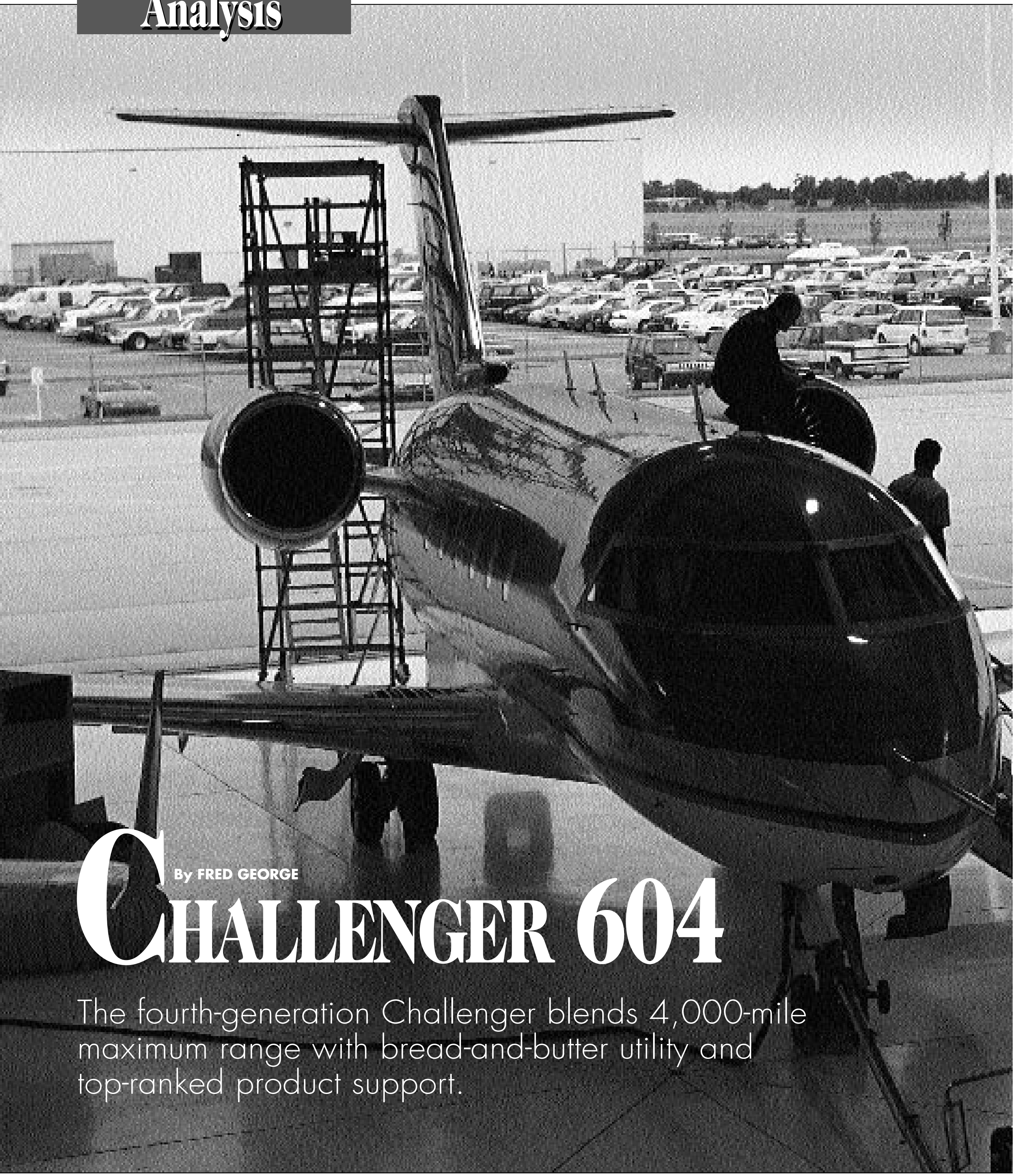


By FRED GEORGE

CHALLENGER 604

The fourth-generation Challenger blends 4,000-mile maximum range with bread-and-butter utility and top-ranked product support.

Flight-test personnel waste no time preparing the Challenger 604 prototype (serial number 5991) for the next flight in the series. The flight is needed in order to complete development work in time for December certification. Winglets effectively increase the span while not significantly increasing wing loading. Even with the yaw damper turned off, the aircraft at normal cruise speed exhibits positive stability in the coupled yaw/roll mode.

The large, double-slotted, trailing-edge fowler flaps are quite effective, but leading-edge devices might help to reduce the V-speeds, in light of the Challenger 604's relatively high wing loading.

The rudder pedals provide +/-7.5 degrees of nosewheel steering. The large NWS tiller provides +/-55 degrees authority and has excellent tactile feel.

Paul Bowen Photography (5)

Friday, June 10 marked a watershed event in the history of the Canadair Challenger. A conforming prototype of the new Model 604, with a B/CA editor on board, flew nonstop from Wichita Mid-Continent Airport to Paris' Le Bourget—a distance of 4,242 nm over the Earth, or 4,011 miles equivalent still air distance, accounting for the winds aloft. This was the longest distance ever flown by a Canadair Challenger.

