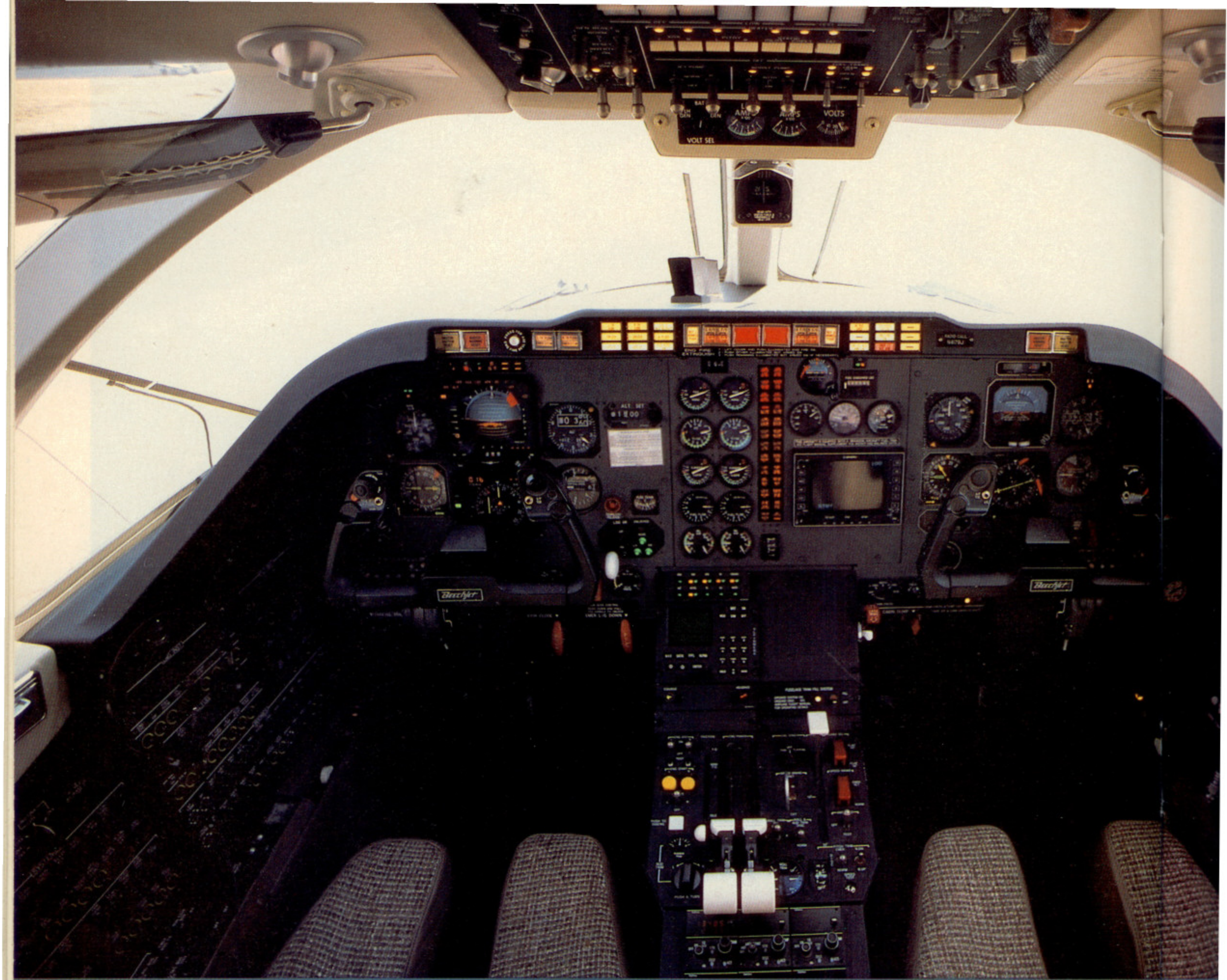
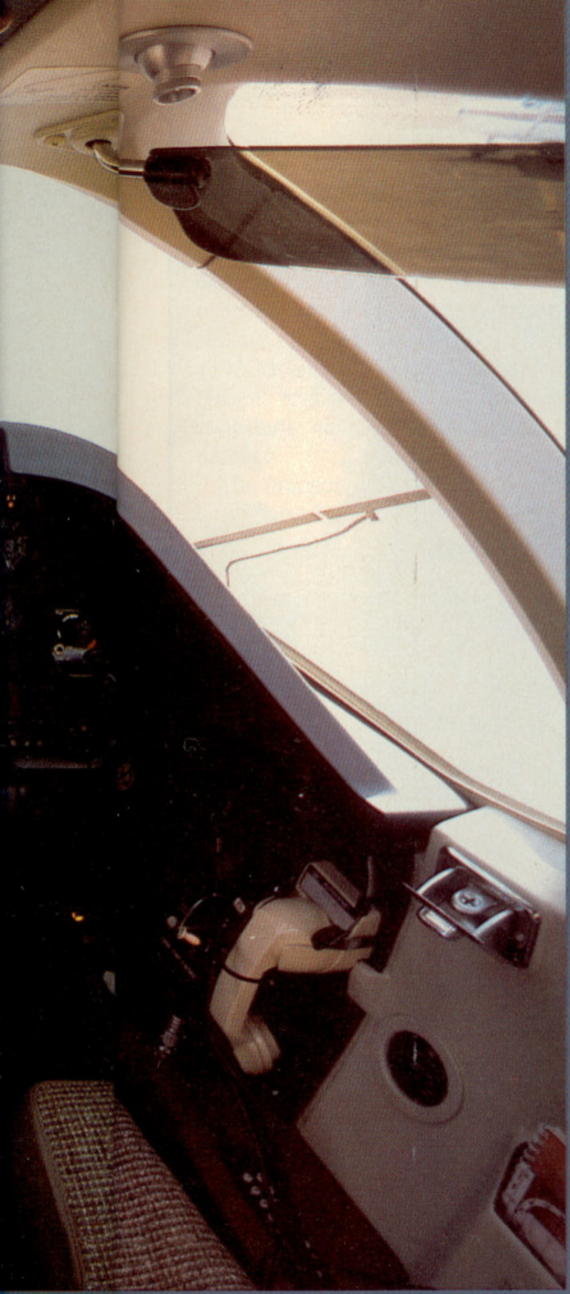
BEECHJET 400

