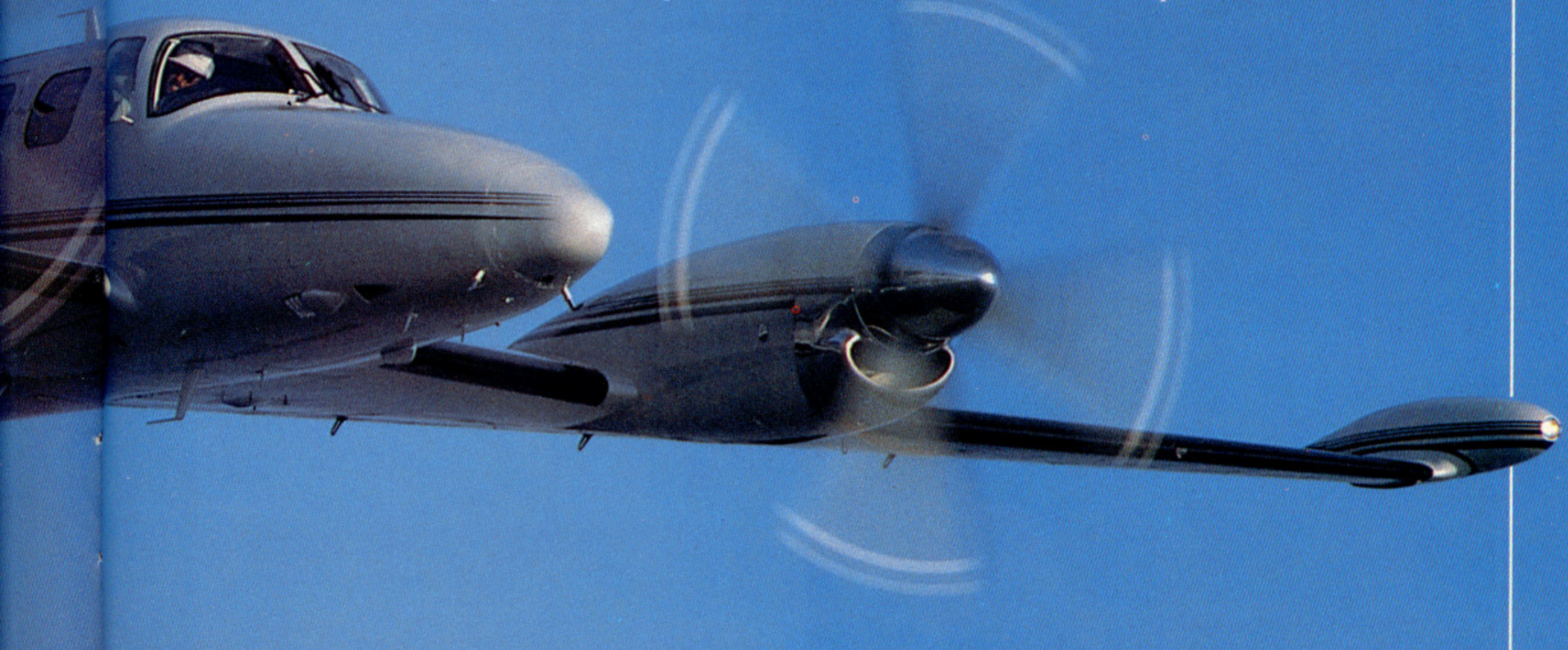
PIPER 400LS

The announcement of Piper's 400-mph jet challenger promised a new turboprop category and renewed competition. There have not been many takers.

BY EDWARD G. TRIPP

THERE are two realities for those who want to develop and those who want to sell turboprop aircraft: The first is that since the advent of air carrier and corporate jets, anything with propellers is considered out of date; the second is that in the general aviation world, Beech has so solidly positioned its King Air family that, in the opinion of many salesmen, it is the automatic choice. Everyone else is just picking at the fringe. Those are two tough cachets to beat, even when you have strong, factual arguments. And it is further proof that there is still a great deal of emotion driving most people's approach to and selection of airplanes.

