RAYTHEON HAWKER 800XP

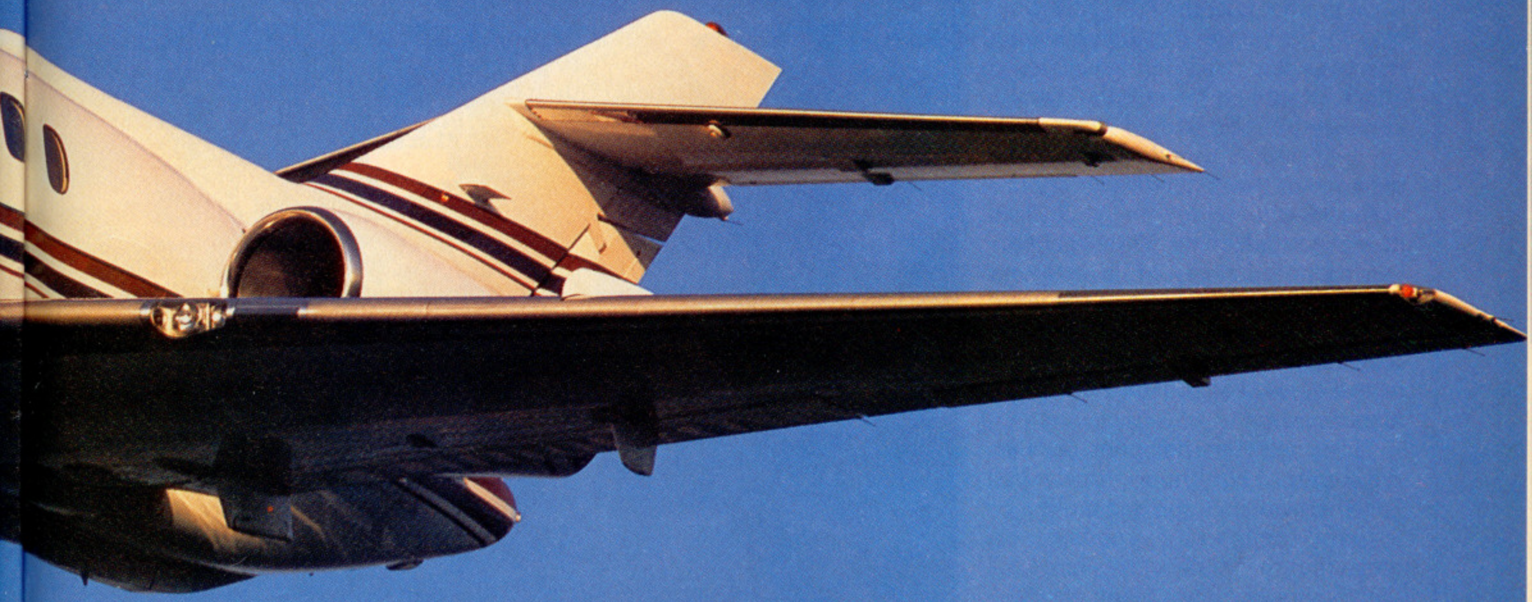
THE HAWKER 800'S NEXT STEP

Raytheon Aircraft spiffs up the 800-series Hawker

BY THOMAS A. HORNE

Hawker business jets, longtime fixtures in general aviation, have taken another step forward in the refinement of their basic, very popular design. Raytheon Aircraft's new Hawker 800XP was certified in July, and deliveries of this mid-sized, transcontinental fanjet will begin this fall. ■ The 800XP is an improvement on the Hawker 800 which, with 273 sales, was itself a successful airplane. Like its predecessors, the 800-series Hawker earned a reputation for its skillful blend of cabin comfort, range, and payload that is difficult to find in other mid-size jets. Never particularly well known for blistering speed, Hawkers are better recognized for their sturdiness, reliability, and excellent handling characteristics. ■ The 800XP promises to give all those attributes a shot in the arm. The XP's two AlliedSignal/Garrett