The Wichita-to-Paris flight proved that the new flagship of the Challenger family could deliver 400 miles more range than the 601-3R at a long-range cruise speed of 424 knots. The 604 also set a Federation Aeronautique Internationale (FAI) range record for Class C-1j—for aircraft with a takeoff weight of 44,092 to 55,115 pounds. More importantly to business aircraft operators, Canadair lived up to its promise to build a Challenger with 4,000-nm legs.

As a result, Challenger 604 operators won't have to stop for fuel when flying from Europe to North America. Notably, westbound transatlantic trips—almost without exception—can be flown at 0.80 Mach because of the aircraft's 3,750-mile range at the 459-knot normal cruise speed.

The Challenger 604, thus, closes much of the maximum range gap between itself and the Dassault Falcon 900B and Gulfstream IVSP—but not at an apples-to-apples 0.80 Mach. Carrying the same payload, those two competitors still have slightly greater range at 459 KTAS.

Although its cabin is larger in cross section than any of its direct competitors, the Challenger 604 interior has less volume due to its shorter usable length.

On shorter, transcontinental missions, the Falcon 2000 is the 604's main competitor because it can carry a 1,600-pound payload 3,000 miles with a cruise speed of 459 knots. The Challenger 604, flying at the same speed, has a 20-percent range advantage with eight passengers on board, but it's largely overkill for coast to coast trips.

That's okay with John Lawson, president of Bombardier's Business Aircraft Division. He claims that the Challenger 604 wins hands down against the heavy-iron business jets, if acquisition and operating cost also are thrown into the comparison. Lawson also claims the Falcon 2000 is only 10-percent less expensive when equipped for transoceanic missions, that it has to stop en route for fuel when facing headwinds on westbound transatlantic trips, plus it actually costs more to operate than a 604. Last year's sales figures add credibility to Lawson's viewpoint. In 1994, Canadair delivered 25 Challengers, topping the sales of the Falcon 900, the Falcon 2000 or Gulfstream IV.

RANGE VERSUS PAYLOAD

The Challenger 604 almost begs business aircraft operators to study the performance charts. Look how tightly grouped the payload lines are on the Range/Payload Profile. Then glance at the Specific Range chart and the Time and Fuel Versus Distance chart. Bombardier's Business Aircraft Division quotes a maximum range of 4,000 nm with five passengers for the Challenger 604, but with eight people in back, the maximum range is still 3,850 miles at long-range cruise. (Bombardier claims that long-range cruise is 0.74 Mach. In contrast, we flew a constant angle of attack, decreasing Mach profile between Wichita and Paris, with speeds ranging from 0.73 Mach and 0.71.)

Loading the aircraft with three more passengers—eight instead of five—results in a comparative decrease in

COLLINS PRO LINE 4 AVIONICS

Challenger 604 pilots will experience the most advanced avionics suite ever installed in a Bombardier business aircraft. That becomes obvious as soon as one enters the cockpit.

Six Collins Pro Line 4 7.25-inch CRTs—two primary flight displays (PFDs), two multifunction displays (MFDs) and two engine instruments and crew advisory systems (EICASes)—occupy a large portion of the Challenger 604's instrument panel. The forward section of the triple-wide center console houses the FMS control display units. The only conventional "steam gauges" are three standby air-data instruments and a wet compass.

The control panel for the dual-channel, digital flight control system panel is located up in the glareshield, where both pilots have unrestricted access to it. Notably, the mode-control buttons have adjacent annunciator lights that greatly enhance hand-eye coordination during mode selection. Mode annunciations also are displayed on the EFIS screens.

Just aft of the power control levers, left- and right-side radio tuning units that control the comm/nav/surveillance radios bracket a central EICAS control panel. The rear section of the console houses the air-data computer, weather radar, IRS and other system control panels.

The density of control functions in the center console requires that pilots spend some time learning where each control function is located and how each control works. Pilots new to the 604 should plan on spending plenty of familiarization time in a cockpit-procedures trainer prior to belting into the simulator, and beyond that, the actual aircraft.

Performance features of the standard avionics package are indeed impressive, and the reliability of the hub-and-spoke architecture Collins Pro Line 4 system has been thoroughly demonstrated on the Canadair RJ, as well as several other aircraft, prior to making its debut on a Challenger. A dual-channel, integrated avionics processing system (IAPS) box forms the hub of the system with various sensors, controls and radios linked by ARINC 429 spokes. The IAPS contains dual digital flight-control systems, each with its own yaw damper, autopilot and flight-director computer; dual FMS cards (with provisions for a third FMS); and a sophisticated maintenance diagnostic computer that will monitor and record data from several aircraft systems outside the avionics suite—including the engines.

Included in the avionics package are dual Litton Flagship IRS, dual all-digital interface Pro Line 4 comm/nav/surveillance and HF radios, dual digital air-data computers, and dual-data concentrator units that listen to inputs from sev-

Paul Bowen Photography (2)

range. Carrying a 1,600-pound payload, the 604 can fly 3,747 nm at long-range cruise and 3,600 nm at 0.80 Mach.

Every aircraft design, however, requires tradeoffs. Glance, for a moment, at the accompanying specifications box. The Challenger 604 has the highest wing loading of any current-production general-aviation aircraft designed for business use. The wing has trailing-edge, double-slotted fowler flaps, but no leading edge devices.

