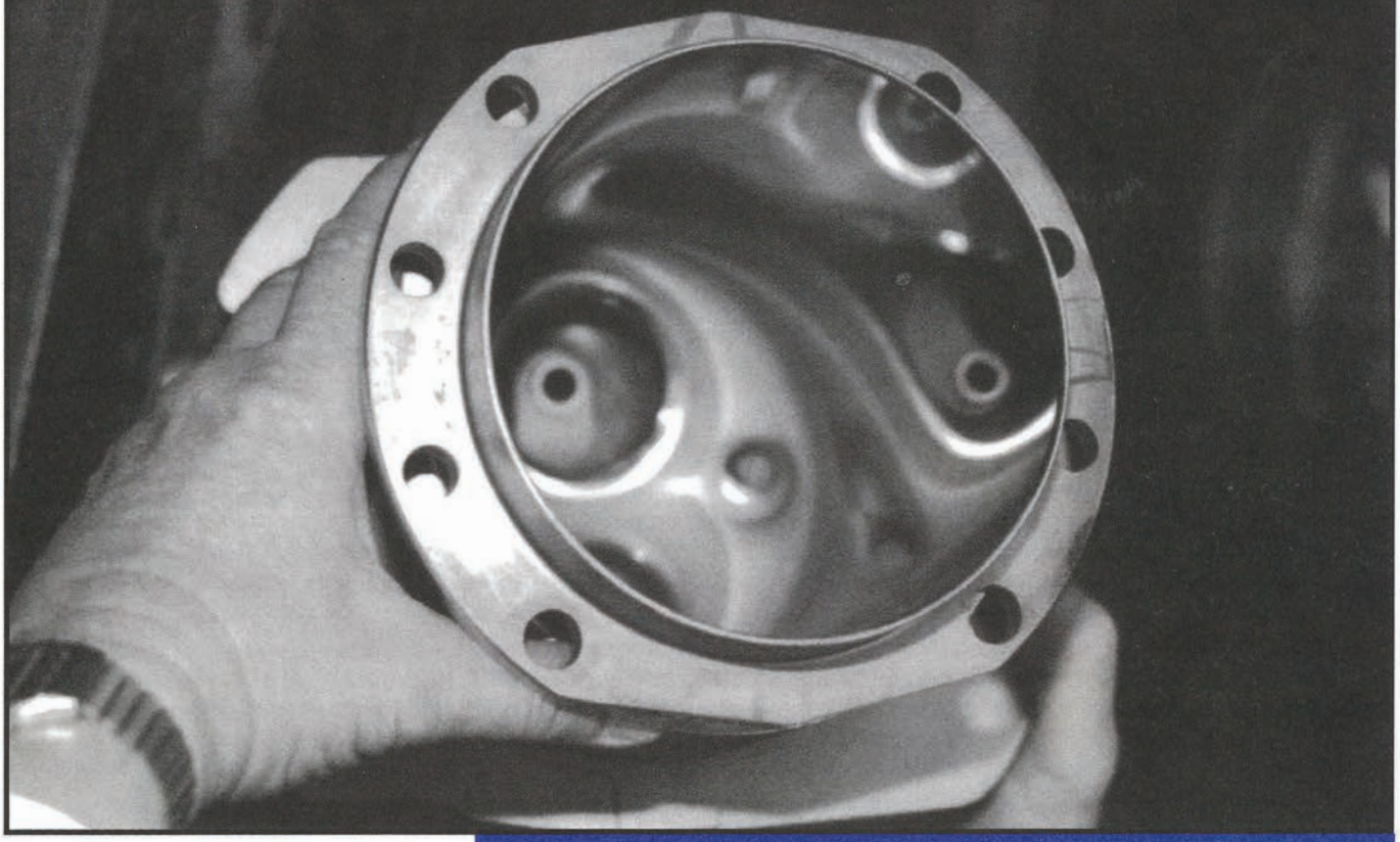
May–June 1994

TBO Advisor™

Nickel to the Rescue!

