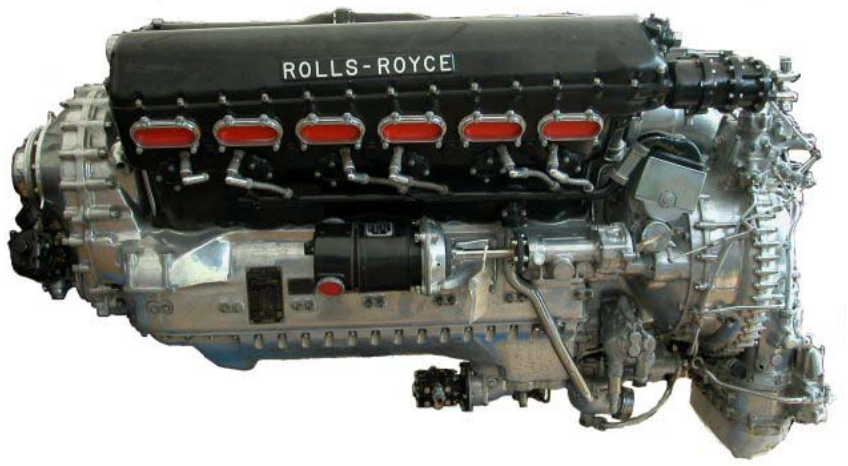
Masters of the V-12



SIXTY YEARS AGO, THE FASTEST airplanes on the planet were powered by enormous, complex V-12 piston engines made by Rolls-Royce, Allison, and Daimler-Benz. Sixty years later, some of the very same engines are still running, powering weekend warbirds, museum artifacts, and Reno racers. Only a few mechanics in the United States have the knowledge, skills, equipment, and temperament to keep them flying. These are some of them.

The Junkyard Cats

Follow a two-lane road running from Nowhere to Nevermind until you're just east of Gilroy, California, and there, down an unmarked dirt road, is Dwight Thorn's company: Mystery Aire Ltd. From this collection of ramshackle industrial sheds emerge the most powerful, reliable, and admired Merlin V-12 air-racing engines in the world. Engine blocks and parts are everywhere. Scarred junkyard cats sun themselves atop pallets of superchargers. Cylinder heads are stacked like cordwood. Every sump and valve cover is filled with eucalyptus leaves and spider nests. Crankcases are slowly sinking into the sandy soil—ashes to ashes, aluminum to aluminum.

How he works miracles in such a setting may be a mystery, but make no mistake: Dwight Thorn builds awesome engines that routinely win races. Looking a bit like Wilfred Brimley in bib overalls, the white-haired, 64-year-old Thorn is putting the finishing touches on a bright red Merlin with mirror-polished aluminum valve covers that will soon fill the snout of the two-seat TF-51 *Crazy Horse*, a Mustang that flies riders for a fee in Florida. Seventy-five percent of his work is overhauls of stock engines like this one. "But the two or three racing engines we do every year take just as long as all the others put together," he says. Thorn charges $60,000 to $80,000 for an overhaul, depending on the condition of

the run-out engine, and $160,000 to $180,000—and up—for a labor-intensive, 3,500-horsepower racing motor.
Exactly what do you do to hop up a Merlin? “Simple,” Thorn says with a grin. “Disconnect the boost [limiting] control. We’ve seen 150 inches of boost, which is where the gauge stops. And which is probably just as well.”

Most of us accustomed to more conventional motorsports assume that “tuning” separates the prime V-12 builders from the also-rans. Tuning means “porting and polishing” the intake manifold passageways to improve the flow of the air-fuel mixture, “boring and stroking” to increase the engine’s working volume, “bench-flowing and blueprinting” to ensure that the cylinders’ mechanical dimensions match—all that plus tinkering with spark timing and tuning exhaust pipes to boost evacuation of the combustion gases must be a large part of successful air-race engine building, right?

Nope. The category in which the V-12 engines run at Reno is called Unlimited, and the rules basically say the engines must reciprocate and turn propellers. There is no size limit, no rule against performance-enhancing devices such as turbochargers, superchargers, nitrous oxide injectors, designer fuel, exotic materials, or weight-saving techniques.