Then, consider the lack of leading edge devices and high wing loading, coupled with the relatively large thrust lapse rate of the high-bypass-ratio General Electric CF34 turbofans. The result is predictable—especially when departing from hot-and-high airports. The 604 has a longer takeoff field length than any of its competitors have, when all are loaded to MTOW.

But, the charts also point out the 604's operating flexibility. Head to head with a Falcon 2000, the 604 needs less runway when departing on a 3,000-mile trip that will be flown at 0.80 Mach with eight passengers.

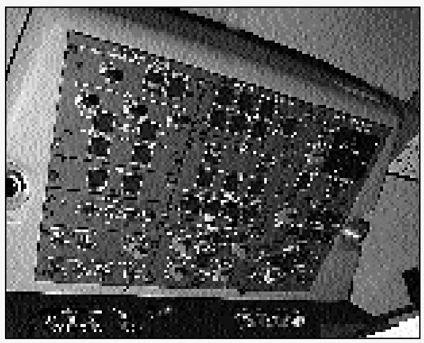
Another one of the Challenger 604's strong suits is better density altitude performance, compared to the Challenger 601-3R. The 604's -3B engines are flat-rated at 8,729 pounds-thrust for takeoff (9,220 pounds APR) to ISA+30°C, compared to ISA+8°C for the 601-3R's -3A1 turbofans. The improvement comes through loud and clear when departing from hot and high airports. The Challenger 604, loaded to a maximum 47,600-pound takeoff weight, needs 9,430 feet of runway when departing from a 5,000-foot elevation airport at 25°C (77°F). That's

eral kinds of sensors and then digitize the data into ARINC 429 format for digestion by the IAPS. A TWR-850 Doppler turbulence-detection weather radar and a radio altimeter also are part of the package.

The biggest change in the Challenger 604's cockpit won't become apparent until power is applied to the system. It's the dual Collins AVSAT 6000 FMS equipped with dual 12-channel, GPS 4000 satellite navigation receivers. Quite candidly, in our opinion, this FMS rivals the best systems we yet have seen in business aircraft. Although many of the features are still under development until late October, the AVSAT 6000 tangibly proves that Collins intends to be a top-ranked competitor in FMS.

The AVSAT 6000 is being developed as a takeoff-to-touchdown system, but it will be a climb-cruise-descent-approach system in the Challenger 604 because autothrottles currently aren't offered as standard or optional equipment.

In addition, the performance-management function of the AVSAT 6000 virtually will store all of the aircraft flight manual and cruise performance numbers for the 604. The FMS will compute the takeoff N1 rpm setting and then display N1 target bugs on the tachometer displays on the EICAS. It also will compute the takeoff field distance, climb performance and top-of-climb point, cruise performance and step-climb point, top-of-descent point and level-off point. The system will feature complete



The quiet, dark design of the cockpit is reflected in the overhead panel, which has systems diagrams on the control panels.

multiple waypoint lateral and vertical navigation guidance, including all ARINC 424 procedure legs necessary to all SIDs and STARs; an automatic FMS-to-NAV hand-off for seamless long-range-nav-to-ILS transitions; GPS non-precision approaches; and full, multiple waypoint vertical navigation with point-to-point gradient computations.

Designed as a "smart box," the AVSAT 6000 will alert the crew if the aircraft's performance—climbing or descending—won't be adequate to comply with either a published or a programmed procedure. When flying a STAR from a close-in high-altitude initial descent point, for example, the pilot will be warned by the system if the aircraft won't make an altitude crossing restriction because of a VMO, published STAR airspeed requirement or 250-KIAS federal speed-limit constraint. The pilot, thus alerted by the FMS, could then change power setting, extend the spoilers or configure the aircraft to comply with the performance requirement.

Fuel calculations will be based on flight-manual performance, real-time fuel flows or a combination of both. No longer, for example, will pilots watch the FMS predict flame-out half way to the destination during climb-out because the system is looking at instantaneous fuel flows rather than at the predicted fuel burn for the entire profile.

The AVSAT 6000 also will retrieve winds and temperature aloft forecasts from an optional airfield flight information service (AFIS) datalink, and will plug the data into the flight plan to update the performance predictions. An alternate flight-plan feature will allow pilots to ask the system to compute "what-if" performance changes based on speed, altitude or route variations.

The standard, but previously optional, GPS 4000 satnav receivers will be certified for non-precision approach. Collins is developing an APR 4000 follow-on box, slated for certification at the end of 1996, that will be capable of both wide-area-differential and local-area-differential GPS navigation that will enable the system to provide GPS precision-approach guidance.

Challenger 604 avionics options include TCAS, GPWS, a third Litton IRS, third FMS card, third data concentrator unit (two are required for dispatch), BFGoodrich lightning detection system, split-scan radar control, a third VHF comm for clearance delivery and a second radio altimeter—and a Collins satcom system with up to six channels.

FROM THE TOP

Paul Brou

"Value for money" is John Lawson's operating philosophy at Bombardier's Canadair division. The president of Bombardier's Business Aircraft Division claims that's why, "We continue to be the primary supplier of airplanes in the large category."

