Business & commercial Aviation
PILOT REPORT

Update: The Improved Hawker 1000

Raytheon Aircraft Company's largest business jet offers more room, better airport performance and increased flexibility.

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What a difference a few months has made in the life of the Hawker 1000. Raytheon Aircraft Company "temporarily suspended" the production of the aircraft in September 1994 to soak up extra inventory while it was repositioning the aircraft in the market. The news had fueled speculation in the business aircraft community that Raytheon had really canceled the program, opting to couch the notice in tactful prose as the company had done earlier when winding down the Starship program. (See sidebar.)

But Raytheon actually was being entirely candid. The company needed a respite during which it could finish work on an optional, more spacious interior, fine-tune the 1000's runway performance numbers, and certify an optional "bump thrust" takeoff power setting to endow the aircraft with more robust hot-and-high takeoff performance.

Most of the improved operational performance had been built into the aircraft originally by British Aerospace. However, BAe had rushed the Hawker 1000 to market in time for the 1991 NBAA Convention, causing its engineers to leave a fat margin of conservatism in the Approved Flight Manual (AFM) runway numbers. Subse- quent testing shaved the surplus padding, resulting in appreciably shorter published runway distances and lower V-speeds compared to the corresponding data in the 1991 AFM. Raytheon will make these improvements available this year—and they are retroactive to previously delivered aircraft.

HOT/HIGH AIRPORT PERFORMANCE

The Hawker 1000's hot-and-high takeoff-performance numbers, however, still imposed some maximum allowable takeoff weight limitations that could be a problem for some operators. As a result, Raytheon elected to work with Pratt & Whitney Canada (P&WC) to certify an electronic "throttle push" in the full authority digital engine controls (FADECs) for better density altitude performance.

As delivered, the Hawker 1000's PW305 turbofans originally were rated at 5,225 pounds-thrust on a sea-level/standard day—leaving no nominal flat-rating reserve for warmer days. The PW305 is capable of maintaining takeoff rated thrust to a modest 21°C (70°F) only when the Automatic Performance Reserve (APR) function is triggered, such as in the event of a single-engine failure on departure.

Hawker 1000 operators can now elect to push the thrust levers to the APR detent to recover more of the 5,225 pounds rated thrust. This technique lets the aircraft depart at a higher weight for a given runway length under hot/high conditions. The price for using "bump thrust" APR for such hot/high takeoffs is more costly engine reserve expense. (See the PW305B sidebar.) To qualify for this special mode of operation, the aircraft must be equipped with P&WC's Engine Diagnostic System (EDS), a box that automatically and electronically logs APR takeoffs, among its other functions. The EDS is being retrofitted to existing Hawker 1000 aircraft free of charge, and it comes with all new aircraft.

These changes have impressive effects on the Hawker 1000's range/payload performance, adding between 2,000 and 2,500 pounds to the maximum allowable takeoff weight when departing from hot/high airports.

BETTER CABIN SPACE UTILIZATION

Following the pattern Beech set when it transformed the Mitsubishi Diamond II into the Beechjet 400, Raytheon now has reconfigured the Hawker 1000 passenger cabin to increase usable space. After May of this year, the 1000 will be offered with a "biomorphically" (similar to ergo-nomically) designed interior, with fluid contours and better space utilization. The interior will be fabricated at Raytheon's Little Rock facility and shipped to Beech in Wichita for installation in Hawker aircraft. The price will be approximately the same as that of the more traditional interiors.

The aisle will be two inches wider, and the interior shell will be moved outboard to enlarge the cabin cross section, thereby providing up to 1.75 inches more head- and shoulder-room for each passenger. In addition, the seats will be reshaped to increase the open space in the cabin, with no sacrifice in usable chair room. Even the lavatory cabinets and fixtures will be recontoured to provide more legroom.

Look closely at the accompanying illustrations, and you'll see that an eighth cabin window has been added to the fuselage of the new model. The cabin's forward storage cabinets will be reconfigured to use their internal space more efficiently, and the extra window on each side will add light to the new interior. For the passengers, up to 22 inches more usable length will be provided, which will be particularly useful as carryon storage space for business materials and personal items.

