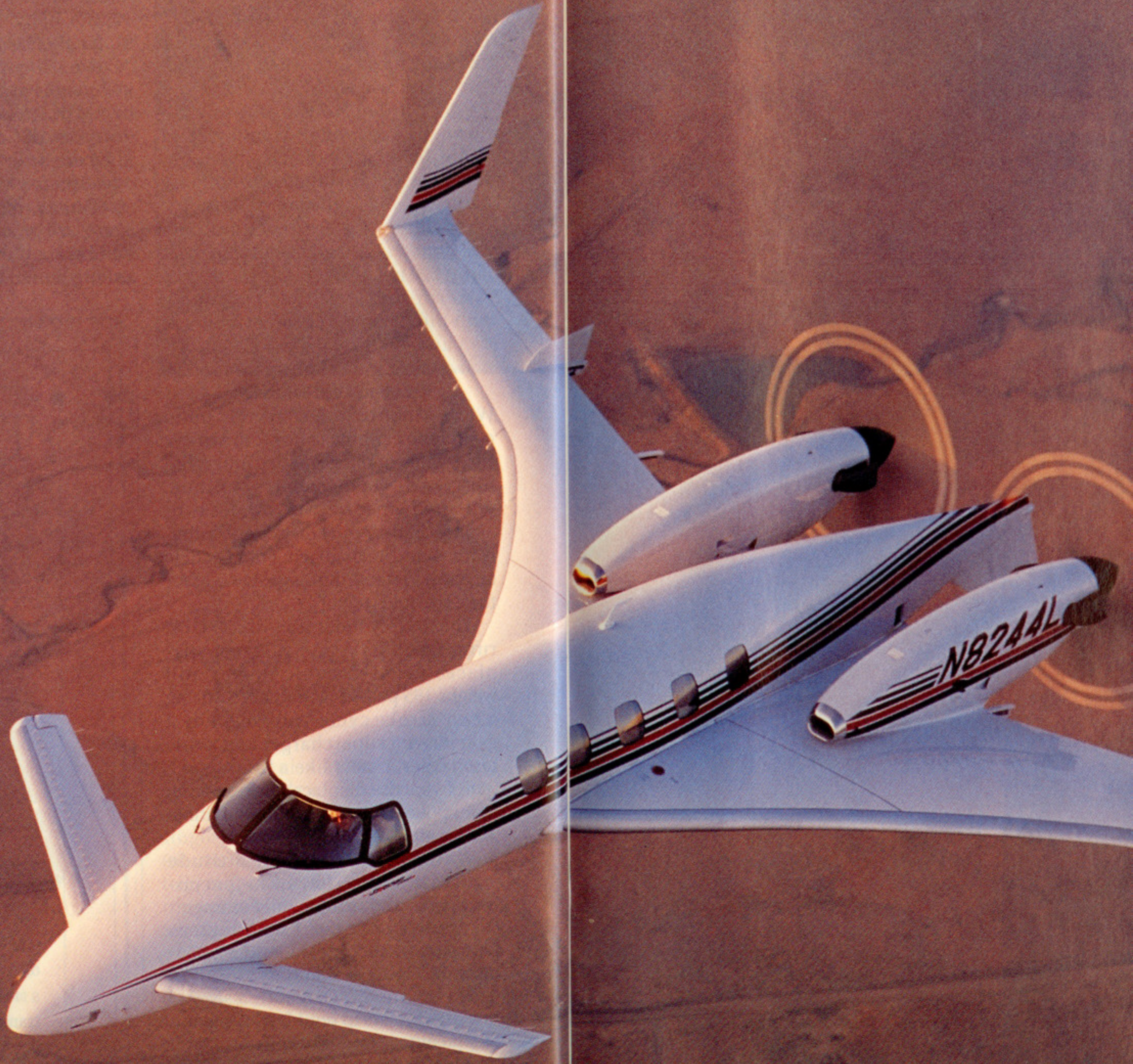
STARSHIP 2000A

Going the original design one better

BY THOMAS A. HORNE

Time flies. The Starship program is 10 years old. The racy-looking composite design that sprang from Burt Rutan's fertile mind in 1983 still turns heads at rampside but perhaps at more leisurely rates these days. In early 1990, when the first production Starships were delivered, a Starship's arrival was enough to stop an airport crowd cold. Now, with some 32 airplanes in the fleet, the Starship has, well, finally arrived. ■ That's not to say that there haven't been problems. Beech found out early that style alone couldn't guarantee a fat order book. It turned out that the original Starship 1, or Model 2000, wasn't fast, roomy, or long-legged enough to satisfy many prospects. Just as worrisome were the 2000's high cabin noise levels and runway-hungry balanced field lengths. Useful load—some 600 pounds with full fuel—was another big con-



PHOTOGRAPHY BY MIKE FIZER

cern. All of this seemed a lot to sacrifice for a $4-million-plus price tag. Pilots may have loved the Starship's advanced cockpit, but those in back—the ones writing the checks—definitely didn't appreciate the shortcomings.

Beech got the message, and the result is the latest Starship iteration, the Model 2000A. Certified in late 1992, the 2000A is now hot on the demo circuit. By external appearance, it would take a sharp eye to spot the differences between a 2000 and a 2000A. But a peek inside and a look at the numbers show that Beech did a great job listening to the critics.

To boost cruise speeds, increase gross weight, and reduce runway requirements, Beech installed longer, larger-diameter exhaust stacks on the new Starship's 1,200-shaft-horsepower Pratt & Whitney Canada PT6A-67 engines. The new stacks increase thrust by reducing exhaust back pressure. At maximum cruise power and 35,000 feet, this translates into speeds of about 315 KTAS at medium weights—approximately 18 knots faster than those of the 2000. At lower altitudes, the speed increases are more modest—about 4 to 10 knots faster than the early Starship.

The new stacks also create less external noise and let the 2000A's engines develop their fully rated takeoff power all the way up to a 10,000-foot density altitude. That's almost 4,000 feet higher than the 2000 and makes a definite increase in takeoff performance under hot and high density-altitude conditions.