The general aviation industry was swiftly sliding down the ways to almost complete collapse when Piper announced its decision to buck several tides in September 1982: It was going to build the highest-flying, fastest turboprop in the business. The Cheyenne IV, as it was called then, was to be a six- to seven-passenger rocket that would represent such a performance advance that it would be compared to



PHOTOGRAPHY BY ART DAVIS

the smaller turbofan jets rather than to other turboprops.

Piper had been trying to play catch-up to other turbine aircraft manufacturers for years and was still trying to overcome a reputation for shoddy design and construction. (Later events would further besmirch the reputation of the Cheyenne line of turboprops and put the ethical position of the entire company in question. The Cheyenne line still carries a stigma, but—much to its credit—Lear Siegler, Incorporated, took immediate steps to deal effectively with Piper's corporate policies and reputation when it acquired the airframe manufacturer in early 1984 [see "Pilot News: Company Shuffles Close Out Year," February 1984 *Pilot*, page 15, and "Pilot News: Good News and Bad for Piper in 1984," June 1984 *Pilot*, page 19].) Piper had already showed leadership and faith in the future by announcing several new product developments, including the immediately successful PA-46 Malibu pressurized single, and it had taken many steps to deal with its reputation for poor quality, but the reputation was hard to overcome. On top of that, and despite the rescue by Lear Siegler, many people continue to speculate on the survival of the company as an airframe manufacturer.

The industry took notice of Piper's plans for its flagship turboprop, powered by a combination of a new Garrett engine and advanced technology Dowty Rotol propellers. Several other manufacturers declared their intentions to jump on the 400-mph bandwagon. Gulfstream Aerospace announced the Commander JetProp 1200; Fairchild, the Merlin 400; the LearFan 2100 was in the works along with the Avtek 400, and Mitsubishi was rumored to be studying a competitive variant of the MU-2. Cessna was mum, but Beech was close with the Super King Air 300. At the annual convention of the National Business Aircraft Association in 1983, both Beech and Gates Learjet (the latter in a joint venture with Piaggio of Italy) presented plans for radical-looking, advanced-technology, high-performance turboprops. Piper had made an impression. Several people at the NBAA convention observed that the exotic Rutan-designed Beech Starship claimed the same 400-mph capability that Piper was achieving with very conventional design and materials.

Most of the super business turboprops have been parked. Beech is still hard at work on the Starship, which by this point probably represents a larger investment than any but the largest corporate jets. Gates has withdrawn from the GP-180 project, and Piaggio is developing the aircraft on its own. For now, Piper is the only producer of a turboprop that can compete with the smaller fanjets, such as the Cessna Citation and Beech/Mitsubishi Diamond, although Beech is not far behind with its King Air 300, which, in turn, is closely followed by the Piper Cheyenne IIIA and Cessna 441/Conquest II.

The Piper Cheyenne IV, which has been renamed the 400LS (confusingly, at times, called the Cheyenne 400LS; all other Piper turbines continue to be called Cheyennes), has had the market to itself since it was certified in July 1984. However, despite the competitive performance of the big Piper, particularly over the typical stage length of most business flights, and what should be appealing initial and operating cost advantages, the airplane has not had the success that Piper and Lear Siegler had been counting on. The results cannot be totally blamed on the state of the marketplace. Piper sold 21 400LSs last year. Beech sold 31 Model 200 and 42 Model 300 King Airs; Cessna sold 61 Citation SII turbofans.

The relative success rates indicate that King Air is still the turboprop of choice and that jets have more appeal than propeller-driven airplanes. Confusion about the future of Piper and the negative reputation of the Cheyenne name possibly have had some effect. The latter is not just the result of a couple of accidents and resulting trials and the attendant sensational articles. The airplanes have been considered to be less than

state-of-the-art in terms of systems, and both the cockpits and cabins have been termed small, cramped and dark. The way in which the 400LS has been presented may also have been a factor.