A new center-club interior design will have much larger work tables. Passengers in the fore and aft facing seats outside of the club section will have more usable legroom and individual worktables.

Double-club seating and club-and-three-quarters configurations also will be available, in addition to the center-club floor plan shown in our illustration.

PRODUCT SUPPORT

Six out of 10 Hawker aircraft are sold in North America, but when Raytheon purchased the program from BAe, most of the product support was concentrated outside of the United States.

Raytheon took several steps to improve the situation. The firm doubled the size of the U.S. spares inventory and moved it from Dallas to Beech's facility in Indianapolis, a city that is a Federal Express hub. Orders now can be shipped up until 2200 hours local time.

The prices of spares have been "rationalized" (equalized) between the United States and the United Kingdom. Raytheon is looking at ways to reduce the cost of parts and maintenance labor, with the goal of cutting maintenance costs by 30 percent.

Four field representatives and four resident service reps were added to the staff. Raytheon now offers 24-hour, toll-free spare parts and technical assistance telephone service split between U.S. and U.K. service centers according to time zones. In addition, United Beechcraft in Tampa now is a Hawker service center.

PRICE AND VALUE

Raytheon is holding the price on the Hawker 1000 at $12.995 million—virtually unchanged from 1992. There are plenty of features to distinguish the improved Hawker 1000 from the Hawker 800 until Raytheon introduces a successor to its largest business jet. The optional redesigned interior gives the 1000 a largess of usable cabin space that is matched by few mid-size competitors.

Better published runway numbers make the 1000 more competitive with other mid-size business jets. The "bump thrust" APR takeoff power setting additionally provides operators with much-improved range/payload flexibility. The Hawker 1000, admittedly, still isn't the class leader in runway performance or cruise speed. However, it will arrive within seven minutes of any mid-size jet, excluding the Citation X, on a 1,000-mile trip.

Since its introduction in 1991, the Hawker 1000 has scored high marks for its battleship-solid reliability, according to operators with whom we spoke. Its docile handling and exceptional stability win high praise from flightcrews. Raytheon's executive team intends to push

Plans For The Hawker 1000

Roy Norris, Raytheon Aircraft Company president, is anxious to clear up rumors about the firm's commitment to the Hawker 1000's future. He admits that the production interruption announcement in 1994 bore an uncanny resemblance to the Starship I announcement.

A comparison between the two events was unavoidable. Norris elaborated, "Unfortunately, [when we] said that we were interrupting production, I think a lot of folks read into it that we meant we were canceling production. That was a speculation, and it was an inaccurate one." Norris claims that Raytheon intends to manufacture the 1000 through 1997, the year in which manufacturing facilities are slated to be moved to the United States from the United Kingdom.

To assure potential customers, Norris offered, "We'd be happy to take them to the plant and show them the production line fully running. We discuss our production rate plans with the customer."

"We don't have any plans for any extreme measures ... or gigantic slashes in prices," Norris said.

This represents an upswing in the short and stormy history of the Hawker program at Raytheon. Less than two years ago, the firm bought both the 800 and 1000 programs from British Aerospace, a strategic acquisition some industry observers questioned because the 1000 was setting no sales records. Potential customers especially balked at paying an extra $3 million for the Hawker 1000, viewing it as a slightly larger version of the Hawker 800. Many saw little difference between the two aircraft, other than price, parts vendors and poorer airport performance.

The sales pulse of the 1000 sagged to a perilously low level, resulting in Raytheon's interrupting its production in late summer 1994. Sales of most new business jets, including both Hawkers, started to soar later in the year, however, as a result of the overall economic recovery. Norris commented that December "was the strongest month in the history of the company, both in traditional Beech products and the Hawkers." The lift also revived the 1000 from its torpor, buoying prospects for its future.

"In fact, we have even increased the production build quantities," Norris asserted, but he declined to reveal actual numbers. Late in 1994, however, a Raytheon official told B/CA that six Hawker 1000s were scheduled to be built this year, and that production build rates or 1996 and beyond hadn't been finalized.