As a result, the top V-12 builders put their engines together using the strongest possible parts, reinforcing weak areas (such as the Merlin’s relatively vulnerable crankcase), and carefully assembling and torquing each and every nut and bolt, but with normal, stock profiles and settings for the camshafts, valves, and ignition.

And then they turn up the boost. The more air and fuel the supercharger can cram into the engine, the more horsepower it makes. But the higher the boost, the stronger the engine must be to withstand the unholy pressures inside the cylinder.

Thorn’s specialty is replacing Rolls-Royce rods with beefy, never-run Allison connecting rods and adapting them to fit Merlin crankshafts and pistons. This allows the engine to operate at 135 inches of supercharger pressure but at lower rpm because of the rods’ greater mass. Before Thorn’s imaginative fix, racing Merlins with their lighter connecting rods turned as much as 3,800 rpm, the propeller spinning so fast the blade tips were supersonic, which meant they weren’t creating thrust. Now racers can back the revs down to 3,300 or 3,400, allowing the prop to get a better bite but sending cylinder pressures into the stratosphere.

Most of Mystery Aire's clients aren't racers. "We're dealing with a different kind of customer now," Thorn says. "Back in the 1960s and '70s, the majority of the owners worked on their airplanes, had military experience, some had even flown the P-51 in the service. Today it's the*nouveau riche*. They're like the Ferrari guys—people who've bought something they assume will appreciate in value."
Between Rolls-Royce, Packard, and Ford of England, 165,000 Merlin engines were made during and after World War II—second only to the approximately 178,000 R-1830 Twin Wasps turned out by Pratt & Whitney and its licensees. Today, enough Merlin parts survive to make perhaps a few thousand. In the '60s, acres of Los Angeles were carpeted with Merlins and Allisons owned by a speculator who had bought them for pennies a pound. When land prices shot up the engines were sent to Japan, melted, and recycled.

Thorn's best engines are built with what the *cognoscenti* call "transport banks." Between 1948 and '50, Rolls-Royce turned out the strongest and most durable Merlins ever for Canadair-built Douglas DC-4s known as Northstars. These 1,760-horsepower engines could pound away for hours without missing a beat, and they made use of every trick Rolls had learned about building durable V-12s. They are the gold standard, and if you want a racer, they are what you need.
What about nitrous oxide? The Luftwaffe used it to augment its simple, single-stage superchargers, and hot-rodders inject it for instant acceleration. (NOX is a powerful oxidizer that "thickens" the air—and therefore the amount of fuel—that an engine can inhale.) Thorn will provide nitrous if asked but says, "It's hard to carry enough to make it worthwhile. A hot-rodder can fit a five-gallon tank and go play all night, but with an engine this size, you've got to have a lot on board."

Scattered throughout Thorn's warren of shops are shelves, boxes, racks, and pallets of Merlin parts, many still in sealed Rolls or Packard packaging. "I've been able to buy a couple of complete [shop] inventories over the years," he says. "I could probably build 20 complete engines from scratch. Not counting the things that wear out, like bearings, I probably have 200 engines' worth. But someday there will be one little widget that nobody has anymore, and you won't be able to finish an engine unless somebody steps up to the plate and manufactures it." Part of the problem, Thorn points out, is that a Merlin has six times as many parts as an Allison. "I blame it on socialism," he says. "The more parts they had to make, the more hours of labor were needed and the more make-work the government achieved."

Thorn's protégé, Mike Barrow, builds his own engines alongside Thorn and pitches in to help when needed. When Thorn retires, it's likely that Barrow will take over the business. "I had a cousin, Louis

Norley, who was an ace with the Fourth Fighter Group," Barrow says. "I've always had a thing about P-51s and Merlins. It's neat to be able to work with this stuff, and I like the air racing too. I've been a crew chief, though when you're both the crew chief and the engine guy, no matter what breaks you're in trouble," he says with a grin.

"People my age—I'm 40—when I tell them that I overhaul Rolls-Royce V-12s for a living, they don't know what I'm talking about."

Tehachapi, California, is a small, high-desert town, but when I ask for directions to Vintage V-12s, nobody knows what I'm talking about. Mike Nixon, a scholarly, preoccupied-looking man who wouldn't look out of place on the campus of Caltech, likes it that way. "I don't do any advertising, and I let the local paper do a story on us once every four years as long as they don't print where we are. It would only attract the tire-kickers."

