MOVING ON UP

TURBO SEMINOLE

The Seminole makes the big time—with turbo power, weather radar, hot props and oxygen.

BY THOMAS A. HORNE

It is tough being the manufacturer of a light twin these days. You have to create an airplane with manners suited to the multi-engine training environment and, at the same time, give it as much operational flexibility as possible, given the competition from many of the lower-priced, sophisticated singles. Consumers are demanding more than ever from a light twin, and a "multi-trainer" just will not survive by fulfilling that role alone.

Bearing this in mind, Piper has added turbocharging, and weather-radar, propeller-deicing and oxygen-system options to its basic Seminole. The result is the latest addition to the Piper twin-engine line, the Turbo Seminole.

It is not that the Seminole was a bad idea—it continues to serve very well as an economical training airplane with acceptable performance in the lower altitudes; and production of the basic Seminole will continue. But the Turbo Seminole's features make it attractive to those who want a more practical, economical and safer light twin that is more capable of dealing with the instrument flying conditions that one encounters in the real world of year-round flying.

The Turbo Seminole has Garrett fixed-wastegate turbochargers installed on the same 180-hp Lycoming O-360 engines that are used in the regular Seminole. To reduce maintenance costs and simplify the design, the airplane also has retained the Seminole's carburetors. This combination of turbocharging and a carbureted induction system is unusual, but can have operational advantages. The heat from the recirculated exhaust gases gives the carburetors protection against icing, in all but the lowest power settings, and guarantees adequate vaporization under all conditions.

The turbochargers enable the airplane to continue climbing at 1,000 fpm or better up through 11,000 feet under gross weight and standard atmospheric conditions; and they give the Turbo Seminole a service ceiling of 20,000 feet, compared to 17,100 for the Seminole. The normally aspirated Seminole under the same conditions will climb at only 500 fpm at 11,000; climbing any higher would be a time- and fuel-consuming project.

There are three important safety advantages gained by turbocharging the Seminole (well, maybe two and a half). The biggest advantage is the substantial increase in the single-engine service ceiling. It is now 12,500 feet, way up from the basic Seminole's 4,100 feet; and it is double that of the nearest current production competition, the nor-

PHOTOGRAPHY BY ART DAVIS

mally aspirated Beechcraft Duchess, which has a 6,170-foot single-engine service ceiling.

Because the turbochargers compress the engine exhaust and then reroute it to the intake manifold, the engines can continue to put out their fully rated 180 hp up to density altitudes of 12,000 feet. This is another advantage the Turbo Seminole has over all the other "light-light" twins on the market today. Under adverse density-altitude situations, the airplane is capable of climbing out after takeoff as though it were at a lower altitude. The turbo system's ability to make intake air denser than it ordinarily would be under ambient conditions fools the engines into thinking they are operating at a lower altitude. This feature also lowers the takeoff ground roll and the takeoff distance to 50 feet under nonstandard conditions, compared to the normally aspirated Seminole and Duchess.

Assuming that you were at gross weight and lost an engine after leveling off at 10,000 feet on an ISA (international standard atmosphere)-plus-10° day (a likely condition for a summer day), you still could eke a 130-fpm climb out of the Turbo Seminole. With partial fuel or passenger loadings, this figure can reach a heartening 200 fpm, even at 12,000 feet. An en route engine failure should present less concern for Turbo Seminole pilots who plan to fly regularly in mountainous areas.

If you compared the single-engine-climb performance figures of the Seminole and the Turbo Seminole, you perhaps would be taken aback. At sea level and gross weight, the Seminole can climb at 217 fpm; the Turbo Seminole can manage only 180 fpm. And the Duchess is capable of 235 fpm. This may look bad at first, but remember that these figures are for sea level. The Turbo Seminole's lower figure is due to its higher gross weight (3,925 pounds, as opposed to the Seminole's 3,800 pounds); but turbocharging permits a single-engine climb—however marginal—at density altitudes that the normally aspirated Seminole and Duchess could not handle after losing an engine on takeoff. At a 6,000-foot density altitude, a gross-weight Turbo Seminole precisely held at the 88-knot best-single-engine-rate-of-climb speed can climb at 140 fpm. While that certainly is not much, it beats the regular Seminole's 20-fpm *descent* rate for those same conditions. At least you would stand a chance of gaining enough altitude to effect a return to the airport, particularly if the airplane were not loaded fully.