PHOTOGRAPHY BY MIKE FIZER



TFE-731-5BR turbofan engines have 4,660 pounds of thrust apiece. The 800s use TFE-731s with 4,300-pound maximum thrust settings. Those extra 720 pounds of thrust should produce XP cruise speeds anywhere from five to 14 knots faster than the 800 (topping out at 443 KTAS at FL370 under ISA conditions), and times to climb should be between 15 and 23 percent quicker. The 800 and 800XP share the same 0.80 Mach maximum Mach operating (M_{MO}) speed limitation. Typical high cruise Mach numbers under optimum conditions run about 0.78 to 0.79 Mach. That, by the way, is plenty of speed for typical missions, which usually cover far less than the XP's six-passenger, full-fuel maximum NBAA IFR range of 2,432 nautical miles.

The XP's increased thrust, coupled with a switch from stall fences to vortilons, ensures that the XP will reach target takeoff speeds in shorter distances and require slower V speeds on approach. The vortilons are small, blade-like fences affixed to the underside of the wings. They are features borrowed from the Hawker 1000, the 800 series' big brother and top of the Hawker line. Like the 800's stall fences, vortilons prevent the spanwise flow of air that sets in at high angles of attack, delay a stall's onset, and make certain that the wings' roots stall before their tips. They do this by creating a vortex that extends over the top of the wing, a method that yields less drag than stall fences. Vortex generators mounted ahead of the ailerons and stall strips attached to the wing root leading edges round out the 800 series' strategies for preserving stability and control at the low end of the flight envelope.

Thrust reversers, an option on 800s, are standard equipment for the XP. Together with an improved brake system and the lower V speeds, these mean that the 800XP can operate off slightly shorter runways than the 800.

None of this is to denigrate the 800, which has great stopping power even without reversers. That's because it—like the XP—has Hawker's "lift-dump" system. After landing, you pull the speed brake handle back to a detent, then out and down. This leaves the spoilers deployed and quickly extends the flaps to a whopping 75-degree deflection. Some claim that lift-dump

can be just as effective as reverse thrust—as long as the runway is dry.

The 800XP's operating weights are higher than the 800's, too. Maximum takeoff weight (28,000 pounds, compared to the 800's 27,400), maximum zero fuel weight (18,450 pounds versus 18,000 pounds), and maximum payload (2,350 pounds versus 2,000) are all up. In fact, the only weights that remain the same are the maximum landing and maximum fuel weights, at 23,350 and 10,000 pounds, respectively.

The combination of better runway performance and increased weights boils down to more flexibility when making trades between range and payload. This is especially true under nonstandard conditions.

Pilots of turbine airplanes are often faced with two dilemmas when it comes to takeoff planning. First, can they accelerate to safe takeoff speeds and still have enough distance to stop on the runway should a major problem occur before V_1 (takeoff decision speed)? Secondly, if the answer to that question is "no," then what—if anything—can be done to correct the situation without affecting the mission at hand?

These questions can be particularly vexing when the pilot is hoping to fly large passenger loads for longer distances out of airports with shorter runways under hot and high conditions. Since takeoff performance can be significantly degraded when these conditions prevail, it may be impossible to load an airplane to its gills with people and fuel and expect it to safely accelerate and decelerate without running off the end of the runway.

There are two variables that affect the solution to the problem. One is always to use airports with two-mile-long runways—which is not practical for many operators. The other is to limit the fuel load so that acceleration and deceleration are improved. This is an easy solution, but there's a catch. Less fuel means shorter ranges, and everyone wants to fly non-stop. Obviously, a great competitive advantage goes to the airplane that can take on these adverse conditions and fly the farthest on a diminished fuel load.

Here's where the 800XP's performance and weight upgrades pay off. Raytheon calculates that on a 95-degree day at Denver's Centennial Airport, with its 10,000-foot-long runways, a Hawker 800XP with six passengers can fly 1,622 nautical miles. That's 309 nm farther than would be the case in an 800. On an 86-degree day, using the shortest, 4,300-foot-long runway at the Hilton Head, South Carolina, airport, the XP can fly six passengers 1,211 nm—316 miles farther than its predecessor.