And the tangible results are being passed on to Challenger 604 buyers. Two years ago, Canadair estimated the price of a completed 604 to be $20 million in 1993 dollars. Now it has increased only to $20.5 million.

Bombardier is attacking operating costs just as aggressively, Lawson explained. "One of the real advantages of the 604 goes back to the flow-through effect of our airline experience with the Regional Jet. We're going to a task-oriented maintenance program on the engines, resulting in a 10- to 12-percent reduction in the overall operating expense. Our airplane actually is less expensive to operate than the Falcon 2000."

Product support is another strong point of the Challenger program. Lawson claims that the firm's product support has scored "unequivocal number one" in five operator surveys during the last four years. "Without question, this is a strong point, and that didn't happen by accident. I think we have been the industry leader in terms of innovative programs like SmartParts, customer account managers and action centers. Customer service and product support are preoccupations with us."

Optimizing cost control and product support aren't Bombardier's only goals, however. Challenger operators told Bombardier that they wanted more range than what is offered by the Challenger 601. "We're going to meet or exceed the goal of delivering a 4,000-mile-range aircraft. Without a doubt, that's why we're bringing this aircraft to market. And all of our flight-test data confirm the predicted performance parameters."

The maximum range is available when flying at 0.70 to 0.74 IMN, depending on aircraft weight—a speed that hardly sets any records in the heavy-iron class. Lawson commented, "When you need 4,000 miles—the full extent of the aircraft's range—we're prepared to fly at LRC [long-range cruise]. We'll compromise and fly at this lower speed, given the difference in acquisition cost between the 900B and G-IVSP. Percentage-wise, the number of 4,000-mile missions we do is quite small. Once you get down into the normal, day-to-day, bread-and-butter missions, we can do them at 0.80 Mach or 0.83."

What's the primary market for the Challenger 604? "We've positioned the aircraft very carefully," Lawson said. "Our focus has been on the family of Bombardier aircraft. The 4,000-mile Challenger 604 fits very nicely between the Learjet 60 and the Global Express. It competes effectively both up and down the spectrum of competitors. It has the widebody cabin, which has always been the hallmark of the Challenger. It competes upward against the Dassault 900 and the Gulfstream G-IV [because] we've managed to maintain a significant price differential between the airplanes, concentrating on the 'value for money' image that we've cultivated."

1,664 feet less runway than needed by the Challenger 601-3R departing under the same conditions at its 45,100-pound MTOW—2,500 pounds *less weight.*

SPEED AND ALTITUDE CAPABILITY

The CF34-3B engines are indeed fuel miserly because of their high bypass ratio. The tradeoff is a relatively high thrust-lapse rate—the inverse change of thrust output with altitude increase.

Improvement in the -3B engine's specific fuel consumption, compared to the -3A1, pays a dividend in increased range when departing from shorter runways. The Challenger 604 can fly 800 nm farther than a 601-3R when departing from a 3,400-foot, sea-level runway.

However, the thrust-lapse rate becomes apparent on climb-out. The 604's service ceiling is 37,700 feet on a standard day—markedly lower than aircraft to which the Challenger is frequently compared.

The CF34 has a relatively low high-altitude, thrust-to-weight ratio compared to many other turbofan engines. Although we have no engine thrust output data for the 604 at 37,700 feet, Bombardier told B/CA that the CF34-3B produces 1,450 pounds-thrust at 0.74 Mach at 41,000 feet—one-sixth of its takeoff-rated thrust.

For example, compare the -3B engine's high-altitude thrust to the output of the CFE738 that is fitted to the considerably lighter weight Falcon 2000. The CFE738 is rated at 5,725 pounds of takeoff thrust, and its thrust output at 0.80 Mach at 40,000 feet on a standard day is 1,468 pounds—more than one-fourth of the takeoff rated thrust.

The differences in the altitude and Mach number at which the two engines are measured means that our comparison is not strictly apples-to-apples. It's more like Macintoshes to Granny Smiths, but the Challenger 604 still has a markedly lower thrust-to-weight ratio than the Falcon 2000 at high altitude, resulting in a lower initial cruise altitude.

Similarly, the Falcon 900B, 900EX and Gulfstream IV have better high-altitude, thrust-to-weight ratios than the 604. As a result, those aircraft each have a higher service ceiling.

Paper comparisons aside, the 604 has no problem climbing to an initial cruise altitude in the high thirties, even on warm days. The rate of climb noticeably slows down above FL 300, based on our observations, but still it climbed directly to FL 370 in 29 minutes on our flight from Wichita to Paris, including an intermediate level-off at FL 330 for ATC and in spite of ISA+4°C to +12°C temperatures. That's 2,000 to 4,000 feet higher than the CL 601-3R operating in similar conditions—but the 604 seldom will climb out of the rigid routing of the published ICAO North Atlantic organized tracks in either direction.

The engine performance is well-suited to the 604's FL 410 maximum certificated cruise altitude. On the flight to Paris, for example, the 604 step-climbed to FL 410 after cruising for four hours at lower altitudes in

ISA+9°C to +14°C conditions. Once there, we saw total fuel flows of less than 2,000 pph.

Such altitude performance allows the 604 to top most of the weather buildups and airline traffic, but not all towering cumulus in the summer months and not the latest generation of Boeings and Airbuses.

