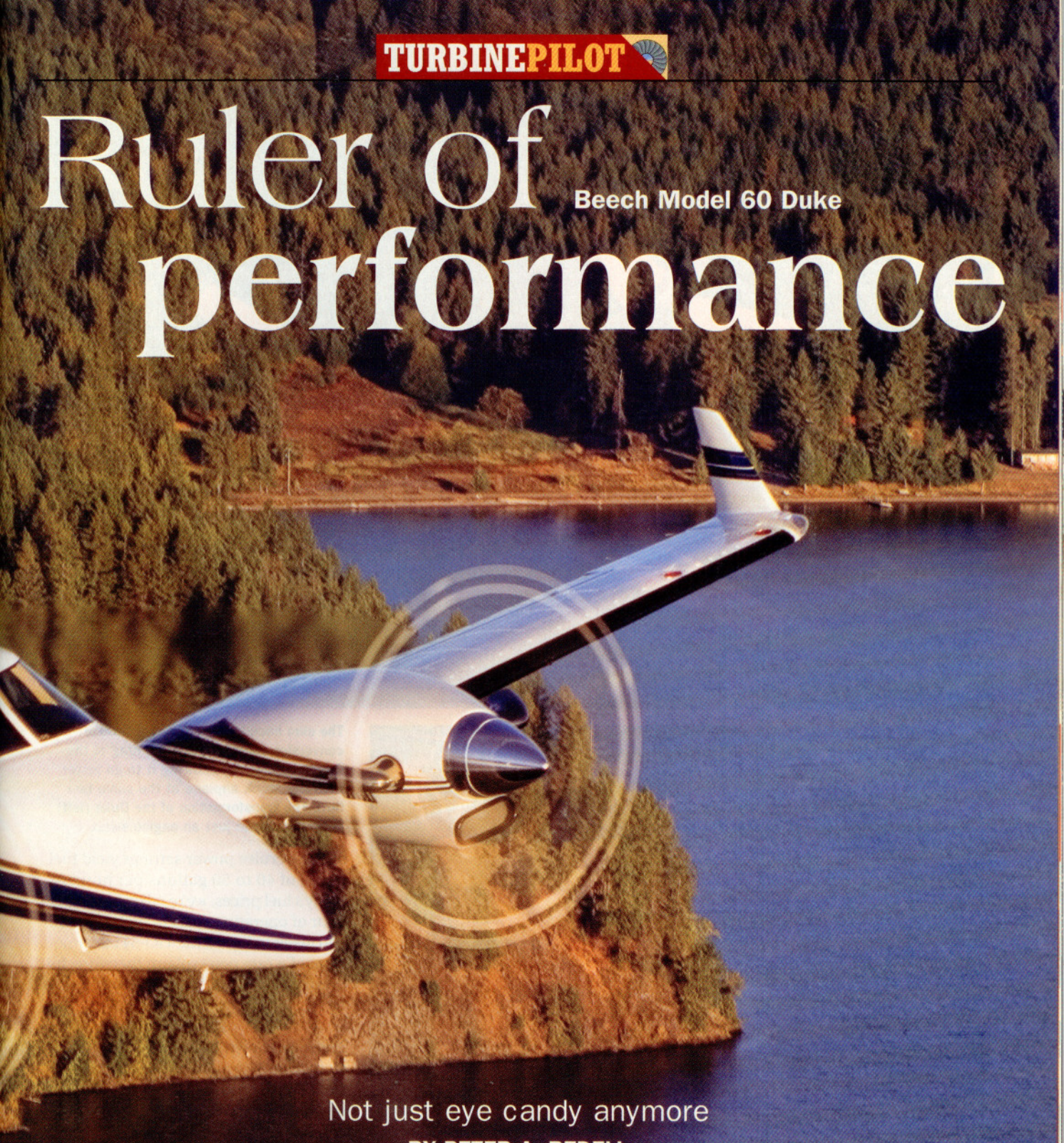
Ruler of Be perform

Not just eye candy

BY PETER A. BED

Ruler of performance

Beech Model 60 Duke



Not just eye candy anymore

BY PETER A. BEDELL

Ever since Beech rolled out its Model 60 Duke for model year 1968, the slant-nosed twin has turned heads. If *ramp appeal* were in the aviation dictionary, the Beech Duke would likely appear as an example. Its stylistic lines, bracketed by a steeply raked nose and towering tail of equal slant, give the Duke an imposing ramp appeal. To be blunt, however, the Duke is the aviation equivalent of a bimbo. It has the looks but unfortunately lacks the performance to back it up.

