Business & commercial Aviation
PILOT REPORT

B/CA Update: BAe 800

If luck is the result of preparedness and opportunity, British Aerospace deserves the good fortune it has been experiencing with its Model 800 business jet.

By JOHN W. OLCOTT

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Since being introduced slightly more than five years ago, the British Aerospace Model 800 has captured about 40 percent of the market for mid-size business jets and continues to sell well to a broad spectrum of companies worldwide. In the first nine months of this year, for example, nearly half the medium jets sold were BAe 800s, many the result of fleet sales for up to four aircraft at one time. While cynics and competitors might suggest that luck has something to do with such success, planners at British Aerospace point to the wisdom of their decisions made in 1981 (when the 800 program was launched) concerning the needs of business aviation.

Rather than concentrate on an entirely new aircraft for the 1980s and early l990s, British Aerospace chose to improve the range and performance of its venerable HS 125 design - which was conceived around 1960 and originally dubbed the Jet Dragon - but retain the basic HS 125 staples: comfort, reliability and good handling. The 125's fuselage had undergone a two-foot stretch in 1971 when the HS 125-600 was introduced and had been re-engined when Garrett TFE731-3s replaced Rolls-Royce Vipers with the advent of the Model 700 in 1976. Thus changes in the fuselage structure did not appear warranted, considering the needs of the marketplace and the availability of competition similarly priced at less than $8 million.

Fitting the more powerful TFE731-5 was a logical improvement, however. Only the wing needed redesign to achieve the capabilities British Aerospace deemed necessary to meet merging requirements of business aircraft operators.

Using the latest techniques in computational aerodynamics and computer-aided design, British Aerospace's engineers fashioned a wing for the Model 800 that is 4.3 feet longer than its predecessors' and has a new airfoil shape over the outer 10 feet of each semi-span. These changes increased the aircraft's aspect ratio (an important characteristic for reducing induced drag and enhancing range) by 13 percent, improved the wing's lifting ability and provided space for 10,000 pounds of fuel.

The Model 800 also received a new cockpit featuring three more inches of length and a handsome, curved acrylic windscreen in place of the flat glass that characterized the forward windows of all previous 125s. Visibility remains excellent, and Ipeco seats combine with the additional room to provide great comfort to the cockpit crew. With the aircraft approved for Bendix, Collins and Honeywell EFIS, the choice of advanced presentations for flight and long-range navigation is very broad indeed.

POSITIONED WISELY

With hindsight, the wisdom of British Aerospace's decisions is clear. Since the time the Model 800 was conceived, international flights by corporate operators more than doubled as businesses responded to an emerging global marketplace. (See "The Professional

International Hand-Holders," page 76.) Thus the importance of range increased, as did cabin size, since flight times of six hours or more were possible-and likely.

Other market conditions also emerged during the decade of the 1980s. American business concentrated on efficiency, not only in fact but in appearance as well. Flight departments were forced to consolidate their fleets, selling off some equipment and extracting greater utilization from the vehicles that remained. (See "Business Aviation in Today's Environment," B/CA, November 1988, page 94.) Efficiency-minded management was attracted to medium-size aircraft that provided sufficient cabin volume and a range to satisfy the demands of international and transcontinental travel without dominating the ramp when parked next to other business jets.

Another phenomena of the 1980s is the fantastic progress made in digital avionics. Electronic flight instrumentation systems (EFIS), laser gyros, solid-state attitude heading reference systems (AHRS) and flight management systems (FMS) became available for business aviation, thereby increasing reliability and easing the workload associated with long-range operations. By certificating the Model 800 with a fully digital electrical system, British Aerospace led the march toward advanced electronics in business jets. Aircraft such as the BAe 800 are available with as much technical capability as the most advanced airliner from Boeing and with more sophistication than many airliners currently in operation.

For example, British Aerospace's current demonstrator, which B/CA evaluated for this article, is fitted with the latest Honeywell SPZ 8000 digital avionics system, including EDZ-817 five-tube EFIS, DFZ-800 dual flight guidance system, dual AZ-810 digital air data computers, dual FMZ-800QD (for quad density) flight management systems, Primus II SRZ-850 nav/com radios and the Primus 870 Doppler turbulence detection radar with LSZ-850 lightning detection. The aircraft also can be fitted with optional dual LASEREF II inertial reference systems. Honeywell's MLZ-850 microwave landing system (MLS), which also is available as an option, was not installed.