In spite of all the changes, Raytheon says that the 800XP will fly pretty much the same as the rest of the 800s. To get a better idea of what that entailed, a session was scheduled at FlightSafety International's Learning Center in Wilmington, Delaware. There, I spent two days and several simulator hours coming to terms with the 800. Veteran Hawker pilot/instructor Ross Nye showed me the ropes.

Structurally, all Hawkers are studies in old-fashioned aircraft design. The control surfaces are all activated through cables and push rods—no clutches, springs, Q-sensing, or power-assisted controls here—which underscores Hawkers' heavy reliance on simple mechanical systems. Taken to extremes, this shows up in a clever, mechanical means of providing extra confirmation that the nose gear is extended. It's a small metal rod, connected to the gear assembly, that pops up on the center pedestal.

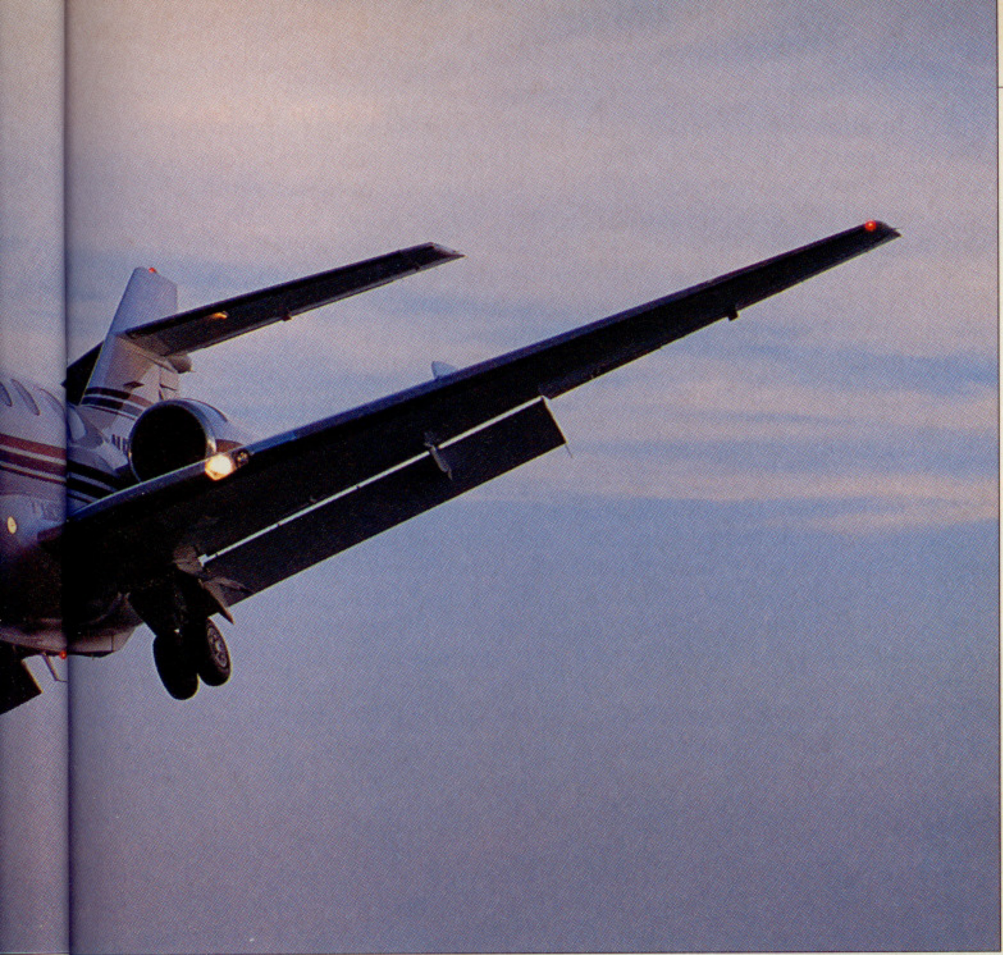
Another cockpit idiosyncrasy is the ram's-horn control yoke. It may look awkward, but it's really quite natural to use.