In addition, Beech reduced the Starship's drag by eliminating the canard's stall strip. After extensive testing, it was learned that the stall strip's absence made no difference in the airplane's behavior at the stall's onset and in fact lowered the stall speed a few knots. This, after the great deal of fuss, weight, and expense occasioned by Beech's having to provide a means of stall warning in a design that simply doesn't produce a conventional stall "break." The Starship's combination of stickshaker and stick-pusher remains in place as both a warning and corrective measure, respectively, for dealing with the gentler way a canard design loses lift at high angles of attack and load factors.

This combination of increased thrust and reduced drag did more than raise cruise speed. It also re-

duced the 2000A's balanced field length to 3,894 feet (down from the 2000's 4,093 feet) and increased the 2000A's maximum takeoff weight to 14,900 pounds (up from the 2000's 14,500 pounds).

In another modification, the 2000A was given a 202-pound (approximately 30-gallon) increase in fuel capacity. This was accomplished by shortening the height of the fuel standpipes in the wings' aft fuel cells.

Total the effect of these performance modifications, and yet another

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improvement is realized for the 2000A—payload with maximum fuel is now about 900 pounds, up 300 pounds from the 2000. Maximum ramp weight, zero fuel weight, and maximum payload also experience similar increases.

As for the cabin, Beech took care of the noise complaints by installing more soundproofing material, as well as special dynamic vibration dampeners designed to absorb the annoying resonances caused by propeller harmonics at cruise power settings. The company claims a 6-decibel average cabin noise reduction.

The seating arrangement has been changed, too. Where the 2000 had eight places, with a bench seat and a toilet up front, the A model comes in a more spacious, six-seat configuration. The potty's been moved to the rear, and the forward baggage area/closet has increased in size from 14 to 19.5 cubic feet.

According to Beech, the cabin improvements have met with rave reviews. Starship Marketing Manager Tom Schiller said that the 2000A is the "only turboprop with a mid-sized jet's cabin comfort" and added that prospects who rejected the original eight-seat Starship's cabin as too cramped and noisy are now having a change of heart. At least two have bought 2000As on the strength of the cabin features alone.