Raytheon clearly has made a major commitment to making a success of its two Hawker programs—the 800 and the 1000—beyond its initial $372-million investment in mid 1993. Almost immediately after acquiring Corporate Jets from British Aerospace, the firm streamlined production at the Hatfield, England facility, substantially reducing assembly time and cost.

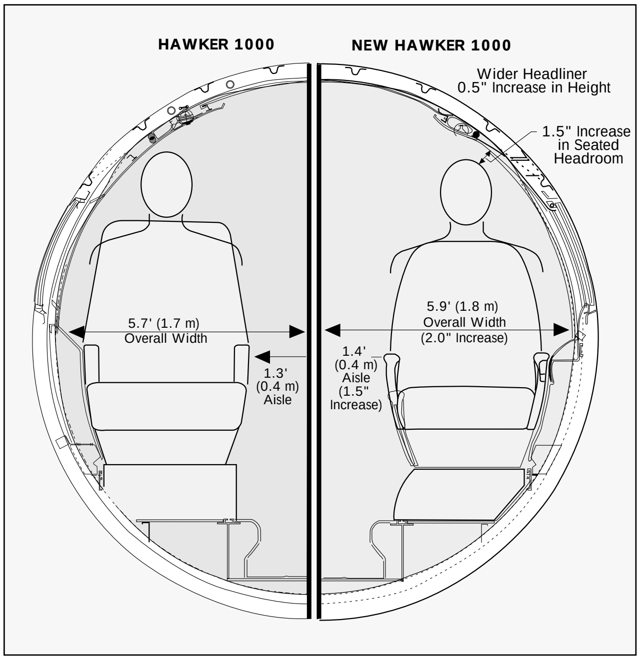
Deliveries of the 1000 are much improved, but some industry observers believe that Raytheon still is deeply discounting its price to move inventory. Not so, says Norris. "We're actively selling the airplane. EJA [Executive Jet Aviation] has options on nine more, and they tell us they will take every one of those and they want more.

"We don't have any plans for any extreme measures . . . or gigantic slashes in prices," he said. "We just don't see that as necessary. We have the EJA orders, and we have a very significant activity level at our advertised prices."

Is Raytheon serious about the future of the 1000? Norris allowed, "We have a very active program for major enhancements in the 1000. We're not ready at this point to go into details on that, but I will tell you that it is a major program of activity within the company right now. We have some improvements that are coming along while we're in production, but they're more of an evolutionary nature."

A Raytheon official told B/CA that the firm is studying a short-term development "X" airplane that would have PW306 engines for better hot/high performance as well as higher cruise speed. A long-term development "Y" model with more radical changes—such as a fuselage stretch, a new wing and new engines—also is being studied, although the Raytheon board has not decided on either growth version.

the company into the leadership position among mid-size aircraft manufacturers. The improved Hawker 1000, with its new interior and more sprightly performance, indicates that Raytheon most assuredly is moving in the right direction. **B/CA**



Hawker 1000 Avionics

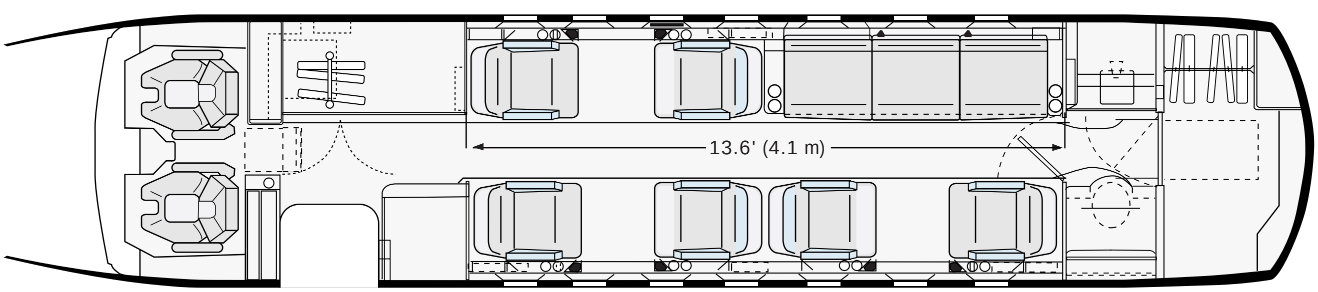
Step into the Hawker 1000 cockpit, and you'll find a mix of British tradition and modern technology. The aircraft's overhead, instrument and console panels are populated by rocker switches, toggles and push buttons that provide manual control for dozens of functions. For example, the cabin pressurization controller is a well-proven analog design.