Performance, systems and procedural improvements mark Beech Aircraft's latest addition to its product line

BY THOMAS A. HORNE

THE Beechjet story begins with the Diamond I, a corporate turbofan introduced by Mitsubishi Aircraft International (MAI) in 1981. For all the fanfare, the airplane faced several important disadvantages. The ardors of complying with the Federal Aviation Administration's new Federal Aviation Regulations Part 25 certification standards caused


VOLTS
VOLT SEL
Beechjet
Beechjet



Mitsubishi to miss its target empty weight of 8,050 pounds; most Diamond Is' average-equipped empty weights were around 9,200 pounds by the time they were ready to go to market. Most important—especially for those operating out of high-altitude airports at high temperatures—is the relatively low amount of thrust developed by the I's Pratt and Whitney JT15D-4 engines. With just 2,500 pounds of thrust per engine, there is not enough power to allow operators always to take advantage of the airplane's full useful load. To meet the certification requirements for second segment climb with an inoperative engine (this assumes that the airplane is flying at V2—takeoff safety speed—with landing gear and lights retracted, and extends from the end of the retraction cycle to a height of 400 feet agl), Diamond I pilots operating out of high-and-hot airports have to offload either passengers or fuel to meet the regulations. Since leaving passengers behind is usually an unacceptable answer, many Diamond I operators in the western states face ranges of as little as 350 to 500 nautical miles, depending on payload and the severity of takeoff conditions.