The emphasis has been on high performance. To date, the 400LS has set more than 30 records in both point-to-point speed and time to climb. The bulk of these have been set by retired Air Force Brigadier General Charles E. "Chuck" Yeager (and all but one—Gander, Newfoundland, to Shannon, Ireland, which was flown by Douglas H. Smith and Calvin A. Arter at an average speed of 369.92 mph—have included Renald W. "Dav" Davenport as copilot). Most pilots hold Yeager in awe for his many accomplishments and adventures. They may very well attribute at least some of the performance of the airplane to his exceptional skill. In most corporations, pilots may not make many positive recommendations, but they can effectively make negative ones.

Businessmen, on the other hand, may get the impression that the 400LS is a hot rod that requires a test pilot to tame it, and that riding back in the cabin is akin to riding as a mission specialist in the space shuttle. Given that many businessmen who make their rounds in corporate aircraft are nervous passengers, and given that the basic objectives of corporate flying are to make schedules, not to keep the guys in back waiting no matter how much time pilots must spend cooling their heels, and to give those folks a good, smooth, anxiety-free ride ("Don't make the ice tinkle in the glasses," is one maxim), the rocket-ship image of the airplane may be working against it.

Turboprops do have some advantages over jets, including better balanced field length requirements, which means more runways are available. Propellers provide quicker response and therefore acceleration, and carrying, in effect, your thrust reversers on the front of the engines also results in better landing performance on contaminated runways. One trade-off in addition to lower sex appeal is higher noise and vibration. Piper began design studies on the 400LS in 1979 with the objective of combining aerodynamics, power and propulsion on the 400LS to add near-jet in-flight performance to better fuel specifics and lower perceived noise levels than existing turboprops. The program was announced in September 1982; the prototype made its first flight in February 1983. A second test airplane was added to the program that June, and certification was obtained in July 1984.

The good old-fashioned way to increase performance is to hang a bigger engine on an airplane. This works to a certain extent, but any design exercise is a critical evaluation and series of compromises of many factors. In fact, the biggest improvement gained by power increases on most aircraft is in climb and altitude performance. At higher speeds, such things as increased drag become limiting factors to performance.

The airframe is based on the Cheyenne III; certification was by amendment to the III's approval (model designations are PA-42-720 for the IIIA and PA-42-1000 for the 400LS) under FAR Part 23, although Piper points out that many of the certification and structural criteria were accomplished to FAR Part 25 standards. Icing system certification is under Part 25; the new, dual-bus electrical system is based on Part 25 requirements. The company has been performing continuing fatigue tests, which had reached 75,000 hours last spring, on a complete airframe to substantiate structural integrity.

Skins are thicker to carry the higher pressurization (7.7 pounds per square inch) and to permit flush riveting throughout the airframe. Flush riveting results in smoother airflow and reduced drag. Computer-aided design was employed to optimize the shape of the inboard wing section.

The fuel system is different, in part because of the different configuration of the Pratt and Whitney PT6 and Garrett TPE331 engines that power the IIIA and 400LS, respectively. The IIIA incorporates a bladder fuel cell in each nacelle. Both use tip tanks, but the 400LS carries fuel in wet outer-wing tanks and in bladder fuel cells in the leading edge of the inboard wings; fuel capacity is slightly higher (3,765 pounds versus 3,899 pounds, respectively).

The environmental control system was changed, principally because of the different characteristics of the Garrett

All of the amenities expected in a corporate transport can be specified for the 400LS, from in-flight telephones and entertainment centers to beverage service. Ample baggage space and a cargo door are also available.

PIPER 400LS

The 400LS can fly jet profiles while keeping passengers comfortable.

engines. Low and high pressure bleed air is drawn from different points on the powerplants; the low pressure port supplies sufficient bleed air at lower altitudes (nominally below 19,000 feet). The two sources are blended from there up. The air is conditioned through an environmental control unit. This system requires that an engine be run to provide cabin cooling or heating on the ground.