The drill for takeoff is to steer with the tiller until reaching 80 KIAS, then transfer your left hand to the yoke for the rest of the takeoff run. At the same time, steering inputs using the rudder pedals can begin. The tiller is much more sensitive than I had anticipated but proved to be no real problem when making either major or minor steering corrections.

The Hawker's pilot checklist has a provision for combining V_1 and V_R in the same number. Having one less number to look up is a nice convenience, and the connection of takeoff decision speed to rotation speed is a logical one.

Nye set up the simulator for a 22,000-pound takeoff weight and standard conditions. That gave us a V_R of 122 KIAS, using the recommended 15-degree flap setting. The takeoff N_1 power setting was calculated at 96.4 percent, but that really didn't matter.

Hawkers are known for great handling, comfy cabins, and a unique lift-dump system.



The Hawker's TFE-731s have digital electronic engine computers (DEECs) that do the figuring, set the proper fuel flows, and prevent overspeeding and overtemping. All the pilot has to do is jam the thrust levers full forward on takeoff and check that N_1 hits the target, and the DEECs do the rest. It's another great Hawker workload-saving feature.

So are the airplane's rudder bias and automatic performance reserve (APR) systems, which kick in when an engine fails or otherwise loses thrust. The rudder bias operates by sensing drops in engine bleed air output. If a drop is detected, the system automatically applies pressure to the correct rudder. The APR comes on whenever there's a five-percent split between the engines' N_2 (high pressure rotor rpm) outputs. APR automatically adds 150 to 200 pounds more thrust to the good engine, density altitudes permitting. Together with the rudder bias system, APR can make all the difference in the world should an engine fail during takeoff.

After a few uneventful takeoffs and landings, Nye naturally failed an engine at V_R. He urged me to put my feet flat on the floor, just to see how well the rudder bias works. Like magic, the Hawker climbed straight ahead, its rudder ball centered. With the APR chugging away, single-engine rate of climb hovered around 1,000 fpm.

Most Hawker 800s were ordered with the Honeywell SPZ-8000 integrated flight control system (IFCS), a high-end setup usually found in Gulfstream G–IVs, Falcon 900s, and Canadair Challengers. The Universal UNS-1B has been the most popular flight management system (FMS). Both will be offered in the 800XP, and so will a full suite of Collins avionics, including the Collins FCS-85 IFCS.

The IFCSs include autopilots and flight directors, of course, and a dual AHRS (attitude and heading reference system) is standard. The AHRS uses miniature enclosed gyros that send rate, direction, and acceleration information to computer boards. The electrical signals are processed and amplified, then sent to the cockpit CRT. The whole works is affixed to a chassis, and for this reason AHRS is often called a "strapdown" gyro. There is no precession with this system, and the information presented is extremely accurate.

Both the Honeywell and Collins packages use a vertical tape display for airspeed. The appropriate numbers are plugged into the FMS, and colored airspeed bugs then appear on the tape. A pink airspeed trend line is also generated, which is helpful in latching onto target airspeeds. Pull the power back and the pink line descends to the airspeed you're about to achieve in a few seconds; dive or apply power and the line rises.

On the overhead panel, right above the pilot's head, is a timer that controls the Hawker's TKS ice protection system. Called an "egg timer" by some, it's operated by rotating the switch clockwise. Crack the switch open to the first few marks and the TKS fluid will ooze out of the leading edge panels at a high flow rate. Crank the timer all the way and fluid is pumped at a slower rate, up to a 61-minute duration. It takes that long to exhaust the airplane's 37-pint fluid capacity. When the egg timer runs down, a small bell goes off—just like, well, an egg timer. The 800XP will have a 67-pint TKS fluid capacity.

There's an ingenious ice detection system that consists of a rotating vane with serrated edges. The serrations pass a wiper blade as the vane rotates; but if ice slows the rotation, an amber ICE DETECTD light illuminates on the overhead panel.

Ice protection for the windshields comes via electrically heated filaments embedded in both the front and side windshield panels. Two dedicated alternators provide the power for this task, as well as heating the pitot tubes and stall/angle-of-attack vanes.