Beech will retrofit all but the soundproofing changes for 2000 owners free of charge. At this time, the switch from an eight- to a six-place interior, however, is not being offered.

The two most interesting seats, of course, are in the front row. Here, you'll find one of the world's best-equipped panels, laid out in an ergonomically friendly design and surrounded by plenty of pilot elbow room. The 2000A's cockpit is the same as its predecessor's.

While the 14-tube Collins Pro Line 4 avionics suite may no longer represent the state of the art as it did in the mid-1980s, it still delivers tons of information in formats that are easily apprehended by those who might otherwise be nervous about flying behind a glass cockpit. Airspeed and altitude, for example, are shown on cathode-ray tubes—but the representations are those of the circular analog instruments that we're all familiar with.

What Beech calls the primary flight display is a large CRT that can serve as an attitude indicator, radar altimeter, flight director, autopilot mode annunciator, fast/slow airspeed indicator (based on target airspeed as selected by the airspeed indicator bug), and course deviation indicator—all rolled into one.

Another large CRT contains the navigation display, which has a horizontal situation indicator, a 70-degree heading indicator arc, weather radar, and waypoint mapping modes. Weather radar imagery can be superimposed on the arc or map displays.

Special features abound. If any tube malfunctions, the information it displayed can be switched to an operat-

ing tube using reversionary features. The airspeed indicator gives trend information, showing your projected airspeed in the next 10 seconds by means of a magenta arc. Push a button, and you learn how much the outside air temperature varies from a standard atmospheric condition. A probe detects the onset of airframe icing, and deice boots cycle automatically at the proper intervals.

Multifunction displays can be used for, among other things, entering flight management system data, storing routes, monitoring flight performance, determining navaid and avionics status, and even listing the type and extent of any engine limitation exceedances.

Other tubes include an EICAS (engine instrument, crew alerting system) display, altitude/vertical speed indicators, and sensor display units—basically electronic radio magnetic indicator heads.

To make the Starship's panel really sing, a good deal of training and practice is a must. A large part of FlightSafety International's three-week pilot initial training course is devoted to learning the Pro Line 4's ins and outs. Even with the FSI course under their belts, many pilots say that it can take up to 15 hours of Starship time before a neophyte feels completely at home

behind that vast electronic array.

Though it's nice to slobber over the avionics, there's no substitute for flying the Starship. I flew the 2000A this past February out of Beech Factory Airport in Wichita, with Schiller in the right seat. His familiarity with the Starship's panel and procedures certainly came in handy, making it easy to see why the Starship is certified as a two-pilot airplane. What most don't know, however, is that the Starship can legally be flown in single-pilot operations. For single-pilot authorization, the pilot must earn a single-pilot type certificate, and the autopilot and flight management system must be operative.

It's always gratifying to indulge yourself in launching 15,000 pounds of airplane with 2,400 shp, but even with all that power, the Starship is a ground-lover on takeoff. As we stormed down the runway, V_R (98 KIAS at our weight), V_1 (102 KIAS), and V_2 (114 KIAS) soon swept by. Initial rates of climb were in the 3,000-feet-per-minute range. Due to high engine torque, the Starship wants to roll and yaw to the right after takeoff. To help counteract this, left roll trim is dialed in as part of the pre-takeoff check list.

It took us just 17 minutes to reach Flight Level 350, where we settled down to a cruise speed of 318 KTAS on our way to the Hutchinson (Kansas) Municipal Airport. Fuel burn was about 320 pounds per hour per engine, for a total consumption rate of approximately 97 gph. With the navigation display in the HSI mode, I saw another helpful feature of the Starship's avionics. To the left of the compass rose, a small arrow gave the

direction of the winds aloft. Next to it was the wind speed: 86 knots, out of the northwest.

Though roll forces are heavy, the Starship does extremely well as an instrument platform. I had expected the airplane to be very sensitive in pitch—like a few canard-equipped homebuilts I'd flown—but this was a world apart. I hand-flew the airplane during most of the flight and found it to have very conventional handling characteristics.

