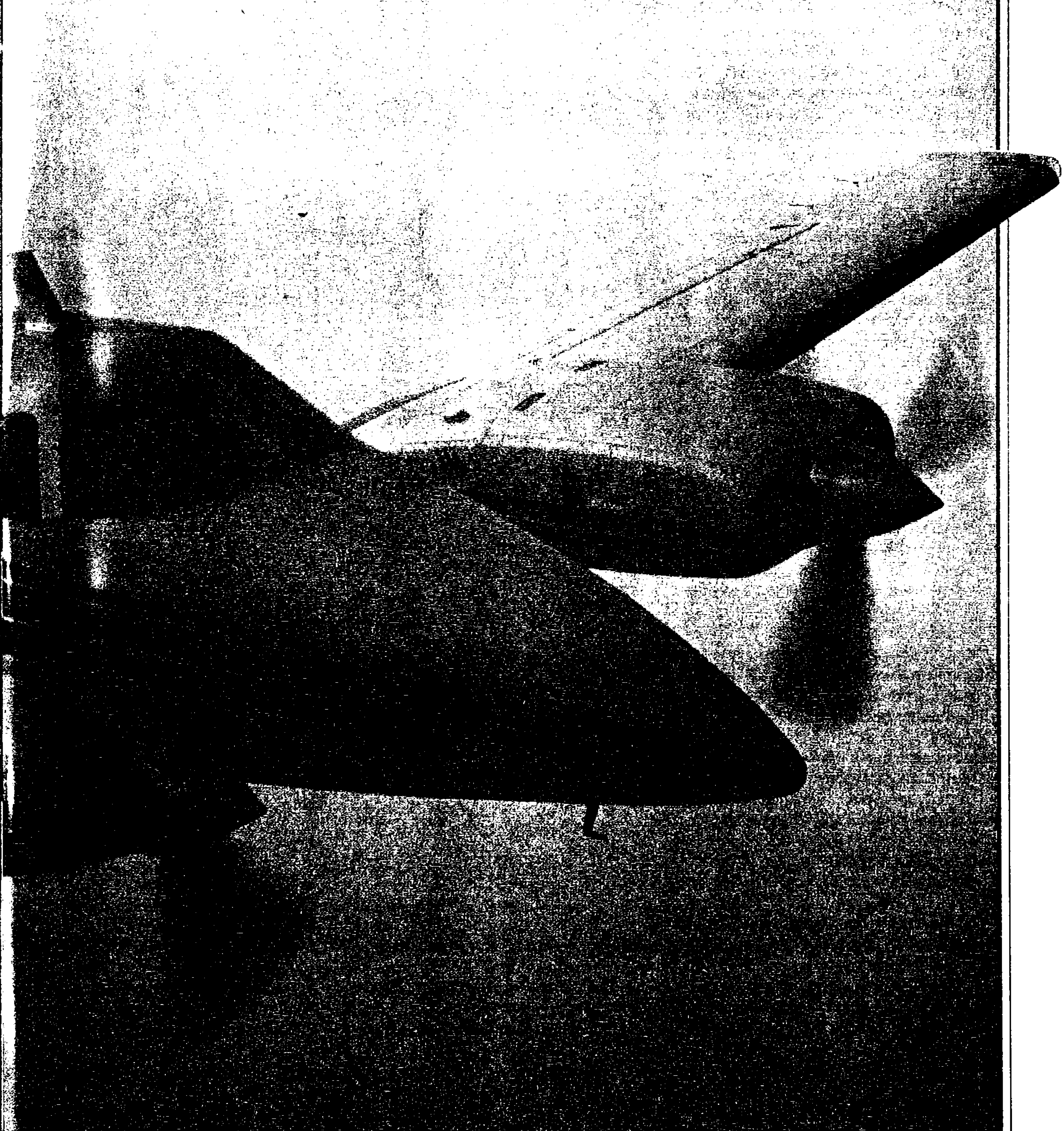
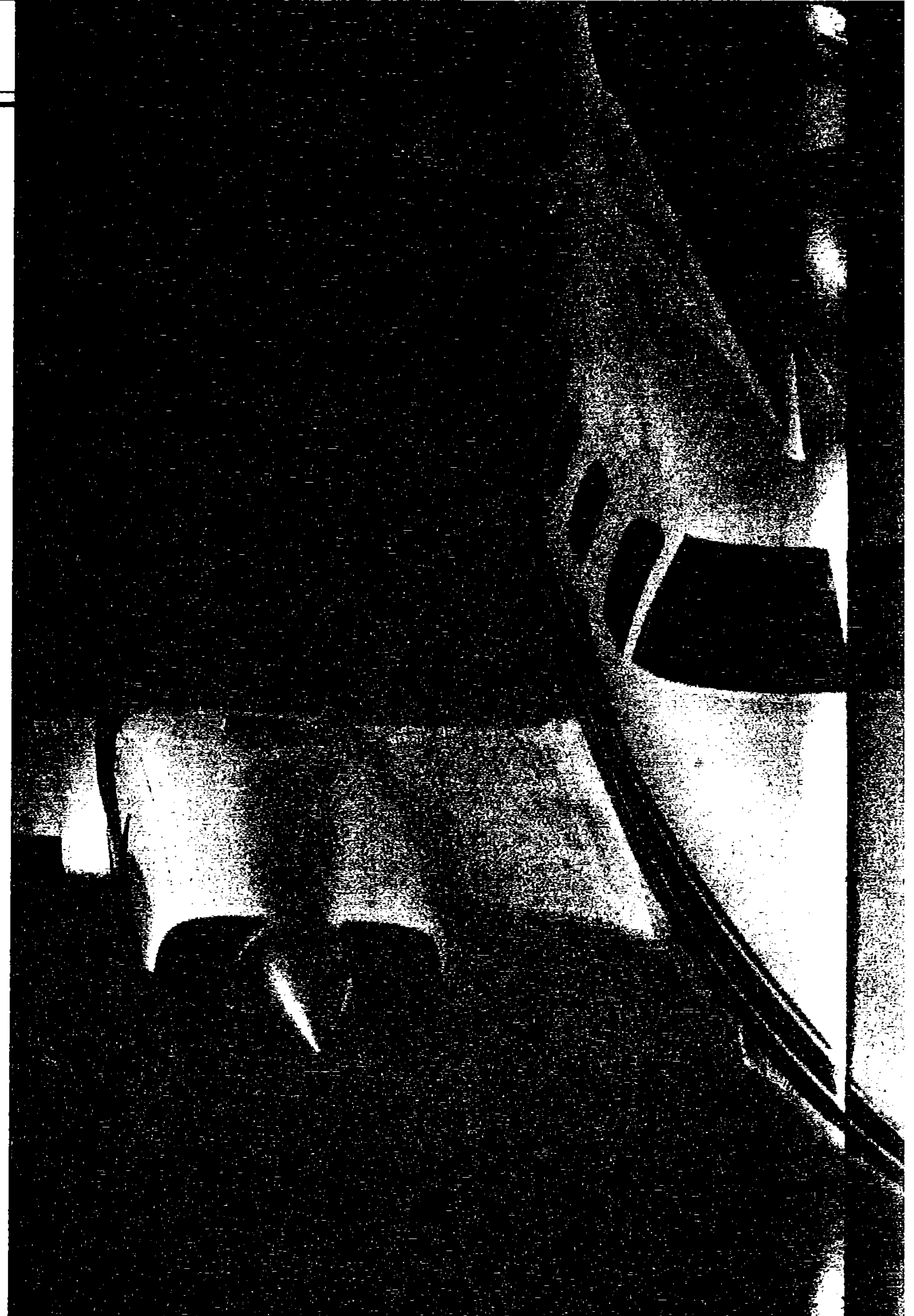
BEECHCRAFT B60 DUKE