Dukes are quiet and comfortable, and maintain the nimble flying qualities that are hallmarks of the light Beech airplanes (albeit a little heavier in feel). Unfortunately, though, the design's greatest weakness has been its performance. Although the Duke's Lycoming TIO-541 engines are rated at a

PHOTOGRAPHY BY TIM HENEGHAN

The slim nacelles of the Royal Turbine conversion (above) lower the drag of the Duke significantly allowing it to go faster than the stock airplane at the same fuel flow. The transformation of the Duke (left) is far more than just an engine swap.

seemingly adequate 380 horsepower, it quickly becomes apparent on throttle-up that not enough of that power makes it to the propellers. As a result, the Duke was never much of a performer. It loves its runway and takes its time gathering up steam to climb. Some speculate that the root of the problem comes from the small-diameter propellers. They are required for adequate ground clearance for the nose-low Duke, but rob the airplane of its ability to turn horsepower into thrust. In addition, those props spin at a not-too-efficient 2,900 rpm.

Besides being big and heavy, the engines are surrounded by an equally gargantuan cowling that scoops volumes of cooling air for the engines, contributing significant drag to an otherwise slick-looking airframe. Matching the titanic size of the engines and cowlings is the TIO-541s' appetite for fuel. Typical rich-of-peak cruise power settings yield fuel burns of 40 to 50 gallons per hour. At today's fuel prices, we're talking $200 per hour of operating costs in fuel alone. To add insult to injury, the TIO-541 is somewhat of a rare powerplant; therefore, its overhaul costs run about $55,000 each.

Looks *and* brains

Those who own Dukes have been passionate and loyal fans who vehemently stick up for their airplanes. Savvy Duke owners are quick to remind the naysayer that with proper maintenance and care, the so-called troublesome engines can easily make time between overhauls and beyond. They're correct, but even the most loyal Duke owner will have to stand up and take notice of Northwest Turbine's Royal Turbine, a supplemental type certificate (STC) that replaces the Duke's 800-pound Lycomings with lighter-weight, yet far more powerful, Pratt & Whitney PT6A-35 engines. The result is everything the

Duke should have been—not just eye candy for ramp dwellers.

Northwest Turbine LLC is an offshoot of Rocket Engineering Corp. in Spokane, Washington. The company cut its teeth modifying Mooneys into high-performance Rockets and Missiles. Today, its bread-and-butter conversion is the popular JetProp PT6 conversion of the Piper Malibu/Mirage. Always on the quest to make good airplanes better is Northwest Turbine Operations Director Darwin Conrad. He and Executive Vice President Jeanie Sadler started Rocket Engineering in 1989 and have been awarded their twenty-fifth STC, the Royal Turbine.

With 1,050 total shaft horsepower to tap into, the Royal Turbine is quite a performer. The flight manual supplement for the conversion states that at its maximum takeoff weight of 7,000 pounds and standard temperature at sea level, the Royal Turbine can leap off the ground in about 1,000 feet and climb at 2,700 feet per minute. If an engine quits, you'll still climb away (again, fully loaded) at about 900 fpm. Cruise speeds top out in the mid-20,000-foot range, where on cold days the airplane will flirt with 300 TAS. For best efficiency, utilize the airplane's impressive climb rate to go right to Flight Level 280, its limited ceiling because of reduced vertical separation minimums, and enjoy a 275- to 290-knot cruise speed on 66 gallons per hour. Pull the fuel flow back to 45 gph—about what a stock Duke would burn—and watch the speed settle on about 230 KTAS. That's about 10 to 15 knots better than a stock Duke on an optimum day and is mostly the result of the lower-drag nacelles that cover the PT6s. Need to get down? Just pull the power to flight idle, point the nose to the ground, and repeatedly remind yourself that you really *can* make that runway under your nose—you're going down at 4,000 fpm! On landing, the Royal Turbine needs about the same 1,000 feet of runway needed for takeoff, thanks to propeller reverse.