Relief came in 1982, when MAI brought out the Diamond IA. The airplane bore the same basic engines as the I, but they were given stronger burner cans and directionally solidified first-stage turbine blades, then certificated to higher internal temperatures and designated with the -4D suffix. This gives the engines five percent more thrust than the -4. More accurate, digital-display N1 (fan rpm) gauges allowed crews to set takeoff power more quickly. Two procedural changes also helped boost takeoff performance and reduce required runway lengths. One authorizes takeoffs with the environmental control system (ECS) off. Since the ECS diverts engine bleed air to drive the airplane's pressurization and air conditioning equipment, ECS-off takeoffs give the engines three percent more thrust. Another permits takeoffs with a zero flap setting (normal takeoffs are performed with 10 degrees of flaps), which allows increases in target takeoff airspeeds (Vr, V1, and V2) of up to nine percent over normal speeds. Consequently, second segment climb performance is significantly improved over that of the Diamond I. But there are drawbacks: This takeoff procedure requires longer runway lengths, and in the event of an engine failure, landings must be made with just 10 degrees of flap deflection. Approximately 60 Diamond IAs were sold.

The IA modifications were made available as a retrofit to owners of Diamond Is under MAI's "PEP" (performance enhancement program) initiative. Most of the 20 Diamond Is that had been delivered were fitted with the new fan blades, burner cans and N1 gauges as part of a hot-section (combustion

chamber) inspection.

The Diamond II, introduced in 1985, marked the culmination of the series. By this time Pratt and Whitney had developed their JT15D-5 turbofan engine of 2,900 pounds thrust. It was just what the doctor ordered for the ailing Diamonds. Introduced in a time of recession, the I and IA were met with a lukewarm reception. MAI had been losing market share, principally to Cessna's Citation II series, even though the Diamond IA's cruise speed is up to 30 KTAS faster, and its IFR ranges, fuel burns and prices are generally comparable to those of the Cessnas. The single-engine climb and balanced-field limitations of the I and IA hardly matter to those flying out of airports east of the Mississippi or other low-lying areas. But the I and IA's perception as a marginal performer had a firm hold on the aviation community.

The new engines changed all that. The extra 800 pounds of total thrust brought tremendous performance increases. Compared to the IA, the Diamond II has an 865-pound greater useful load and a 1,150-pound higher takeoff weight, can carry up to 1,500 pounds more on high/hot takeoffs and still meet Part 25 requirements, and needs less runway. (For example, at an airport pressure altitude of 5,000 feet and a temperature of 30 degrees Celsius [86 degrees Fahrenheit] the Diamond II can perform takeoffs at just 130 pounds below maximum takeoff weight using a 6,350-foot runway; under the same conditions, the IA would have to offload 430 pounds and would require a 9,200-foot runway.)

Similar improvements can be found in time-to-climb and cruise performance. At maximum takeoff weight, the Diamond II takes 34 minutes to reach its maximum operating altitude of 41,000 feet; the IA, certified to the same altitude, takes a full 77 minutes. The II's advantages in cruise speed range anywhere from 26 KTAS/Mach .04 at Flight Level 310 to 46 KTAS/Mach .08 at FL410.