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The basic Arrow cabin reaches new heights: a 183-knot cruise speed at 20,000 feet.

There is another nice side benefit of the turbocharging: reduced noise levels. The exhaust goes by the turbochargers before it is sent overboard, so exhaust noise is lessened. Changes to the propeller governor give the Turbo Seminole a lower, 2,575-rpm maximum takeoff setting, and this also helps keep the noise down. For an extra $255, optional soundproofing can be ordered to lower the cabin sound level further.

As for the radar and the propeller deicing options, they were not available on the first four Turbo Seminoles, built before October 1. After that time the single opening at the tip of the nose, which used to serve as a combination landing-light fixture and air inlet for the heater, was eliminated so that radar equipment could be installed in the nose compartment. Without the landing light in the way, the radar an-

tennas have an unobstructed "view" of the weather ahead. The post-October Turbo Seminoles have two landing lights mounted on the underside of the nose section, and inlet air comes from a NASA-type flush air scoop on the left side of the nose. The only other things that distinguish a Turbo Seminole from the standard model are the louvers on top of the engine nacelles and single, rather than double, exhaust pipes. And, of course, the new paint schemes.

The nose compartment can accommodate either an RCA Weather Scout II or a Bendix RDR-160 color or monochromatic radar unit, although it will be interesting to see how the display will be sandwiched into the already-crowded panel.

Hot props are just the first step in a sequence of events that Piper hopes will lead the Turbo Seminole to eventual certification for flight into known-icing conditions. Right now the stumbling block is the design of leading-edge deice boots that will conform to the airplane's double-tapered wings. The bend in the wing just outboard of the nacelles is particularly troublesome to deice effectively. B.F. Goodrich is working on the problem, but Piper is reluctant to say just when it anticipates that the Turbo Seminole will get its icing certification—maybe in 1982, the rumors go. When this happens, though, the Saratoga will benefit as well, since the two airplanes share the same wing design.

If you ever have flown a Seminole, you hardly would know you were in a different airplane—except for a few operational differences and some of the V-speeds, which have increased by only a couple of knots, due to the Turbo model's higher gross weight.

The Turbo Seminole is just as much a pleasure to fly as the regular Seminole. Frise-type ailerons give it a crisp control response and a roll rate that encourages playfulness.

Preflight still is ultra-simple, with those ingenious fuel-sump drain points on the side of the fuselage just aft of the right wing's trailing edge. Checking the fuel can be done with dignity—no groveling under the wings, as with other light twins. Engine oil and fuel can be checked at the same stop, since the fuel tanks are located in the nacelles just aft of the engines.

The airplane comes with a graduated fuel-quantity checker, which you insert into the tank to determine partial loadings. You put your finger over the top of this tube-like device when it is in the tank, withdraw it and then read off the fuel level. Yes, it is crude, but it works.

To prime the engines, there are buttons on the side panel that you depress to inject fuel into the cylinders. The normal starting procedure goes like this: mixtures rich, props forward and throttles forward one-quarter inch. Turn on the master, the boost pumps and the magnetos. Then, while engaging the starter, push the Prime button for no more than two seconds. The boost pumps must be on for this new priming system to work.

For its Vmc (minimum control speed with engine inoperative) of 57 knots, the rotation speed (Vr) of 75 knots seems high. But, being a T-tail, the Turbo Seminole produces little propeller blast against the stabilator, and 75 knots guarantees enough airflow to make this an effective control surface.

The takeoff power setting is 36.5 inches of manifold pressure and 2,575 rpm. Setting the power is critical in a turbocharged airplane, as it is possible to overboost, or exceed the engine's tolerances to withstand high compression values, through sudden application of full throttle. To help protect against this, there are two overboost warning lights added to the row of emergency annunciator lights just under the glareshield in front of the pilot. At 36.1 inches mp those lights illuminate. If they are ignored and the pilot continues to stiff-arm the throttles, an overboost relief valve "pops off," automatically reducing the manifold pressure by five inches or so and causing a corresponding drop in available power.