OPERATIONAL RANGE

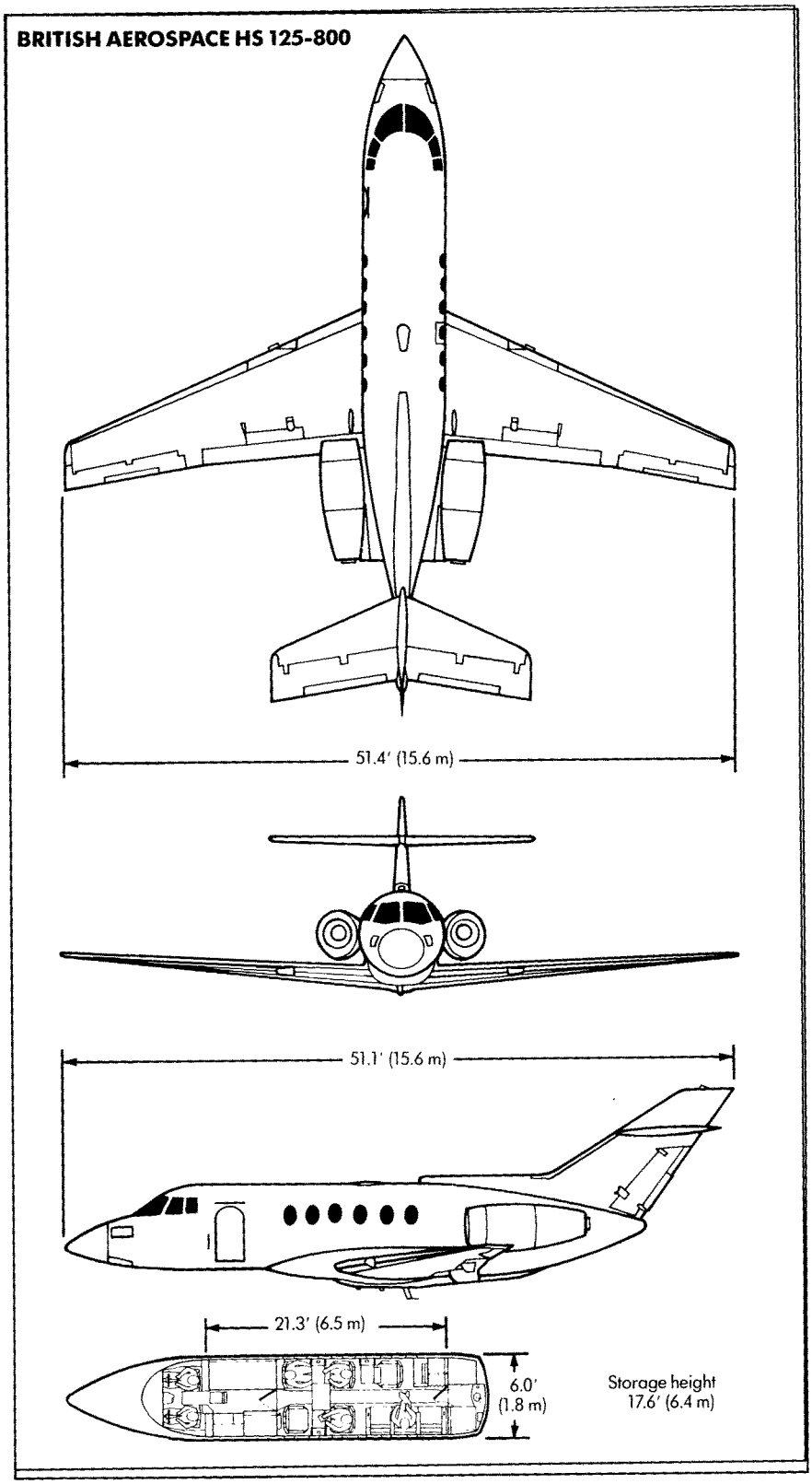
According to B/CA's April 1988 Planning and Purchasing Hand book (page 64), the BAe 800 has a maximum ferry range with NBAA VFR reserves of 3,033 nautical miles (based upon a basic operating weight of 15,563 pounds) and a seats-full range with NBAA VFR reserves of 2,921 nm. To match or exceed such range performance, an operator must choose aircraft that traditionally are classified as heavy business jets, such as the CL-601-3A from Canadair, the Model 50 or Model 900 from Dassault and the G-III or G-IV from Gulfstream Aerospace. Incidently, the Model 800's range exceeds that of the TFE731-3-powered BAe 125-700 by about 14 percent and is nearly twice the range of the last Viper-powered 125.

To obtain a practical sense of the Model 800's range capabilities in the real world of long-range travel with four passengers aboard (800 pounds payload), we queried Lockheed DataPlan for information on a theoretical transatlantic crossing from JFK to London's Luton Airport. With B/CA's avcomps (AViation-related COMPuter Services) specialist Richard Aarons establishing computer access to Lockheed's resources in Los Gatos, California, and manually inserting wind information, Lockheed's mainframe accessed its file of BAe 800 performance data and generated a realistic flight profile for crossing the North Atlantic via a great circle route at the appropriate altitude for the intended direction of flight and with a minimum of 45 minutes reserve fuel at 5,000 feet altitude over the destination. Boeing's 85 percent, seasonally-averaged winds were used, thereby anticipating a tailwind of 21 knots for the eastbound leg and a headwind of 54 knots for the westbound crossing. (For more on what Boeing's wind tables provide and information on overwater flight planning, see "International Performance," page 83).

