TEACHING THE MENTOR

BY VINCENT CZAPLYSKI

TURBINE ENGINE GIV

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TURBINE ENGINE GIVES T–34 NEW CAPABILITIES

The temptation to tinker with an existing aircraft design is more than some people can resist. Usually, though, progress in such endeavors is measured in teaspoons, each hard-won step forward an exercise in compromise. Large performance leaps? Probably just wishful thinking. ■ Not so in the case of the AT–34 Turbine Mentor, a one-of-a-kind modification of Beech's venerable military trainer that has taken the conventional fast track to better performance by adding lots more power. Picture if you will a Mentor on steroids. The steroids in question are the injection of an Allison turbine engine, and the result is an airplane with an eclectic personality. There's something for everyone—the rough-and-tumble appeal of a workhorse

PHOTOGRAPHY BY MIKE FIZER

warbird, the smooth reliability of a modern turboprop, and the familiar good manners of a Bonanza.

The original piston-powered Mentor was the brainchild of the late Walter Beech, who in 1948 produced three Model 45 prototypes, in the belief that the armed services soon would need an economical, new-generation primary trainer. The fact that the military hadn't asked for a new design or that tens of thousands of war-surplus training aircraft were then available didn't faze Beech. He pressed ahead anyway, introducing the airplane at the 1949 Cleveland Air Races. The fully aerobatic, tandem-seat design was based in large part on the then-two-year-old V-tail A35 Bonanza. It shared the same wing and landing gear—and many fuselage parts, as well.

Beech's blind faith is hard to imagine in this age of multi-million-dollar Joint Primary Aircraft Training System (JPATS) competitions, but his intuition proved on target. The Air Force eventually ordered a total of 353 T-34A Mentors, which it operated between 1953 and 1961. The Navy followed suit with orders for 423 T-34B Mentors between 1954 and 1957. B-model changes requested by the Navy included one more degree of wing dihedral, a simplified On-Off fuel selector, a castering nosewheel, fixed-position seats with adjustable rudder pedals, and a strengthened main gear assembly.