The rest of the 800 and 800XP electrical system is fed by two main generators capable of putting out 400 ampere/hours of power apiece. One generator is more than enough to meet the airplane's full electrical demand; but in the unlikely event of a dual generator failure, the airplane has additional batteries capable of driving essential equipment for limited periods of time. One can drive the standby attitude indicator for up to two hours. Another can run the number one radios and transponder, number one N_1 gauge, and the ILS crosshairs on the standby attitude indicator. The duration of this battery depends on how much you transmit, but it can last as long as 45 minutes.

Up to 8,500 pounds of fuel can be put in the Hawker 800 series' wing tanks. A ventral tank can carry 1,500 more pounds. There's a 500-pound limitation on wing fuel imbalance, but

WHAT'S IN A NAME?

One pioneer yields generations of aircraft

Hawker's namesake is Harry Hawker, an Australian who moved to England to build airplanes for World War I. He was central in developing the Sopwith Camel fighter and later formed his own aircraft company. Unfortunately, he died in the crash of an airplane he was testing.

What's now known as the Hawker line follows a convoluted and confusing genealogy that extends to 1959. That's when de Havilland announced plans to develop its new DH–125-1. The airplane was a business jet with twin 3,000-pound-thrust Viper turbojet engines and a 20,000-pound maximum takeoff weight. De Havilland took the DH–125 through to certification in 1964, and 10 were delivered. These were built first at the company's Hatfield, England, plant, then at its Chester, England, facility. In those days, you could buy one new for $575,000.

In late 1961 British aircraft manufacturer Hawker-Siddeley acquired the DH–125 project. When production of the -1A and -1B series of the airplane began in 1965, they were designated HS–125s—but people just called them "Hawkers." They were powered by the Viper 521 and 522 engines, of 3,120 and 3,330 pounds thrust, respectively. Gross weights jumped to 21,200 and 21,700 pounds, and 77 of these airplanes were sold.

The HS–125-3 was the next in the line. It was the first to have the ventral fuel tank. Gross weight went up to 22,700 pounds, and 64 -3s were sold.

The -4 model, also called the Hawker 400, came out in 1968, and 116 were sold. These brought aerodynamic improvements, an airstair door, and a redesigned cockpit. Gross weight went up again, to 23,300 pounds.

From 1969 to 1975, Hawker-Siddeleys were sold in the United States under an agreement with the Beech Aircraft Corporation, which created the Beechcraft Hawker Corporation to do the job. The 400s sold here were designated BH–125s, for Beech/Hawker. One product of that union was a conversion of many cockpit toggle switches to rocker-type panel switches, a change made at Beech's insistence.

The Hawker 600 was introduced in 1971 and garnered 72 sales. These had a three-foot fuselage stretch, 3,750-pound-thrust Viper 601 engines, and maximum gross weights of 25,000 pounds.

The 700 was next out, in 1976. The big change here was the switch from the loud, gas-gobbling Vipers (pilots counted on burning 3,000 pounds of fuel for the first hour of a flight with Vipers) to 3,700-pound-thrust Garrett TFE 731-3 engines. These were a big hit, with 215 deliveries.

Hawker-Siddeley encountered financial difficulties in the late 1970s, like many other English aviation firms of the day. British Aerospace (BAe) came to the rescue, nationalizing it in 1977. In 1981, the government took 48 percent ownership of BAe and sold stock for the remainder.

The BAe 800, with 273 sales, has been the most popular of all the de Havilland-inspired designs. It was introduced in 1984.

The BAe 1000 came out in 1991. This is the largest of the breed, with 5,225-pound-thrust Pratt & Whitney PW 305B engines, a 24.4-foot-long cabin, and a 3,000-nm range. Interesting note: The other cabin dimensions (6-foot width, 5.8-foot height) have remained the same since 1961. Forty-seven 1000s have been delivered, more than half of them to Executive Jet Aviation of Columbus, Ohio. There, they serve in a fleet of business aircraft operated under a fractional ownership arrangement. Customers buy shares in airplanes; and possession of the shares, in turn, entitles them to a certain number of flight hours per year.

