THE AEROSTAR APPEAL

They are pilots' airplanes, fast and responsive. But they are not airplanes for every pilot.

Two years ago, Piper Aircraft Corporation decided to suspend production of the Aerostar. It was easy to understand but hard to accept. The market for new general aviation aircraft was already well into its steep decline, and at a base price of a half-million dollars, even the world's fastest piston twin was attracting very few buyers. According to some observers, concerns about product

BY MARK M. LACAGNINA

Superstar 680, a Machen-modified Aerostar 602P

PHOTOGRAPHY BY ART DAVIS

liability also were involved in Piper's decision to stop building new Aerostars.

Although it was clear that Piper considered the Aerostar a losing proposition, there was hope for another revival; the airplane had risen from the ashes before. Machen, Incorporated, which had developed Aerostar conversions, appeared to be a good prospect for acquiring the type certificate and production rights, but the company was discouraged by the price, which included a requirement that Machen obtain a $4-million liability policy each year naming Piper as an insured party.

A production revival now appears unlikely, and those who want to own one must select from the Aerostars that still are flying among the 1,011 built. The Aerostar is highly desirable for its speed, responsiveness and exotic looks, but it is not an airplane for everyone. Safe and efficient operation requires a considerable investment, not only of money but of time and effort to learn and understand the airplane's systems and operating procedures.

Although there are eight different models, none is a radical departure from the design that Theodore R. "Ted" Smith unveiled 20 years ago (see "Aerostar," September 1982 *Pilot*, p. 36, and "Milestones," November 1984 *Pilot*, p. 38). Smith's vision was of a family of 43 different Aerostars, ranging from a single-engine trainer to a twin jet, all using the same fuselage, wings and tail. The family never materialized; the design was developed only as a piston twin. (Specifications and performance data and current prices for the various models appear in the table on page 44.)

With its oval cabin section, forward door and long, pointy nose, the airplane does resemble a jet. Indeed, both the Aerostar and the Learjet have NACA 64-series wing sections with only two degrees of dihedral and one degree of incidence. The Aerostar's stabilizers are highly swept (as well as structurally identical and interchangeable).

Smith claimed his design incorporated 25-percent fewer components than comparable airplanes. The use of relatively thick wing and fuselage skins reduced the number of stringers and stiffening members required for structural strength. Despite the apparent structural simplicity, the Aerostar never was easy to build. Many parts had to be hand-built and -fitted, and all external skins are butt-joined, rather than lapped, and except for portions of the control surfaces, are flush-riveted. (After moving Aerostar production facilities from Santa Monica, California, to Vero Beach, Florida, Piper improved manufacturing economy by investing in tooling that helped cut construction time from 5,700 man-hours to about 4,500 hours per unit.)

Aerostar production began in 1968 with the Model 600, which had naturally aspirated, 290-horsepower Lycoming IO-540 engines and a maximum takeoff weight of 5,500 pounds. The Model 601, with Rayjay turbochargers and manual wastegate control systems, was introduced a year later. The 601 can maintain rated sea-level power (290 hp at 29.5 inches manifold pressure and 2,575 rpm) to 16,000 feet. Maximum takeoff weight is 5,700 pounds. Fifty-nine Model 600s and 68 Model 601s were built before production was interrupted at the end of 1970, when American Cement Company, which had acquired the Aerostar line