The Challenger 604, in contrast to other large cabin business aircraft, has an initial cruise altitude of FL 370 to FL 390—right in the heart of the North Atlantic track system's commercial traffic.

LONG LEGS, SHORT TRIPS

A 2,000-pound increase in maximum landing weight gives the 604 a huge boost in flexibility that's especially useful on multiple-leg business trips. Subtract the 380-pound increase in basic operating weight (BOW), compared to the 601-3R, and the 604 provides a net useful load increase of 1,620 pounds at the first landing site.

What does that mean to an operator? You could depart White Plains with five passengers and fly to Dallas. Then, you could board three more people and proceed to stops in Atlanta and Raleigh-Durham. Finally, you could return to White Plains—without refueling any place en route.

Most operators won't need to hopscotch between four U.S. cities in one day, but the ability to fly many short legs without refueling allows people to pick and choose fuel stops based on cost per gallon. Just as importantly to many operators, less than 5,500 feet of runway would be needed at any of the airports visited.

CABIN COMFORT AND INTERIOR NOISE LEVELS

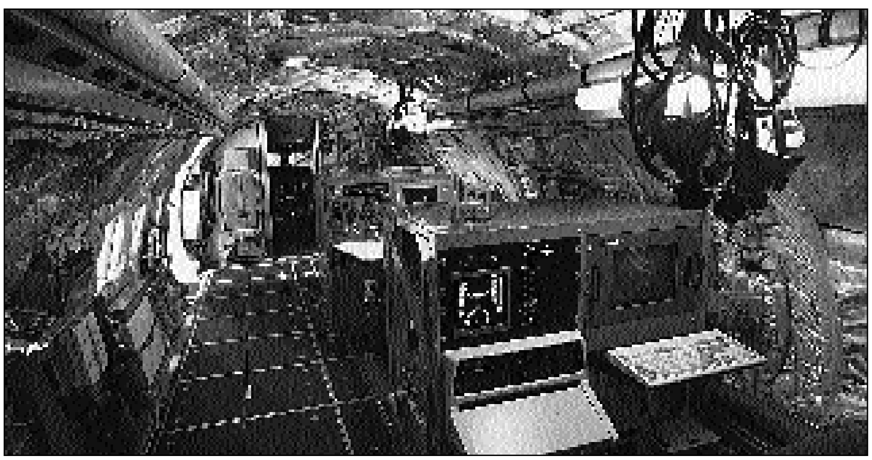
Bombardier advertises the Challenger 604's cabin as 28.3 feet long from the cockpit divider to the aft pressure bulkhead. Take a tape measure to a production interior, though, and you'll find that the usable length from the divider aft of the galley to the lavatory wall is close to 16.4 feet—sufficient space for the popular, double-club seating configuration.

Alternatively, the interior might be equipped with a forward club section and a half-club, plus a side-facing divan in the rear section.

The Challenger 604 will be certified for a maximum of 19 passengers, but that would be a tight fit indeed, considering the available cabin length.

Bombardier provides an interior completion allowance weight budget of 3,815 pounds, based on a manufactured empty weight of 21,620 pounds. Operators, however, will have to be careful when selecting optional equipment such as satcom (175 pounds), a third Litton Flagship IRS and a third data-acquisition unit (35 pounds each), as well as cabin amenities.

For this report, the aircraft we flew was serial number 5991, and although it is a production-conforming prototype, it didn't have a production interior. An objective evaluation of passenger amenities and cabin sound levels, therefore, was not possible. We expect the 604 to have interior comfort and sound levels similar to those of the Challenger 601-3R.



Paul Bowen Photography (2)

Serial Number 5991's passenger cabin was stuffed with orange test gear when we flew the 604 in late July. Production models will have a comfortable, two-lounge interior configuration, similar to this Challenger 601's.

ROBUST SYSTEMS

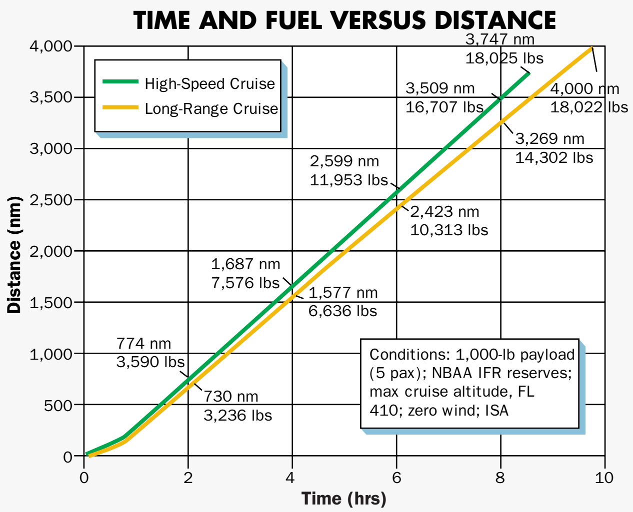
The Challenger 604's systems and avionics, as one might expect, complement its transoceanic range. (See sidebar.) The 604 also benefits from the Challenger RJ fleet. Most of the systems used on the Challenger have been well-seasoned with several thousand hours of use in airline service, providing accelerated testing well beyond Bombardier's in-house capabilities. It's as though your personal automobile components were undergoing continuous reliability testing on a fleet of New York City taxi cabs.