At one point while I'm in Nixon's compulsively neat shop, a deliveryman from town shows up and takes in the spectacle of a dozen or more glossy V-12s. "What are they for?" he asks, wide-eyed. For airplanes like those in the pictures on the walls, Nixon explains. "You mean for, like, hobbyists?" Well, something like that.

Nixon's "hobbyists" are, for the most part, serious restorers rather than racers. "I can do a restoration engine and see it come back for an overhaul in six or seven years," he says. "Racers fly your engine for two or three years and blow it up. See that yellow supercharger and set of valve covers?" he asks, pointing to a rack of Merlin parts. "They're from an engine I first worked on in 1978, and it's on its fourth owner since then."

Nixon knows he can't hand-pick his customers, but he does steer clear of some. He recalls the guy who bought a P-51 and called for some engine operating tips. "I was on the phone for 15 minutes and couldn't get a word in edgewise," he recalls. "I hung up and said, 'He's dead in a month.' I was right: He flew into a hill while doing a low-level inverted pass."

Until recently, Nixon specialized in all-out racing engines that compete in the Gold races, but he burned out on the serious competition. Besides, he says, "It's far better for us to have four or five guys who fly our engines in the Silver and Bronze races [at least in part contested by basically stock, authentic warbirds] at Reno, have a great time, and tell everybody about it than it would be for us to win the Gold. Or, worse, be leading the Gold and scatter an engine. It takes years to get over something like that."

Nixon knows that well. He says the race business peaked in 1982, when he built the engines for four of the seven finalists at Reno and *Dago Red* won with one of his engines. “We were overwhelmed with work after that,” he says. But such reputations, if not easy come, are certainly easy go. Several of his race engines blew during a subsequent season, due to problems he traced back to a piston-ring supplier, and the gossip mill began to grind. “The only Gold racer I’d have any interest in now would be a Griffon-powered airplane, because it would be a challenge and because there’s so much Griffon stuff available,” Nixon says.

Many people think the Merlin was a spinoff of Rolls-Royce’s Type R racing engine, which powered the Supermarine Schneider Cup floatplanes. But the 1,650-cubic-inch Merlin was derived from the 1927 Kestrel V-12; the 2,240-cubic-inch Griffon was the production version of the big R. Development of the Griffon was put aside when the Hurricane and Spitfire needed a smaller, lighter engine.

When Germany attacked England with V-1s, Rolls shoehorned Griffons into what became amazingly fast, low-level Spitfires designed to run down the jet-powered flying bombs. After the war, Griffons powered the four-engine Avro Shackleton maritime patrol bomber. Hundreds survive, having led a sweet life of low-power, low-level loitering. There are even Griffon “box engines” available, still in crates after being overhauled by Rolls-Royce.

Vintage V-12s has accumulated a considerable stock of Griffon parts, but what Nixon is proudest of is his selection of “early-engine stuff.” With almost 150 P-51Ds flying, along with a considerable number of late-model Spitfires, restorers are today embarking on more interesting projects. And if you want to do an A-36 Mustang with its original Allison, a long-nose P-40, or a late-’30s Spitfire, you may need to come to Nixon for the parts. He guesses that his trove’s value is at least “a couple million,” but who can put a price tag on racks of prop reduction gears that look big enough to fit a ship’s engine or a box of thousands of tiny lock-tab washers in an English Whitworth standard size that no longer exists?

Nixon’s most recent project has been the restoration of a rare Daimler-Benz DB 601 inverted V-12 for a New Zealand collector’s Messerschmitt Bf 109E. “The biggest problem has been all the magnesium parts—intake manifolds, valve covers, accessory cases, things like that,” he says. “Since they’re all down at the bottom of the engine when it’s mounted in the inverted position, moisture gets at them and they corrode away.”