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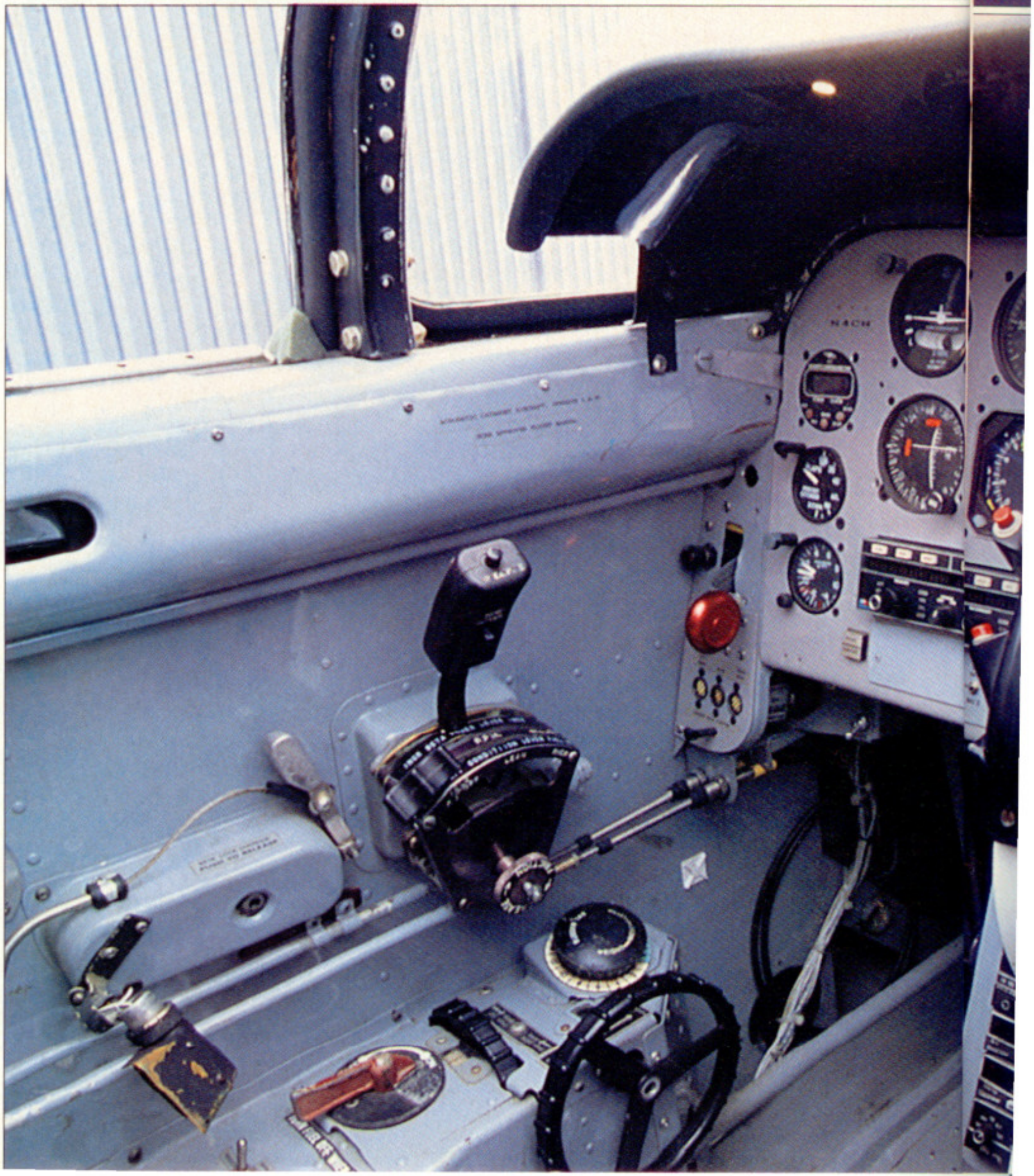
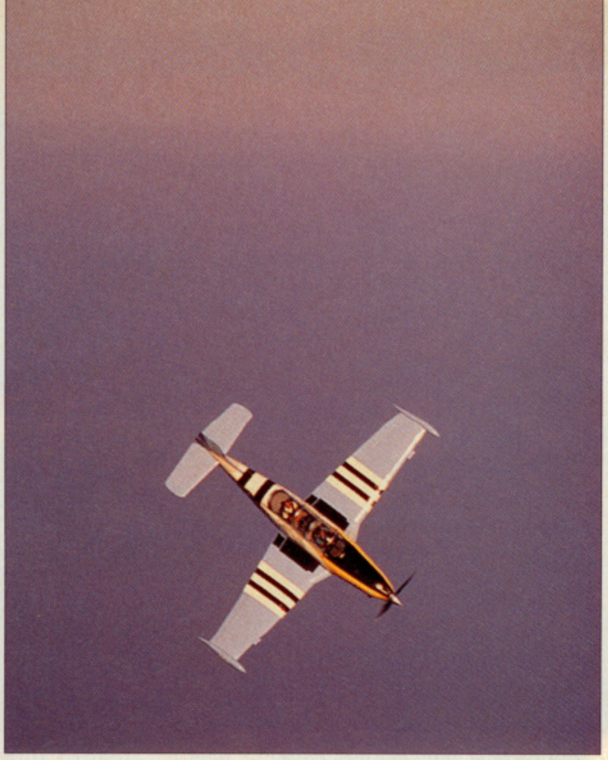
Beech Aircraft was also able to parlay the design into overseas orders. It shipped a total of 312 T-34As to various foreign military services, dubbing the export version the Model 45 Mentor. The 45 was nearly identical to the T-34A, with the exception of instrument panel layout changes and the use of some vacuum-run instruments rather than electrically powered ones. Beech also licensed production of the aircraft to Fuji Heavy Industries of Japan and the Canadian Car and Foundry Company. Seventy-five other 45s were assembled in Argentina from parts supplied by Beech.