ECI Announces the End of the Chrome Age



Lycoming Owners Face New Oil Pump A.D.
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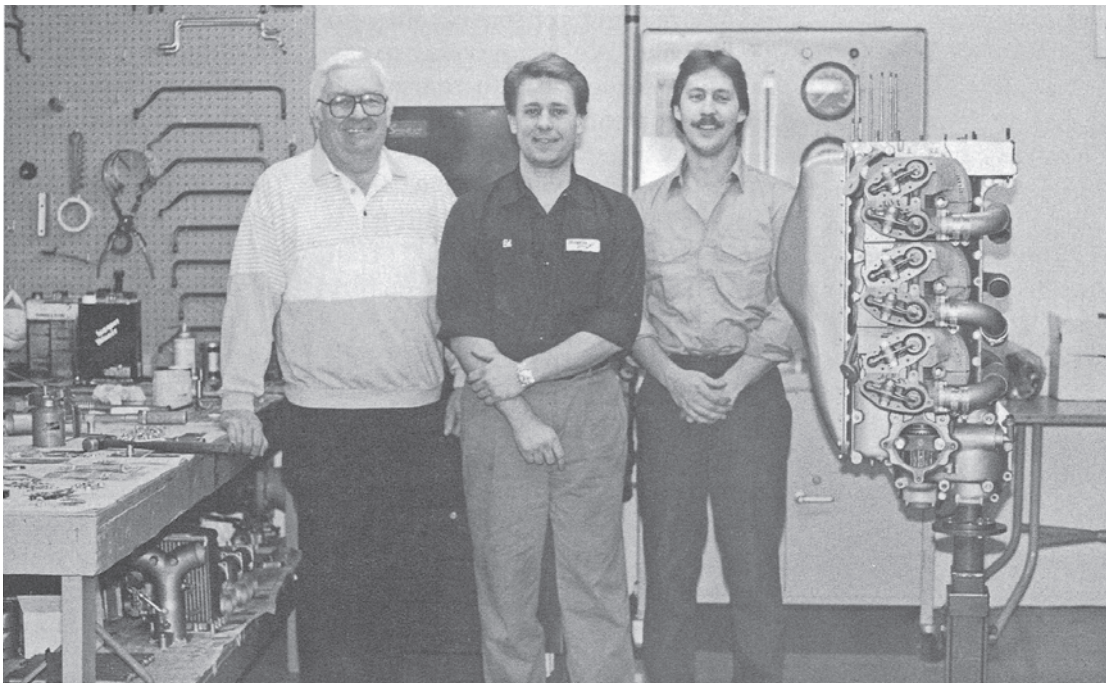


Ed Rachansk, Sr.with sons Ed and Mike

the Blueprint Difference

by Kas Thomas

One of the nice things about the overhaul business – as opposed to the engine manufacturing business, say, or the PMA parts business – is that almost all the really successful shops are family-owned and run. Which is good, because it means you can be sure there's somebody at the top who cares about the things other than quarterly earnings and shareholder reports and all the other bean-counterly bullspit that makes Textron (for example) what it is today. It means there's a very special type of accountability that doesn't exist in a big corporation. Someone's personal reputation – someone's family coat of arms – is at stake. Which (let's face it) *changes everything*.

Family-owned businesses also tend to reflect the peculiar idiosyncrasies – the unique biases – of their owners. This can be a blessing or a curse. But the great thing about living in a free country is, if you don't like the way Ray Kroc does burgers, Dave Thomas is right down the street.