Fantasy airplane for most of us, but a very solid performer for the select few

BY EDWARD G. TRIPP



PHOTOGRAPHY BY ART DAVIS



THE world's ultimate personal business airplane" is how Beech literature presents the Duke. "Even on a crowded, wing-tip to wing-tip flight line, there is no mistaking a pressurized Beechcraft Duke. . .It sits tall and proud on the ramp, dominating everything around it. . .From the very beginning, the Duke was designed to be more than an exceptional airplane. . .It was designed to be a visible extension of your personality. To be testimony to your lifestyle. And to make a bold statement about your achievements no other airplane can."

As a matter of fact, that is the way almost everyone talks and writes about the Duke. It certainly is different—special—looking and is perceived as an aircraft with a peculiar little niche.

Last year, I had several opportunities to use B60s, the current Duke model. One was several years old and had about 1,400 hours on it; the other, the aircraft used to illustrate this article, was brand new. The particular image of the Duke was reinforced whenever we taxied onto a ramp as people volubly expressed their admiration (and even secret desires) for the airplane.

There are some negative aspects to the image. It is known as "the tank," as a runway hog, very cramped inside, a maintenance technician's dream and very, very expensive. People talk about those aspects of the Duke, too.

My reintroduction to the Model 60 renewed my appreciation for it as an airplane and for several of its design and construction features.

When Beech announced the development program in the fall of 1966, the technical and operational strong points of the design were emphasized; the romance did not start until several years later. It was termed "the lowest-priced pressurized twin-engine Beechcraft in history." The higher priced ones were the Models 88 (pressurized Queen Air) and 90 (King Air). Cessna's first pressurized twin, the Model 421, was in development and was about to be marketed. The Duke was to start deliveries in the fall of 1967, but the program slipped a year.

When it did appear, the large dorsal fin, which runs from the top of the cockpit to the base of the vertical stabilizer, was still very much of the visual signature of the airplane, but the companion ventral fin had disappeared. The large amount (10 degrees) of dihedral in the horizontal tail surfaces remained.

The early advertising copy talked of the Duke as an aircraft of the future: "It's happened. . .One of the most phenomenal aviation breakthroughs of all time. . .*The best performing, lowest priced, IFR-equipped, pressurized twin in the world!*. . .This is tomorrow's airplane—here today. . .The most conclusively *proven* twin in the sky." Promotional literature singled out the 380-hp Lycoming engines as ones designed from the beginning for high-altitude, turbosupercharged operation (however, the original recommended TBO was only 800 hours). The propellers were controlled by nitrogen or dry-air charges, rather than engine oil, to preclude the problems of coagulated oil at low temperatures. Promotional literature also focused on the advanced construction techniques and materials used: "[Beech engineers] saved enor-

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mous amounts of weight, space and future maintenance costs. . .No airplane ever built has been more thoroughly and thoughtfully engineered." And, indeed, the Duke from the beginning has employed sophisticated metal bonding, honeycomb structure (in the tail surfaces), chemically milled skins and extensive flush riveting—methods and materials only lightly explored for general aviation applications back then. The airframe was "designed and tested in excess of the required load factors." The pressure vessel was tested through 30,000 cycles (it has a 15,000-hour life limit); computer-aided design was employed; and a fuselage mock-up was constructed in part to help study cockpit arrangement and pilot work load.