It always is a good idea to stand on the brakes and get the rpms up to around 2,000 just to double-check before starting the takeoff roll. This also stabilizes the turbochargers' output and gives you the chance to check for any unwanted surging. Check the directional gyro setting, the oil and fuel pressures, the vacuum and alternators, then the mani—oh, no. They have gone and put the manifold pressure gauge right smack behind the pilot's control yoke.

Some pilots criticize the old Seminole panel's layout because the manifold pressure gauge is off to the right of the power quadrant, and the tachometers (there are two) are to the left—the reverse of their controls' respective positions on the quadrant. They have their order correct now, and a dual-pointer tachometer is now standard; but on the human factors scale, I would give this new arrangement about a two. No, higher. Maybe a seven, but only

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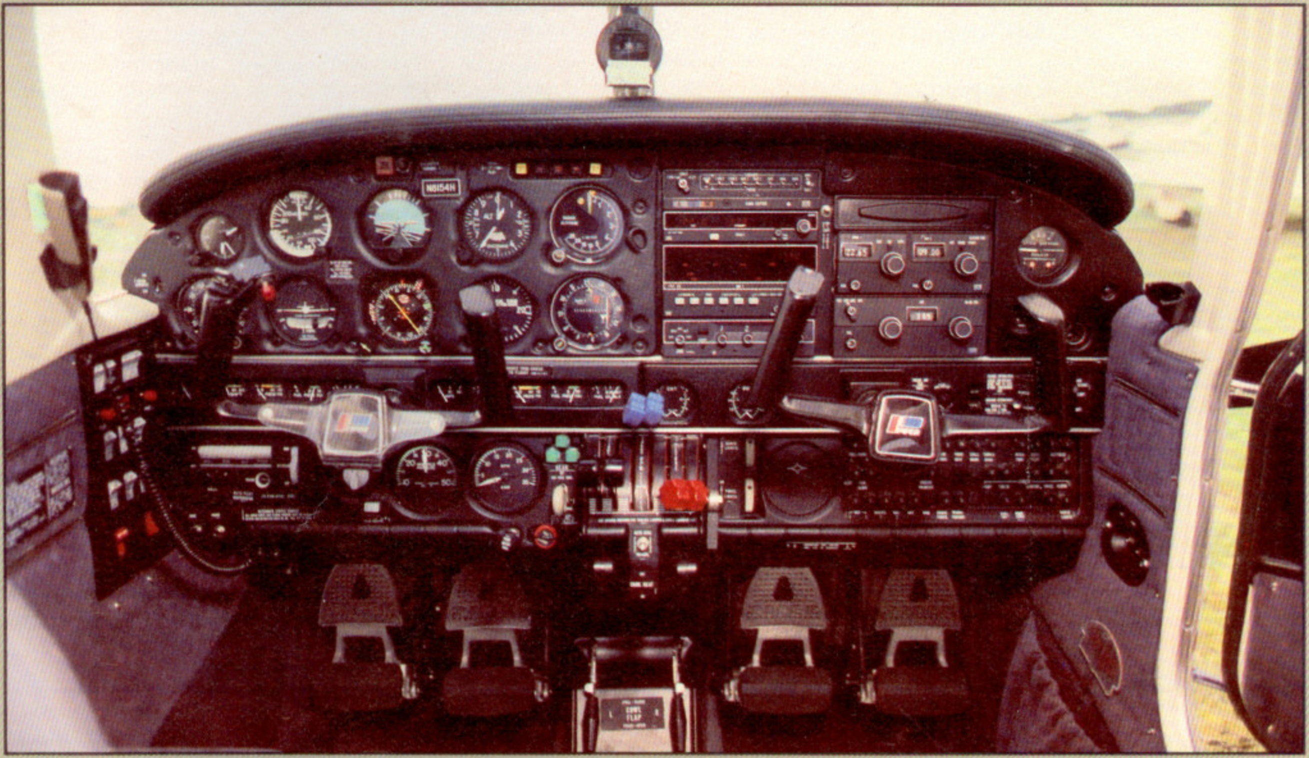
Expect a 'big-airplane' feel at liftoff and again at the flare; short-field performance is the best of today's light twins.