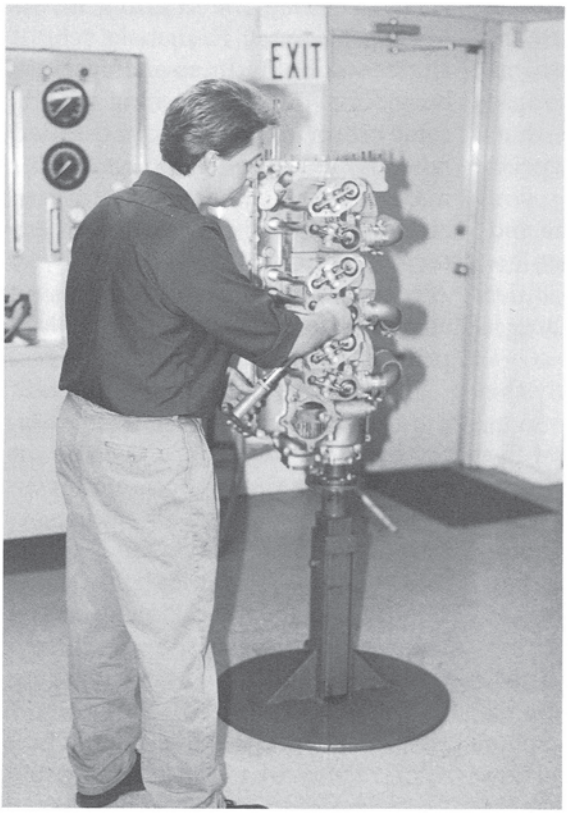
Not everyone agrees with how Blueprint Engines does engines. Some people would rather reuse a cam than throw it in the trash. (Blueprint's policy is 100% new cams and lifters. Period.) Some people would sooner chrome-plate than punch a barrel oversize (Blueprint prefers oversizing), but hey, you wanna spray-paint your engine and call it "rebuilt," there are overhaulers who will accommodate you. Blueprint has its *own* way of doing things. The Rachanski way.

The Rachanski way is largely the doing of Ed Rachanski, Sr., ex-Air Force mechanic and founder of Blueprint. Although he technically no longer runs the shop, Ed Sr.'s influence is felt throughout the small, family-run operation. After leaving the Air Force (where he maintained C-119s, Curtiss Wright R-3350s from spontaneously disassembling), Rachanski became intensely involved in drag-racing, eventually landing a spot on the Lincoln-Mercury team (which included, at that time, "Dyno Don" Nicholson and George DeLorean, among others). When he wasn't touring the country in his *Marauder* Comet, Rachanski rebuilt engines at home in an increasingly busy shop. Aircraft-owning friends came to him with engines that needed rebuilding; Rachanski obliged. Ultimately, sensing that he could turn aircraft engines into bread and butter, Rachanski moved to Midway Airport and obtained FAA's blessing as a Certified Repair Station. Blueprint

Engines was born.

Today, after 20 successful years in the aircraft-engine biz, Ed Rachanski, Sr. has semi-retired to become an independent aircraft accident investigator (he was the lead engine expert on the Long Beach, CA, Malibu crash) – something that grew naturally out of his shop experience. "I believe Blueprint was the first Certified Repair Station to have a working dynamometer in the shop," Rachanski recalls. "Every once in a while, there'd be an accident in the Chicago area, and FAA or NTSB would ask if they could bring us the crashed plane's engine and run it in our dyno. That's how I got started in the accident investigation business."

Rachanski's sons, Mike and Eddie, have taken over the day-to-day operation of the shop. By virtue of their early exposure to Dad's race-car experiences (which included working on Indy engines), and the more recent forensic examinations of crash site engines, plus the usual fallout from 20 years in the aircraft engine overhaul biz, the Rachanskis have acquired a unique perspective on engines. They've seen, heard, tried, and dissected every trick part and overhaul technique known to NASCAR; they've picked apart turbocharged Continentals that have, quite literally, crashed and burned. They know what makes a race-car engine blow up; they know what makes a Lycoming piston melt. As a result, they're not about to do anything stupid to your engine – or let you do it, either.



Ed Rachanski, Jr. does most of the final assembly work. Althought Blueprint has done GTSIO-520 Continental, most engines are ungreared Lycoming sixes.

Ground Rules

There are certain ground rules at Blueprint. For example, camshafts and lifters don't get reused, they go in the trash. "We're not trying to say that the people who do regrinding do bad work or anything like that," Ed Rachanski, Jr. points out. "It's a matter of philosophy. We just feel, for our customers, the best thing is a new cam and new lifters." (That doesn't necessarily mean *factory new* – many of Blueprint's cams come from Air Support International. "We're very satisfied with Air Support's cams," Rachanski notes.)