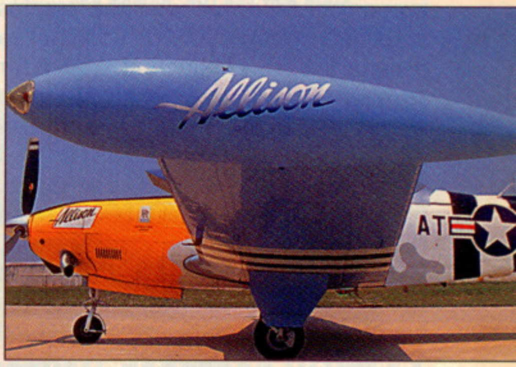
Both A- and B-series Mentors were powered by the 225-horsepower Continental O-470. It proved to be a marginal





The fighter-style cockpit helped ease the transition to jets for military flight students. The Allison engine provides a climb rate of 2,800 feet per minute and a cruise speed of 170 knots.

powerplant for the production aircraft, however, largely because of a military parts policy which added weight to the original design. Book figures called for a sea-level climb rate of 1,150 feet per minute at the aircraft's maximum 2,900-pound gross weight, a 1,333-foot takeoff run to clear a 50-foot obstacle, and a top cruise speed of 164 knots—all targets the airplane had difficulty meeting. Beech did its best to lighten the aircraft by incorporating many magnesium parts, but the real solution lay in greater power. The Air Force avoided the power issue altogether, electing instead to retire its T–34As in 1961, when it went to all jet trainers. The Navy eventually ordered a heftier (4,300-pound maximum gross weight), better-performing turboprop version, the T–34C, powered by a 650-shaft-horsepower Pratt & Whitney PT6A-25 engine derated to 400 shp. Between 1977 and 1990, Beech sold 353



T–34Cs to the Navy, 271 of which it still operates in the primary trainer role. Beech produced for the export market 129 T–34C-1s, powered by the same engine derated to 550 shp.

Except for a brief period, Beech never offered the Mentor in the civilian marketplace. In 1987, it offered individuals the chance to piggyback on the production run for the Navy's final T–34C order. Anyone with the requisite $1.3 million could fly away in a factory-new turbine Mentor, but there were no takers. Over the years, however, about 250 piston-powered Mentors have come into private hands in this country, through government auctions and foreign sales. Except for those parts common to Bonanzas, Beech does not support civilian-owned Mentors. Two companies perform most of the maintenance, restoration, and conversion work on the civilian fleet. They are Nogle and Black Aviation of Champaign, Illinois, and Parks Industries of Amarillo, Texas.

Charlie Nogle, owner of Nogle and Black, traces his love affair with the Mentor back to "...the first time I laid

The vertical stabilizer was borrowed from a Travel Air, while the wing was built from Baron spars and Bonanza leading edges.

eyes on one." He purchased the remains of the first wrecked Air Force Mentor to become available at auction, waited for another to crash, and bought that one as well. Between the two he had enough parts to build his own Mentor. He used the leftovers as the seeds of a business, figuring others would want Mentors of their own. His instinct proved right. With sons Jim and Jud—who operate the business with him—Nogle has bought, sold, restored, and maintained a large portion of the civilian T–34 fleet. His company holds supplemental type certificates (STCs) for various T–34 modifications. The most popular are engine upgrades, he says; most owners elect either the 285-hp Continental IO-520 or the 300-hp Continental IO-550, either of which allows the Mentor to perform as well as (or better than) originally advertised.

A FULLY RESTORED MENTOR IN GOOD CONDITION WILL BRING $200,000 OR MORE. AN EXCEPTIONAL EXAMPLE MAY FETCH TWICE THAT PRICE.

A fully restored Mentor in good condition will bring $200,000 or more. An exceptional example may fetch twice that price. Some parts have become hard to find, a hurdle that Nogle helps owners to overcome. Founder and president of the T–34 Association, Nogle has amassed what must be the world's largest privately held collection of T–34 parts, both original and remanufactured, all stored in a warehouse in downtown Champaign.

The thought of getting his hands on a flyable T–34C had intrigued Nogle for some time. Unfortunately, the Navy was not releasing any of the turbine-powered airplanes. In fact, rumor had it that the brass had agreed to a request from Beech to keep them off the open market. Along with a partner, Nogle decided to transform a T–34A into a turboprop, and the result is the Allison-powered AT–34. The partners originally intended the aircraft as a sales demonstrator, hoping to drum up modification business. It made several trips through South America, where it was showcased to those foreign militaries operating Model 45 Mentors.