According to information we obtained from Lockheed DataPlan, the BAe 800 with four passengers and baggage could fly from JFK to Shannon, Ireland at 0.75 Mach in 6+13 hours consuming 8,661 pounds of fuel and arriving over Shannon with 548 pounds of fuel in excess of what was needed for holding-sufficient for one hour and 16 minutes of flight (including our specified hold of 45 minutes at 5,000 feet). Lockheed's computer estimated the aircraft would climb to FL 370 in 21 minutes and then be stepped to FL 410 within 36 minutes after takeoff, remaining there until the descent was initiated nearing Shannon. Initial fuel burn at FL 370 was estimated to be 779 pph per engine, dropping to 627 pph engine by the top-of-descent point. After completing the 2,672-nm flight from JFK to Shannon and refueling there, the remaining leg to London was not a challenge. Assuming seasonally-averaged winds, however, a New York-London flight nonstop was not possible either eastbound or westbound.

A more practical routing would be refueling at Gander, Newfoundland and then proceeding nonstop to Luton, thereby providing significantly more options upon reaching the destination. Lockheed estimated the great circle leg between Gander and Luton, a distance of 2,054 nm, would take four hours and 48 minutes at 0.75 Mach, consume 6,893 pounds of fuel and provide 2,249 pounds reserve fuel in excess of what was needed for holding-sufficient to reach Paris.

The return trip was planned via Reykjavik, Iceland for



refueling and then nonstop to JFK, the latter leg being 2,291 nm along a great circle route. Lockheed estimated the flight at 0.75 Mach would take 6 + 04 hours against a 54-knot headwind and consume 8,608 pounds of fuel, leaving 599 pounds of fuel in excess of our requested reserves. The initial climb was to FL 390, with a step about two hours before landing in New York. Fuel burn at the top-of-climb was estimated to be 737 pph per engine, dropping to 596 pph per engine at the top-of-descent.

LONG-RANGE COMFORT

Comfort is a major consideration for any aircraft capable of six-hour flights, and in this area the BAe 800 has been well received. Delivered "green" from its point of manufacture in Chester, England, the Model 800 can be fitted with a variety of interior finishings according to the customer's specifications. Arkansas Mod Center located in Little Rock and recently sold to British Aerospace, has completed the majority of Model 800s in North America, but KC Aviation, located in Dallas, and Innotech, located in Canada, also are noted for the quantity and quality of their completions on the HS 125 series.

Typical interior arrangements consist of a baggage area directly opposite the entrance door, four facing chairs positioned either in the forward or rearward portion of the cabin, a separate chair opposite a three place divan, and a lavatory situated aft. Several variations on that eight-place theme are available, including a seating arrangement for 10 passengers. Cabin height remains 5.75 feet throughout the cabin's entire length (21.3 feet) and maximum width is 6.0 feet throughout the passenger volume. While the Model 800's "standup" height is achieved with the aid of a 1.3-foot-wide floor channel about six inches deep, access to the seats

BAe 800 SPECIFICATIONS

B/CA EQUIPPED PRICE	7,500,000
SEATS	2+6/9
ENGINES	
Model	2 GTEC TFE731-5R-1H
TBO	On Condition
Power	4,300 lb. ea.
DESIGN WEIGHTS (lb/kg)	
Max ramp	27,520/12,483
Max takeoff	27,400/12,428
Max landing	23,350/10,591
Zero fuel	18,000/8,165
BOW	15,563/7,059
Max payload	2,437/1,105
Useful load	11,957/5,424
Max useable fuel	10,000/4,536
Payload (max fuel)	1,957/888
Fuel (max payload)	9,520/4,318
LOADING	
Wing (lb/ft²)	73.3
Power (lb/lb)	3.2
PSI	8.6
LIMIT SPEEDS	
MMO	0.800 Mach
VMO	335 KIAS
VFE	220 KIAS
V2	136 KIAS
VREF	115 KIAS
PERFORMANCE (ft/m)	
BFL (SL, ISA)	5,600/1,707
Climb (fpm/mpm)	
All engine	3,500/1,067
Engine-out	780/238
Certificated ceiling	41,000/12,497
All-engine service ceiling	39,000/11,887
Engine out service ceiling	17,400/5,304

and the divan is achieved easily.