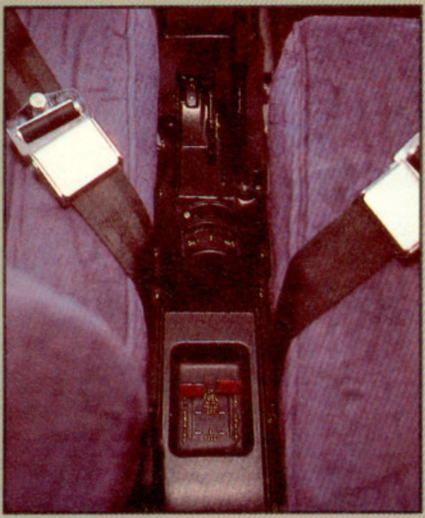


because it makes you more aware of the instrument, causing you to check it more often during the runup and the takeoff roll. But still, it is *hard* to check, requiring a lot of head-cocking at a critical time.

So down the runway you go, waiting for your Vr of 75 and tilting your head over so you can monitor the manifold-pressure situation. Acceleration is fast—65, 70, 75 and ease back on the yoke. Hmmm, nothing happens. Easing back just does not do the job. You really have to pull. Pull you do, and the transition to flight is abrupt. In all Seminoles, rotation and liftoff come at the same time, and they seem to jump right off the ground, that is, on the second pull. The aerodynamic idiosyncrasies of the T-tail configuration cause the need for all that back pressure at liftoff, but I don't mind. There is a safety factor in it.

By the time you realize that you have to pull harder, you have gained all that much more momentum and airspeed. Once off the ground, you certainly have accelerated on past the Vsse (minimum intentional one-engine inoperative speed) of 82 knots and are well on your way to the 88-knot blueline (best single-engine rate-of-climb) airspeed. From liftoff to blueline should take about three seconds, based on retracting landing gear immediately after liftoff. It takes approximately six seconds for the gear to retract.

The critical airspeeds are easy to remember because Vsse (82 knots) is the same as Vx (best angle of climb) and Vxse (best single-engine angle of climb); and the Vyse (best single-engine rate of climb) of 88 knots is the same as Vy (best rate of climb). Thanks to the same large rudder that the Turbo Seminole shares with its predecessor, it too has a Vmc below its stall speed in the landing configuration. But there has been one small change here. Vmc has gone up from the earlier Seminole's 56 knots to a new figure of 57 knots.



A climb to 10,000 feet took about nine minutes on a hot (90°F at the surface) summer day. At 10,000, the outside air temperature was 6°C, or about ISA-plus-12°. Our true airspeed came out to 170 knots at 75 percent power with the mixture 100° rich of peak exhaust gas temperature. That amounts to 195 mph, not bad for the book fuel-consumption rate of 24.2 gph. Leaning to peak egt results in a four-knot decrease in true airspeed at this power setting, but produces a 3.4-gph fuel savings. Leaning is simplified in the Turbo Seminole because of a new, dual-pointer egt gauge, a standard item.

The 75-percent-cruise true airspeed figures rise until, at 20,000 feet, the Turbo Seminole reaches a maximum true airspeed of 183 knots. The regular Seminole maximizes its speed down lower, where, at 7,500 feet, it develops a maximum cruise of 168 knots.

You can order oxygen for the airplane in one of two ways. You can, for $2,060, have a built-in, 48.3-cubic-foot oxygen bottle installed aft of the baggage compartment. Or you can order a smaller, portable unit that fits between the front seats for a little less than half the price of the built-in system. The built-in system will provide four persons with 2.8 hours of oxygen at a 15,000-foot cruising altitude.

Landing the airplane is straightforward, with a pattern entry speed of 100 knots and minimal pitch-trim requirements with gear and flap extension. The normal airspeed for final approach is 90 knots; but lightly loaded the Turbo Seminole can be flown on final at 80 knots, giving a somewhat steeper approach profile and a much shorter landing roll.