It is interesting that, for all the changes and improvements made to the Duke over the years, very little has been done in the cockpit. It was a very well-done job, particularly if it is compared to the standard arrangement of the mid to late 1960s. The Duke did not borrow the center control of the Bonanza and Baron series; it has conventional yokes. Nor did it use the reversed propeller and throttle or gear and flap switches of the smaller, more popular Beech designs. Fuel management was simple, since the system has only three positions for each side: Off, On and Crossfeed. From the start, it had a dual-bus electrical system, 125-amp generators and a nickel/cadmium battery. Independent pitot-static systems were available for pilot flight instruments as well as for the copilot flight instruments, which were optional. There was a great deal of thought given to the installation and maintainability of instruments and avionics and other components.

The aircraft was developed to be certificated for flight into known icing, and the optional air conditioning system could be operated during takeoff and landing.

The flaps, which extend beyond the trailing edge of the wing, are semi-Fowler in principal, extending aft as well as down to increase chord and provide a bit of additional lift.

The pressurization differential was 4.6 psi maximum (now 4.7 psi), which provided a 10,000-foot cabin at 24,800 feet and a maximum operating altitude of 30,000 feet (originally 31,300).

The Duke originally was designed as a four-seater (with optional fifth and sixth seats); the familiar club seating option came later. The elaborate nose contains a large baggage compartment with a flat floor (the nose gear rotates 90 degrees on retraction to provide the flat floor).

The most significant original limitation was the low standard fuel capacity (142 gallons/852 pounds usable and 204 gallons/1,224 pounds optional).

From the original concept to the finished product, the original Duke was a significant technical exercise and development.

It was designed as a single-pilot airplane, and much to Beech's credit, a school for pilots and maintenance people was offered almost from the start. The school runs four days: three days of classroom and one day (or part of a day) for a checkride. At a current cost of $350 (free with the purchase of a new Duke), it is very cheap insurance for anyone who owns or flies a Duke.

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The company anticipated an average production run of 200 units per year (the initial base price was $166,500). Sales never reached company projections. In fact, in the now-15-year run of the Duke, a total of 596 have been built. The original Model 60 had a production run of approximately 126. The A60, a 1971 model year introduction, had a production run of about 120. The B60, the current Duke, was introduced in the 1974 model year, and 350 have been produced to date.

Initial response was enthusiastic, but there were still some attributes of the airplane that proved unsatisfactory because of either service-life experience or customer-acceptance complaints.

Many of the customer or potential-customer objections had to do with the relatively small amount of room in the cabin for passengers (people in the front seats are taken care of quite well, except for what some pilots consider too much squeezing, crawling and generally undignified processes to get into the seats).

A certain amount of the mechanical and systems problems owners experienced have resulted from lack of knowledge of the aircraft and the environment in which it operates and, a certain amount, from maintenance shortcomings (one service manager, aggravated by my constantly squawking pressurization, governor and turbocharger problems years ago, asked: "How perfectly do you want it to operate, anyhow?"). To put it another way, a lot of the problems that have occurred with any high-performance, particularly high-altitude, aircraft over the years have been a combination of lack of knowledge on the part of both operators and repair shops, and the need to develop a different strategy for both operation and maintenance. Powerplant management and maintenance and the acceptance of progressive as opposed to "don't fix it unless it breaks" service are requirements that many operators still don't follow. The Duke and anything else that regularly operates at extremes of altitude (and temperature), and any complex, sophisticated agglomeration of systems, requires a great deal more care and feeding—and thoughtful operation—than a basic or even moderately sophisticated aircraft.

There is another side to it, of course: the primary and component manufacturers. Some pieces or systems, which appear perfectly functional and suitable to the engineers and the finance departments and which work fine during factory analysis and test, don't do too well in the field. Or, continuous use points out shortcomings of design or materials or installation.

For whatever reason, some of the early Duke owners had very unsatisfactory experiences. An acquaintance of mine, who had owned several Bonanzas and Barons, was so unhappy with his and with the difficulty he had in getting it maintained satisfactorily that his company bought a non-Beech product when they moved up to a turboprop. It was from early owners that the Duke garnered the reputation of having poor runway performance and gained such nicknames or epithets as the tank, the turtle and the truck. And quite a few of them decided it was a maintenance hog, too.

Beech, along with its suppliers, responded to a lot of the operational difficulties. As previously mentioned, there have been two model changes. There also have been quite a few improvements that did not result in a new model designation. The first was an increase in engine TBO to 1,200 hours, announced for the 1970 model year. There were pressurization prob-