Raytheon Corporate Jets (RCJ), a branch of the American electronics giant that also owns Beech Aircraft, bought the Hawker line in August 1993. The BAe 800 and 1000—now officially called Raytheon Hawkers—are still built in England, but interiors and other final touches are done at a completion center at RCJ's offices in Little Rock, Arkansas.

Beech and Raytheon merged in September 1994 and created the present-day Raytheon Aircraft Company. Beech and Hawker products are now sold under the Raytheon aegis. Hawkers are still assembled in Chester, but that's to change by 1997, when Raytheon will build its jets in Wichita.

Depending upon your age and inclinations, you may know the 125 series of business jets as DH–125s, HS–125s, BH–125s, BAe 800s or 1000s, or Raytheon Hawkers. For most, however, the name "Hawker" just seems to roll off the tongue the easiest. With 859 total sales of all types of general aviation "Hawkers," Harry's memory lives on. And Raytheon, wisely, shows no sign of tinkering with such a well-known name. □

Nye claims that the airplane is still easy to control with this kind of imbalance. "It isn't even enough to trip the autopilot off," he said.

To bolster his case, there's always the incident involving a Hawker 800 flying over Botswana. Botswana's president, Quett Masire, was aboard when a ground-to-air missile shot off his Hawker's right engine. In testament to the airplane's strength, the airframe remained intact. However, shrapnel severed the fuel lines in the right wing tank, and pilot Arthur Ricketts was faced with an approach and landing with 3,500 pounds of fuel in one wing and none in the other. Things worked out fine, and advertisements proudly featured the damaged airplane safe on the ground.

After all the simulator's stick-shaking and -pushing, low approaches, and engine problems, it was a pleasure to climb aboard the real thing. A few days after the sim session, I boarded N937H—one of Raytheon's Hawker 800 demonstrators, and the airplane photographed for this article—for a 923-nm flight from Wichita's Mid-Continent Airport to AOPA's home base at the Frederick, Maryland, Municipal Airport. With four Raytheon Aircraft staffers our takeoff weight was 25,882 pounds, with 8,400 of that in the wing fuel tanks. We didn't need to use the ventral fuel tank, so it was left empty.

It was a 95-degree day in Wichita, and our balanced field length worked out to be 7,030 feet. That's 300 feet shy of the full length of Runway 19L, our assigned runway. V_1 and V_R were 129 KIAS, and that speed came and went quickly. Soon we were climbing away at about 3,000 fpm and 200 KIAS. By FL290 the climb rate had dropped to 1,700 fpm—not bad, considering the adverse (ISA +17) density altitude. We had filed for an initial cruise altitude of FL370 and reached it 25 minutes after takeoff, having burned 1,000 pounds of

RAYTHEON ON A ROLL

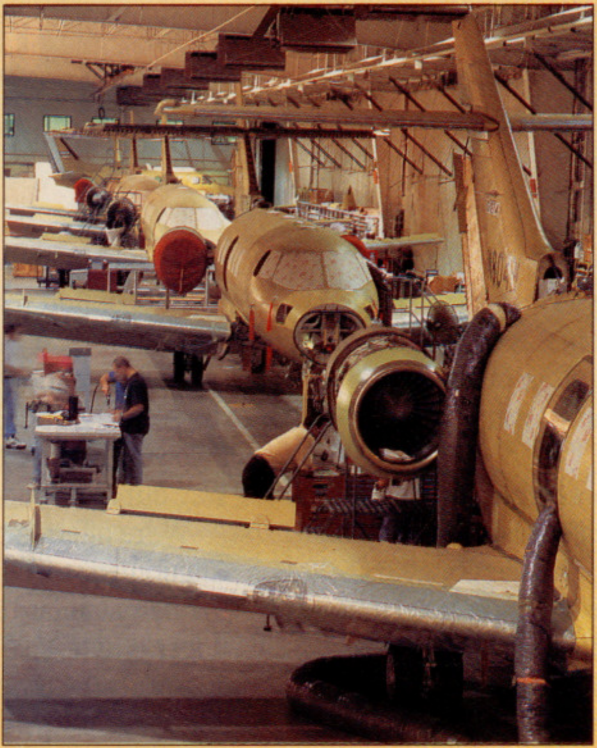
Business is booming for Beech and company

Raytheon Aircraft Company is feeling its oats these days. For example, the company just moved its management into a brand-new custom-built, 100,000-square-foot office building in Wichita.