Nixon points to the engine’s original valve covers, amid a shelf of equally useless DB 601 parts. They are magnesium doilies that are filligreed with rot, which is why it took parts from two donor 601s to

complete the job. He also had to have a propeller reduction gear cover, a casting about the size and shape of a bedpan, manufactured. “Pattern, casting, and machine work, it cost $20,000,” he says. “I look at that and laugh when people suggest building an entire new Merlin. It would cost $1 million per engine, easy.” The rebuilt DB 601 will cost its owner nearly $300,000, plus $100,000 for the original core and the extra engines bought for parts, but then Nixon has put a year and a half into the job. It’s the second 601 he’s done; the first one took over three years.

The German, American, and British V-12s are fairly similar in general, but Nixon says the complexity of the DB 601 is obvious. “The British and Americans did more in-the-field maintenance, whereas the Germans would just send the whole engine back to the factory. They could change the engine in a Messerschmitt in a little over an hour.” And that’s why you see World War II photos of shirtless, oil-covered GIs pulling cylinders and replacing pistons. The Germans left that work to men in white shopcoats.

“Still, there were very few people either at Rolls, Allison, or Daimler-Benz who knew the whole engine,” Nixon says as he recalls the roots of his profession. “Almost everybody was a specialist. It was only in the 1950s and ’60s that we evolved to generalists who actually work on the whole engine—guys like Dwight Thorn and me and a few others who have basically had to learn the whole engine.”

Is Nixon’s business growing as warbirding increasingly becomes the sport of kings? “ ‘Stable’ is a better word for it,” he says. “We’ve had some huge incremental increases, like when in the late ’70s a lot of ex-South American airplanes became available, and then in the late ’80s when all the Spitfire gate guardians came down to be made flyable for the 50th anniversary of the Battle of Britain, but I don’t think there are any more ‘secret’ warbirds out there anymore. The legendary 50 P-51s that were supposedly in China turned out to be nonexistent. When the Berlin Wall came down, that was the last time a large group of World War II aircraft suddenly became available.

“But the nice thing for us is that when you restore an airplane, you never see it again. When you restore an engine, it comes back for an overhaul every six or 10 years.”

The Odd Couple

Sam Torvik and Bill Moja have worked together for 30 years and still argue about whether the shop radio is too loud. Torvik is small, tightly wound, and wears a trimmed beard. He’s the Merlin specialist. Moja is a big, shuffling, mustachioed galoot, the kind of man whose shirttails are usually out. He prefers Allisons. “The English engines...,” he shakes his head. “Full of lousy rubber seals and way too many

pieces. They're like Jaguars burning out at the side of the road all the time. I don't know why we're still doing Merlins. There's so much labor in 'em."

Torvik and Moja are the V-12 masters at JRS Enterprises, which is housed in an old brick building next to some automobile dealers in suburban Minneapolis. The "R" has fallen off the JRS sign, and a constant stream of traffic rumbles past on a four-lane highway. This was once the hobby shop of racer John Sandberg, who was killed in 1991 in his remarkable homebuilt Unlimited racer *Tsunami,* a mini-Mustang that was the smallest airplane ever to have carried a Merlin. Today, JRS Enterprises is basically a fabrication shop fulfilling small contracts for the aerospace industry, but the engine building continues almost as though nobody knows how to stop it.

"Why are we still doing this? Because we always have," Moja says. "Nobody's making much of a living doing this stuff, because it's just for rich boys and their toys—that and flying museums. But it's warm in here during the winter, and you get to go home at 3:30."

Torvik is happiest left to himself. He has his own small engine assembly area, where he's finishing up an early Merlin that will go to a collector in England. (Early Merlins and Allisons are far rarer than the later more powerful and sophisticated variants.) "I don't know what it's going into, either a Spitfire or a Hurricane," Torvik says.

He is impressed by what he's seen of German World War II engines, having recently worked on a BMW radial from a Focke-Wulf Fw 190 fighter. "Their technology was so far ahead of ours at the time, it was easy to see," he says. Moja demurs, of course. "They were *way* too complicated," he says. "You didn't have to be a rocket scientist to work on an Allison."

Amid piles of engine parts and tools, Moja is building an Allison for a P-40 restoration. Hanging on a wall nearby are a huge Merlin connecting rod bent a good 10 degrees from straight and a supercharger impeller that looks as though somebody had punished every blade with a hammer. They're from *Tsunami*'s Merlin, and they show what happens when an anti-detonation injection system fails. "If the ADI system fails, you can't reach anything in the cockpit fast enough to keep the engine from blowing up," Mystery Aire's Mike Barrow had told me, and this display proves it. The explosion nearly blew *Tsunami*'s cowling off.