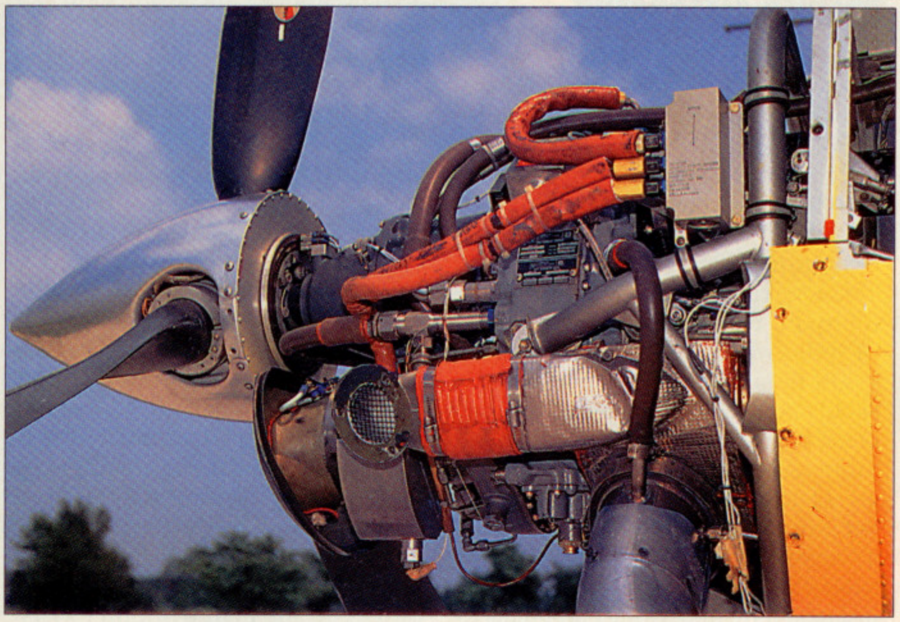
Eight years and two engine upgrades later, the AT–34 remains the sole example of its kind. With no success in the foreign military market, it is now leased to the Allison Engine Company, which uses the AT–34 to impress other piston aircraft owners with the performance benefits of turbine power.

But sales success and design success are two very different animals. Nine hundred pounds lighter than the T–34C, the AT–34 is a screamer. Flat-rated from 495 shp to 450 shp, the Allison 250 B17F has two more oil injector ports than the standard engine, which give it a 30-second inverted flight capability. At a mere 205 pounds, the Allison engine is significantly lighter than the 225-hp Continental it replaced. To keep CG limits the same, the firewall was moved two feet forward. The resulting elongated nose section creates a sleeker look and provides room for an additional baggage compartment. The space can also be fitted with a removable smoke system for airshow work.

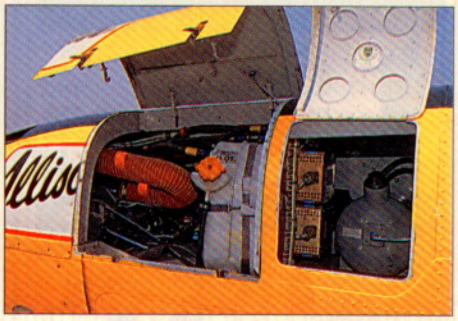
Larger wing bladders increase the standard fuel capacity from 50 to 80 gallons. Removable 20-gallon Osborne tip tanks boost total fuel capacity to 120 gallons, of which 114 (764 pounds) is usable. Aerobatics are not approved with fuel in the tip tanks.

The AT–34 owes much to other branches of the Beech family tree. The gear assembly is from the A36 Bonanza and is a stronger design than that of the original Mentor. The vertical stabilizer, transplanted from a Travel Air, lends a less angular appearance to the tail feathers. The wing is a hybrid, made from Baron main wing spars and A36 Bonanza leading edges, with slightly thicker skin than the original.