A total package

But what makes the Royal Turbine a whole new animal isn't just a swap of recips for turbines. This is a massive conversion that replaces the entire instrument panel and much of what was in it. The result is not just a better airplane in terms of performance, but also in terms of safety, reliability, comfort, and convenience. It also explains the $930,000 price tag for the conversion, not including the donor airframe.

Well-cared-for piston engines are reliable, but even the most pampered recips can't hold a candle to the reliability of the PT6. Reliability equals safety, especially when discussing twins in which pilots have a hard time coping with a failed engine. There's also the recommended time between overhauls of the PT6, which is 3,500 hours, more than double that of the stock Lycomings. Additionally, pilots of stock Dukes hold their breath after takeoff, praying that

Wide-chord, four-blade Hartzell propellers (above) provide tremendous thrust and low vibration while maintaining adequate ground clearance. A new Moritz electronic engine instrument cluster (left), a custom annunciator panel, and a Shadin ETM trend monitor/air data computer are a major part of the Royal Turbine treatment.

one of those big Lycomings doesn't conk out in that no man's land after liftoff but before the airplane actually begins to climb at a rate better than a Cessna 150 loaded with sumo wrestlers. With the Royal Turbine's abundance of power, there's no doubt that the machine will still rocket away from the ground at a good rate on one engine.

Even at its higher indicated airspeeds, the Royal Turbine is a quiet machine. With the cabin pumped up at high altitude, headsets are an option in the cockpit. In the back, it's measurably quieter still. This reduced noise level is accompanied by a lack of vibration that simply cannot be found in a stock Duke. The four-blade Hartzell props, even at their highest rpm, are smooth and quiet, negating the need to reduce rpm unless maximum range is needed.

On the convenience side, owners of Royal Turbines don't have to fret about thermal shock issues and unrealistic climb or descent requests from controllers like owners of stock Dukes do. In addition, engine preheat is simply not an issue with the turbine in all but the most severe climates. Just fire it up and go. One Royal Turbine owner, who is also an airframe and powerplant mechanic, says his annual inspections are a snap without the piston engines taking up some 80 percent of the labor required to complete the job.

Out for a spin

I had the pleasure of flying the Royal Turbine from Northwest Turbine's home

A very special Duke mechanic

By Michael Maya Charles

At 89, when most octogenarians are choosing the color of their rest home walls, Dane T. Scag is finishing up his Inspection Authorization (IA) class at a mechanic school near Nashville. He was the oldest student to ever take the FAA test at the school and scored better than some of the young bucks in his class.

Although he holds graduate degrees in both physics and math, Scag says, "I became a mechanic the day I was born." His love of design and engineering, and desire to work on his own airplanes, led him to get his A&P license in 1982.

Scag bought his first aircraft, an Ercoupe, in 1946. He used it to cover a huge territory as a product development engineer at Allis Chalmers. He flew the little Ercoupe "everywhere," he says, including over the western mountains. An early Beech Bonanza followed in the early 1950s, followed by a Rajay turbocharged Piper Apache in 1959.

Looking for a new challenge after he retired from AC in the early 1970s, he bought a struggling Wisconsin snow thrower company called Bob Cat. "I didn't know anything about manufacturing or snow throwers...." But he turned the company around by designing a new commercial lawn mower to complement the product line. An English company bought him out several years later.

Not happy with idle hands, Scag started another company, named it Scag Machine, invented a better commercial lawn machine, built the company to $40 million in sales, and sold it, too.