Since British Aerospace allows customers to specify their own completions, interior sound levels will vary somewhat among aircraft. Typical sound readings fall in the low- to mid-70s A-scale decibel range, however, and subjectively the cabin offers a comfortable environment for conversations and work.

Passengers have noted that the roominess of the lavatory, which extends across the width of the aircraft and benefits from no reduction of floor-to-ceiling distance in the aft cabin, is a major asset for this medium-size business jet. In fact, the BAe 800 provides more room is this area than its immediate competitors. In addition to an electrically flushing toilet and a sink with a thermostatically controlled supply of hot water, the lavatory provides access to a luggage compartment for the crew.

Cockpit comfort also is a major consideration for a long-range aircraft. The BAe 800 provides the crew with adequate room for work and an occasional stretch, and a removable jump seat is available for an observer (or possibly a third crewmember, but the fit would be tight for an extended trip). Of more significance to pilots, however, is room for the latest in avionics equipment. As described earlier, British Aerospace is at the forefront in the application of digital avionics in business jets. The aircraft we flew lacked nothing in the way of avionics for long-range operations.

FLYING THE 800

We accompanied John Thomas and David Rolands, both demonstration pilots for British Aerospace, Incorporated, on an extended flight from Savannah, to Islip, New York via stops in Caracas, West Palm Beach and Cleveland. Except for the Cleveland-Islip leg, the passenger load was six people in addition to the crew of two. Thus we had an excellent opportunity to sample the adequacy of the BAe 800 for long-range missions.

Departing SAV with 9,200 pounds of fuel on board, our ramp weight was 26 470 pounds, slightly more than a half ton below the aircraft's maximum ramp weight of 27,520 pounds. The auxiliary power unit, a Turbomach Solar T-40, had done a good job keeping the cabin cool (by means of the BAe 800's air cycle system) and supplying electrical energy for stabilizing all navigation systems prior to engine start. We determined that at our ambient temperature of 30 degree centigrade BFL was 5,320 feet; and V1 and V2 were 131 and 132 knots, respectively. Using the APU, which is an optional item and installed during completion, we required no ground support equipment prior to or during starting.

Despite some delays in our altitude clearances, we reached FL 350 about 29 minutes after takeoff and within five minutes were cleared to our requested altitude of FL 370. At the end of the first hour, still at FL 370, we had consumed 2,050 pounds of fuel since startup and were indicating 0.724 Mach with a true air temperature of ISA+9, which resulted in 428 knots TAS and a total fuel consumption of 1,605 pph. Large buildups, however, forced us to request FL 410 about 1+28 after takeoff, and the climb was accomplished easily at our weight of about 23,700 pounds. Tops, however, extended above the BAe 800's certified ceiling of 41,000 feet, so a deviation was requested into airspace controlled by Cuba.

The significant value of a well-equipped aircraft is particularly obvious when deviations from plan are nec-

essary. The Honeywell FMSes gave us an exact fix on our position as we were cleared to a new heading and flight level by Cuban ATC. (Incidently, the handoff from Miami to Cuban control occurred without hassle .) When anti-icing systems were activated as we entered clouds, the digital fuel computers on the Garrett TFE731-5s automatically made the necessary adjustments. Honeywell's Primus 870 doppler radar with turbulence and lightning detection provided a good presentation of the significant weather that impeded our initial course. What a comfortable way for a pilot to practice his trade.

Two hours into the flight and at FL 370, we were achieving a Mach of 0.754 while consuming 1,630 pph. By 2+45, our Mach had increased to 0.762 in ISA+5 conditions as we prepared for the descent into Caracas' control. All the pertinent approach information, including the arrival routes, missed approach instructions and required holding pattern, were recalled from the FMS quad-density database for visual presentation on the multi-function display.

We touched down 3+45 after leaving SAV, having consumed 6,190 pounds of fuel and matching our estimated flight particulars within a percent or two.

The return legs to West Palm Beach, Cleveland and Islip (encompassing an additional 6+40 hours of flight) also were according to plan, indicating that the BAe 800 achieves the performance presented within its flight manual. Comfort levels such as sound, cabin temperature uniformity and sufficient room to switch positions or obtain something from the refreshment area, were very good - indeed they were more than sufficient for the length of our overall trip. Also important for any business aircraft, the interior furnishings by Arkansas Mod Center were first-class and apparently quite durable.

Not to be overlooked are the very comfortable handling qualities of the BAe 800. The aircraft has a solid feel, good stability and well-damped responses to gusts and control inputs. Even without all its sophisticated avionics, the Model 800 is one of the more pleasant business jets to fly. The fact that it accommodates highly advanced and workload-reducing systems simply adds to its attributes.

British Aerospace's success with the Model 800 is more than luck-it is the result of a solid product addressing the needs of a demanding and changing business climate. **B/CA**