Otherwise, not much else on the outside distinguishes the AT–34 from its more mainstream contemporaries. Inside, the battleship-gray cockpit is strictly utilitarian, befitting for a military trainer of this vintage. Front and rear instrument panels have been refurbished with modern flight instruments, along with necessary turbine engine instruments. Two sets of duplicate condition levers and power levers are nestled in control quadrants on the left sidewall, close to the gear and flap controls. Located just a few inches below



The Allison 250 has two more oil injector ports than standard, allowing 30 seconds of inverted flight.



these are aileron, elevator, and rudder trim wheels. The arrangement makes for minimum fuss when changing speeds and configurations, a plus in an airplane expected to fulfill formation, aerobatic, and instrument training roles. The aircraft is unpressurized, but diluter demand oxygen regulators are installed for high-altitude flight.

Under Jud Nogle's watchful eye, I performed the Allison's straightforward starting drill. Battery On, starter On, and monitor N_1 as the engine winds up. At 15 percent N_1, push the condition lever to full forward and watch the Turbine Outlet Temperature (TOT) rise and stabilize, the indication of a successful light-off. Then it's starter Off and generator On.

Taxiing is an easy matter but requires a deft touch on the power controls. The aircraft wants to accelerate even at idle, but an occasional tug of the power lever (throttle for die-hard piston pilots) into the Beta range reverses the propeller just enough to slow things down without resorting to brakes.

The AT–34's impatient behavior on the taxiway forewarns of its takeoff and flight performance. I had barely set takeoff power before the airspeed reached the rotation speed of 60 knots. On the humid, 85-degree-Fahrenheit afternoon when we flew the airplane, the rate of climb settled on 2,800 feet per minute as we left the pattern at 80 knots, weighing about 2,700 pounds—700 pounds below the AT–34's 3,400-pound maximum. I was told to plan on applying serious amounts of right rudder in the climb, and the torque from the big three-blade prop didn't disappoint. With the nose lowered to maintain a 120-knot cruise climb, the VSI still showed better than 1,500 fpm as we quickly neared 10,000 feet for some air work.

Power is usually torque-limited for takeoff, but on very hot days the 810-degree-Celsius TOT takeoff limit may be reached first. There are no automatic torque or temperature limiters on the Allison, so it's up to the pilot to be sure neither limit is exceeded. (The torque gauge indicates horsepower directly, with 100 percent meaning that the engine is producing its full 450 shp. At higher altitudes, where TOT temperature is the principal limiting factor, available horsepower begins to drop off.)

Once level, a fuel flow of 29 gallons (194 pounds) per hour delivered 170 knots indicated. Pitch trim proved extremely sensitive. Just thinking about moving the trim wheel seemed to affect the airplane. The fighter-type cockpit and first-class visibility naturally inspired yanking and banking, so steep turns seemed a good place to start. Well-balanced stick forces made the 80-degree banked turns an exercise in pure fun. A few aileron rolls further showed off the airplane's ease of handling—and my own aerobatic rustiness. On a later flight with Allison pilot Jim Jackson, during his far more polished set of maneuvers, I would see what a good aerobatic trainer the Turbine Mentor really is.

With no autopilot and limited baggage capacity, the AT–34 is not everyone's idea of the perfect cross-country airplane. What it lacks in these departments, however, it makes up for in speed and endurance. At flight level 180, a fuel flow of 21.5 gallons (144 pounds) per hour nets a true airspeed of 200 knots, allowing for four-and-a-half hours' cruise with IFR reserves. At non-oxygen altitudes, endurance drops noticeably. To get the same 200 KTAS at 8,500 feet, expect to burn about 29.5 gallons (198 pounds) per hour, which yields three hours' cruise with IFR reserves.