The Hawker 1000 is equipped with an impressive complement of avionics equipment centered around Honeywell's SPZ-8000 dual-channel, fail-operational digital flight control system.

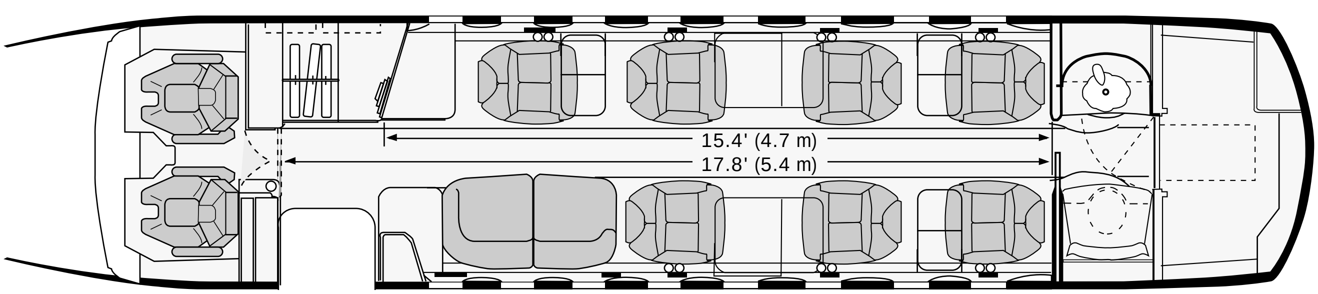
Housed in the instrument panel are five Honeywell five- by six-inch display tubes that offer some integrated display tube technology, while relying on round dial altimeters. The left- and right-side Primus II comm/nav/ident radio systems are controlled by two full-color radio management units. Dual Laseref II inertial reference systems provide attitude and position change information. Left- and right-side NZ-910 FMSes with multiple waypoint vertical navigation handle virtually all navigation chores during the terminal area and en-route phases of flight.

In addition, 1000's the avionics suite comes with Honeywell's Primus 870 Doppler turbulence detection radar, the LSZ-850 lightning sensor system and a radio altimeter.

HAWKER 1000



NEW HAWKER 1000



Flying Impressions

Pilots will find plenty to do prior to starting the engines of the Hawker 1000.

The performance section of the flight manual provides very precise numbers for hot, high and heavy conditions, but only after as many as seven iterations of cross-checking the very traditionally British formatted charts and at least 30 minutes of work. Raytheon Aircraft Company President Roy Norris admitted, “I guess it’s like English literature; it’s unique in the world. Certainly, the British approach to the flight charts is different from what you or I have been more comfortable with over the years. It’s an area that needed improvement and, yes, it is an active project that is under way.”

The aircraft would benefit from a laptop computer performance program. Fortunately, the pocket checklist’s tabular performance data can be used to look up most airport performance data. However, the paper stock of the checklist—lacking a protective plastic coating—quickly can become dog-eared.

Once belted into the left seat, though, we found the Hawker’s traditional and distinctive “ram’s horns” yoke comfortable to the touch, foretelling much about decades of Hawker refinements. That trait is appreciated at high speed, because the Hawker 1000’s roll-control forces are substantial, but not onerous. At low airspeeds, a gentle nudge is ample for roll control.

The docile and stable Hawker 1000 has more gentle pitch force at rotation than does the Hawker 800, but it retains the hefty stick-force gradient associated with airspeed changes. The FADEC-equipped PW305B engines take most of the work out of thrust management.

Except for hot, high or heavyweight takeoffs, the Hawker 1000 displays sprightly departure and climb performance, but in a refined, British manner that’s soothing to passengers. However, during takeoff the engine bleed air to the air cycle machine must be shut off, resulting in no air conditioning, heating or pressurization until the aircraft is established in the final climb segment. The standard Solar APU is not certified for inflight use except for emergencies. Takeoff data with the engine bleeds turned on should be published this year. (An optional AlliedSignal GTC36-150W, available for an additional $150,000, is certified for ground and inflight operations.)