Naturally aspirated Model 600A

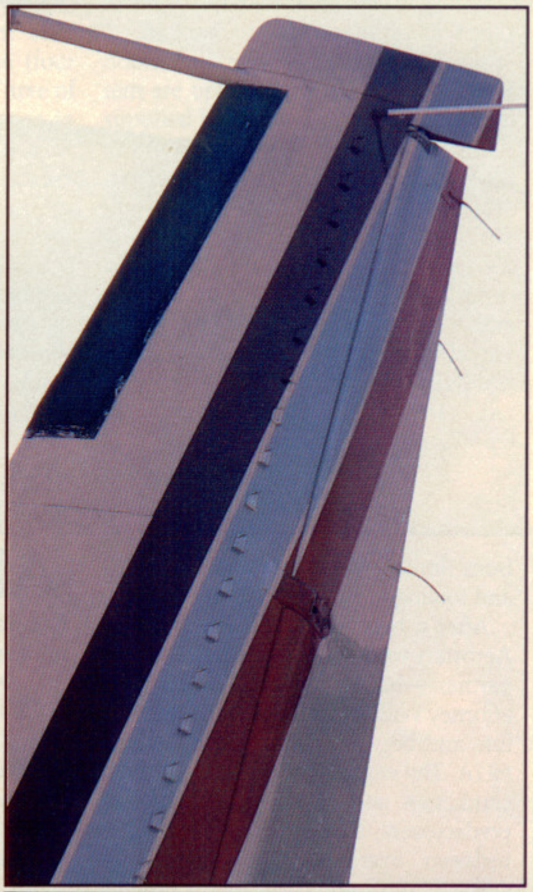
BERL BRECHNER

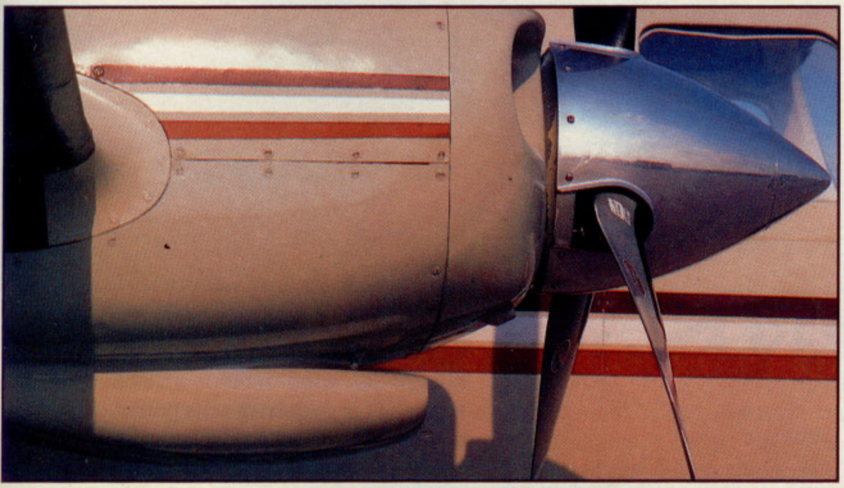
Aerostar 601P, the first pressurized model