That's just for starters. Recently, its MkII military trainer, a turboprop single that's essentially a modified Pilatus PC-9, won the competition to fulfill a 711-airplane, $7 billion order for the U. S. military's JPATS (Joint Primary Aircraft Training System) program. Challenges from other manufacturers make the outcome unofficial, but at this juncture it looks as though the MkII will be our next-generation trainer for the Air Force and Navy.

As discussed in the accompanying article, the Hawker 800XP will make its debut this fall at the National Business Aircraft Association's annual convention. Four more Hawker 1000s are set for delivery to Executive Jet Aviation, although Raytheon spokesmen hint that a replacement for the 1000 is now under discussion.

The 800XP won't be the only new Raytheon airplane to surface at the NBAA show. Raytheon officials promise the unveiling of a new entry-level business jet on September 25; and speculation about this airplane's looks, equipment, and performance have been running wild as of this writing. Raytheon's been stubbornly mum on the subject.



The first 800XPs—and the last of the 800s—going through the final assembly line in Wichita.

The appearance in *Flight International* of a line drawing purporting to represent the mystery ship has drawn little comment from Raytheon's public relations shop. Rumors about the use of a composite-construction airframe, a fly-by-light control system, and new Williams fanjet engines abound, but Raytheon won't confirm or deny them. All the company will say is that the general aviation world will be "shocked" when they learn about the new airplane's speed, efficiency, and cabin setup.

Of course, by the time you read this, the airplane will have already made its grand entrance. Then the real judging will begin. □

fuel in the process.

Once established in cruise, our speed settled down at 0.76 Mach, or 443 KTAS. Fuel flows went down to 800 pph per side, and Rob Jenner, one of Raytheon's demonstration pilots, soon asked for a look at the thunderstorms ahead.

Using our Collins TRD-850 Doppler weather radar, we could superimpose the cells' returns on our electronic HSIs. The cells were really popping, and topped out at FL450. We used a really neat feature that let each of us look at the storms at different radar range settings. I set my radar panel to view the storms at the 100-nm range. Morrow selected the 50-mile range. When the radar swept in one direction, I saw my returns on my EHSI. When it swept the other way, Morrow could see his 50-nm returns on his EHSI.

While the Hawker's modern cockpit is a treat, so is its cabin. The larger the airplane, the more important its cabin ergonomics become; and in this department the airplane also shines. Karl Childs, vice president of Raytheon's domestic business jet sales organization, showed how the Hawker's double-club seats and aft divan could be transformed into sleeping berths. This particular airplane had a typical eight-place arrangement with an aft lavatory, though Hawkers can be ordered with customized interiors to suit any taste or mission. Completions are performed at the Hawker final assembly facilities at Raytheon's Wichita location.

"We're finding that many customers pick the Hawker 800 series as a more conservative alternative to buying a larger jet," said Childs. "But we also see Hawkers bought as airplanes that supplement corporate fleets having Gulfstreams, Falcons, and Challengers. The 800 can handle most of the trips that bigger jets fly, but at lower cost."

Cost, of course, is a relative term. The 800's base price of $9,995,000 and average hourly direct operating cost of $1,115 may seem astronomical, but they're far less than those of larger corporate jets.

Two hours and 20 minutes after takeoff, we were in the pattern at Frederick, having consumed 3,800 pounds of fuel. Bruce McNeely, Hawker marketing manager, pointed out that we had enough fuel remaining to take off and return non-stop to Wichita with NBAA IFR reserves.

Hawkers can handle most of the trips that bigger jets fly, but at lower operating costs.

With flaps set at the full 45-degree setting, V_{REF} down short final was 123 KIAS. After touchdown the lift-dump (N937H doesn't have thrust reversers) did a fine job of slowing us down. It takes hold fast: When you put the air brake lever into lift-dump, the flaps extend at 15 degrees per second, which means that they took just two seconds to go from the 45-degree position to the 75-degree position.