Another ground rule: Ed Rachanski, Jr. decides whether your cylinders are reusable or not, and if they're not, you'll be asked to buy new cylinders. "Basically, our policy is, we'll take a first-run Lycoming cylinder ten-thousandths' oversize, or we'll take a first-run Continental cylinder fifteen over," Rachanski says. "That's if everything checks out okay as far as cracking of the head goes. After the second run, Nu-Chrome becomes an option. But it all depends what the cylinders look like. If they're good, we can reuse them, but if they're cracked, we replace them with new and ask the customer to bear the added cost. Some engines, particularly the Duke engine and your Navajo engines, the big TIO-540 Lycomings, we just tell customers to buy new cylinders and be done with it." Blueprint used no Engine Components cylinders.

Crankshafts that can be cleaned up with light polishing get reworked in-house; those that need an undersize grind get sent out to Aircraft Specialties Services in Tulsa. Crankcases get trued up by Ajax in San Antonio. "We've had very good luck with our cases," Rachanski points out. "What convinced me on Ajax was the helicopter engine cases we started sending them ten years ago. That HIO-360 engine is really hard on cases. They fret and wear – they're just plain tired at the end of a TBO run. But Ajax does a terrific job with them. They align-bore and recertify the cases, and when they come back to us they're fully Anodized and deburred. We've never had one fail."

For run-of-the-mill accessories – magnetos, starters, and such – Blueprint uses Terry Norris's Aircraft Systems, in Rockford, Illinois (one of the country's most highly qualified – and most highly regarded – independent accessory rebuilders). For turbochargers, controllers, and waste gates, Blueprint goes to Mike Rogers at Kel-Pak. TCM fuel systems get sent out to Mike's Fuel Metering in Tulsa, while Bendix systems get sent back to Precision. Net result: "We get very few comebacks for accessory problems," Rachanski remarks. (Accessory-related problems make up the bulk of warranty complaints at some shops.)

No Break-In

Engine break-in is another area where Blueprint deviates significantly from centerline. The Rachanskis simply don't believe in break-in. "If you build a cylinder up,

and the cylinder is perfectly round, and you use a cam-ground piston, with the correct tolerances, and put a film of oil between the parts, *what is there to break in?"* Ed Rachanski, Jr. asks. "Stop and think. If there's oil between the parts, why would you need to 'break' anything?"

"What we do," Rachanski says, "is put a very carefully controlled hone finish on our barrels. Then we go back over the barrel with a Flex-Hone" – also known as a porcupine or ball hone – "to knock off all the torn and folded metal, and 'plateau' the peaks. This gives the best possible surface for the rings. They seat immediately, the first time you run the engine. When the engine comes out of our test cell, it's completely broken in."

Since no further break-in is needed, Blueprint ships all customer engines with either SAE 50 Aeroshell Oil W (ashless dispersant) in the summer or Aeroshell 15W-50 in the winter. No mineral oil is ever used.

"The key, really, is knowing how to use a Flex-Home," Ed Rachanski, Sr. confides. "Those sharp, cut metal edges that you get after putting the crosshatching in, those microscopic folds in the metal actually *glow red* at operating temperature. They glow red-hot and coke the oil. When you get rid of that, you get rid of glazing and oil breakdown, you keep metal from contaminating the oil system – you get rid of 'break-in' problems."

Secret Ingredient

Blueprint pioneered the use of Lenckite oil additive in aircraft engines (see *TBO advisor*, March-April 1994, p7) and considers it a key ingredient in every overhaul. Not only does Blueprint send every customer engine out the door with a supply of Lenckite, but the additive finds extensive use during the actual process of engine buildup. Certain parts will be coated with Lenckite and then held at 150° to 200° in an oven for an hour or so, prior to final assembly. The Lenckite pre-treatment causes the parts to "soak up" a certain amount of the oily substance and stay wet during future dry starts. In this way, a good deal of possible scuffing wear is avoided in the engine's first hours of operation (and for some time thereafter, according to Ed Rachanski.)

Mike Rachanski measures the combustion chamber volume of a Continental TSIO-360 cylinder. Cylinders are "power balanced" by arranging high- and low-volume cylinders in a special order. Blueprint is one of very few shops to employ this technique.