With its optional, heavy-duty brakes, the Turbo Seminole's already good short-field characteristics get even better. Over a 50-foot obstacle, landing distance can be reduced 15 percent below what it would be with standard brakes, and the normal, non-obstruction landing ground roll goes down by 35 percent. Even without the heavy-duty brakes, you can expect landing rolls of 600 feet or less, unless you happen to use airports with high elevations. Needless to say, making these kinds of short-field, panic-stop landings a regular practice will shorten the lives of the tires and the brake pads, so there is not much sense in doing them often. But it is nice to know that this kind of capability is there, should you ever really need it. And besides, they are fun to practice now and then, if you don't mind hearing your tires "give rubber."

All Seminoles have good short-field performance, but you will not be able to realize it unless you start flaring sooner than you might in other light twins. If you hold 90 for too long on your way down final, you will find yourself floating on past a lot of runway. A good target speed for short final is 80 knots. Then begin bleeding off more airspeed as the runway nears in preparation for the landing flare.

Landing the Turbo Seminole gives you another chance to experience the nosewheel's affinity for the runway. Unless you roll the pitch trim all the way back, provide generous back pressure at touchdown and keep a small amount of power in as you land, the nosewheel will drop to the tarmac immediately after the mains are on.

I recently flew a normally aspirated Seminole on a 270-nm cross country and later thought of how the flight might have been different, had I been in the Turbo model.

On board were myself (180 pounds) and three passengers—one 200 pounder and two women at about 120 pounds each, 50 pounds of baggage and full fuel. This was to be the kind of a mission for which the manufacturer would say the airplane was well suited; and I guess that is right, but it is pushing it a bit. As a four-place-plus-full-fuel airplane, the normally aspirated Seminole is not practical.

The center of gravity that day was right in the middle of the envelope, but we were about 20 pounds over gross. We waited 10 minutes with the engines turning at 1,000 to 1,200 rpm with an occasional shot of power up to 1,500 rpm, and I figured that we must have burned off the excess weight in fuel in the process. If we were being wasteful, at least it was in the name of safety.

The Turbo Seminole's extra 125 pounds of maximum gross takeoff weight certainly would have been welcome at a time like this. It provides just the right amount of extra weight allowance to permit a fuller utilization of the airplane's load-bearing potential. There would have been a landing weight restriction. Those extra 125 pounds would have to have been burned off in fuel before we would have reached the Turbo Seminole's 3,800-pound maximum landing weight.

When we took off from the Frederick, Maryland, airport (elevation 304 feet) temperature was 77°F, and there was a five mph headwind component down the runway. Our accelerate/stop distance in the Seminole would be 2,080 feet; because of the Turbo Seminole's extra weight, this figure would have been higher—2,600 feet. continued overleaf

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Frise ailerons give the Turbo Seminole light control forces and a lively roll rate.

Turbocharging would have made a marked difference, however, in the takeoff distance to a 50-foot altitude. The Turbo Seminole would have attained 50 feet of altitude after traveling 1,890 feet horizontally. As it was, computations showed that 2,800 feet would be required for the normally aspirated Seminole to achieve the same altitude. Unfortunately, the pilot's operating handbooks for both the Seminole and the Turbo Seminole do not give figures for accelerate/go.

What if an engine had failed on takeoff? The numbers are meager, but the spread would have been close. It would have been a single-engine climb rate of 150 fpm that day for our Seminole, 165 fpm for the Turbo. Pre-takeoff computations for the return leg, though, better illustrated the "sort-of" difference that turbocharging would have made in a takeoff-engine-failure situation. At Willimantic's (Connecticut) Windham Field (elevation 244 feet) the temperature had reached 90°F, with light and variable winds. The Turbo Seminole still would have been able to climb on one engine at 165 fpm; the normally aspirated Seminole—110 fpm. It would have been a pretty sick climb in both airplanes; but if the failure took place above treetop height, we would have stood a better chance of a safe return to the airport in the Turbo.