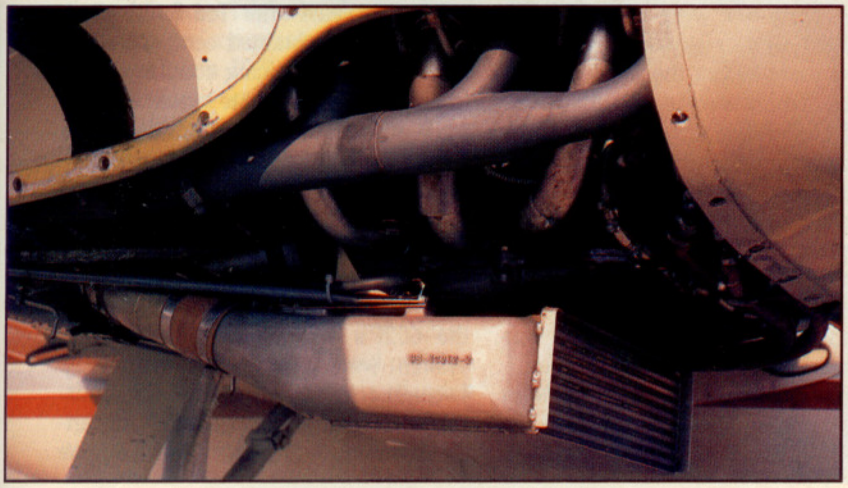
ROGER ROZELLE

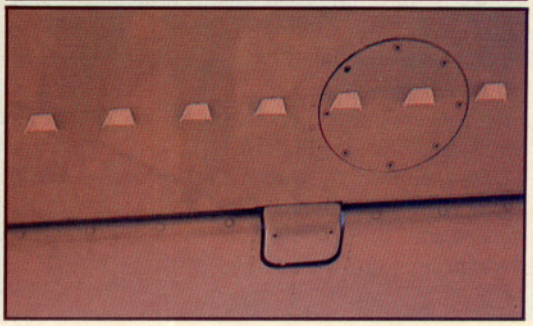
Machen Superstar 680

Frank H. Sjolie of Annapolis, Maryland, said his Aerostar 602P, N68980, "was not the same airplane" after it was modified by Machen. Sjolie said it now cruises 30 knots faster at altitude while consuming only five more gallons of fuel per hour. The Superstar conversion includes vortex generators on the vertical stabilizer and beneath the wings and intercooler air scoops below the engine cowls. Horsepower is boosted from 580 to 680.









Aerostar 700P, last of the breed

from Smith's investors, sold the rights and tooling to Butler Aviation.

After a two-year hiatus in which no Aerostars were built, Ted Smith and two partners—his son, Ronald Smith, and attorney William Calfas—reacquired the line and began building the 600A and 601A. The engines in both have heavier crankcases and crankshafts than their predecessors, and recommended times between overhaul (TBOs) were increased from 1,400 hours for the original models to 2,000 hours for the 600A and 1,800 hours for the 601A.

Of all Aerostar models, the 600A had the longest production life: nine years, in which 206 were built. After 48 601As were produced, the model was replaced with the 601B, which has automatic wastegate control systems, a longer wingspan (36.7 feet, rather than 34.2 feet) and more wing area (178 square

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feet, rather than 170). The larger wing improved the Aerostar's climb performance and load-carrying capability. The 601B's maximum takeoff weight is 6,000 pounds. Forty-one were built between 1977 and 1982.

Three years before the 601B was introduced, Smith unveiled his first pressurized model, the 601P. With a maximum differential pressure of 4.25 psi, the pressurization system maintains a cabin altitude of about 11,000 feet while the airplane cruises at 25,000 feet. After the tenth Model 601P was built, wingspan was increased from 34.2 to 36.7 feet and maximum takeoff weight was increased from 5,700 to 6,000 pounds.

Several improvements were made in 1977. Maximum useful loads for the 600A and 601P were increased by changing the zero-fuel-weight restriction from 5,400 to 5,900 pounds, and downlocks were incorporated in the landing gear to decrease the potential for inadvertent retraction on the ground.

Piper Aircraft acquired the line in 1978, two years after Ted Smith died. The company obtained certification for flight into known icing conditions and improved the wastegate systems in the 601P and B, increasing critical altitude from 16,000 to 23,000 feet.

The 601P is the most common Aerostar; 454 were built before it was replaced by the 602P in 1981. Unlike the 601 models, which had turbochargers and wastegates installed at the factory, the 602P's engine and turbocharging system were certified as a unit by Lycoming. Engines in the 601-series airplanes are "turbonormalized." (In standard conditions at sea level, each engine

After building about 110 Model 602Ps, Piper introduced the 700P in 1983. This Aerostar has intercooled Lycoming TIO-540 engines that produce 350 hp at 42 inches and 2,500 rpm. The 700P is the only Aerostar with cowl flaps, added to meet engine-cooling requirements. After building only 25 Model 700Ps, Piper terminated production of the Aerostar (see "Aerostar 700P," November 1984 *Pilot*, p. 32).

Although it is not building Aerostars anymore, Piper continues to supply parts and provide initial and recurrent training courses for pilots and mechanics. The four-day initial pilot-training course costs $1,000; the two-day recurrent course costs $600. (Contact: Piper Training Center, Post Office Box 1328, Vero Beach, Florida 32960; telephone 305/567-4361.)

There were seven pilots in the initial course I attended last summer. Most of them had purchased Aerostars after having owned other light twins (four Senecas and one Beech Baron). Three of the pilots had very little experience in Aerostars and were attending the Piper school, in part, to satisfy insurance requirements; they had hired professional pilots to accompany them on their flights to Vero Beach. Another pilot was considering buying an Aerostar and had come to school to learn more about the airplane; he eventually bought one. We spent three days in a classroom studying the Aerostar's systems, and there is much to learn. (Indeed, any pilot expecting to translate knowledge of the systems of another light twin will find that, in many cases, he will be starting from scratch in the Aerostar.)