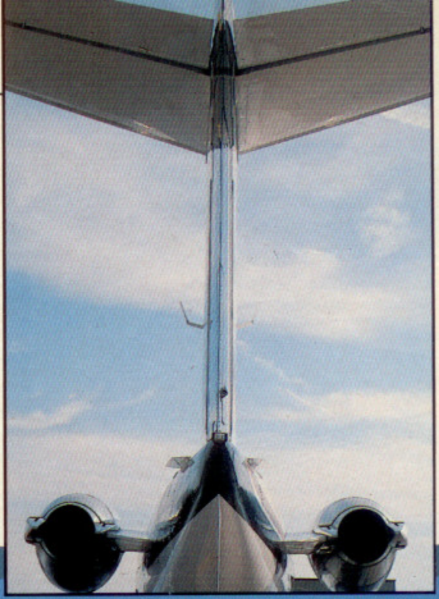
The Diamond II's normal optimum-altitude (41,000 feet) cruise speed (approximately 446 KTAS) also looks very good when compared to those of the Citations and model 25D and 35A Learjets—the very airplanes the Diamond II seeks to challenge. The Diamond has a speed advantage of nearly 50 knots over the Citation SII and comes in only a few knots below the Citation III and approximately 15 knots below the Learjets. But the Citation III and the Learjets burn from 50- to 500-pph more fuel, respectively, to accomplish their speed advantages at their higher optimum altitudes.