Neither slow flight nor a stall series held any unpleasant surprises. Power-off stalls proved gentle, with recovery

PILATUS PC-7

THE OFF-THE-SHELF MILITARY TRAINER ALTERNATIVE

The world has changed a lot since the introduction of Beech's turbine-powered T-34C Mentor and Cessna's T-37 jet trainers. Consider for a moment the demands faced by their eventual replacement. It must perform in a jet-like fashion, to facilitate a student's probable move to a front-line fighter or jet transport. Yet it should offer lessons to the pilot whose entire career may be spent flying prop-driven aircraft. It should be a good instrument platform, at the same time possessing superb visibility and nimbleness for formation, aerobatic, and basic air combat maneuver training. An upgradeable, modern avionics suite goes without saying. To support a variety of mission scenarios, it should have underwing hardpoints to carry external fuel tanks and weapons systems. It should be equipped with ejection seats, in recognition of the sometimes aggressive nature of its flying. It should be easy to fly, yet difficult to fly well. Not least of all, it must be economical, reliable, and quiet.

A tall order, perhaps, but one which any manufacturer worth its salt had better be prepared to fulfill. As the aerospace industry holds its collective breath in the long-running JPATS (Joint Primary Aircraft Training System) competition, it's worth remembering that Pilatus Aircraft Ltd. already has a proven family of such aircraft flying—the PC-7 and PC-9 turboprops. Both are currently in use by various air forces worldwide. When Raytheon Aircraft's MkII initially got the JPATS nod from the Pentagon in June, it was really a vote of confidence in the PC-9. Much of the MkII's design is derived from that aircraft. If the Raytheon award survives the contract review forced by several losing manufacturers, Pilatus, the world's largest manufacturer of single-engine turboprops, will receive royalties from Raytheon during the life of the contract. In the minus column, the MkII finds itself competing against the PC-7 and PC-9 for those same foreign military sales marketplaces. (A large part of Raytheon's MkII output, in fact, is expected to flow to foreign air forces, some of whose training fleets make this country's T-37 and T-34C trainers look positively leading edge.)

Of the PC-7/PC-9/MkII design family, only the PC-7 is available in the civilian marketplace. Most of the several hundred copies sold since 1978 have been military orders, but a handful of well-heeled individuals in the United States and elsewhere have anted up the $1.5 million admission price (at current exchange rates) to get their hands on one.

The standard PC-7 comes equipped with a 650-shp Pratt & Whitney PT6A-25A engine flat-rated to 550 shp, with a recommended TBO of 3,000 hours. It boasts a sea-level initial rate of climb of 2,150 fpm at its Aerobatic category maximum takeoff weight of 4,189 pounds. At its heavier Utility category maximum takeoff weight of 5,952 pounds, it will still climb at better than 1,200 fpm. Maximum operating speed/Mach (V_{MO}/M_{MO}) is 270 knots, or 0.55 Mach. It has less performance than its brawnier big brother, the PC-9, which is powered by a Pratt & Whitney PT6A-62 engine flat-rated to 950 shp—or its take-charge first cousin, the Raytheon MkII, with its 1,150 shp Pratt & Whitney PT6A-68 series engine. The PC-9 will climb at 4,090 fpm and hit top speeds of 320 KIAS, or Mach 0.68—most definitely jet-like. Nonetheless, the PC-7 possesses the kind of high-performance characteristics that place it squarely in this elite class of aircraft.

Recently we flew N7TP, owned by Charles Nogle of Champaign, Illinois. Nogle's PC-7, upgraded with a larger Pratt & Whitney PT6-25C engine proinstantaneous following a slight push on the stick. The wing dips to the left during power-on stalls and is recovered easily with aileron. Bonanza pilots will no doubt feel right at home after a short time aloft in the Turbine Mentor.

On the way back for some pattern work, Nogle suggested that I lower the gear and flaps and try a high-performance descent at flight idle, something that obviously shouldn't be done in a piston-powered airplane. With airspeed held below the 109 KIAS gear and flap extended limit, our descent rate increased to more than 4,000 fpm.

My first approach was a little faster

Charles Nogle's Pilatus PC-7 rides behind a Pratt & Whitney PT6A-25C producing 750 shaft horsepower.

ducing 750 shp, performs considerably better than the standard airplane. Operating in the Aerobatic category, we saw initial climb rates of better than 3,300 fpm, placing the airplane about midway in climb performance between the stock PC-7 and PC-9 models. The bigger engine doesn't increase speed—the airplane is still limited by a redline of 270 knots. But the extra punch highlights the quantum leap in raw performance between this modern class of turboprop and the aging Mentor fleet. The performance also holds up pretty well when measured against old-generation pure-jet trainers like the Cessna T-37, something that hasn't gone unnoticed by government bean counters around the world.

