, he bought a video that illustrated how to assemble one. "Hey, that's the way I did it," he says. That's coming a long way from someone who'd never done more than tinker with the engine in a car, and he came out relatively unscathed.

"That was my first experience," Larry says. "It was fun." Somewhere between the price and performance—and a long way from repurposing a questionable used engine—builder Joel Fuller, EAA 666996, found another option: He chose building an engine over installing one out of a box, but in his case, it was a kit engine. It was a compromise, but it was a good one. He benefited from the kit—an AeroVee made by the same company as his airplane—and got an engine that offered a power-to-dollar ratio that was hard to beat, less than one-half the price of the factory-built Jabiru he was considering.

The design of the engine helped. His previous mechanical experience was keeping his own car running through college when he couldn't afford to pay someone else. With the AeroVee, "The assumption is the people who are putting it together have never done it before," he says.

While it looked easy enough, he figured there'd be a few gotchas. He'd read postings on the AeroVee group on Yahoo.com, so he was aware of some of the common problems, and he paid special attention to the DVD video assembly manual that came with the engine.

"Everybody said, 'Just follow the instructions and it'll work,' and it did," he says. In fact, he was a little surprised that it was so straightforward. The one thing he might have done differently is to get the book *How to Rebuild Your Volkswagen Air-cooled Engine*, which Volkswagen automobile owners swear by, just to get more information about why things are how they are. All told, with all the help that's out there, he also thought building the engine was one of the easier parts of the entire airplane.

RAVE REVIEWS

Building the engine that goes into the airplane you've also built offers a new set of rewards—a super-bonus to your grand prize of having an airplane to fly, these builders say. For example, you're tackling a new project, you're learning something that you can apply to the maintenance of the aircraft, and you're building a deeper connection with your airplane. That said, for every reason

Wag-Aero manuals that detailed the rebuilding; he scoured airworthiness directives to see what had been sent out about his engine. He checked copies of *EAA Sport Aviation* for restoration shop ads, and he



builders have for taking on their own engine, there are reasons not to—for one, you're taking time away from finishing your airplane.

And then there's the big one: "If it doesn't work, you've got nobody to blame but yourself," says RV-4 builder and airframe and powerplant (A&P) mechanic Joe Arnold.

"Big picture, engines are easy," Joe says. While he found that building an airplane isn't as easy as maintaining one—that was kind of a surprise, he says—he found that putting the engine back together was one of the least complicated parts. "Engines are pretty much specifications," he says. "As long as you're within tolerances, you're pretty good."

By doing it himself, he also figured he was doing it better than shipping it off for rebuild. "Basically, I didn't ever want to have to worry about it," Joe says. "Build it once, build it right, and I don't worry about whether it was done right or not, because I know every piece of it."

Likewise, the experience gave Joel a head start in what he hopes is a long-term relationship with that engine. As he tells it, he'd like to keep it long enough that he's eventually going to have to rebuild it. So, he says, he might as well dive in. But the experience also helped him figure out what was normal—and what was not—during the test-flying stages. "I know what everything looks like," Joel says. "I know the way it was the

first time I started it up. Having worked with it, I know all the nooks and crannies, and it's something I've had my hands on a lot."

Joe was surprised at how easy it was to build the engine, but thinks a lot of builders might be afraid to try it if they don't know where to find help.

When all was said and done, Joel said he thought building the engine was easier than building the airplane.

Jim says he, too, felt good about the annual after the project was complete, even though he eventually sold the airplane. He says he

learned more than if he would have just installed an engine out of the box. "You know all about the rest of the airplane, you might as well know about the engine," Jim says. "A lot of the magic goes away."

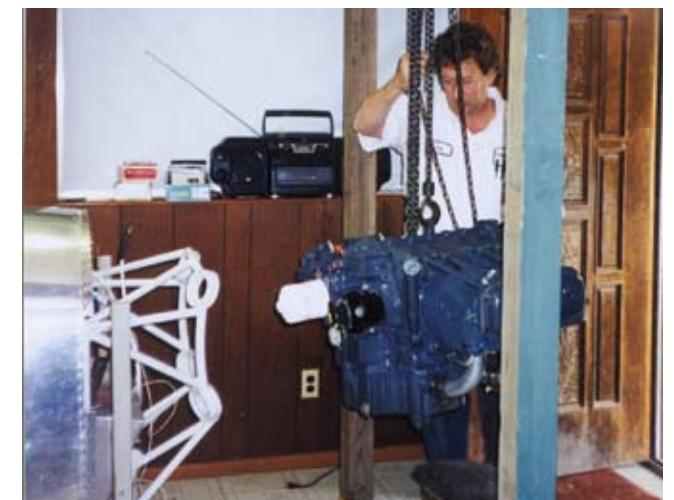
That's in addition to being about half the price.

"It's kind of a win-win," Joel says. "I saved money and I have more knowledge, for basically what's an insignificant amount of time it took me to get it airworthy."

Indeed, Joel chose wisely when he picked an engine that could be assembled from a kit; everything came in the same package, and each part was ready to assemble straight from the box.

But that's not always the case, and the extra time spent building the engine—time that, in theory, at least, could be spent getting the airplane ready to fly—might deter some builders from doing this one, final step, and opt instead to mount-and-go. That was one of the concerns that Jim had, as his 10-year build on his Glasair ended. He was anxious, but looking back through his logbooks, he realized that rebuilding the engine took about seven months, but that was scattered between finishing other projects on the airplane.

He was able to use Ken's tools, but an engine project does require a few specific items that are unique to the task—cyl-



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inder wrenches, compression gauges, magneto timers, timing strobes—and that can add to the price tag, and the delay. Fortunately, many of those tools are floating around chapter hangars, and if not, they're inexpensive.

Even more than the perceived costs and time delays, Joe expects that a lot of would-be builders get turned off the project for a bigger reason—they don't know where to find help, whether it's getting manuals or finding a certified machine shop to tune the inner workings of the engine. That's a big issue if the engine has some damage history. Jim admits he wouldn't have done the project without Ken, for that reason.

Indeed, many parts need to be sent out for refurbishment—engine cases, cylinder heads, crankshafts. Knowing what to do with each—and finding a supplier you can trust—is certainly a challenge that can be overcome by outsourcing. That's probably harder than the actual building itself, Larry says. "If you're going to do an engine rebuild, it's a partnership," he says. "It's not something you're going to do by yourself."

Yet, for Don, building an engine seemed like the EAA thing to do. It was a personal goal, and he looked forward to achieving it and feeling that reward. That's the same spirit that drives him—and his chapter neighbors—to build airplanes in the first place, he says. He wasn't worried; with help, he figured it would all work out.

"At the time when I first built the airplane, I didn't have near the experience I do now piddling and changing all these engines and doing these kinds of things—I didn't know anything about it," Don says. "It's just a hobby, so it's fun, and it's interesting. When you set the goals to win these air races, you try to figure out how to do all that stuff. You dwell on it, you think about it, and come up with solutions."

Like anything, he says, once you steady the crankshaft to the workbench, it's just a matter of bolting things on. 

Greg Laslo is a writer and editor in Kansas City, Missouri.