B/CA Analysis: British Aerospace HS 125-700

One of the grand designs of corporate aviation continues to attract customers with its gentlemanly characteristics, amply sized interior and newly acquired Garrett AiResearch TFE 731-3 turbofans.

By Richard N. Aarons and John W. Olcott

British Aerospace's HS 125 has been doing its transportation thing so faithfully and unobtrusively for so long that it's sometimes easy to forget that the airplane has evolved right along with the newcomers and still gives them all a run for the money.

In fact, a comment to that effect from one of our readers reminded us that it's been quite a while since we at B/CA took a long look at England's business jet offering. Obviously, we decided to do something about that situation.

Just how long has the HS 125 been around? Well, the first customer airplane was delivered in 1965. However, a little research turned up an even more interesting fact. The HS 125 was the first turbojet to be certificated that was designed from scratch as a business aircraft. That is to say it wasn't a redesigned fighter or part of a military competition. It was a business jet from day one.

The first HS 125 had a range of 1,300 nm and carried 8,200 pounds of fuel. The latest version is three feet longer, has a range of 2,500 nm and carries 9,450 pounds of fuel. (In B/CA, we use "HS 125" in all references to the aircraft that has been called variously "HS 125," "BH 125" and "DH 125".)

The latest in a series that began with -1A and ran through -100s, -400s, and -600s, is the HS 125 Series 700, a Garrett TFE 731-powered version.

There are now over 100 HS 125-700s operating around the world, about two-thirds of them based in North America. And they're coming off the assembly lines, at record rates.

The keys to the HS 125's success have been, we think, the aircraft's reputation for complete operational dependability along with its program of continuous engineering improvements.

An example of those engineering improvements is a drag reduction program that has resulted in a net drag decrease of 8 percent from the -1A version to the Series 700 aircraft, despite the latter's increased size.

An example of dependability is the Qantas HS 125 used for airline crew training. To date, the aircraft has amassed 13,000 hours and logged some 50,000 landings.

It's difficult to stick the HS 125 into a neat market slot, we are told by British Aerospace salesmen. Certainly, the airplane is considered head-on competition for the Westwind series from IAI and Rockwell's Sabreliner 65A. The aircraft also is priced in the same ballpark as the Falcon 20. However, BA believes the HS 125 is an attractive "alternative" aircraft for fuel-conscious, big-iron departments and a step-up airplane for small-jet departments looking for budget-priced, big-cabin transportation.

We have to agree with that assessment We've met HS 125 owners that fall into both classifications.

(You'll notice that we have presented a comparative specification table in this article rather than a comparison profile. The reason we could not generate the comparison is that some data for the Westwind 2 and, to a lesser extent, the Sabreliner 65A are still preliminary, despite the fact that both aircraft are FAA certificated.)

Our HS 125 evaluation flight was out of White Plains with British Aerospace demonstration pilots Doug MacDonald and John Thomas. We spent two hours in the air and several more on the ground examining the HS 125's features and flight characteristics.

Handling the HS 125

The HS 125 has been described as an English country gentleman. We at B/CA have to agree. Certainly the airplane is not flashy in performance; however, it is absolutely dependable, predictable, serviceable, rugged . . . and all the rest of the adjectives you'd use to describe the pipe-smoking, tweedy sort of country gentleman you'd trust.

Here are some observations from our flight evaluation notebook:

➤Preflight — The typically British design of the HS 125 leaves the pilot more things to look at during preflight than do other European and U.S. designs. British airworthiness authorities insist that all flight control hinges, counterweights and the like be accessible for visual inspection. It's there, so you look at it. All fluid levels can be checked from the ground without use of a step ladder. However, removal of the dorsal vent FOD plug requires a walk on the wing so nonskid shoes or a fearless copilot (or both) are mandatory equipment.

➤Cockpit — The pilots sit erect and have plenty of space over their heads and between their shoulders and the sidewalls. The seats are firm and well articulated — not as fancy as some we've seen recently, but certainly not deficient.

Visibility from the cockpit, both on the ground and in the air, is excellent.

B/CA's pilots ended the flight evaluation with the impression that the cockpit has grown in complexity over the years and therefore some of the switches and controls (especially avionics) are now located where they fit rather than where they'd be in an ideal installation. However, it must be remembered that since the aircraft is purchased "green," designing the cockpit and avionics installation is really up to the ingenuity of the buyer and the completion center. Only the switches on the overhead and the location of the circuit breakers are fixed by the factory.

Generally, the overhead panel is nicely arranged. Switches located there control the electrical and fuel systems, engine starting, lighting and anti-ice. The only significant fault we can find with the cockpit is that circuit breaker protection for many of the secondary systems is located on a panel immediately behind the copilot's seat. Granted, no systems involving safety of flight systems are breakered on this panel. However, inflight manipulation of these breakers requires the copilot to move his seat forward while the captain turns almost 150 degrees in his seat to accomplish the task. The result is two pilots flying from awkward positions.