After descending to 15,000 feet, we went through a stall series that would have been out of the question in any other twin.

With power at flight idle, aft stick pressure was applied until the stick-shaker activated. At this point, airspeed was about 95 KIAS. There was some mild buffeting but no dramatic pitching, bucking, or wing-dropping. Schiller took things a step further by hooking his elbows around the yoke and hauling back until the stick-pusher engaged. The nose dropped a few degrees, we added power, and the Starship was flying.

The next exercise began with mushing along at stickshaker and 85 KIAS. By advancing power, a climb rate of about 300 fpm was achieved—quite a feat for a "stalled" airplane.

For a final stall demonstration, Schiller took the airplane to stickshaker, then simultaneously applied full right elevon and full left rudder. We were in a fully developed cross-control stall, but once again, the airplane didn't bite. Like before, the airframe buffeted slightly and mushed, with the wings almost level. In any other airplane, this would have been a recipe for a spin entry.

Ramp-watchers can spot a 2000A by its big exhaust stacks and lack of canard stall strips.

Upon entering the pattern at Hutchinson, we slowed the airplane to V_{FE} (180 KIAS), and flaps and gear were extended at the customary points on the downwind leg.

Landings are challenging for two reasons. The first is the airplane's deck angle on approach. Approach speeds range from 107 to 121 KIAS, depending on weight, and on final, it appears as though the nose is abnormally low. The second reason ties in with the first, in that there is a great urge to raise the nose and execute a conventional landing flare. With practice comes the realization that the nose-low attitude is the proper one and that very little flare is required for a mains-first touchdown. I'm told that the actual moment of touchdown can be a graceful affair, but this, too, requires a fair amount of practice.

We flew an ILS approach into Wichita's Mid-Continent Airport, using 30-percent-torque settings. The airplane came down the pipe as if on rails, at 140 KIAS with gear and flaps extended. There was some turbulence, but none of it produced any of the yawing or rolling you might ordinarily expect. Pitch excursions in turbulence were very small.

Once planted on the runway, you sample the Starship's rather stiff ground handling. The airplane stands tall, on gear that seem to provide a modicum of shock absorption. There is a power-assisted brake mode for normal braking action and an antiskid mode for those times when maximum braking response is needed on short or slippery runways.

From a design standpoint, the Starship is a remarkable machine. It was brought to market after one of the most thorough certification trials ever performed. The reason for that thoroughness had to do with Beech's need to prove that a canard-configuration, pusher-propeller, composite-construction airplane could be every bit as safe as a conventional design.

As a result, the Starship's airframe was certified to the latest amendments to Federal Aviation Regulations Part 23 under the "damage tolerant" school of thought. This approach assumes that any structure will have flaws, and these flaws can be predicted and tracked.

To comply, the Starship was subjected to ground-to-air-to-ground cycles for 20,000 hours' worth of simulated flight; inspection for damage took place every 5,000 hours. Then damage—in the form of deliberately inflicted impact damage, cuts, and burns—was inflicted, and the airframe tested for an additional 20,000 hours. The Starship passed, writing the book for composite designs to follow.

Besides these breakthroughs in composite certification, the airplane also met the most stringent standards for lightning protection. Lightning will not pass harmlessly through a pure composite airframe (which offers too

much electrical resistance and the possibility of explosive damage), so a fine mesh of aluminum wire is embedded into the Starship's outer ply of graphite fabric as a conductive medium. Testing showed that the airframe could withstand up to 200,000 ampere-hours of electricity—jolts more powerful than the average lightning strike. Lightning strikes on Starships in service proved the design's effectiveness in harmlessly dissipating electrical energy.

In spite of all these strengths, the Starship remains a subject of criticism. Other turboprop twins are faster, skeptics say, and have blanket permission for single-pilot operation. For the money, some say, you might as well buy a jet.