The en route phase really would have given us a chance to use turbocharging as it is meant to be used. We were cleared to 7,000 feet, where the winds were 270 at 20 knots. A nice tailwind. But at 12,000 they were blowing at 40 knots and even stronger above that. On the eastbound leg it would have been easier—and much faster—to cruise at a higher altitude to take advantage of these winds. Had weather been a factor, we probably could have climbed above all but the most threatening cloud layers.

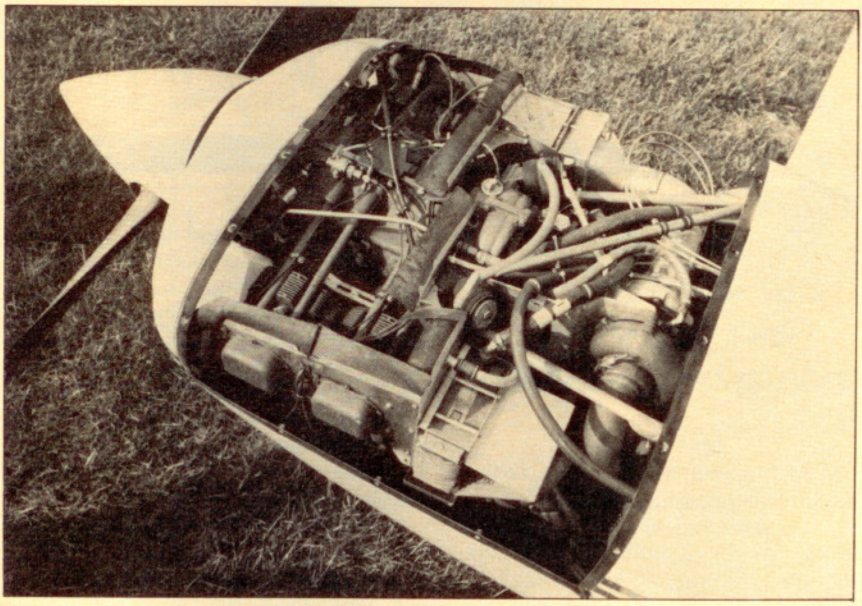
On the return trip, though, flying lower, say at 4,500 feet, would have made sense, Turbo or not, to minimize the adverse effects of a headwind. Some curious facts emerge when you run the figures for a lower altitude cruise for the two airplanes. At 4,500 feet with 65-percent power and mixture leaned to peak egt, the Seminole that day would have burned a published 22 gph and yielded a true airspeed of 147 knots. The Turbo Seminole will go only one knot faster at this altitude and power setting, but burns 28 gph to do it. And this is at an "economy" power setting. To make cost- and speed-effective use of any turbocharged airplane, you should fly as often as you can as high as you can.

Turbocharging, radar and deicing on a light-light twin that operates well in short-field situations is an unusual combination of attributes. But it is a combination that only can increase the utility of the basic Seminole design. Decked out with other options, such as three-blade propellers, a propeller synchrophaser, three-axis auto-pilot, area navigation and a radar altimeter, you would have what many would say is the ultimate, current production light twin. If and when icing certification comes, the Turbo Seminole will have everything it needs to operate regularly in hard instrument conditions.

Piper's logic behind this design is based on the assumption that twin-engine business flying with average passenger loads of only two or three will not justify the continued use of a six- or seven-place airplane. The Turbo Seminole has been priced competitively, also. Its base price is $5,500 less than that of the normally aspirated Beechcraft Duchess.

As a trend in an airplane's design history, there is a certain inevitability about turbocharging. Typically, a new airplane is brought onto the market, and within a year or two the engine displacement is increased and/or turbochargers are added. This either can be a significant step in expanding the capability of the airplane or a signal of the beginning of the end of its production life. Manufacturers sometimes will offer turbocharging and other snazzy options in an attempt to do something—anything—to increase the appeal of an airplane with lagging sales.