A thorough discussion is beyond the scope of this report, but a brief description of the systems is in order. Think of the Aerostar as an electro-hydraulic airplane. Many systems are operated with electricity, including the fuel-selector valves, nosewheel steering solenoid and elevator and rudder trim actuators, as well as the wastegate controls in early turbocharged models. Some airplanes have air-conditioning systems incorporating four electric motors that draw a total of 70 amperes; use of these systems is prohibited at night or in IFR weather conditions. (Other Aerostars have engine-driven compressors with no such restrictions.) Each of the two alternators is rated at 70 amps, but maximum continuous output is limited to 55 amps because of the heat produced.

The landing gear, main landing gear doors, flaps and nosewheel steering system are operated by hydraulic pressure supplied by a pump driven by the right engine. An electrically activated auxiliary hydraulic pump is mounted behind the baggage compartment. There is a separate hydraulic system for the brakes. (One of the many things one learns in school is to bleed off all pressure from the hydraulic system before checking the reservoir. If this is not done, the fluid level will *appear* too low even though supply is adequate, and any fluid added will eventually be vented overboard.)

produces 290 hp at 29.5 inches of manifold pressure, and the turbocharger wastegates are fully open. The engines, in effect, are operating as if they were naturally aspirated. As a 601-series Aerostar begins to climb into thinner air, the wastegates begin to close and the turbocharger compresses the induction air to maintain 29.5 inches of manifold pressure. At critical altitude, the wastegates are fully closed, and manifold pressure begins to drop as the airplane climbs higher.) The 602P's engines have a lower compression ratio and are "boosted." (At sea level, their wastegates already are partially closed, and the turbochargers are compressing induction air to produce 290 horsepower at 37 inches of manifold pressure and 2,425 rpm. A 602P's turbocharging system is designed to maintain 37 inches to critical altitude.)

The control systems for the ailerons, elevators and rudder use tubes and bellcranks rather than cables and pulleys.

The Aerostar's fuel system has been the subject of controversy (see "Aerostar Fuel System: Not As Simple As It Seems," September 1979 *Pilot*, p. 68). The system comprises a rectangular bladder tank in the fuselage behind the rear seats and one wet-wing tank outboard of each engine nacelle. The fuselage tank holds 41.5 gallons of usable fuel; 62 gallons, usable, are contained in each of the wing tanks. Each tank has its own sump. Though the sumps are interconnected, check valves prevent fuel from flowing from one tank to another.