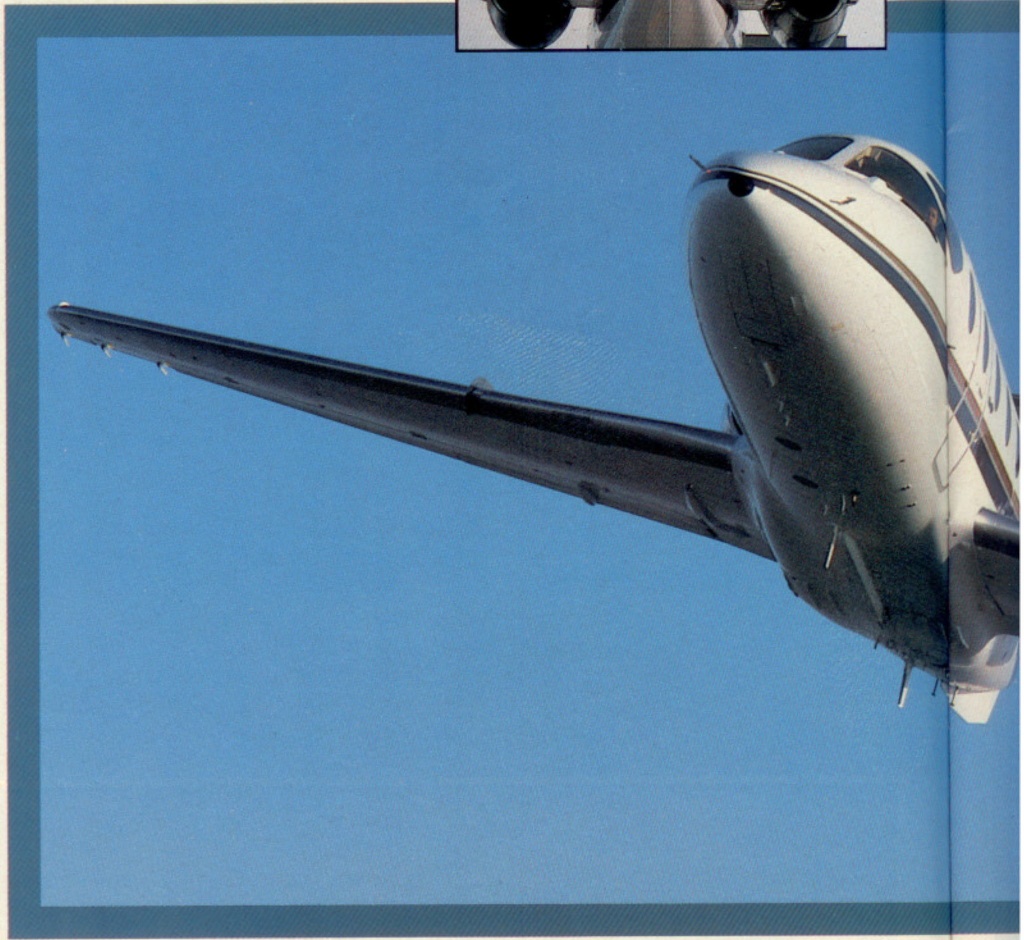
•

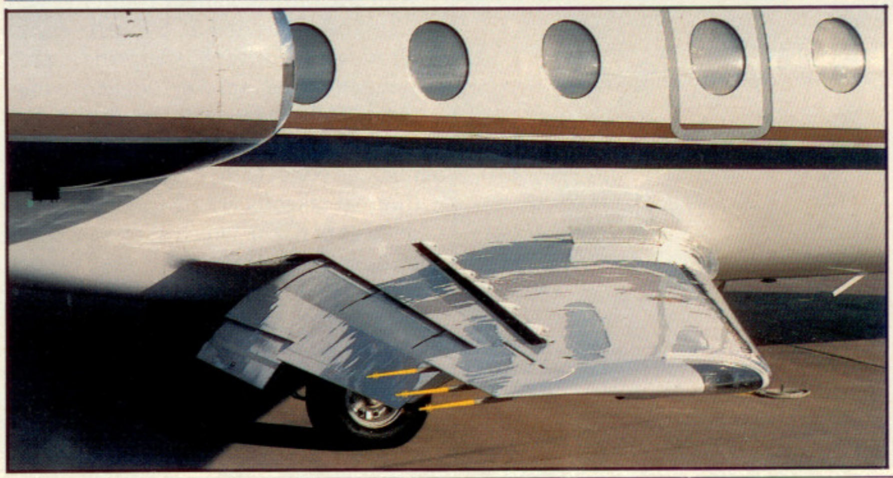
In late 1985 Beech Aircraft Corporation acquired the Diamond II program from Mitsubishi and renamed the Diamond II the Beechjet 400. It was more than a change in name alone. While the performance profiles remain essentially the same as those of the Diamond II, Beech has made some attractive enhancements to the basic airplane.

One of them is an additional 100-gallon aft-fuselage fuel tank and filling system. Developed by the Branson Aircraft Corporation of Denver, Colorado, and offered as an option on all Diamonds, the system is standard equipment on the Beechjet 400. The extra fuel stored in the fuselage tank can extend the range of the Beechjet 400 by as much as 250 nm. The filling system is helpful in reducing turnaround time, simplifying the refueling process and sparing the airframe from paint and other damage caused by inadvertent fuel spills and clumsy line personnel. The Branson fuel system was offered as a $10,000 option by Mitsubishi. On the Beechjet, it is a standard feature.