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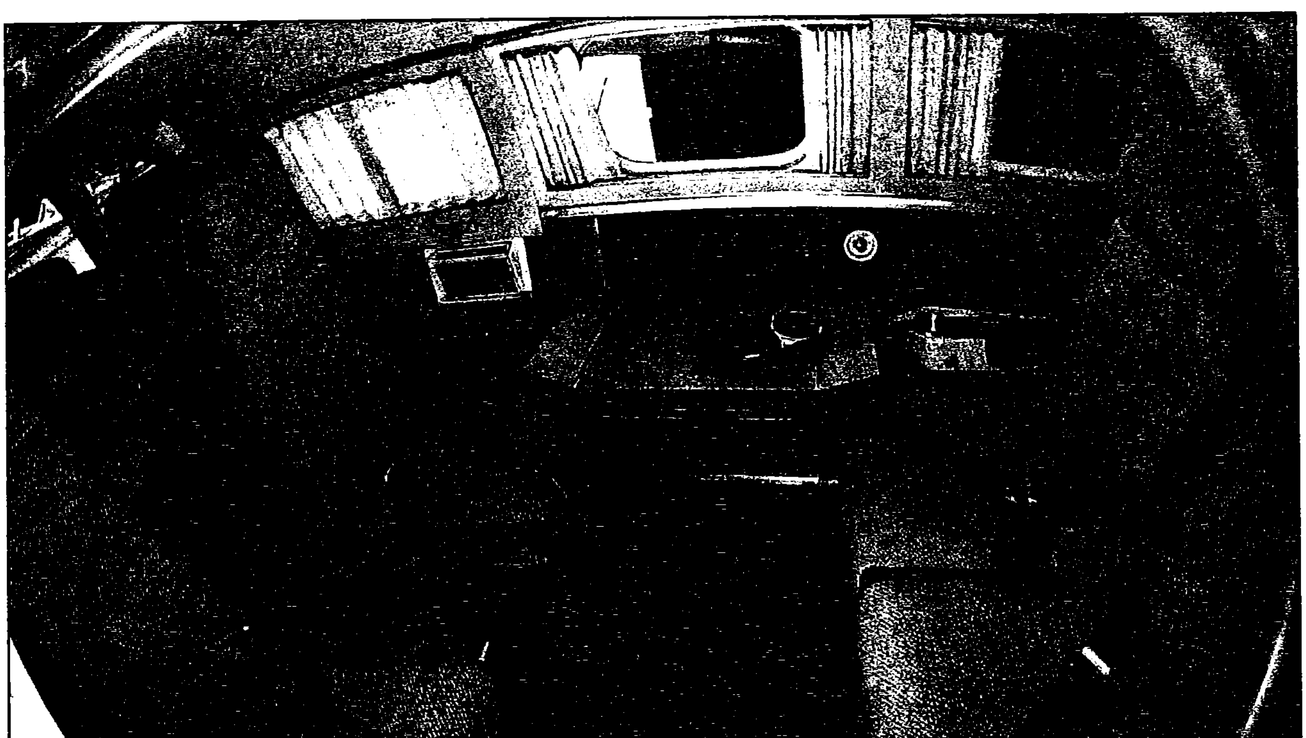