It would be difficult to imagine that anyone would come away unimpressed from a flight in a Hawker. There's scads of high-tech virtues in the front office, and enough cabin to please the most jaded travelers in back.

Hawkers, produced in six variants since 1964 by a sequence of five different corporate entities, have withstood both the competition and the test of time. If it ain't broke, the saying goes, then don't fix it. In view of Hawker's history, the adage could be amended. It ain't broke, but they fixed it anyway, a little at a time. The Hawker 800XP should preserve this tradition. □

Raytheon Hawker 800
Base price: $9.995 million

Specifications	
Powerplants	2 Garrett TFE 731-5R turbofans, 4,300 lbst ea
Length	51 ft 2 in
Height	17 ft 7 in
Wingspan	51 ft 4.5 in
Wing loading	73 lb/sq ft
Power loading	3 lb/lbst
Seats	8 to 12
Cabin length	21 ft 4 in
Cabin width	6 ft
Cabin height	5 ft 9 in
Empty weight	16,000 lb
Max ramp and taxi weight	27,520 lb
Max useful load	11,520 lb
Max takeoff weight	27,400 lb
Max payload	2,000 lb
Max landing weight	23,350 lb
Zero fuel weight	18,000 lb
Fuel capacity, std	1,501 gal usable 10,000 lb usable
Performance	
Balanced field length	5,625 ft
IFR range with NBAA reserves, eight passengers	2,411 nm
Rate of climb, engine out	784 fpm
Rate of climb, two engines	3,228 fpm
Cruise speed, 37,000 ft	438 kt
Max FAA-certified altitude	41,000 ft
Landing distance	2,325 ft
Limiting and Recommended Airspeeds	
V_1, flaps 15, APR	134 kt
V_R, flaps 15, APR	134 kt
V_2, flaps 15, APR	137 kt
V_{LO} (extend and retract)	220 kt
V_{FE} (15 degrees)	220 kt
V_{FE} (25 degrees)	175 kt
V_{FE} (45 degrees)	165 kt
V_{MO} (SL to 32,200 ft with fuel in ventral tank)	280 kt
V_{MO} (SL to 12,000 ft)	335 kt
M_{MO}	M0.80

Raytheon Hawker 800XP
Base price: $9.995 million

Specifications	
Powerplants	2 Garrett TFE731-5BR turbofans, 4,660 lbst ea
Length	51 ft 2 in
Height	17 ft 7 in
Wingspan	51 ft 4.5 in
Wing loading	74.9 lb/sq ft
Power loading	3 lb/lbst
Seats	8 to 12
Cabin length	21 ft 4 in
Cabin width	6 ft
Cabin height	5 ft 9 in
Empty weight	16,100 lb
Max ramp and taxi weight	28,120 lb
Max useful load	12,020 lb
Max takeoff weight	28,000 lb
Max payload	2,350 lb
Max landing weight	23,350 lb
Zero fuel weight	18,450 lb
Fuel capacity, std	1,501 gal usable 10,000 lb usable
Performance	
Balanced field length	5,510 ft
IFR range with NBAA reserves, eight passengers	2,432 nm
Rate of climb, engine out	862 fpm
Rate of climb, two engines	3,415 fpm
Cruise speed, 37,000 ft	443 kt
Max FAA-certified altitude	41,000 ft
Landing distance	2,420 ft
Limiting and Recommended Airspeeds	
V_1, flaps 15, APR	135 kt
V_R, flaps 15, APR	135 kt
V_2, flaps 15, APR	138 kt
V_{LO} (extend and retract)	220 kt
V_{FE} (15 degrees)	220 kt
V_{FE} (25 degrees)	175 kt
V_{FE} (45 degrees)	165 kt
V_{MO} (SL to 32,200 ft with fuel in ventral tank)	280 kt
V_{MO} (SL to 12,000 ft)	335 kt
M_{MO}	M0.80

For more information, contact Raytheon Aircraft, Post Office Box 85, Wichita, Kansas 67201-0085; telephone 316/676-7111, fax 316/676-8286.

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.