The Rachanskis credit Lenckite with reducing warranty claims to near-zero (as far as cylinder scoring and piston scuffing go) and helping customers get longer life out of cylinders, valves, and guides. "We feel pretty strongly about it," Ed Rachanski, Jr. admits. "It's helped our customers a lot." (One of Blueprint's customers – nearby Executive Helicopter – got 7,700 hours out of a set of HIO-360 cylinders built up by Blueprint. *See TBO Advisor,* March-April 1994.)

No Porting

Given the Rachanskis' race-car background, you might think they'd be the first to put porting and polishing to work for their aircraft-engine customers. But you'd be wrong. A flow-bench is one piece of gear you *won't* find at Blueprint. Ed Rachanski, Sr. (one of few aircraft-engine overhaulers who can claim to be a member of the Society of Automotive Engineers) explains Blueprint's position this way: "Porting is something whose benefits really begin to come into play after 5,500 rpm. On lower-rpm engines, you really don't get much benefit. Just look at an engine like the Continental O-470. I mean, you've got intake pipes that aren't tuned, you've got a muffler in the exhaust – what's the point of flow-matching the cylinders? You "unmatch them the minute you hook up those pipes. If you were turning 6,000 rpm, then it would be another story. Maybe."

On the other hand, the Rachanskis *do* believe in "cc-ing" and power balancing. Mike Rachanski demonstrated his technique for "cc-ing" (measuring the combustion chamber volume) a Continental TSIO-360 cylinder. First, valves are installed and the spark plug holes capped off to prevent fluid leakage. Next, the jug is inverted on a special tabletop and bolted down. A special swivel-arm (with a vertical "dipstick") is lowered into the open end of the cylinder barrel; the exact depth to which the dipstick portion is lowered is determined by a metal pin on the *outside* of the cylinder barrel, which hits the limit of its movement when it contacts the cylinder hold-down flange. At this point, the cylinder is filled with a known amount of fluid (naphtha); the cylinder is checked for leaks, which would indicate poor valve sealing. Assuming there are no leaks, Mike continues to fill the cylinder barrel with fluid, until the

"dipstick" reads at the proper level (an arbitrary mark). The final few millimeters of naphtha are added with a calibrated buret. When the dipstick mark is reached, all the "fluid added" numbers are added up to determine the actual cylinder volume. Then the next cylinder is brought to the table and measured in the identical fashion.

In the end, you know what the actual cylinder volume is for each cylinder in a set – and you know how far apart the "best" and "worst" cylinders are. Typically it's 20 or 30 ml. (The differences are mostly due to differing valve heights and irregularities in cylinder head castings, particularly around the spark plug holes.) Unfortunately, FAA doesn't allow any machining inside combustion chambers to "even out" the cylinder volumes among cylinders. But clearly, if one cylinder has more clearance volume than another, its compression ratio (and power output) will be different as well.

Blueprint attacks the problem by arranging the cylinders in a particular order on the crankcase, using what a mathematician might call a "least differences" algorithm. "We power balance an engine differently than just about anyone else in the business," Ed Rachanski explains. "What we try to do is *minimize* the power differential between the cylinders *in the firing order.* What you *don't* want is a high-output cylinder firing directly opposite a low one. We try to achieve the least horsepower difference going from one cylinder to the next, in the firing order. This smooths out an engine like you wouldn't believe."

Also tending to make Blueprint-build engines smooth is the attention to mass balance given such items as con rods and counterweights. "We 'gram' your rods and counterweights," Ed says. "The counterweights, for example, have to be within half a gram. We consider balance to be very important.

Good Geometry

Something else the Rachanskis are sticklers about is "truing up" seat and guide geometries. Most shops pop old seats and guides out, hand-ream the holes, put new inserts in, and grind seats with a motorized grinder than pilots off the guide boss – a lousy way to maintain concentricity between guide and seat. At Blueprint, special tooling is used to hold the cylinder while the seat hole is cut directly on-center with the guide (and 100% square to the guide in the transverse plane), so that the valve-seat contact area is uniform and heat dissipation is optimal.