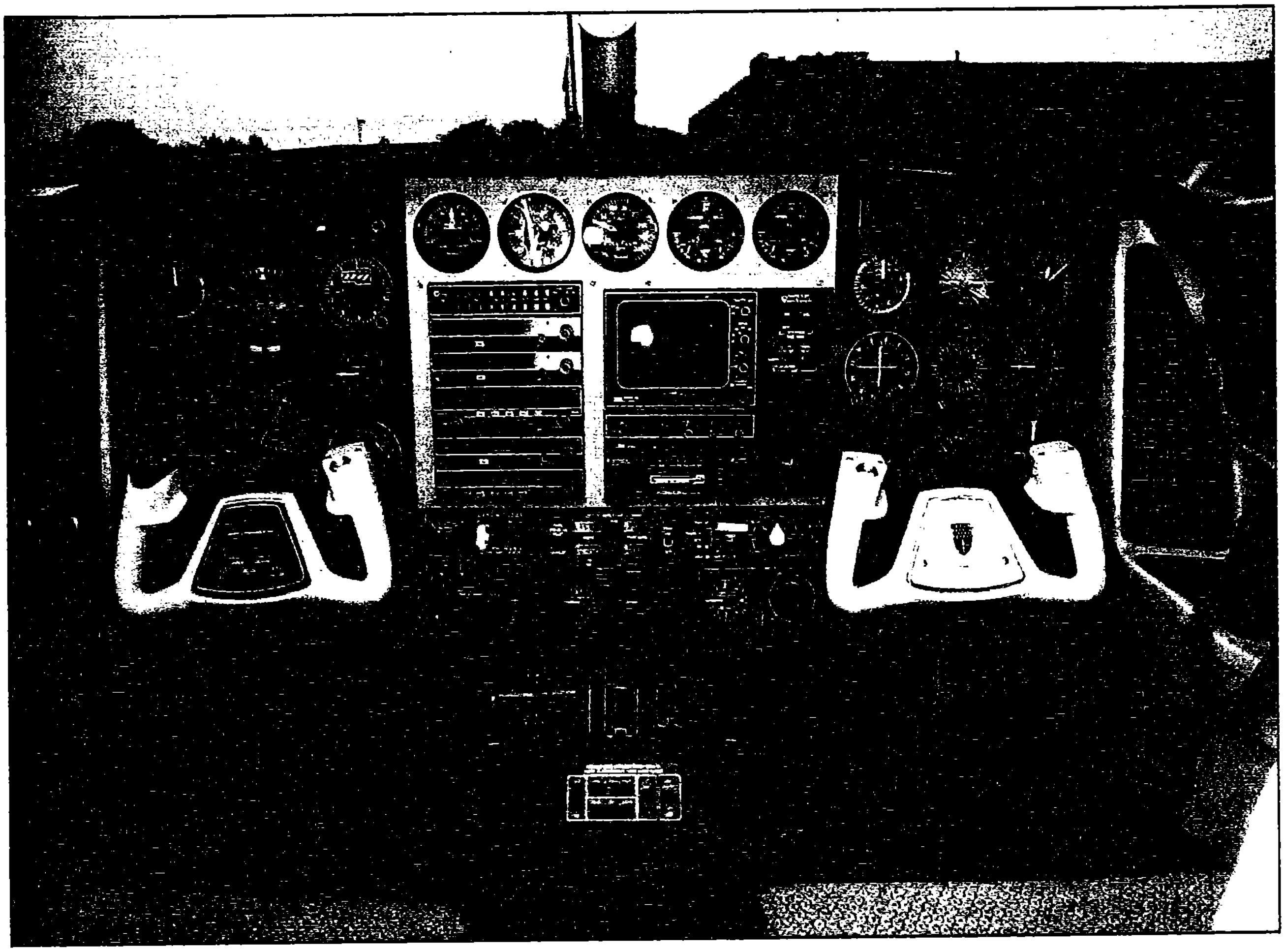

lems and problems with the security or sealing of the cabin door. There also were problems with the turbosuperchargers, and exhaust gases were causing corrosion, particularly to the flaps. Passengers complained it was a noisy airplane. There were valve, connecting-rod and crankcase problems, too.

The A60 was introduced as a 1971 airplane, and many of the difficulties had been addressed. The turbos were made of stainless steel, and the exhaust system had been redesigned. A new pressurization system was fitted, steps had been taken to deal with water leaks, and the flap motor was changed. The maximum takeoff rate was increased from 6,725 to 6,775 pounds.

For the 1974 model year, the Duke became the B60, with a lot of internal engine changes that made the designated model TIO-541-E1C4 from the previous E1A4. The pressurization outflow valves were moved to the back of the aft pressure bulkhead, which increased the cabin length by six inches.

In 1975, a new pressurization system manufactured by AiResearch was added, along with longer exhaust stacks to deal with the flap corrosion problem. In 1976, TBO was increased to 1,600 hours and an optional wingtip fuel tank system was offered that increased total usable fuel to 232 gallons/1,392 pounds.

In 1978 and 1980, Beech paid even more attention to the passengers. The flow of pressurization air was redesigned and interior soundproofing was improved. The interior was redesigned yet again to provide more elbow and hip room and to create a greater visual illusion of space.

The original nicad batteries, which had caused service problems, were replaced with two, 12-volt, 25-amp lead acid batteries mounted in series.

By this time, the combination of inflation and more-profit-per-unit pricing policies had taken hold. The base price, which had risen to $187,000 in 1974 ascended to $258,000 in 1977, $313,000 in 1979, $341,700 in 1980 and $433,250 in 1982.

There have been a few airworthiness directives affecting the Duke over the years. The first one our records show was issued in 1971 and restricted operations from known icing conditions until an electrical transducer was added to the deice system. Another required replacement of the pilot side window before pressurized flight could be conducted. There was one that required replacement of the elevator hinge supports and two dealing with the wing outer panel to center section attach nuts. Two ADs dealt with the problems of moisture in the cabin and fuselage and one with possible interference between the fuselage moisture barrier and elevator controls. There was a problem with potential propeller blade shank cracking, another with engine piston pins and yet another with fuel cell leaks. There are several ADs on accessories, many of which are common to several aircraft.

By the time the B60 was introduced, Beech was marketing the airplane as a personal business machine directed at successful individuals who had made it on their own and wanted to show it. It had lost its niche as the fastest pressur-