The beauty of the Branson system is



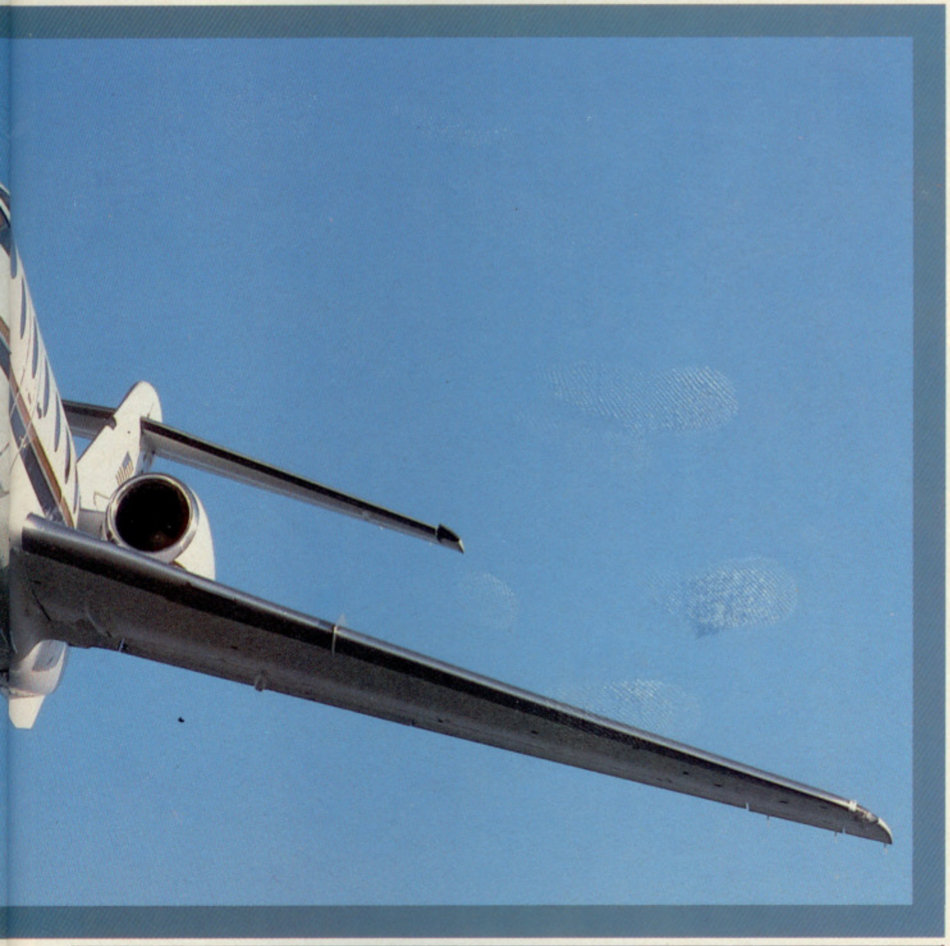




that it obviates the need to use the fuselage tank's filler port, which is located above the right engine pylon. It can be awkward to fill this tank because linemen are typically perched high on a ladder and cannot see the fuel level as it nears the top. If there is an overflow, the spillage can make its way into a fuselage vent, causing fumes in the cabin. Belt buckles and poorly-aimed fuel nozzles contribute to the problem of paint damage.

The Branson filling system lets the pilot transfer fuel from the left wing tank to the aft fuselage tank when the airplane is on the ground. This is accomplished by using an electric boost pump. The transfer process takes from 10 to 15 minutes and is stopped automatically when the fuselage tank is full. Using these procedures, linemen need only fill the two wing tanks.

Another Branson modification—an enlarged tailcone baggage compartment—is also standard with the Beechjet. This compartment has a 33-cubic-foot capacity, more than twice as large as the standard tailcone baggage compartments on the Diamonds I, IA and II. For these airplanes, the Branson baggage compartment was a $34,950 option.



Beech has also amplified on the creature comforts. The Diamond II began with what was already a capacious cabin, with more head and shoulder room than its closest competitors, but Beech has added club-style seats that swivel and track inboard for even more comfort. Beech also moved the lavatory seat to the front of the cabin, behind the cockpit, where it is can be isolated by means of two close-fitting sliding wood panels. The seats and headliner have been redone in the fabric styles used in the Beech King Air 300, and the windows now incorporate rotating polarizing sunscreens that will be familiar to all who know the King Air series. The airplane retains the Diamond II's rear bench seat, which will seat three with a fair degree of comfort.

The real pleasure is in the cockpit, however. Its organization helps keep work load at a manageable level, especially during emergency procedures. The overhead panel contains generator, battery, fuel, ice protection and lighting switches. The overhead subpanel contains ammeters and a voltmeter. The glareshield indicator panel consists of indicator lights that give status reports of the autopilot, fuel crossfeed, speed brake and thrust reverser (if so equipped—the Rohr thrust reverser option costs $189,875) systems. Also included are the engine fire extinguishing controls and thrust reverser emergency stowing switches.

The master warning annunciator panel is arranged vertically at the center of the instrument panel, to the right of the engine instruments. Especially noteworthy is the color-coding of the Beechjet's circuit breakers—blue circles surround those breakers on the left load bus, with yellow for the right bus, red for the emergency bus, green for the standby bus and color-striped circles for the nonessential and AC buses. This is extremely helpful in troubleshooting electrical malfunctions and emergencies.