If an engine were to fail during takeoff, a bleed-air powered, rudder-boost system would take most of the work out of directional control, and there is ample reserve thrust for one-engine inoperative (OEI) climb out. Because of the aircraft’s tame handling characteristics, returning to the airport for an OEI landing should not pose a challenge.

Our initial rate of climb with both engines was in excess of 3,500 fpm at a takeoff weight of 28,000 pounds en route from Little Rock, Arkansas to White Plains, New York. Leveling at FL 330 at ISA+7°C, our initial cruise speed was 0.78 IMN at 27,400 pounds at maximum cruise thrust. We later climbed to FL 370 at 0.72 IMN, at a rate of 400 to 500 fpm, after the aircraft burned off enough fuel to weigh 27,000 pounds. We accelerated to 0.76 IMN at ISA+6°C after level-off. Hawker 1000 operators told us that such performance is nominal for the aircraft.

Subjectively, cabin sound levels were comfortable, although we didn’t take measurements.

Descending for approach, we found that using the speed brakes produces virtually no pitch change because they have upper and lower wing-surface panels. Extending the flaps, however, produces a noticeable increase in lift, or “ballooning.” This tendency can be minimized by slowing the aircraft prior to extending the flaps.

On final, the Hawker 1000 displays rock-solid stability. Flaring for the touchdown, we found plenty of ground-effect cushion, but little tendency to float. It’s difficult to make a bad landing in a Hawker.

Actuating the lift dump system simultaneously lowers the wing flaps to 75 degrees and extends the speed brakes. As a result, the effectiveness of the wheel brakes, especially on contaminated runways, is impressive. Standard thrust reversers save brake wear and enhance deceleration on slippery runways.

Ground handling of the Hawker 1000 is easy. The nosewheel steering tiller, though, has a slow steering ratio that requires a healthy amount of rotation to turn the nosewheel.

The newest Hawker fits as well as your favorite pair of blue jeans, feeling comfortable from any seat in the cockpit or cabin. Now, if only there were an electronic flight engineer to work through those onerous performance calculations.

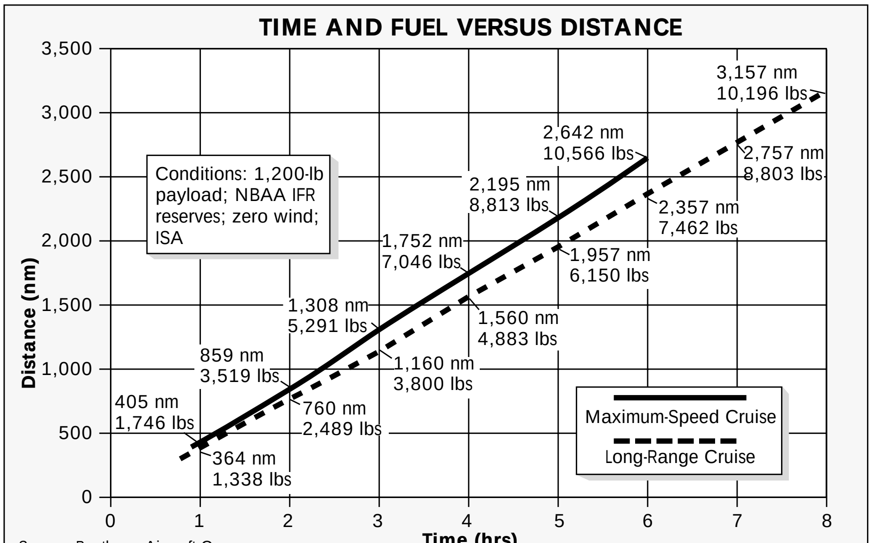
Hawker 1000

These graphs present range, fuel and payload information that is designed to show the capabilities of the Hawker 1000. Do not use these data for flight planning.