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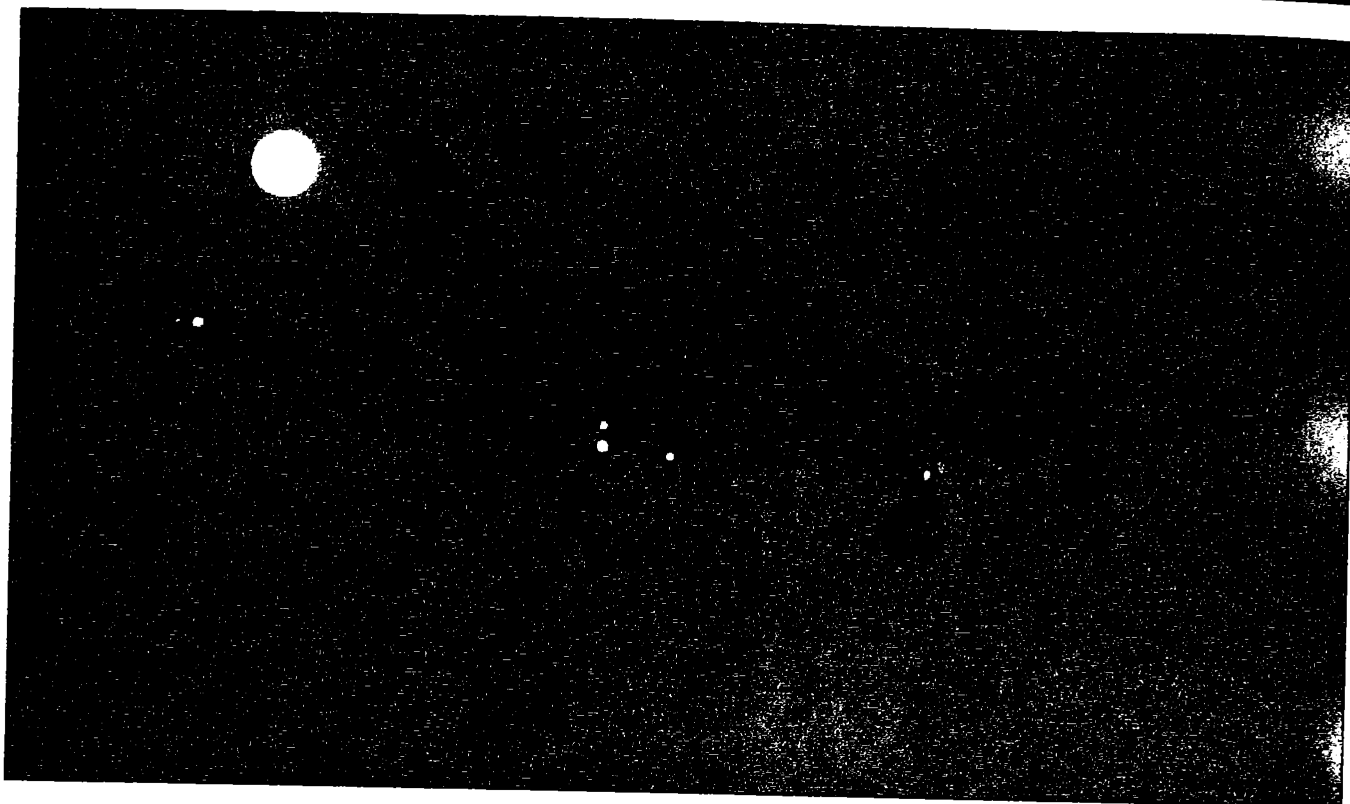
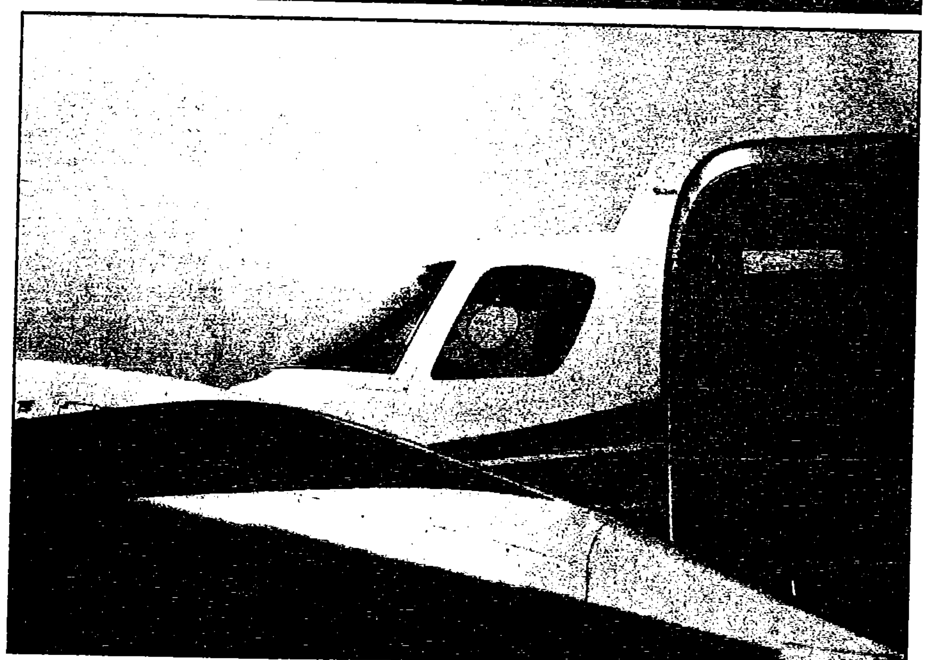
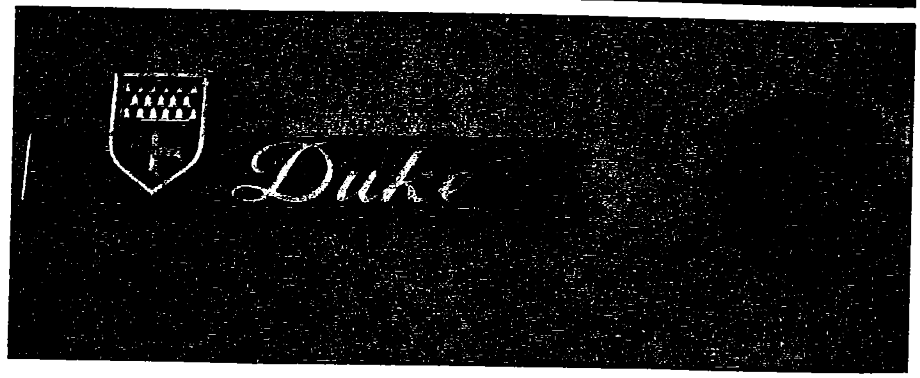


ized piston twin by a few knots to the Aerostar 601 and 602P (see September 1982 *Pilot*, p. 36) and found a more limited market slot due to competition from larger cabin and lower cost aircraft. It had become a very limited production aircraft, much as the Models 18 and 65 (Queen Air) had before it.