The start sequence is very simple; select an engine, push the start button and move the appropriate thrust lever to the Idle position at eight-percent turbine rpm speed. The rest of the ignition sequence is automatic. In flight, the airplane demonstrates excellent stability and requires little effort to trim. Stalls—


N417BJ

preceded by a stickshaker warning—are very mild and consist mainly of buffeting, with no tendency to drop a wing. Roll inputs can require above-normal control force. The Beechjet uses spoilers for roll control, and they double as speed brakes. With speed brakes deployed, the high airloads require a fair amount of muscle to further deflect a spoiler.

The Beechjet uses trim ailerons for trim in the roll axis. A blip or two of the yoke-mounted trim button take care of a wing-low situation caused by uneven fuel consumption or fuel loads. The only oddity in the airplane's control feel becomes apparent when the airplane is untrimmed in roll and the pilot releases the control yoke. In this case, airloads blow down the spoilers, automatically snapping the yoke to a central position. It is a signal that further trimming is necessary.

Transition to the Beechjet should present no problems for pilots with experience in turboprops. Preparing the airplane for approach is straightforward; speed brakes may be deployed at any speed, and the landing gear, the double-slotted Fowler flaps and landing lights may all be extended at 200 KIAS. With just a little practice and a knowledge of the proper power settings, approach and landing is an uncomplicated, rewarding procedure. Approach speeds hover around 105 KIAS—very low, considering that the Beechjet is capable of Mach .78. The cost of initial training for two pilots and two mechanics at FlightSafety International's Houston, Texas, facility is included in the price of the airplane.

The combination of high-quality construction (sub-assemblies for the Beechjet are still built by Mitsubishi and sent to Beech for final assembly), Beech's strong support network and attention to detail in both construction and service should give the airplane several important advantages that were lacking in its previous life. So far, the airplane has been a modest success for Beech, with construction running at the rate of one and a half airplanes per month. In many respects the airplane's future will depend on the reception accorded Beech's Starship, a futuristic, composite turboprop twin with a projected cost of more than $4 million. Will future corporate buyers opt for a more conventional jet, or pay a premium for a new concept? Whatever the answer, the company is in a position to respond. □

Beech Aircraft Corporation
BE400 Beechjet
Base price: $3,270,000
AOPA Pilot Operations/Equipment Category*:
Global

Specifications

Powerplant(s)	Two Pratt & Whitney JT15D-5 turbofans; 5,800 lb total takeoff thrust (sea level, standard temperature)
Recommended TBO	3,000 hr
Hot section maintenance	1,000 hr
Length	48 ft 4 in
Height	13 ft 9 in
Wingspan	43 ft 5 in
Wing area	241.4 sq ft
Wing loading	65.6 lb/sq ft
Power loading	2.7 lb/hp
Seats	9–11
Cabin length, including flight deck	20 ft 11 in
excluding flight deck	15 ft 7 in
Cabin width	4 ft 11 in
Cabin height	4 ft 9 in
Empty weight	9,265 lb
Max ramp weight	15,850 lb
Useful load	5,925 lb
Payload w/full fuel	1,021 lb
Max takeoff weight	15,850 lb
Max landing weight	14,220 lb
Zero fuel weight	12,470 lb
Fuel capacity, std	4,993.5 lb (4,879.6 lb usable) 745.3 gal (728.3 gal usable)
Oil capacity, each engine	8.12 qt
Baggage capacity, aft tailcone	450 lb, 33 cu ft
forward closet	150 lb, 12 cu ft
aft cabin (rear seats folded down)	400 lb, 13 cu ft