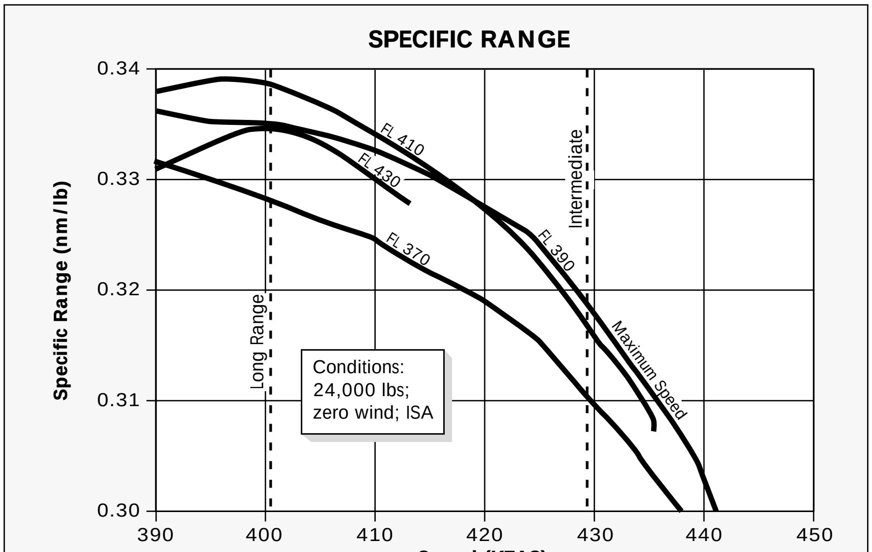
Time and Fuel Versus Distance—This graph shows the plot of two missions: the first flown at maximum-speed cruise and the second at long-range cruise. The numbers at the hour lines indicate cumulative miles and fuel burned for each of the two profiles. The intermediate points on these lines are accurate only for the full trip; however, they can provide the user with a rough idea of the time and fuel required for trips of intermediate length.

Specific Range—The specific range of an aircraft, the ratio of nautical miles flown to pounds of fuel burned (nm/lb), is a measure of its fuel efficiency. This graph shows specific range values at four altitudes at an intermediate 24,000-pound cruise weight. For example, the specific range at high-speed cruise while flying at FL 410 is 0.308 nm/lb. Notably, the chart also shows that climbing to FL 430 at this weight hurts its specific range.

Range/Payload Profile—The purpose of this graph is to provide rough simulations of trips under a variety of payload and airport density altitude conditions, with the goal of flying the longest distance. For the Hawker 1000, we have used a constant 0.70 Mach cruise speed for all weights. The payload lines, which are intended for gross simulation purposes only, are each generated from several points. Time and fuel burns, shown at the top of the chart, are plotted only for the longest mission. For example, payloads up to 1,200 pounds have relatively little impact on the Hawker 1000's maximum range. Hot-and-high airport conditions, however, may limit its maximum takeoff weight—unless the bump-thrust power setting is used.