It may be that the macho image and the visceral visual appeal of the Duke took it out of contention for many potential buyers. It may be the hangar tales that grew out of its flying and maintenance characteristics. Or, it may be that people or companies buying aircraft in this price and performance range want to see larger interior cubic space even if the available payload is little different. For whatever reason, the Duke is not taken seriously as a competitor in the pressurized twin market. Although it is not the most fuel efficient, it does have competitive useful load and performance, and, despite its reputation, it is price competitive. Particularly when the usual passenger load (less than four) in this category aircraft is considered, the Duke has a lot to recommend it.

It also is a delightful airplane to fly, so long as the pilot understands the nature and the characteristics of the airplane (again, it makes sense to go to school). Pre- and post-flight checks are





straightforward. The only real caution, particularly for those aircraft with the optional 232-gallon fuel capacity, is that the Duke is another airplane that should not be topped off immediately after flight if it is going to be left in the sun or otherwise subjected to substantial temperature variations. (Pilots must be cautioned not to leave a fully fueled aircraft in the sun for too long lest they get a face full of gasoline when the caps are removed.) If maximum endurance is the goal, it is strongly recommended that the pilot monitor the refueling and ensure that it is done on a level surface to preclude imbalanced loads. Line personnel must be cautioned not to insert the nozzle too far into the tank to avoid damaging the bladder.

There are three parts of the flight regime that deserve good training and careful attention from any Duke pilot: takeoff, landing and low-speed management. These three areas probably have done more to fill the hangar tale books on the Duke than all others combined.

The operating manual says that a Duke will get off the ground and over a 50-foot barrier in 2,626 feet and that it will get on and stopped over a 50-foot barrier in 3,065 feet (unlike some aircraft, if you can land the Duke there, chances are you can get it back off). To do the first requires careful use of all 760 horsepower. To do the latter requires very precise descent, speed and power management; it also requires several decisions during the approach and, at all but long runways, a definite commitment to continue the landing.

Despite its 380-hp engines, the Duke is not going to win any drag races. It is slow to accelerate initially. Among other considerations, it requires that the pilot learn to take density altitude considerations very seriously. Operating off runways of less than 4,000 feet (or even more than 4,000 feet in more than sea level, standard temperature conditions) suggests establishing full power before brake release. Rolling takeoffs and during-the-roll power applications greatly lengthen the required runway length. Precision in rotation (lighten the nosewheel at 85 knots and plan to fly off at 95 knots) and both aircraft and airspeed management are important.

Thank goodness for the short gear retraction and extension time, because acceleration to best single-engine rate of climb speed is slow, particularly when it is hot. This is the period of maximum exposure. When the aircraft is clean and initial climb speed is reached and the first power reduction is made (preferably at 1,000 feet agl), the rush is over and things both settle down and quiet down—those short, fat propellers make a lot of noise when they turn at 2,900 rpm. In fact, to comply with Federal Aviation Regulation Part 36, the maximum continuous power setting of 2,900/41.5 has been supplemented with a "Maximum Normal Operating Power" of 2,750/36.5, which is the old recommended normal cruise climb power setting. Aside from noise relief, the initial fuel flow setting of 520 pounds per hour can be reduced to 396 pph (or about $40 per hour less at the fuel pump).

From here on up to cruise altitude, the pilot can enjoy the surroundings, the view (which is a lot better from the cockpit than it may appear to be while standing on the outside looking in) and the very well organized cockpit. A cruise climb of 140 knots provides good visibility and an average of 700 fpm or better to altitude.

Cruising at altitude is where the Duke excels. At an average power setting of 65 percent, it is quiet, quite fast and very comfortable. The cockpit design may be 15 years old, but it is still unsurpassed by the competition and by quite a few of the turboprops and turbojets.

Night lighting is excellent, and there are several variations as well as segmented controls to adjust them to any pilot's preference. Exterior lighting, with all the options, is excellent, too. It would be pretty hard not to see a Duke at night with a navigation, two rotating beacon, a wing-tip recognition, three strobe, and taxi and landing lights on during an approach.

Even in the older Duke we used last year, but particularly with the 1982 model, there is more than enough room for five in the airplane for long flights. The seats are quite comfortable, with good support and a variety of adjustments, for four-hour legs.

Descent management is easy without concern for rapid cooling of those expensive engines or for loss of pressurization. High-speed and high-rate descents with power can be made clean. Even faster ones can be made thanks to the 174 KIAS gear- and approach-flap extension limits. The pressurization controller enables the pilot to ensure that even the highest-rate descents do not bother the passengers.

Instrument flight in the Duke is enjoyable and secure so long as the pilot knows the airplane and its characteristics (so what, we say the same thing about any airplane). Pitch stability is excellent, and configuration changes, such as gear and flap extension or retraction, provide little if any pitch change. Yaw stability is about the same as in the Bonanza and Baron families. In other words, in turbulence, Dutch roll is very apparent. What a difference a good yaw damper makes.

Pitch forces are fairly high; roll input requires a bit less effort, and yaw even less. Control response is positive and crisp, even at low airspeeds, and the airplane is highly maneuverable.

I settled on an approach speed of 130 knots, until it was time to commit to land, for the best combination of stability, response and quick reaction to missed-approach decisions. Work load was very low, even when hand-flying the approaches in tight conditions and high ATC-induced work load.

Attitude and power changes do require attention to the trim of the airplane, and three-axis trim controls—particularly rudder and elevator—are welcome pilot aids.