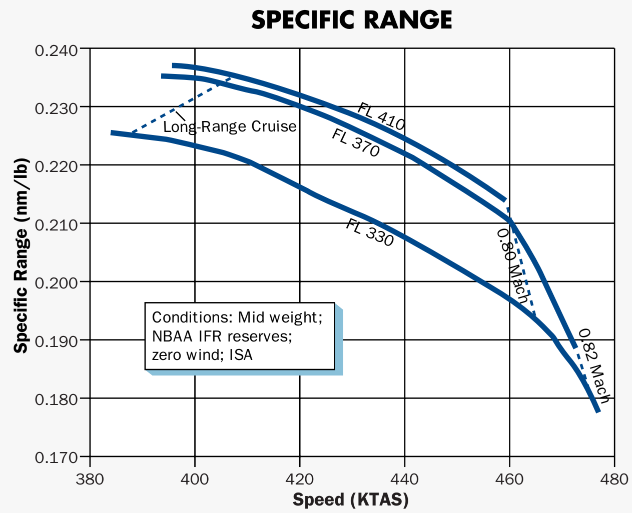
Triple redundant hydraulic systems power the hydraulically actuated flight controls, each of which are fitted with two pumps—mechanically or electrically powered. An artificial control force system using simple springs in the control linkage provides control feet to the pilot. No mechanical backup system is required.

The AC electrical system is powered by left- and right-side generators, plus a generator on the AlliedSignal 36-150 APU (approved for inflight operation) and an air-driven generator that automatically deploys in the event of a total electrical failure.

On our flight, two air-cycle machines supplied heated and refrigerated air to pressurize and air-condition the cabin. The normal takeoff procedure calls for departing with the engine bleeds off, except when needed for anti-ice bleed air. During takeoff, the APU may be used to supply bleed air to the air-cycle machines so that the cabin has a constant supply of pressurized air.

The fuel system has left- and right-wing tanks, plus a center tank that is linked to five tanks in the fuselage: forward and aft center tanks, two saddle tanks and a tail tank. In the original plans, the 604 was supposed to have a fuel-transfer system that would bias the fuel load toward the aft part of the c.g. envelope, thereby reducing stabilizer trim drag. That plan was later abandoned because of certifica-

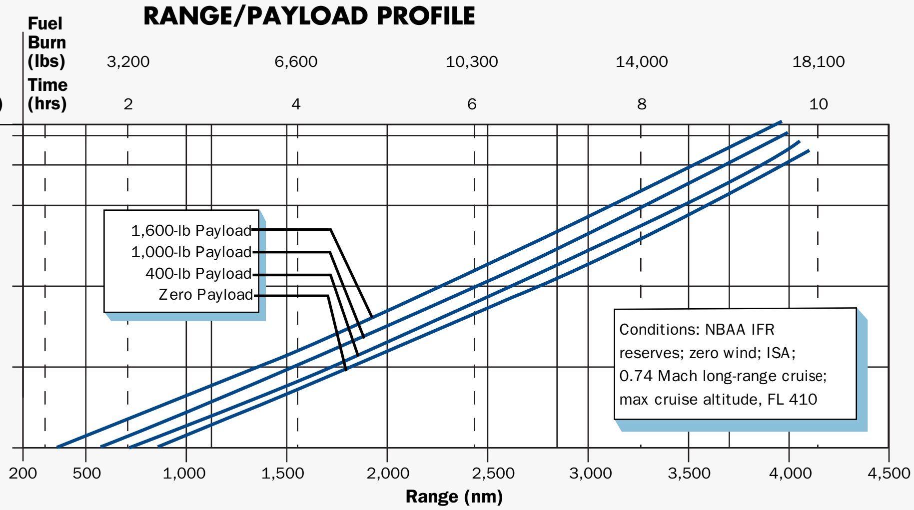




RANGE/PAYLOAD PROFILE

Balanced Field Length (ft) SL ISA	5,000 ft ISA+20°C	Gross Takeoff Weight (lbs)
6,315	9,720	48,200*
6,150	9,430	47,600
5,260	7,955	44,000
4,360	6,615	40,000
3,810	5,365	36,000
3,745	4,250	32,000

*Optional weight increase



Data source: Bombardier Business Aircraft Division. All data preliminary.

CANADAIR CHALLENGER 604

These graphs present range, fuel and payload information that is designed to show the capabilities of the Challenger 604. 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. For example, the Challenger 604 can carry a 1,000-pound payload 4,000 miles at a long-range cruise speed of 0.74 Mach to 0.71 Mach. Flying at a constant 0.80 Mach high-speed cruise results in a range of 3,474 miles.

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 three altitudes at a mid-range cruise weight. For example, the Challenger 604 cruising at 0.74 Mach at FL 370 at a mid-range cruise weight of 40,000 pounds achieves an SFC of 0.228 nm/lb.

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 Challenger 604, we have used a constant 0.74 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, the Challenger 604 can carry a 1,000-pound payload (five passengers) 4,000 nm, and it has a 9,430-foot takeoff field length when departing from a 5,000-foot elevation airport on an ISA+20°C day.