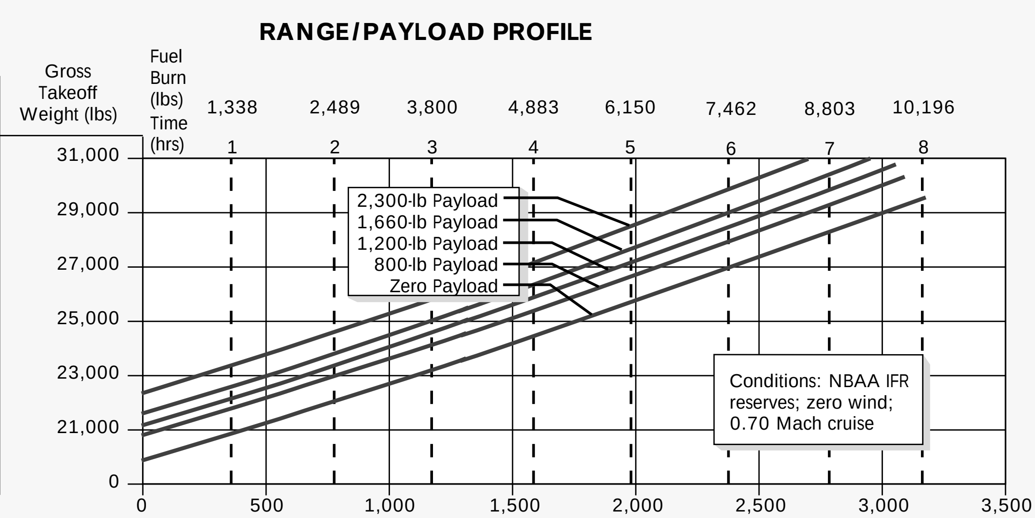
Source: Raytheon Aircraft Company



Source: Raytheon Aircraft Company

RANGE/PAYLOAD PROFILE

Balanced Field Length SL ISA	Balanced Field Length 5,000 ft ISA+20°C	Gross Takeoff Weight (lbs)
5,950	—	31,000
5,105	10,014	29,000
4,595	7,225	27,000
4,385	6,120	25,000
4,185	5,225	23,000
4,100	4,500	21,000
		0



Source: Raytheon Aircraft Company

The P&WC PW305B Turbofans

The Hawker 1000 program was the launch customer for Pratt & Whitney Canada's new PW300 turbofan engine.

In 1990, the engine received initial certification in Canada, and the intervening years have given it time to mature. It has a 4.3:1 bypass ratio—unprecedented in 5,000-pounds-thrust class engines—for much-improved fuel economy.

This is the first engine in this size range to be fitted with a dual-channel, fail-operational full authority digital engine control (FADEC) that helps boost fuel economy another three percent as well as improve throttle response, stall resistance and internal component durability.

Among its features, the engine has an overall pressure ratio of 24:1, thereby allowing it to squeeze more energy out of each pound of fuel. Its cruise-thrust specific fuel consumption (uninstalled) is 0.675 at 0.8 Mach at FL 400—12- to 15-percent better than that of existing engines when the PW300 program was initiated.

As configured for the Hawker 1000, however, the PW305B produces all of its available 5,225 pounds of thrust for sea-level/standard day takeoffs, leaving no margin for hot and high conditions. For normal takeoffs, as soon as the temperature increases above 15°C or the elevation increases above sea level, normal takeoff thrust drops off. According to a P&WC program-briefing handout, the normal takeoff thrust at an ambient temperature of 24°C is 4,750 pounds. P&WC claims the engine can be grown to a 5,485-pounds-thrust rating, with only a throttle push and without compromising durability.

The maximum cruise thrust at FL 400 (0.8 Mach uninstalled) is 1,132 pounds—about the same as the newest and most fuel-efficient version of the AlliedSignal TFE731, the -60. The Hawker 1000, as a result, has a maximum high-altitude, weight-to-thrust ratio of 13:1—better than that of the Hawker 800—but not as good as some mid-size competitors' numbers.

To improve takeoff thrust output under hot and high conditions, an operator now can choose to use an optional, "bump thrust" takeoff power setting. In essence, that setting allows the use of the warm-day temperature margin built into the engines' Automatic Performance Reserve (APR) feature.

APR normally would be activated only during a one-engine inoperative takeoff, but the "bump thrust" setting allows its use for normal takeoffs.

To use the bump-thrust setting, the aircraft must be equipped with P&WC's Engine Diagnostic System (EDS), now standard on all production Hawker 1000 aircraft.

The EDS logs such unusual events as OEI, as well as other unforeseen malfunctions.

Using bump thrust for takeoff also costs the operator one full hour of P&WC Eagle Service Plan engine reserve. This year's rate for ESP is $143.75 per hour for North American operators who average at least 84-minute stage lengths. Thus, the cost for using bump thrust is an extra $287.50 for each use in addition to the normal ESP cost.

The initial hot-section inspection and overhaul periods are 1,250 and 2,500 hours, respectively. P&WC expects to stretch those intervals to 2,250 and 4,500 hours as the engine reaches full maturity.

The PW305 should be one of the easiest to maintain turbofan engines that has ever been installed on a business aircraft. Mechanics are sure to appreciate its modular design, quick disconnect fittings and many inspection plates for borescope analysis.