By this time next year, we will have the benefit of perfect hindsight to help us assess the flying public's reception of the Turbo Seminole idea. Right now it looks like a logical next step in what may be the development of a new role for light-light twins as more popular business airplanes. The Turbo Seminole offers the performance, features and flexibility that make it an acceptable compromise for those who are accustomed to slightly more powerful airplanes. And those moving up to the Turbo Seminole from a multi-engine trainer will welcome the newly found freedom to explore a wider range of altitudes and weather conditions. □



You rarely get something for nothing, and turbocharging is no exception. Look at all that hose and ducting! TBO for the Lycoming TO-360 is 1,800 hours—200 hours less than the normally-aspirated Seminole, mainly because of higher operating temperatures associated with turbocharging. The airplane pictured in this article is one of the first Turbo Seminoles and does not have the new landing lights.

PIPER TURBO SEMINOLE PA-44-180T

Basic price $101,500

Price as tested $144,676

Specifications

Engines	2 counterrotating Lycoming TO-360-E1A6D 180 hp @ 2,575 rpm
Recommended TBO	1,800 hr
Propellers	2 two-bladed Hartzell, 73-in constant speed, hydraulically actuated, full-feathering (3 blades optional)
Wingspan	38 ft 6 in
Length	27 ft 6 in
Height	8 ft 6 in
Wing area	180 sq ft
Wing loading	21.80 lb/sq ft
Power loading	10.90 lb/hp
Passengers and crew	4
Cabin length	8 ft 6 in
Cabin width	3 ft 5.5 in
Cabin height	49 in
Empty weight (basic aircraft)	2,435 lb
Equipped empty weight	2,685 lb
Useful load (basic aircraft)	1,490 lb
Useful load (as tested)	1,240 lb
Payload with full fuel (basic aircraft)	842 lb
Payload with full fuel (as tested)	592 lb
Zero fuel weight	3,800 lb
Ramp weight	3,943 lb
Maximum gross takeoff weight	3,925 lb
Maximum gross landing weight	3,800 lb
Fuel capacity	110 gal (108 usable)
Oil capacity (ea engine)	6 qt
Baggage capacity	200 lb (26 cu ft)

Performance

Takeoff distance (ground roll)	1,300 ft	
Takeoff over 50 ft	2,300 ft	
Rate of climb (gross weight)	1,290 fpm	
Single-engine rate of climb (gross weight)	180 fpm	
Maximum level speed (16,000 ft pressure altitude)	195 kt	
Cruise speed (75% power, 20,000 ft)		
100° rich of peak egt	183 kt	24.2 gph
Peak egt	180 kt	20.8 gph
Cruise speed (65% power, 12,000 ft)		
100° rich of peak egt	160 kt	22 gph
Peak egt	157 kt	19 gph
Cruise speed (55% power, 6,000 ft)		
100° rich of peak egt	142 kt	19.6 gph
Peak egt	138 kt	16.8 gph
Range 75% cruise (w/45-min res @ 55% & peak egt) 20,000 ft		
100° rich of peak egt	705 nm	
Peak egt	785 nm	
Range 65% cruise (w/45-min res @ 55% & peak egt) 12,000 ft		
100° rich of peak egt	680 nm	
Peak egt	765 nm	
Range 55% cruise (w/45-min res @ 55% & peak egt) 6,000 ft		
100° rich of peak egt	665 nm	
Peak egt	765 nm	
Maximum operating altitude	20,000 ft	
Service ceiling	20,000 ft	
Single-engine service ceiling	12,500 ft	
Landing distance (ground roll)		
Standard brakes	590 ft	
Heavy duty brakes	383 ft	
Landing over 50 ft		
Standard brakes	1,400 ft	
Heavy duty brakes	1,190 ft	

Limiting and Recommended Airspeeds

Indicated airspeeds, not calibrated

Vsi (Stall speed with no flaps)	60 kt
Vso (Stall speed with full flaps)	57 kt
Vmc (Minimum control)	57 kt
Vr (Rotation)	75 kt
Vxse (Best single-engine angle of climb)	82 kt
Vyse (Best single-engine rate of climb)	88 kt
Vx (Best angle of climb)	82 kt
Vy (Best rate of climb)	88 kt
Vle (Maximum landing gear extended)	140 kt
Vfe (Maximum flap extended)	111 kt
Vsse (Minimum intentional one-engine inoperative)	82kt
Va (Design maneuvering)	137 kt

Based on manufacturer's figures