"What we try to do is minimize the power differential between cylinders in the firing order."

Not only that, but seats and guides are installed in a cylinder that has been *oven-heated,* rather than torched. "You go into most shops," Ed Rachanski says, "and they have the torches going, and the cylinders sitting there shooting blue flames out the ports. That's not the way the factory does it We do it like the factory does. It takes a little longer, maybe, but we don't warp anything, and let me tell you, when one of our seats goes in, it doesn't come back out. You *never* hear of one of our engines dropping a valve seat, or having a guide pull loose."

One-on-One Service

Because Blueprint is small (60 to 80 engines a year) and family-run, the principals – Mike, Eddie, and Ed Sr – have time to deal with customers' concerns one-on-one. "I generally will invite the customer down, if he's in the area, to come and look at his engine after it's all apart," Eddie notes. "We save all the old parts. If there's a crankcase fretting, we show the customers what it looks like and explain it to him. Sometimes I'll spend two or three hours – whatever it takes."

Magnafluxing and careful inspection of steel parts (especially the crankshaft) is taken very seriously by the Rachanskis. They've seen the results of prop strikes – both pre- and post-accident – and treat any prop strike in a counterweighted engine with grim seriousness. "What we'll often do, if the customer has the money," Eddie says, "is radiograph the crankshaft and counterweights." A full x-ray series costs about $450, according to Rachanski, but is worth it since Magnafluxing only detects *surface* flaws. (Radiographing is not mandatory; it's up to the customer.)

In general, Blueprint tries to do what the customer wants – as long as it's consistent with safety. "We had a Mooney customer once," Eddie recalls, "who insisted that we build him a special engine. It had to have the D1A helicopter pistons a counterweighted crank, a different prop, the whole nine yards. We told him there was no way to get it STC'd. He didn't care. He went out and registered his Mooney in the Experimental category. And for a while there, he had just about the fastest Mooney in existence. It later turned out he couldn't sell the plane to anyone – no one wanted an Experimental Mooney – so he had us take it all apart and convert the engine back."

Special Expertise

Blueprint is capable of overhauling almost any current-production Lycoming or Continental engine. While we were there for this story, we saw a variety of engines apart, including O-300, TSIO-360, IO-520, and GTSIO-520 Continentals, plus a Lycoming O-320-H2AD. (They still do the occasional helicopter engine, too.) Still, Ed Rachanski, Jr. sees his shop as primarily a six-cylinder Lycoming shop. The bulk of Blueprint's 60- to 80-engine-a-year business is with operators of Navajos, Dukes, Az-

tecs, Saratogas, and Skylane RGs. "We actually stock some exchange engines for the Navajo Part 135 operators," Eddie says. "Mostly, we're a custom overhaul shop. We take the customer's core and overhaul it. But we do stock some exchange engines."

Most engines arrive at Blueprint via motor freight, but customers who prefer to fly in can get R&I services (engine removal and installation) at Priester Aviation at nearby Pal-Waukee Municipal (PWK).

Small Is Beautiful

Blueprint is such an impressive shop – competent, thorough, efficient, experienced, reasonably priced (prices are on a par with, say, Firewall Forward; e.g. $35,300 for a TIO-541-E1C4, with new cylinders), and dyno-equipped to boot – that you wonder why they haven't grown to become a 200- or 300-engine-a-year behemoth. But as it turns out, the Rachanskis tried "big" and "big" wasn't for them. "Back when we were at Midway Airport," Ed Sr. recalls, "we had eight or nine guys in the shop. We were starting to get big. And we just couldn't keep control over quality. So I always told the boys, don't ever try to do 200 engines a year. You lose too much."

Thus, Blueprint remains small by choice. They're big on quality and service however, and we certainly hope they can grow to accommodate the 100 or more engines a year that they will almost certainly *be forced* to do once word of their quality and attention to detail begins to spread. As small, family owned shops go, this one rates five stars.

Power by Blueprint Inc, 6800 W 73rd St., Bedford Park, IL 60638-6024 or call Ed Rachanski, Jr. at 888-645-1101 or 708-790-0108.