A tour of N7TP's cockpit reveals the kinds of updated amenities not found in the Mentor. There is, for instance, a modern master caution annunciator panel that tracks the health of important systems and a glareshield-mounted angle-of-attack indicator to guide aviators in flying proper approach attitudes. An air-conditioning system is no doubt much appreciated by students and instructors alike during summertime sessions. The PC-7's pneumatically sealed canopy prevents engine exhaust fumes from leaking into the cockpit, a perennial problem in the T-34C during ground operations. Although N7TP does not have ejection seats—they are an option—the airplane can easily handle the extra weight. Well-organized system controls and niceties like electric trim and electric canopy retraction lend the cockpit an overall contemporary look and feel that the Mentor does not have.

Compared to the Mentor, the PC-7 is considerably beefier. The PC-7 bulks out at 5,952 pounds, more than double the heft of the original piston-powered T-34 and almost a ton heavier than the turbine-powered T-34C. The PC-7's high wing loading of 33.3 pounds per square foot helps give it snappier control characteristics, more fighter-like than Bonanza-like.

If choice is the consumer trend of the 1990s, the PC-7 allows for a great deal of it. The South African Air Force recently ordered 60 PC-7 MkII Astras, a variant being delivered with a custom-designed glass cockpit avionics suite. G loading has been increased from the standard aerobatic category +6/-3 to +7.8/-3.5 and the engine upgraded to the 750-shp Pratt & Whitney PT6A-25C. The Astras will replace the SAAF's fleet of 1940s-vintage North American T-6G Harvards.

While the outcome of JPATS remains in question in the United States, it's easy to see what a whole bunch of other countries (and a few lucky individuals) have already discovered—the PC-7 is a versatile, capable aircraft. It (and its more powerful siblings) stand ready to claim the title of new-age Mentor in the global marketplace. —*VC*

than my 80-knots-over-the-fence goal and resulted in a floater. But by the second attempt I was hitting my aim point on speed. The third one was an ego-boosting squeaker. According to Nogle, the airplane has no bad habits, and I was starting to believe him. I reluctantly made the final full-stop landing—which, with the help of Beta thrust, required no braking to make the first turnoff comfortably.

Too bad the AT–34 hasn't received a warmer welcome. It's a back-to-the-future example of how to breathe new life into an old design. □

AT–34 Turbine Mentor
Price of Allison engine conversion: $400,000
Price as tested: $575,000

Specifications	
Powerplant	Allison 250-B17F turboprop, 495 shp derated to 450 shp
Propeller	Hartzel three-blade, reversible, feathering, 2,030 maximum rpm
Length	27 ft 8 in
Height	10 ft
Wingspan	32 ft 10 in
Wing area	177.6 sq ft
Wing loading	16.8 lbs/sq ft
Power loading	7.6 lb/hp
Empty weight	2,100 lb
Maximum takeoff weight	3,400 lb
Useful load	1,380 lb
Fuel capacity	120 gallons (80 gallons in mains, 40 in removable tip tanks)
Performance	
Aerobatic category G limits	+6/-3
Rate of climb, sea level	2,500 fpm
Takeoff distance (50 ft obstacle)	700 ft
Landing distance (50 ft obstacle)	670 ft
Max cruise @ 10,000 feet	210 KTAS
Service ceiling	25,000 ft
Limiting and Recommended Airspeeds	
V_X (best angle of climb)	70 KIAS
V_Y (best rate of climb)	100 KIAS
V_S (stall in clean configuration)	60 KIAS
V_{SO} (stall in landing configuration)	55 KIAS
V_A (design maneuvering)	148 KIAS
V_{NE} (never exceed)	219 KIAS

All specifications are based on manufacturer's calculations. All performance figures are based on standard day, standard atmosphere, sea level, gross weight conditions unless otherwise noted.