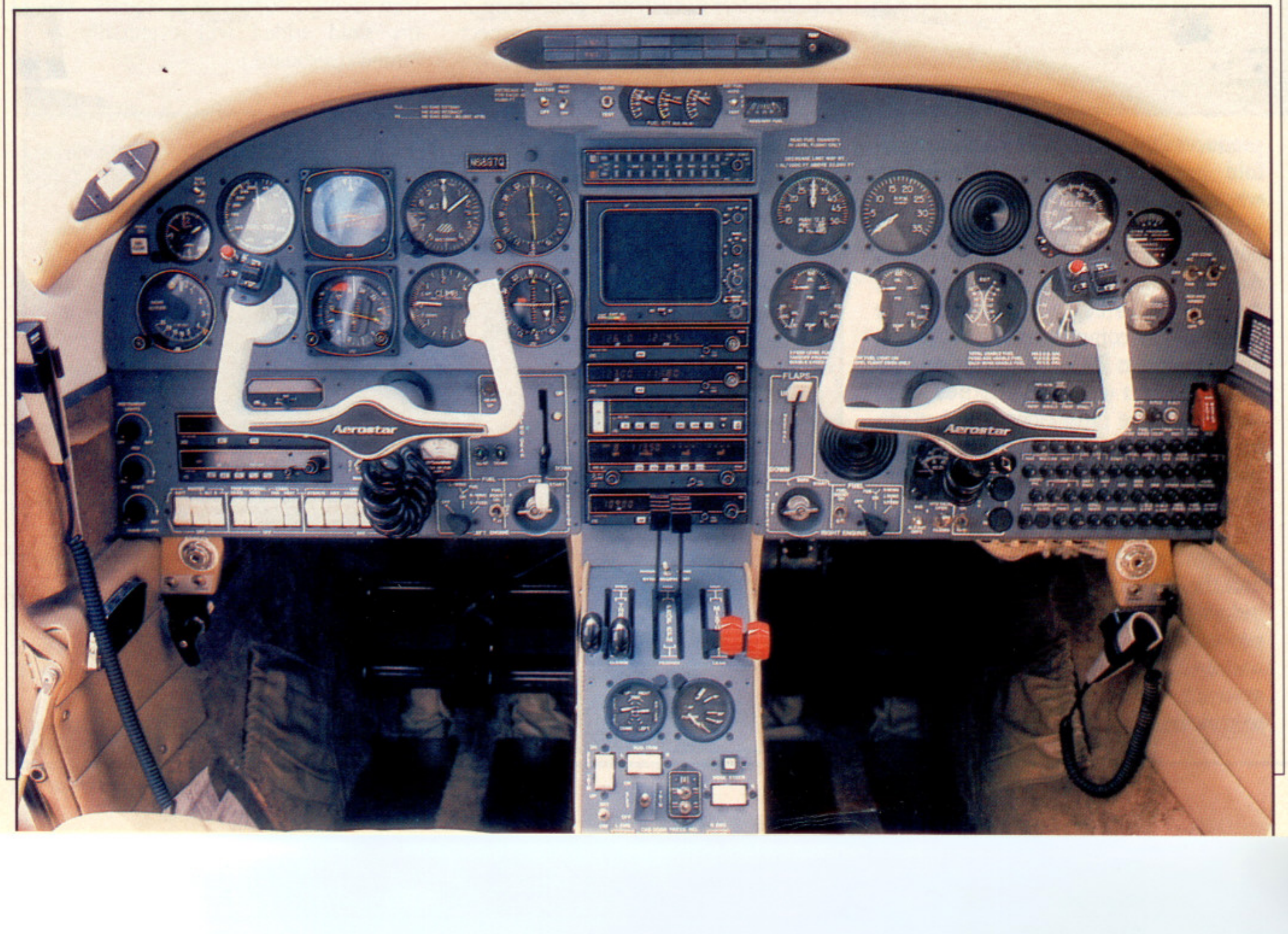
When operated by the book (that is, with fuel selectors in their On positions) in straight-and-level flight, fuel is drawn from all three tanks at a proportion of 4.2 gallons from the wings for every gallon from the fuselage tank. Therefore, by the time the wing tanks are empty, about 12 gallons should remain in the fuselage tank. Few flights, however, are conducted perfectly straight and level, and fuel imbalances do occur in the wing tanks. The proper procedure is to use crossfeed only long enough to balance the wing tanks. Years ago, however, it was common practice among some pilots to use double crossfeed during cruise to empty the wing tanks before drawing any fuel from the fuselage tank. This can get a pilot in trouble in two ways. First, should an electrical failure occur, the fuselage tank will remain isolated (the valves, remember, are operated by electric motors). Second, the single supply line in each of the long wing tanks can become unported. For example, if there is less than 36 gallons in the tank, unporting can occur if that wing is lowered more than six degrees.

A rash of accidents related to fuel mismanagement led to an airworthiness directive in 1979 that required crossfeed procedures to be placarded and a new fuel gauge, with continuous readings of quantities in each tank, to be installed. (The original gauge indicated total fuel supply and had a spring-loaded switch to change to an indication of fuel remaining in either wing tank.) The directive, AD 79-1-5, also required installation of a low-fuel warning light and revision of the flight manual, reducing maximum usable fuel supply by four gallons to 165.5 gallons.