Most of the other systems of the two models are the same. The hydraulic system and landing gear have been modified to handle the higher weights of the 400LS. Many small refinements have been made, as well. For instance, the main landing gear doors are canted, a modification that aids in gear retraction but also has resulted in decreased drag with the gear extended.

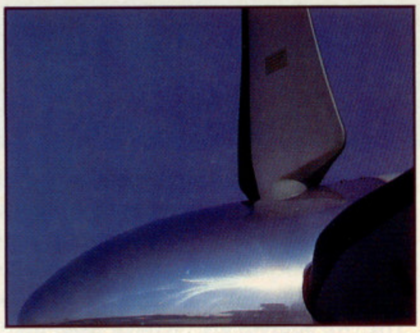
The 400LS is the first design to use the Garrett TPE331-14 engine. It produces 1,645 shaft horsepower (shp) and is flat rated at 1,000 shp in this application, which enables rated power to be pulled up to 20,000 feet in standard atmospheric condition (the gear box is rated at 1,250 shp). In this installation, the engines are counter-rotating: clockwise on the left engine and counter-clockwise on the right. Although designated as a TPE331, the engine is quite different from others in the series. It is a modular design, which permits extensive work, such as hot-section inspection or gearbox overhaul, without removing it from the wing. Maximum propeller rpm is 1,540. Pilots used to other engines in the series will be envious, since the concern with uneven shaft cooling after shutdown does not exist in the Dash 14.

Garrett claims a 10-percent improvement in fuel efficiency over earlier versions and fixed hourly cost for both scheduled and unscheduled maintenance with its Maintenance Service Program (MSP). There are two microprocessor-based Integrated Engine Computers (IEC) on each powerplant that provide torque indication to the cockpit, calculated exhaust gas temperature and torque limits, self-diagnostic capabilities and engine performance data storage for automated trend monitoring. Each powerplant also features a

Many prospects consider the cabin too narrow (right). Piper has contracted with well-known industrial designer Ben Isaacman to make better use of available space. Mock-up is shown above.

Standard interior, shown at left, includes seven chairs, with the forward four in a club arrangement. Seats are comfortable, and noise level is comparably low. Compare aisle width to new design at far left.

PIPER 400LS



negative torque sensing system (NTS) that will move the propeller toward the feathered, or high-pitch, position if a loss of power is sensed.

Engine power is translated into motive power by large, four-blade, advanced-airfoil, composite Dowty Rotol propellers. Many advantages are claimed for the propellers, including lighter weight, corrosion and fatigue resistance, greater damage tolerance and the ability to tailor the activity of each blade along its length and chord to minimize vibration and maximize performance. Each blade consists of carbon fiber spars over a foam core, bonded lightning conductors and a reinforced leading edge to minimize erosion. Deicing is provided by conventional electrically heated elements.

Computer-aided design was also employed in the nacelle design to minimize drag and improve airflow. The straight-through design of the engine results in exhaust being routed out the aft end of the nacelle, over the wing. There is a slight amount of residual thrust. The spinners are an area-rule design that reduces drag at the junctions of the propeller shanks and hubs.

We waited quite awhile to fly the 400LS after its introduction, in part because we wanted the opportunity to fly a variety of missions—short dashes and long-haul—to see how flexible an airplane it is. Since the emphasis was on all-out performance, we also wanted the opportunity to sample flight profiles that considered the passengers in back. We missed several opportunities for long-distance positioning flights because of schedule conflicts and finally settled for a trip to Piper's Vero Beach, Florida, base, where the 400LS and other Cheyenne lines were being relocated after the decision to close the Lakeland, Florida, manufacturing facility.