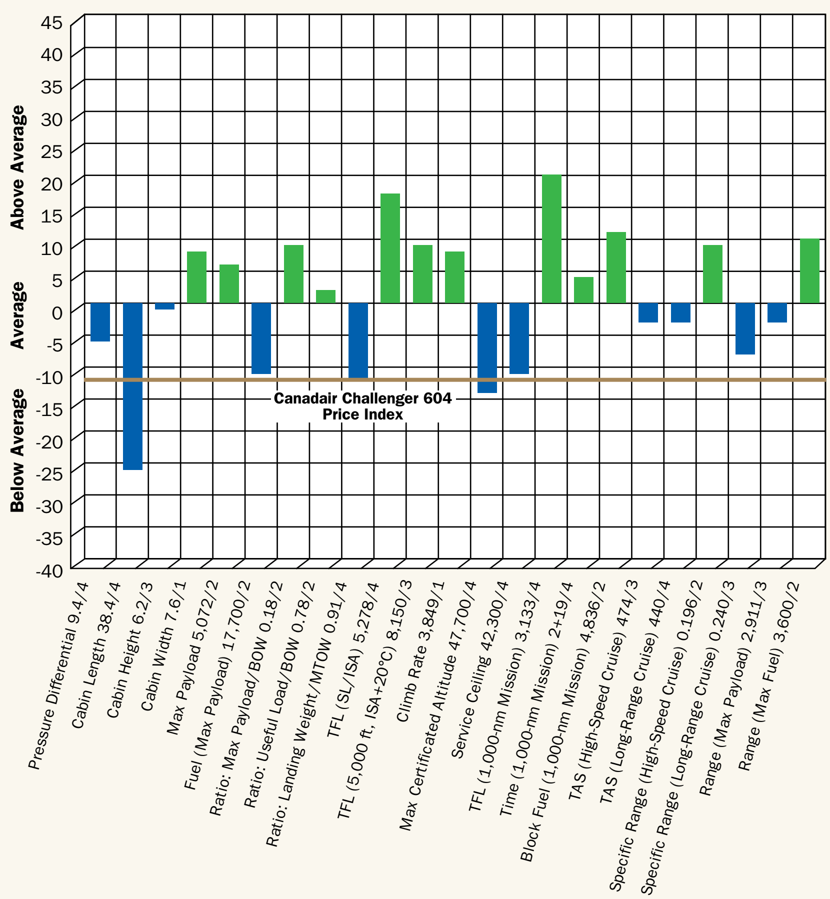
tion concerns, and the current system transfers fuel from the outlying fuselage fuel tanks to the center tank when its volume permits.

Take a good look at the landing gear in the accompanying photographs. The struts and rolling stock are noticeably larger on the 604, almost as large as the undercarriage fitted to the RJ. The 604 has 50-percent bigger brakes than the 601-3R, thereby eliminating heat problems and vastly shortening turnaround times because the brakes don't have to cool down as much after shutdown. Bombardier test pilots have stopped the aircraft in as little as 1,300 feet after touchdown—but that's part of a flight-test profile, and they don't have to pay for brakes.

Pilots will be firmly in the loop of Challenger 604 systems. The two center EFIS displays of the six-tube system normally are dedicated to engine instruments and crew-advisory system (EICAS) functions that display full systems synoptics, analog engine gauges and alphanumeric messages. This is one of the best EICAS installations we've seen installed on a business or regional aircraft.

Another reason pilots will remain in the loop is that the CF34 engines do not have an rpm synchronization function, thus the crew has to fine-tune the power levers to keep the big CF34 fans in pitch harmony. Lack of attention to engine sync, in our opinion, would very much annoy the passengers in this aircraft.

B/CA COMPARISON PROFILE®
(% Relative to Average)



Data source: Bombardier Business Aircraft Division

Designers attempt to give aircraft exceptional capabilities in all areas—including price—but the laws of physics do not allow one aircraft to do all missions with equal efficiency. Tradeoffs are a reality of aircraft design.

In order to obtain a feeling for the strengths and compromises of a particular aircraft, B/CA compares the subject aircraft's performance to the composite characteristics of aircraft in its class. We average parameters of interest for the aircraft that are most likely to be considered as competitive with the subject of our analysis, and then we compute the percentage differences between the parameters of the subject aircraft and the composite numbers for the competitive group as a whole. Those differences are presented in bar-graph form, and the absolute value of the parameter under consideration, along with its rank with respect to the composite, are given.

For this Comparison Profile®, we present selected parameters of the Canadair Challenger 604 in relation to a competitive group consisting of the Dassault Falcon 900B, the Falcon 2000 and the Gulfstream G-IVSP. It should be understood that this Comparison Profile® is meant to illustrate relative strengths and compromises of the subject aircraft; it is not a means of comparing specific aircraft to each other.

PERFORMANCE AND VALUE

The B/CA Comparison Profile® indicates that the Challenger 604 faces strong competition from its main rivals: the Dassault Falcon Jet 2000, Dassault Falcon Jet 900B and Gulfstream IVSP—at least if price is not a factor.

Other aircraft have more cabin volume, but the Challenger 604 has copious room for eight to nine passengers. The chief competitors are strong performers, especially when runway length is a limitation. Most operators, though, won't need to operate routinely from runways that are 6,000 feet or shorter and, with its additional range, the 604 can fly nonstop—in either direction—between Europe and North America at 0.80 Mach with eight passengers.