➤Systems — The systems themselves are pilot-pleasers and (we suspect) just as pleasing to the mechanics who have to maintain them. All systems were designed with simplicity and maintainability as primary objectives, which certainly reflects in cockpit workload.

Fuel system management, for example, is a matter of making sure you've got enough on board for continued flight. Everything else is either on or off.

Most system controls on the HS 125 are mechanically linked to the devices they actuate. Hydraulic system control levers, for example, are connected mechanically to the hydraulic valves they operate. Thus the pilot does not have to worry about dual system failures — an electrical system failure, for example, that could cause loss of hydraulic subsystem control. (You'd think with all those cables and pulleys running around the airplane that cable rigging would be a maintenance nuisance; however, our conversations with operators did not suggest any problems in this area.)

➤Taxi — Ground control via a sidewheel-controlled, hydraulic nosewheel steering unit is positive and easily mastered after 10 minutes of practice. Authority seems nicely matched to the task.

➤Takeoff — Again, ground steering is positive and easily controlled. Tracking is good. Rotation requires firm control movement (as does any maneuver with this aircraft); however, the airplane seems to acquire its rotation target naturally with no tendency toward over-rotation.

Although we did not get the opportunity to explore engine-out takeoff maneuvers in this airplane, our experiences in earlier HS 125s with rudder biasing have been good. The rudder bias system automatically applies corrective rudder deflection during asymmetric thrust situations. It's like having the copilot jumping on the correct rudder pedal when the engine starts to quit — a real help. The system has dual actuators and a manual override. If one-half of the system fails, the other half can support about 50 percent of the original load. The device is pneumatically sensed, controlled and operated.

➤Climb — The HS 125 is no rocket to altitude, but neither is it particularly sluggish, We experienced an initial climb rate of 4,000 fpm at 236 KIAS. Hand-flying the airplane through FL 370 we were still maintaining a respectable 2,400 fpm. The last climb segment from FL 380 to FL 390 was accomplished at a rate of 500 fpm at a weight somewhat over 18,000 pounds. Throughout the hand-managed climb, control feel was positive and the airplane was very stable. At no time did the B/CA pilots feel they needed autopilot assist to maintain reference speed. Climb visibility is excellent over the nose and to the sides.

➤Cruise — Cruise stability is good, requiring no special piloting technique. In fact, the airplane can be comfortably hand-flown at FL 390 with none of the fingertip squirreliness common to many business jets at altitude.

It's difficult to communicate the subjective experience of airplane feel in terms other than engineering relationships, but we'll take a crack at it. The HS 125 has a slightly heavy feel to it. For those of our readers who have flown the Falcon 10, we can best describe the HS 125 as having the Falcon 10's control heaviness without the agility. Learjet pilots would probably think the airplane truck-like. Falcon 20 pilots should feel right at home.

The hydraulically operated air brakes incorporate panels that deploy on both top and bottom wing trailing edges, creating no pitch change with deployment. The system is quite effective and produces little rumble and no unsettling lurching for passengers.

Cruise speed checks at FL 390 (-37°C) were right on book predictions. For example, we recorded 426 KTAS while consuming 1,250 pounds of fuel per hour at max speed cruise and 396 KTAS on 1,110 pounds per hour at long-range cruise settings. Both these checks were accomplished at about 18,000 pounds gross weight.

The Collins FCS-80 flight control system with full vertical modes handles the airplane smoothly and precisely. Altitude roundouts are soft and right on the numbers. Engagement is smooth and trim correspondence at disconnect is okay.

➤Approach — The HS 125's excellent speed stability continues through the descent and transition to approach speeds. Trim change requirements are almost unnoticeable as the gear is lowered and flaps are positioned.

Attitude for the flare is very comfortable. Arresting approach sink and transitioning into the flare seem to require pressure adjustments rather than gross control movements. Our guess is that this gentleness and predictability in flare and touchdown can be quite comforting features in operations on marginal runways. Touchdown is soft and rollout control good.

Despite the fact that over 500 HS 125s have made it into service over the last 15 years, none have had thrust reversers until quite recently. The reason is simply that the British never believed the airplane needed them and (apparently) their customers didn't either. Instead, braking augmentation is provided by a lift dump system.

The lift dump system combines airbrake extension with a 75-degree flap angle to increase aerodynamic drag. When the 75-degree flap angle is added to the 15-degree touchdown attitude, you have two huge panels nearly perpendicular to the aircraft's direction of flight. The lift dump mode is mechanically locked out unless the flaps are in the landing configuration (45 degrees) and weight is on the main gear. The lift dump mode is actuated when the pilot moves the airbrake handle to its lift dump position. The movement requires a manipulation that would be difficult to accomplish accidentally.

British Aerospace says the lift dump system improves deceleration on very slippery surfaces by 50 percent over normal braking, with airbrake extension alone providing some 30-percent improvement.

Recently British Aerospace has offered Aeronca-built thrust reversers as an option for the HS 125-700. At this writing, revised performance figures were not available, so we can't tell you what the $210,000, 281-pound option does for an operator other than give extra margin for slippery runway situations.