Another controversial AD, 83-14-7, resulted from what the Federal Aviation Administration considered "unacceptable pre-stall controllability" when an Aerostar is loaded to aft CG and operating at 90-percent power with flaps and landing gear extended. (The FAA's investigation was prompted by a series of reports in the *Aviation Consumer*, which questioned the airplane's stall characteristics.) The AD changed the aft-CG limit from 167.8 inches to 166.0 inches and prohibited extension of flaps with the CG aft of 163 inches. The flap restriction does not apply to airplanes modified by Piper or Machen. Piper's fix is a ventral fin attached to the rudder post. Although Piper paid the costs for this modification, many owners have opted, instead, for Machen's more aesthetic fix, which includes vortex generators on the vertical stabilizer and beneath the wings and left horizontal stabilizer. Machen currently charges $2,000 for the modification.

Before buying any airplane, it is important to check for compliance with ADs and manufacturers' service bulletins. Those in the market for an Aerostar also should keep in mind some problems uncovered in service difficulty reports. In the past six years, several reports discussed exhaust-induced corrosion of aileron controls and loose rivets on rudder and elevator torque tubes. Two reports cited dual alternator failures. Other reports included: cracks in fuel tanks and sumps; a wing leading

Arrangement of switches and indicators was improved somewhat in the Model 700P. But don't look for any manual trim controls; the Aerostar is an electro-hydraulic airplane.



edge that collapsed due to a frozen float valve (at school, we were taught to check these valves for freedom of movement during every preflight); rusted heater relays and broken fan blades; burned resistors in deice systems that caused boots to remain inflated; cracked and broken nosewheel steering components (several reports indicated that towing limits may have been exceeded); broken bolts that caused nose gear mechanisms to jam in their wells, and cracks in engine crankcases, crankshafts, exhaust pipes and clamps, oil cooler flanges and turbocharger scrolls.

Loose rivets in outboard wing sections are a common problem, caused by expansion of fuel in the wing tanks of Aerostars left out in the sun, according to Piper. The company advises owners to delay topping the tanks until immediately before flight. (A former Aerostar structural engineer disagrees with Piper's explanation, contending that rivets loosen when the wings flex in flight.) A check for fuel seepage from the outboard sections of the wings should be accomplished before flight.

Previous reports on Aerostars in *Pilot* have stressed the importance of having maintenance performed by people who know the airplane. Otherwise, a lot of money may be spent having mechanics learn the airplane's systems by trial and error. In addition to the obvious safety implications, thorough knowledge of the airplane's systems will enable an owner/pilot to guide maintenance personnel in troubleshooting.

At Piper's training center, pilots are given a few items to add to their preflight check lists. For example, the security of the elevator trim tabs, both of which are riveted to an interconnecting tube, can be ascertained by holding one of the tabs while moving the other to check for looseness. Preflight inspection procedures are covered before a flight with one of the center's instructors during the fourth day of school. The flight is a training session rather than a check ride (although the center declined to issue a flight transition certificate to at least one pilot; see "Safety Corner: Check lists," March *Pilot*, p. 106) and typically requires about 2.5 hours.

My transition flight in an Aerostar 602P was administered by Robert D. Scott, manager of the training center. In addition to guiding me through simulated emergency operations, Scott recommended some procedures that seem to work quite well. I discovered that for smooth taxiing, the nosewheel steering system is best left alone except for sharp turns; differential braking is sufficient to keep the airplane tracking the taxiway centerline. On takeoff, too, the toe brakes suffice until the rudder becomes effective at about 40 knots. The airplane's flight manual recommends using either zero or 20 degrees of flap for takeoff. Scott prefers using 20 degrees, since accelerate-stop distance is reduced by about 1,000 feet and a smoother liftoff can be achieved. We climbed at 101 knots, the best angle-of-climb speed, until clear of obstacles and then accelerated to 117 knots, the best single-engine rate-of-climb speed.

We maintained maximum continuous power and 155 knots, which provides a good rate of climb and a high ground speed; the relatively shallow deck angle results in an adequate flow of cooling air for the engines.

Fast, powerful and with sensitive and responsive controls, the Aerostar is an exciting and satisfying airplane to fly. Only the Model 700P has a supplementary stall-warning system, but I found the 602P's airframe provided ample notice of an impending stall, and recovery from power-on and power-off stalls was straightforward.