Over a period of two days, we flew with Douglas H. Smith of Piper, then later flew the same airplane, the 29th 400LS, N41191, for a photographic session out of Frederick, Maryland. The longest trip we flew was just over 300 nautical miles, but in a series of five flights with 10 takeoffs and landings, we sampled cruise altitudes ranging from 12,000 feet to FL410 and made several quick turnarounds that would be typical of many corporate operations. The passenger load varied from none to four, and takeoff weights ranged from 12,000 pounds down to just under 9,500 pounds. We operated from non-controlled airports and TCA-bound high-density ones and flew a variety of precision, non-precision and visual approaches. We also flew some of the maximum-performance profiles that so much has been made of.

One of the real tests of the airplane, which is in the category for which I like to get some good systems and operational training before flying, was that I got into the airplane and started to operate it (under Smith's careful eye and tutelage, of course), and instead of going out to try some of the rudiments—a typical training profile—we flew a mission, including a couple of high-ATC-workload and traffic encounters.

That speaks well for the airplane and its cockpit and systems design. The panel is jet simple, focused on flying, managing power, communicating and navigating. System annunciators are mounted just below the glare shield. There are just two pairs of levers on the quadrant: power levers that also control propeller blade angle in the beta (reverse) and ground idle modes, and combined fuel/propeller or rpm levers. Trim controls are lower on the quadrant, and, in most installations, principal flight control system or autopilot controls and long-range navigation controls are mounted below and behind them. There are two overhead switch panels that contain most of the electrical, engine, ice protection, lighting and avionics controls. These are mostly color-coded push-on/off buttons (green is for go).

There are many procedures and systems checks, of course, and the check list is detailed. There are many systems to learn with respect to normal and emergency operations. Proper training is, as always, essential, but pilots accustomed to turbine airplanes will find the 400LS an easy aircraft to learn.

The airplane has a stick pusher that is activated if speed is reduced to 77 knots (stall speed clean at gross weight is 93 KIAS). One system that I expected to find as a go/no-go item because of the massive tail and power/propeller combination is not: a yaw damper. One was installed and is a useful aid in turbulent air, but it is not required.

The airplane is equipped with a three-tube Collins electronic flight instrument system (EFIS) and the Collins digital APS-65 flight control that includes airspeed and vertical speed hold modes and half-bank and soft-ride modes to add to passenger comfort at high altitudes and in rough air. Collins Pro Line II avionics constitute one of the two standard packages (the other is a Bendix/King package). Bendix/King EFIS is another option. King's digital KFC 400 flight control system has just been certificated in the 400LS, so customers now have a choice of either the Collins or King digital system as part of the basic equipped price of the airplane. Radar and known-icing equipment are also included.

Interior cabin space is a frequent criticism of the Cheyenne series, and Piper has contracted with Isaacman Associates to redesign the interior for greater actual and apparent space. A mock-up is shown on page 43; Piper hopes to display the finished product this month.

Operation on the ground and in flight is crisp, effective and without tricks or traps. Control pressures are fairly heavy, as they should be for an aircraft of this size and weight and considering the range of dense to thin air in which it operates. Handling at altitude, by the way, is solid. The 400LS will go right up to FL410 (ATC willing) and is easy to hand-fly there. Its climb performance, as a matter of fact, is better than several jets, even above 35,000 feet. I stalled it at 41,000 feet, which seems odd at best: I did it as a demonstration of the spread between cruise and stall speeds and as a further sampling of its handling qualities at altitude.

In most flights, I stuck to a maximum deck angle of 10 degrees up and down, using attitudes that would not alarm the average passenger. Even with this temperate profile, performance is competitive with the fanjets. We did not even bother with maximum cruise power, selecting long-range cruise, which produces low cabin noise levels. Passengers remarked that they could easily hear the conversation in the cockpit.

We encountered a good bit of turbulence and some shear during a couple of approaches. The 400LS handled it well, and I found during landings at lighter weights that it has a tendency to float, just like a Cherokee.