JRS does 15 or so engines a year, most of them radials for collectors and restorers and a few commercial operators. They do only one or two V-12s a year but are usually at work on several at a time while they wait for overdue supplies or missing parts. "The commercial stuff, that's a push, because those people *need* their engines," Moja says. "A V-12, the worst that happens is a rich boy misses an airshow.

We haven't worked on a weekend since September '91." Which, as it happens, is when Sandberg died and JRS was out of the air-racing business.
"The round motors are probably more reliable than the V-12s," Moja admits, "but remember, the V-12s were made for an entirely different purpose. [The radials] were the truck engines, hauling bombs for the most part. The V-12s were the hot rods, made to go balls-out all the time. You're asking me to fly behind it? I'll take the radial every time."

A variety of ailments can afflict a V-12 when it's asked to do too much—even Moja's Allisons. They're prone to cylinder-liner distortion if overboosted, because the liners are locked to the block both top and bottom, and when uneven expansion is exacerbated by sudden overheating, the liners deflect slightly and let the combustion charge sneak past the rings. That is invariably fatal to that piston, which destroys the head with its shrapnel. "The Merlin's liners, even though they're thinner, stay pretty much round, because they float at the bottom end, where they're sealed by O-rings," Moja points out.

Imagine a soup can with both its top and bottom cut out and you have a small, very thin cylinder liner. Grab it by each end and twist, and it distorts—becomes slightly oval. Grab it by only one end and you can't do that.

"See that semi out there?" Moja asks, pointing to a battered white trailer outside the shop. "It's filled with cylinder heads that prove you can overboost an Allison." Sandberg began his short air-racing career with an Allison-powered Bell P-63 Kingcobra. An inveterate tinkerer, he continually had its engine modified in a variety of ways, never leaving well enough alone. "We modified and modified that engine and kept blowing it up," Moja says. "Then we finally took it back to stock and it ran better than ever."

"There are no tricks to building a good engine," Sam Torvik says. "Everybody thinks there's magic involved, but there isn't. You just have to build it right and use the best parts. It's becoming harder and harder to find them, though. When you keep blowing these things up racing them, where are you going to get parts for your regular customers?"

Some of the simplest yet most difficult-to-find parts—new crank and rod bearings, for example—would be easy for a competent fabricator to manufacture, "but the people who could do it don't want the liability," Torvik points out. Torvik and Moja blame "the boat people" for the dearth of parts. "When the hydroplane guys found out they could use Merlins and Allisons [for Gold Cup racing], it drove the value

of a core from $250 to $25,000," Moja says. "And then the tractor-pullers came along. Then when they screwed up all the engines they could find, they went to turbines. If I get a call from a tractor-puller looking for parts, I won't even talk to him."

The heart of a Merlin or Allison engine—"the core"—never wears out, unless the ravages of time simply corrode it beyond redemption or racing use overstresses it. The crankcase and crankshaft, cylinder banks, accessory-case and valve covers, heads and cams, supercharger, propeller reduction gears, and various pumps and fittings are usually salvageable. During a serious rebuild, new pistons, rings, bearings, valves, springs, camshafts and followers go into the core, and the cylinder liners are bored slightly oversize. Sometimes, all that's needed are new seals, gaskets, and O-rings.

But that won't be enough to help a buyer who has fallen for the bargain price of a former hydroplane engine. The main clue that the engine's been on the water is nonstandard fittings for oil-scavenge pumps at the aft end of each head, which are necessary because the engines sit at an angle in boat-racing. They live a short life turning at very high revs, with the prop jumping in and out of the water, and their cores are useless for anything but...well, boat anchors.

Of course the air racers destroy engines too. "Yeah, but they only do it once a year," Torvik says.

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For all these men, building V-12s is not so much a profession as a calling. And the nature of the priesthood is unlikely to draw young airframe-and-powerplant graduates who have airline companies beating down their doors. If the V-12 business weren't turning at least a modest profit, none of these shops could afford to pay the light bill. But you get the feeling it's not about the money.