The caveats of operating any light twin apply to the Aerostar. Single-engine performance is poor and requires flawless technique. On approach and landing, the pilot has to stay ahead of

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the airplane; getting behind the power curve results in a very high sink rate. Knowledge of systems and the techniques for using them properly is important in operating any airplane; for the Aerostar, it is imperative.

A review of 178 accidents from 1980 through June 1986 reveals a few patterns worthy of note. The sample included nine stall/spin accidents. Four occurred during approach, two during low-level maneuvers and three on takeoff. Fourteen Aerostars were landed gear-up; eight others experienced inadvertent landing gear retractions on the ground. During the period, 12 Aerostars crashed out of control. Three of the accidents occurred in areas where thunderstorms were present. There were two engine failures on approach and one on takeoff. Two Aerostars crashed while taking off in instrument weather conditions, another while taking off with ice on its wings and empennage. One stalled and crashed during a missed approach. Another descended into a lake after its pilot apparently fell asleep at the controls; fatigue was cited in another accident with no determined cause.

Three Aerostars crashed after their pilots became distracted by cabin doors that had popped open. During the same period, six other pilots were able to land safely with open doors; one of them, however, lost a finger when his hand was blown into the propeller while attempting to close the door. Clearly, the security of the door should be checked during preflight. In addition, training center instructors recommend against taxiing with the upper portion of the door open to ventilate the cabin because the door can warp and become misaligned at its latch points.

Machen offers a variety of modifications for the Aerostar. The Superstar 650 conversion provides 70 more horsepower for improved takeoff, climb and cruise performance. The cost for installation by Machen is $39,900 for a 602P and $49,900 for a 601P; a conversion kit costing $37,000 also is available for field installation. According to Machen, a Superstar 650 cruises at 240 knots, burning a total of 42 gallons per hour at 75-percent power and 25,000 feet.

For $13,900, installed, Machen's Superstar 680 conversion adds intercoolers to the modifications included in the 650 package. The company claims 250 knots and 40 gph at 75-percent power and 25,000 feet for the Superstar 680. In addition, maximum takeoff weight is increased 200 pounds. (A more detailed report on Machen's Superstars will appear in a future issue of *Pilot*.) Intercoolers are available in kit form for $12,500. According to Machen, a 601P with intercooler modification, alone, cruises at 238 knots; a 602P, at 245 knots. Fuel consumption is about 34 gph. An auxiliary fuselage tank, with a capacity of 42 gallons of usable fuel, is available for $5,900, installed, or $4,500 in kit form (Machen, Incorporated, South 3608 Davison Boulevard, Spokane, Washington 99204; telephone 509/838-5326).

The Aerostar Owners Association serves as a focal point for communication among owners. The association publishes a quarterly newsletter and holds an annual meeting and safety clinic each spring. The association is administered by Yodice Associates, 600 Maryland Avenue S.W., Suite 701, Washington, D.C. 20024; telephone 202/863-1000. (Yodice Associates is a law firm in which John S. Yodice, AOPA's general counsel and a regular contributor to *AOPA Pilot*, is a partner.)

The Aerostar long has been revered as a pilot's airplane. However, those who desire the speed, agility and good looks will find a high price to pay. For starters, figure about $1,000 to $2,000 for an annual inspection on a well-maintained airplane and between $2,000 and $7,500 for insurance. In addition to money, an Aerostar demands time and attention. Anyone who occupies the left seat must be committed to staying ahead of the airplane. For an airplane as fast as an Aerostar, that is quite a commitment. □