Piper has achieved its design goals with the airplane. It is unquestionably the highest-performing turboprop around and can chase the jets while burning 30- to 35-percent less fuel. The greatest shortcoming we saw during our brief time with it is its payload with maximum fuel. As N41191 is equipped, which includes 675 pounds of options, payload is only 363 pounds. However, with maximum payload of 2,048 pounds, 41191 can still fly a trip of more than 1,100 nm with IFR reserves. That makes it very competitive with other turboprop and turbofan aircraft in typical corporate operations.

Piper is far from achieving its marketing goals, however. No turboprop is selling very well these days, and there are a great many bargains to be had. But the 400LS was to establish a new benchmark that would bring both turboprop and jet customers into the new propeller-driven niche that, for the moment, does not seem to exist.

Whether it is a strategic marketing error or the fact that other airplanes are too entrenched, squeezing the 400LS from both sides, or whether it does represent a new part of the market, only time—and a lot of sales calls—will tell. □

Piper PA-42-1000 400LS
Base price $2,731,250
Price as tested $2,681,605
AOPA Pilot Operations/Equipment Category:*
All-weather $2,731,250 to $2,975,000 (est.)

Specifications

Powerplants	2 Garrett TPE331-14 single fixed-shaft 1,000 shp each (flat-rated)
Recommended TBO	3,000 hr
Propellers	2 Dowty Rotol four-blade full-feathering, reversible 106-in diameter
Length	43 ft 5 in
Height	17 ft
Wingspan	47 ft 8 in
Wing area	293 sq ft
Wing loading	41.12 lb/sq ft
Power loading	6.03 lb/hp
Seats	8-9
Cabin length	18 ft 2 in
Cabin width	4 ft 3 in
Cabin height	4 ft 8 in
Max ramp weight	12,135 lb
Max takeoff weight	12,050 lb
Max landing weight	11,100 lb
Max zero fuel weight	10,000 lb
Std empty weight	7,277lb
Empty weight, as tested	7,952 lb
Max useful load	4,858 lb
Useful load, as tested	4,183 lb
Max payload w/full fuel	1,038 lb
Payload w/full fuel, as tested	363 lb
Fuel capacity, std	3,900 lb (3,820 lb usable) 582 gal (570 gal usable)
Oil capacity	11 qt, left engine 12 qt, right engine
Baggage capacity	forward: 300 lb, 17 cu ft aft: 300 lb, 31 cu ft

Performance

Takeoff distance, ground roll	1,500 ft
Takeoff distance over 50-ft obst	2,150 ft
Accelerate/stop distance	3,260 ft
Max demonstrated crosswind component	18 kt
Rate of climb, sea level	3,250 fpm
Single-engine ROC, sea level	1,000 fpm
Cruise speed/endurance w/45-min rsv (total fuel consumption)	
@ max cruise, 24,000 ft, 11,000 lb	349 KTAS/ 3.5 hr (939 pph/140 gph)
@ long-range cruise, 41,000 ft	297 KTAS/7.5 hr (448 pph/67 gph)
Max operating altitude	41,000 ft
Single-engine service ceiling	28,000 ft
Landing distance over 50-ft obst	2,310 ft
Landing distance, ground roll	1,100 ft

Limiting and Recommended Airspeeds

Vmca (min control w/one engine inop)	99 KIAS
Vx (best angle of climb)	115 KIAS
Vy (best rate of climb)	138 KIAS
Vyse (best single-engine rate of climb)	125 KIAS
Va (design maneuvering)	187 KIAS
Vfe (max flap extended)	
10°	194 KIAS
30°	167 KIAS
Vle (max gear extended)	170 KIAS
Vlo (max gear operating)	
extension	170 KIAS
retraction	170 KIAS
Vmo (max operating)	
to 27,100 ft	244 KIAS
at 41,000 ft	177 KIAS
Vr (rotation)	105 KIAS
Vs1 (stall, clean)	93 KIAS
Vso (stall in landing config)	84 KIAS

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

**Operations/Equipment Categories are defined in June Pilot, p. 103. The prices reflect the costs for equipment recommended to operate in the listed categories.*