Over time, the twin-breasted Piper became a Beechcraft B55 Baron, then a pressurized Baron 58P, and finally, a new Duke in 1982. He owned that airplane for almost 25 years. This long-term ownership experience led to his becoming a technical guru for the Duke Flyers Association, where he offers his vast Duke experience with wit and humor.

base at Spokane's Felts Field. The mission of the first flight was to get some photos of the airplane over nearby Lake Pend Oreille in Northern Idaho. With three people and 140 gallons of fuel, the Royal Turbine was off the ground in less than 1,000 feet and climbing at about 3,500 fpm. In this airplane, there's no excuse not to go high—even for short trips. The climb rate is so good that you'll be at altitude in no time. The fuel burn drops off precipitously up there while true airspeed increases just as quickly. Finally, with pressurization, nobody's battling the ear-popping climbs and descents that the Royal Turbine is capable of.

After a neck-twisting, eyeball-searing job of getting the photos you see with this story, Conrad took over and demonstrated the single-engine capabilities of the Royal Turbine by sliding a power lever to idle and feathering that engine's propeller. Once trimmed up, the autopilot was flying the airplane hands- and feet off. At altitude, Conrad says it'll fly at 240 KTAS on one engine. At our relatively light weight, the airplane mustered a 1,200-fpm climb on one engine through 8,000 feet. With the engine back online, Conrad demonstrated an approach into a busy airport with a demanding controller and flew the airplane at 190 knots indicated to the outer marker *and* made the first turnoff from the runway without any heroics.

One unfortunate drawback of converting any piston airplane to a turbine is the fact that the max structural cruising speed (the bottom of the yellow arc

In the 1990s, he formed yet another new company, Great Dane, to build an even better hydraulic, zero-turn, stand-on commercial mowing machine. The machine became wildly popular with golf courses and landscapers. In 2000, John Deere bought the Great Dane Company with its 25 patents, and, once again, made Scag a wealthy man.

Scag sold his beloved Duke and bought a new Beechcraft King Air 90, then a Cessna Citation CJ, but "it cost about $10,000 every time I walked up the steps to get into it," he says. So he sold the jet and found another Duke, which he flew for a few years. At the EAA AirVenture a couple of years ago, he took a demo ride in the turboprop Duke conversion offered by Rocket Engineering.

"That was a mistake," Scag admits wryly. "We rotated at 95 knots—pitched up 10 degrees—and saw 4,000 feet per minute on the VSI." Scag was instantly hooked. He bought the first production airplane from Rocket Engineering, and has had it ever since. "I absolutely love it," he says.

Sadly, Scag has macular degeneration, a progressive eye disease, and had to give up flying in May 2006 because he couldn't pass the FAA eye test. A friend who is an American Airlines captain now flies him around while he sits in back with his King Charles Cavilier Spaniel, Lady Abigail.

Although his flying days are admittedly over, Scag plans to keep the Turbine Duke another two to three years, and he will continue helping his many Duke owner friends who have come to depend on him for maintenance counsel. He plans to use his new IA to sign off their annuals, too. Lucky friends, those.

on the airspeed indicator) becomes the new never-exceed speed (the redline) in a turbine airplane. The Royal Turbine's new redline is 198 KIAS, which is easy to exceed at lower altitudes, reinforcing the need to get the airplane to altitude quickly.

Our second flight found me in the left seat of the Royal Turbine for a quick trip to altitude to verify speed claims. Start-up is standard PT6, watching for oil pressure, ignition, fuel flow, and light off while monitoring temperatures. On takeoff, like many twin turboprops, the spool-up time of the Pratts is not at the same rate, so Conrad suggests holding the brakes until at least 400 foot/pounds of torque is reached on both engines. Early in the roll, you'll still need to jab the brakes for directional control as the power is fed in until the rudder becomes effective. Unfortunately, you can't just push the power levers to the stops or you'll over-torque the engines. Takeoff power is 1,200 foot/pounds of torque and trying to finesse the power levers while keeping the centerline under the nose—as well as simply hanging on for the ride—can become a chore for the uninitiated. Things happen very fast in this airplane. In about 900 feet and a scant nine seconds from brake release, the Royal Turbine reaches about 90 knots and is clawing for altitude at a 25-degree deck angle and better than 3,500 fpm.

The jets will have the speed advantage, but the Royal Turbine will out perform any VLJ in runway performance, opening up thousands more airports for potential use.