	Aerostar 600/600A	Aerostar 601/601A	Aerostar 601B/601P	Aerostar 602P	Aerostar 700P
Price new	$93,500 to $324,000	$112,500 to $164,900	$186,000 to $323,760	$333,500 to $408,890	$499,300 to $514,280
Current market value	$40,000 to $120,000	$55,000 to $90,000	$70,000 to $150,000	$150,000 to $260,000	$300,000 to $360,000
		Specifications			
Powerplants	2 Lycoming IO-540 290 hp @ 2,575 rpm	2 Lycoming IO-540 290 hp @ 2,575 rpm	2 Lycoming IO-540 290 hp @ 2,575 rpm	2 Lycoming IO-540 290 hp @ 2,425 rpm	2 Lycoming (L) TIO-540 350 hp @ 2,500 rpm
Recommended TBO (hr)	1,400 (600)/ 2,000 (600A)	1,400 (601)/ 1,800 (601A)	1,800	1,800	1,800
Propellers	2 Hartzell full-feathering 3-blade, 78 in dia	2 Hartzell full-feathering 3-blade, 78 in dia	2 Hartzell full-feathering 3-blade, 78 in dia	2 Hartzell full-feathering 3-blade, 78 in dia	2 Hartzell full-feathering 3-blade, 76 in dia
Recommended TBO (hr)	1,500 (or 4 yr)	1,500 (or 4 yr)	1,500 (or 4 yr)	1,500 (or 4 yr)	1,500 (or 4 yr)
Length (ft)	34.8	34.8	34.8	34.8	34.8
Height (ft)	12.1	12.1	12.1	12.1	12.1
Wingspan (ft)	34.2	34.2	36.7	36.7	36.7
Wing area (sq ft)	170	170	178	178	178
Wing loading (lb/sq ft)	32.4	33.5	33.7	33.7	35.4
Power loading (lb/hp)	9.5	9.8	10.3	10.3	9.02
Seats	6	6	6	6	6
Cabin length (ft)	12.5	12.5	12.5	12.5	12.5
Cabin width (ft)	3.8	3.8	3.8	3.8	3.8
Cabin height (ft)	4.0	4.0	4.0	4.0	4.0
Max ramp weight (lb)	5,525	5,700	6,025	6,029	6,356
Max takeoff weight (lb)	5,500	5,700	6,000	6,000	6,315
Max landing weight (lb)	5,500	5,700	6,000	6,000	6,000
Zero fuel weight (lb)	5,400	NA	5,900	5,900	6,050
Empty weight (lb)	3,560	3,730	4,000	4,125	4,221
Max useful load (lb)	1,965	1,970	2,025	1,904	2,135
Payload w/full fuel (lb)	972	977	1,032	911	1,142
Fuel capacity (lb/gal)	993/165.5	993/165.5	993/165.5	993/165.5	993/165.5 1,233/205.5 opt
Baggage capacity (lb/cu ft)	240/30	240/30	240/30	240/30	240/30
		Performance			
Takeoff roll (ft)	1,550	1,645	1,900	1,800	1,950
Accelerate/stop (ft)	3,050	3,145	3,490	3,400	4,000
Rate of climb (fpm)	1,800	1,800	1,970	1,755	1,820
Single-engine ROC (fpm)	360	380	254	302	320
Cruise speed (KTAS)/	211/	237/	233/	229/	258/
Fuel consumption (gph)	33.4	29	36	37	51
@ power setting/altitude (ft)	70%/7,500	70%/20,000	74%/20,000	75%/20,000	81%/25,000
Max operating altitude (ft)	21,200	30,000	30,000 (601B)/ 25,000 (601P)	25,000	25,000
Single-engine svc ceiling (ft)	6,300	10,800	9,300	12,900	14,900
Landing roll (ft)	1,200	1,230	1,230	1,217	1,425
		Limiting and Recommended Airspeeds (KIAS)			
Vmc (min control w/critical engine inoperative)	84	84	84	84	85
Vx (best angle of climb)	100	100	100	101	101
Vy (best rate of climb)	122	122	117	117	116
Vyse (best single-engine ROC)	113	113	109	117	116
Va (design maneuvering)	162	162	166	166	160
Vfe (max flap extended)	148	148	148	148	148
Vlo (max gear operating) extend/retract	156/NA	156/NA	156/130	156/130	153/140
Vno (max structural cruising)	215	215	215	215	215
Vne (never exceed)	241	241	241	241	244
Vs1 (stall clean)	83	83	86	86	75
Vso (stall in landing configuration)	74	74	77	77	71

Figures based on standard day, standard atmosphere, sea level, gross weight conditions, unless otherwise noted.