Even BA officials tell us that they decided to go ahead with the reverser option only because "there are some flight departments that simply won't talk to you unless you offer reversers. We wanted to be in the ball game for those orders, so we had to do it."

Passenger Features

➤Cabin — In this class airplane, what's in back is just as important as what's up front. Our impression is that the cabin is really the HS 125's best feature. The airplane we flew (destined for customer service immediately after our flight) had an interior by Innotech, the Montreal-based completion center. Materials and craftsmanship were as good as we've seen in any business jet regardless of cost.

Cabin layout, typical we were told of the HS fleet, included a forward club arrangement with an aft three-place couch and two opposing forward facing seats. The couch, comfortable for three folks on a two-hour trip, converts to a pull-out bed. Cabin ventilation was efficient and unobtrusive. Noise levels were remarkably low. In all operations, we were able to carry on conversations without voice strain.

The Garrett AiResearch pressurization system performed without noticeable bumps despite abrupt power changes induced by our flight test schedule.

We also were impressed with the space available for inflight storage of consumables, briefcases and the like.

Our overall impression of the cabin is that its size and appointments are more than adequate for short, high-load factor missions or 2,400 nm five-passenger journeys.

Earlier we touched briefly on the HS 125's systems; however, there are several system elements we want to explore in more detail.

➤Automatic Performance Reserve (APR) — This system, designed jointly with Garrett AiResearch, is a computer that monitors engine performance during takeoff. If it detects a loss of power on one engine, it will command an increase in thrust on the other. The amount of additional thrust available depends on a complex formula involving ambient conditions, engine speeds and temperatures.

From a performance standpoint, APR enables the pilot to calculate runway requirements as though the aircraft were equipped with more powerful engines than it actually has. The extra power is available, however, only when needed in an emergency.

In practical terms this means greater range/payload flexibility. BA gives these examples:

(1) When takeoff distance is limited, APR increases allowable takeoff weight by up to 2,200 pounds (depending on ambient conditions), thus increasing range by over 575 nm with all other things being equal.

(2) When altitude and temperature are limiting second-segment climb performance, APR increases allowable takeoff weight by up to 2,900 pounds, thus increasing range by over 800 nm.

➤Fuel System — The fuel system comprises four integral tanks, one in each wing, a dorsal tank in the dorsal fin and a ventral tank under the rear fuselage. Single-point refueling is standard and gravity refueling points are available for all four tanks.

Only the wing tanks are gauged. Thus a fuel totalizer is a practical necessity. Engines are boost fed from wing-area collection tanks. The dorsal tank gravity-feeds to the ventral tank. Interwing jet pumps move the ventral tank fuel to the wings, thus, from the pilot's viewpoint there is no "fuel management" task.

➤APU — An APU is standard in the purchase price. The customer can opt for a Solar unit or an AiResearch system. The Solar is certificated for inflight operation.

➤Hydraulics — Two engine-driven hydraulic pumps provide service for landing gear retraction and extension, main gear doors, wheel brakes, anti-skid, nosewheel steering, flap operation and airbrake actuation.

An auxiliary hand pump system provides power for emergency lowering of the gear and flaps. An isolated accumulator supplies emergency brake system pressure.

The Business Side

Last year was the best year ever for the HS 125 program, with a total of 57 orders (41 from North American customers). The aircraft's production rate is set at three per month at British Aerospace's Chester (England) facility and is expected to remain at that level.

To date some 150 Series-700 airplanes have been ordered worldwide with about two-thirds of that number destined for North America.

HS 125s are fixed priced in blocks, with adjustments made twice yearly on the average. The current base price for a green aircraft is $4.3 million. Progress payments are made in 10-percent units.

Although BA's Chester facility is equipped to do aircraft completions, most North American customers use one of six U.S.-based completion centers active in HS 125 work. They are: AiResearch Aviation, The Jet Center, KC Aviation, Arkansas Mod Center, Atlantic Aviation and Innotech Aviation.

Interior and avionics installation typically requires four months and costs $850,000 to $900,000. Aircraft ordered today are scheduled for spring 1982.

Certainly when an airplane project gets halfway through its second decade of production, folks in the corporate planning center start to get itchy. Isn't it time for an "all new" design? Well, it could be, but BA isn't talking other than to say that the company has made an internal decision to remain in the corporate transportation market.

Schemes for the future run the gamut from "don't change a thing (on the 700) except the paint" to "let's start with a clean piece of paper and design an aircraft for the '90s."

There is no question that the HS 125-700 is an impressive amount of transportation for the dollar, and one of the things that keeps the price tag relatively low is the fact that most tooling is amortized.

As B/CA editors talked to operators about this aircraft, the one comment we heard again and again was that the airplane was "predictable and dependable." Indeed, fleet dispatch reliability is better than 99-percent. Decisions to start "messing about" with things that are going that well are understandably taken with cautious deliberation. B/CA

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