At $4.69 million, there's no doubt that the Starship's price is a deterrent for many prospects. Beech recently announced a lease and maintenance program that may appeal to the wary. Monthly payments are $31,950, with walkaway provisions at two- and five-year terms. Buy-out can take place at any time. Maintenance is free for the first two years or 720 hours. Pratt & Whitney's warranty covers two years or 1,000 hours, and Collins backs the avionics with a two-year warranty.

Beech reports an upsurge of interest in Europe, where the Starship presents some definite operational advantages over jets. There, common practice is for air traffic control to keep jets in the 18,000- to 25,000-foot altitude range, where they're punished by high fuel burns. Couple this with the under-1,000-nautical-mile stage lengths typical of the region, and the Starship makes sense. The Starship performs best in the low 20s, and its range at maximum power settings is just over the 1,000-nm mark. A British 2000A owner reports that, compared to his old Lear 55, he can fly the same routes on one-third the fuel.

The Starship's place in aviation history is secure. Its futuristic lines and unusual configuration will always make a statement about its owners, a fact that the Beech sales force counts on to attract a special breed of clientele. The enhancements of the 2000A should go a long way toward further establishing the Starship as a machine as capable as its stylistic promise. Just how much further will depend, of course, on its success in an increasingly demanding marketplace. □

Beechcraft Starship 2000A
Base price: $4,696,000

Specifications

Powerplants	Two P&W Canada PT6A-67A, 1,200 shp ea
Recommended TBO	3,000 hr
Propellers	Two McCauley five-blade, 104-in diameter, constant-speed, full-feathering, reversing
Length	46 ft 1 in
Height	12 ft 11 in
Wingspan	54 ft 5 in
Wing area	281 sq ft
Wing loading	51.3 lb/sq ft
Power loading	6 lb/hp
Seats	8
Cabin length	22 ft
Cabin width	5 ft 6 in
Cabin height	5 ft 4 in
Empty weight, as tested	10,080 lb
Max ramp weight	15,010 lb
Useful load, as tested	4,925 lb
Payload w/full fuel, as tested	1,139 lb
Max takeoff weight	14,900 lb
Max landing weight	13,680 lb
Zero fuel weight	12,600 lb
Fuel capacity	565 gal (all usable), 3,757 lb
Oil capacity, ea engine	16 qt
Baggage capacity	fwd 160 lb, 14 cu ft; aft 525 lb, 35 cu ft

Performance

Takeoff balanced field length	3,854 ft
Maximum demonstrated crosswind component	21 kts
Rate of climb, sea level	3,650 fpm
Single-engine ROC, sea level	1,100 fpm
Recommended cruise power speed/endurance w/45-min rsv @ FL290	312 KTAS/4.25 hr; 112.5 gph (748 pph)
Maximum cruise power speed/endurance w/45-min rsv @ FL220	331 KTAS/3.25 hr; 150 gph (998 pph)
Maximum-range cruise power speed/endurance w/45-min rsv @ FL350	291 KTAS/5.85 hr; 89 gph (592 pph)
Max operating altitude	41,000 ft
Single-engine service ceiling	18,500 ft
Landing distance over 50-ft obstacle	2,150 ft

Limiting and Recommended Airspeeds

V_{MC} (min control w/one engine inoperative)	
Flaps extended	89 KIAS
Flaps retracted	94 KIAS
V_X (best angle of climb)	115 KIAS
V_Y (best rate of climb)	140 KIAS
V_{XSE} (best single-engine angle of climb)	115 KIAS
V_{YSE} (best single-engine rate of climb)	130 KIAS
V_A (design maneuvering)	181 KIAS
V_{FE} (max flap extended)	180 KIAS
V_{LE} (max gear extended)	200 KIAS
V_{LO} (max gear operating)	
Extend	200 KIAS
Retract	180 KIAS
V_{MO} (max operating Mach number)	.6 Mach; 265–173 KIAS, depending on altitude
V_R (rotation)	101 KIAS
V_{S1} (stall, clean)	97 KIAS
V_{SO} (stall, in landing configuration)	90 KIAS

For more information, contact Beech Aircraft Corporation, Post Office Box 85, Wichita, Kansas 67201-0085; telephone 316/681-7111.

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.