Our uninterrupted climb found us at FL280 in a short 12 minutes, for an average climb rate of 2,200 fpm. Fuel required to climb to FL280 was 16 gallons total, and the density altitude that day was almost 30,000 feet. We topped out at 280 KTAS on 66 gph at FL280. Cabin altitude at FL280 is a high 12,000 feet, so I wouldn't spend long at that altitude without supplemental oxygen. At FL260, speed was 287 KTAS on about 70 gph on this warmer-than-standard day. With cooler temperatures, the magic 300-knot number appears realistic.

Following another toss-out-the-anchor, flight-idle descent, I flew an ILS approach while slowing from the redline speed back to approach speed. The Duke's high gear and flap operating speeds are complemented by the fact that trim changes are minimal. I couldn't duplicate Conrad's "first turnoff from the runway" trick, but even on my first try, we didn't use more than 1,200 feet of pavement. Unlike in a stock Duke, I'd be comfortable flying this airplane in and out of 2,500-foot runways—paved or not.

Required for the conversion are vortex generators, winglets, and aft body strakes made by Boundary Layer Research. These items combine to raise the maximum takeoff weight of any Duke to 7,000 pounds from the stock airplane's 6,725- or 6,775-pound MTOW. Since the new engines are lighter than the original Lycomings, the airplane gets a useful

load increase of about 350 to 400 pounds depending on the donor airframe. Conrad says most airframes roll into the shop weighing about 5,000 pounds empty and leave weighing about 4,600 pounds. The test airplane has a useful load of 2,485 pounds and a full-fuel payload of 1,782 pounds.

In a perfect world, one could find a well-cared-for, late-model Duke with low airframe time and run-out engines for $250,000 to $300,000, depending on avionics and equipment. After the conversion, you'll have a 290-knot twin turboprop with new engines for a total investment of about $1.3 million. Cabin size and cruise performance is about on par with an EADS Socata TBM 700, although the Royal Turbine handily outclimbs the single-engine TBM. Comparative twin turboprops would be the Cessna Conquest I, Piper Cheyenne, and Beechcraft King Air C90, all of which are quite a bit slower and use more fuel, but have larger cabins. Most interesting is how the economics of the Royal Turbine will compare to the uber-hyped very light jets that are coming to market. If the VLJs can keep prices in the $1.5 million range, it will be an interesting comparison. The jets will have the speed advantage, but the Royal Turbine will outperform any VLJ in runway performance, opening up thousands more airports for potential use.

So far, 15 orders have been placed for the Royal Turbine and a few are from folks who've never owned a Duke. Individuals and owners of small businesses are attracted to its small size and economy compared with the larger turboprops like King Airs and Conquests. Owners we talked with have praised the entire operation at Northwest Turbine and report excellent post-sale support. They too wish that the pressurization system had a little more oomph and that the airplane could carry more fuel. For now, the airplane holds 266 gallons of Jet A, which provides about 3.5 hours of fuel at high-speed cruise. If you can get a direct climb to altitude, keep the power back in cruise, and start your descent 10 minutes from your destination, the Royal Turbine can stay airborne for about 4.5 hours with reserves. Remember, the Duke has no potty, though.

There are some flies in the ointment, however. Because it's so new and lacks a history, the insurance for the airplane could be a deal breaker for some pilots lacking in multiengine turbine time. In addition, to maximize its efficiency, the airplane must be flown high. In the Northeast, where controllers and traffic flow determine altitudes to be flown, the Royal Turbine pilot may find himself stuck at less-than-optimum altitudes where the airplane is nudging the airspeed redline and slurping copious amounts of Jet A.

In the end, however, Northwest Turbine has given the Duke a much-needed performance makeover to match its dashing looks. The Royal Turbine is simply a hoot to fly. Its abundance of performance and nimble flying characteristics, combined with its comfort and efficiency, make it a superlative turbine airplane for a pilot with a family or small business. ACPA

Peter A. Bedell is a first officer for a major airline and co-owner of a Cessna 172 and Beechcraft Baron.

For more information about the Royal Turbine, visit the Web site (www.royalturbine.com) or call Northwest Turbine at 509/535-0187.