Performance

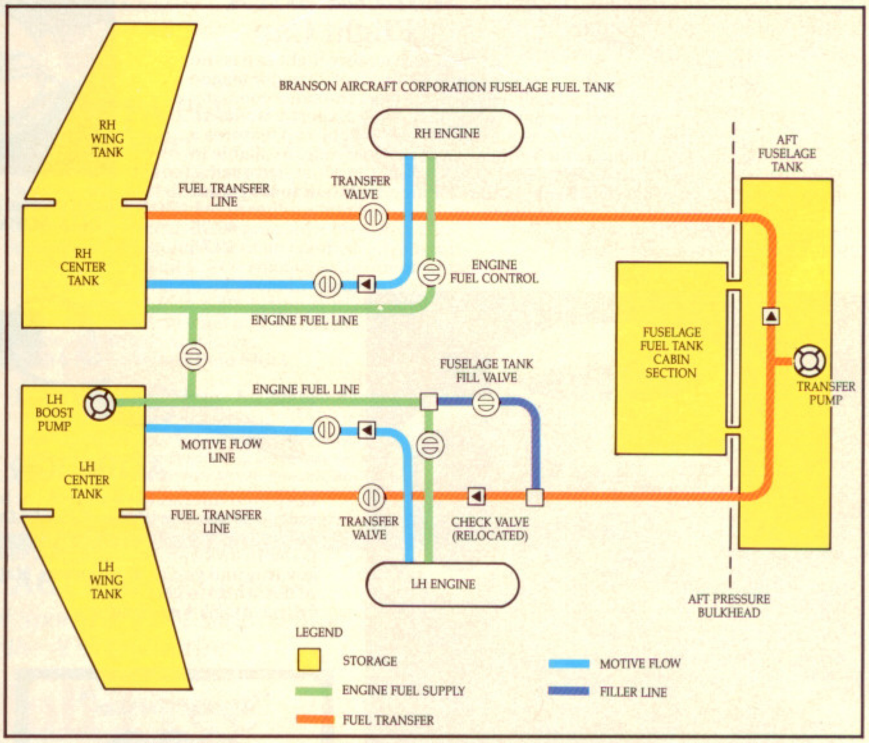
Takeoff balanced field length	3,950 ft
Rate of climb, sea level	3,960 fpm
Single-engine ROC, sea level	1,110 fpm
High-speed cruise, 13,000 lb, 31,000 ft	454 KTAS/Mach 0.78; 1,502 pph/224 gph
Range w/IFR reserves	1,530 nm
Long-range cruise, 13,000 lb, 41,000 ft	394 KTAS/Mach 0.7; 866 pph/129 gph
Range w/no reserves	2,219 nm
Max operating altitude	41,000 ft
Pressure differential	9.1 psi (6,400-ft cabin at 41,000 ft)
Landing distance, anti-skid on, no thrust reversers	2,830 ft

Limiting and Recommended Airspeeds

Vmcg (min single-eng control, ground)	93 KIAS
Vmca (min single-eng control, air)	90 KIAS
V1 (critical engine failure)	108 KIAS
Vr (rotation)	119 KIAS
V2 (takeoff safety speed)	123 KIAS
Vmo (max operating); to 14,000 ft	264 KIAS
14,000–17,000 ft	264–320 KIAS
17,000–26,000 ft	320 KIAS
Mmo (max Mach operating) above 26,000 ft	Mach 0.785
Vfe (flaps extended); flaps 10°	200 KIAS
flaps 30°	165 KIAS
Vle (max gear extended)	200 KIAS
Vlo (max gear operating)	200 KIAS
Vsb (max speed brake deployment)	no limit
Vww (max windshield wiper)	200 KIAS
Vs1 (stall clean)	111 KIAS
Vso (stall in landing configuration)	87 KIAS
Vref (final approach at 13,000 lb)	108 KIAS

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

* Operations/Equipment Category reflects this aircraft's maximum potential. See June 1987 *Pilot*, p. 98. □



Branson fill system and long-range tank is standard. It speeds turnaround time by using the left center tank to fill the aft fuselage tank. Note that left engine fuel line must bypass engine and transfer line's one-way check valve to accomplish internal transfer.