Final approach and landing is where a lot of pilots—including long-time Duke pilots—have decided it is a tough airplane. Pilots tend to be tough on brakes. Part of this is that pilots tend to land too fast; the Duke floats just like a Cherokee or Bonanza or Mooney if you attempt to plant it on the ground at too high an airspeed.

The technique that works best for me (and it was taught by a very experienced Duke pilot) is to keep the approach speed above blue line (Vyse) until the decision is made to land, particularly if runway length is a consideration. At the decision point—about 200 feet in the air—start reducing power and airspeed (the manual recommends an approach speed of 95 knots at normal approach weights). I call it a decision point because from there on you should not attempt a balked landing

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unless you are on the razor edge of competence. If there is any doubt at this point, execute a missed approach unless you are blessed with a very long runway in front of you.

The Duke is a good airplane in which to demonstrate the concept of getting behind the power curve. The best place to check this out is at altitude. Just as during takeoff, a lot of time is required to accelerate from a slow-speed maneuver, such as approach to stall or, even more telling, Vmc. So long as a pilot knows the technique and the characteristics of an airplane, a missed approach or any other change in plans is strictly no sweat, so long as power and airspeed and descent rate are all in hand. In a Duke, knowing, practicing and adhering to the characteristics of the airplane make all the difference between competent confidence and hair-raising adventure. Stalls, single-engine work and approaches to minimums can be handled as a matter of course if you are trained properly.

And it makes it easier on the airplane and its systems, and any passengers who may be on board, too.

My reunion with the Beech Duke, which included a lot of night and IFR hours, was a pleasure. It renewed my appreciation for an airplane that is competitive in many ways but that suffers from its reputation as an aircraft only for those high rollers who have made it big and who want to show it to the world. □

BEECH DUKE
Model B60
Base price $433,250
Price as tested $644,452
AOPA Pilot Operations/Equipment Category*:
All-weather $559,000 to $650,000 (est.)

Specifications

Powerplants	2 380-hp Lycoming TIO-541-E1C4, 6 cyl, 760 hp total @ 2,900 rpm/41.5 in
Recommended TBO	1,600 hr
Propellers	2 Hartzell, 3 blade, constant speed, full feathering, 74 in dia
Length	33 ft 10 in
Height	12 ft 4 in
Wingspan	39 ft 3 in
Wing area	212.9 sq ft
Wing loading	31.8 lb/sq ft
Power loading	8.9 lb/hp
Seats	6
Cabin length	11 ft 10 in
Cabin width	4 ft 2 in
Cabin height	4 ft 4 in
Empty weight	4,425 lb
Empty weight, as tested	4,919 lb
Max ramp weight	6,819 lb
Useful load	2,394 lb
Useful load, as tested	1,900 lb
Payload w/202 gal/1,212 lb fuel	1,182 lb
Payload w/232 gal/1,392 lb fuel, as tested	508 lb
Max takeoff weight	6,775 lb
Max landing weight (with 10 ply tires; 6,600 w/8 ply tires)	6,775 lb
Fuel capacity	147 gal (142 gal/852 lb usable) 207 gal (202 gal/1,212 lb usable) 237 gal (232 gal/1,392 lb usable)
Oil capacity, ea engine	13 qt
Baggage capacity	
front (nose bay)	500 lb, 32 cu ft
aft cabin (6-seat configuration)	70 lb,—

Performance

Takeoff distance, ground roll	2,075 ft
Takeoff distance over 50-ft obst	2,626 ft
Accelerate/stop distance	3,600 ft
Max demonstrated crosswind component	25 kt
Rate of climb, sea level	1,601 fpm
Single-engine ROC, sea level	307 fpm
Max level speed, 23,000 ft	246 kt
Cruise speed/Range w/45-min rsv, 232 gal fuel @ 6,125 lb mid-cruise weight (fuel consumption, both engines)	
Approx. 79% power, best economy	
26,000 ft	240 kt/1,068 nm (260.4 pph/43.4 gph)
16,000 ft	222 kt/[illegible] (284.4 pph/47.4 gph)
Approx. 65% power, best economy	
26,000 ft	226 kt/1,127 nm (225 pph/37.5 gph)
16,000 ft	207 kt/1,032 nm 235.2 pph/39.2 gph)
Approx. 55% power, best economy	
26,000 ft	219 kt/1,178 nm (209.4 pph/34.9 gph)
16,000 ft	201 kt/1,088 nm (216 pph/36 gph)
Max operating altitude	30,[illegible]
Single-engine service ceiling	15,[illegible]
Landing distance over 50-ft obst	3,065 ft
Landing distance, ground roll	1,318 ft

Limiting and Recommended Airspeeds

Vmc (Min control w/ critical engine inoperative)	85 KIAS
Vx (Best angle of climb)	99 KIAS
Vy (Best rate of climb)	120 KIAS
Vxse (Best single-engine angle of climb)	100 KIAS
Vyse (Best single-engine rate of climb)	112 KIAS
Va (Design maneuvering)	160 KIAS
Vfe (Max flap extended)	
15°	174 KIAS
30°	140 KIAS
Vle (Max gear extended)	174 KIAS
Vlo (Max gear operating)	174 KIAS
Vno (Max structural cruising)	207 KIAS
Vne (Never exceed)	233 KIAS
Vr (Rotation)	85 KIAS
V_{S1} (Stall clean)	81 KIAS
V_{SO} (Stall in landing configuration)	73 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 Category reflects this aircraft's maximum potential.*
See June 1982 Pilot p. 93.