Competitors offer more speed, higher cruise altitudes and, in some cases, more range.

Throw in the $20.5-million purchase price for a completed aircraft, however, and the Challenger 604 moves into a class of its own. The price of upper end mid-size jets is now $16 million, but their cabins are far smaller than the Challenger's. Heavy-iron business jets now cost $24 million to $27 million—or more.

FLYING THE CHALLENGER 604

Our first impressions of the Challenger 604—frequently the ones that count the most—are a mix of experience with older 600-series aircraft and new discoveries. The cockpit is exceptionally comfortable, even for the tallest and largest pilots. Visibility out the windows is superb, making it possible to fly either left- or right-turn circling approaches with good visual reference to the runway. The steep view over the nose eases taxi chores and provides excellent visibility during

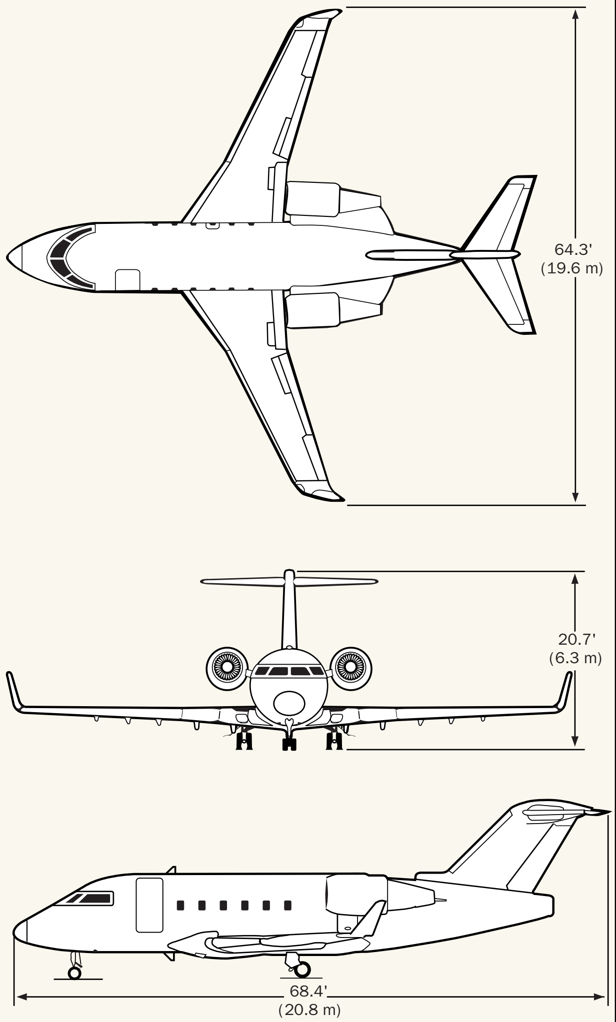
4,000-plus fpm climb-outs.

The avionics suite is particularly noteworthy. The six-tube Collins EFIS system is unsurpassed in any current-production business aircraft in terms of functionality, power and redundancy. The Collins AVSAT 6000 FMS, making its first appearance on the 604, surpasses any FMS ever installed in a Challenger.

Serial number 5991, still packed with bulky, orange test gear, weighed in at 30,390 pounds on the day of our flight from Wichita. The crew included Canadair Chief Test Pilot F. Douglas Adkins in the right seat, Engineering Test Pilot Bruce Robinson in the jump seat, and Flight-Test Engineer Ted Squelch at the flight-test control panel. Fuel weighing 9,450 pounds brought our ramp weight up to 39,840 pounds—about 7,700 pounds under MTOW.

After Adkins started the engines using APU bleed air, we taxied from Bombardier's Wichita Flight Test Center to the active runway. The Challenger 604's rudder pedals provide +/-7.5 degrees of nosewheel steering authority, and a large, arc-shaped tiller wheel on the left console provides up to +/-55 degrees of steering authority for close-in maneuvering.

CANADAIR CHALLENGER 604



We noted that the heavy duty, conventional hydraulic, carbon-carbon wheel brakes are quiet and chatter-free, with nice linear response characteristics to brake-pedal inputs. Taxiing out from the ramp, in close proximity to other aircraft, ground support equipment and numerous obstructions, made us appreciate the excellent visibility from the 604's cockpit.

Our weight at takeoff was 38,550 pounds, resulting in a computed V_1 decision speed of 120 knots, 126 KIAS for rotation, 135 for the V_2 takeoff safety speed and 159 for flap retraction. The FMS performance section is not yet complete, so we manually entered the takeoff N_1 speed in the FMS, which then displayed it on the EICAS fan-speed tachometers as target bugs. The computed takeoff distance was 4,950 feet for Wichita's 1,270-foot elevation and 79°F outside air temperature.

Most takeoffs are performed with the engine bleed air turned off, except for engine and airframe anti-ice when needed. The AlliedSignal 36-150 APU, however, is approved for operation up to 20,000 feet, so it's used to supply bleed air to the air cycle machine during takeoffs. We used the APU to pressurize the cabin for the first four minutes of the flight.

Pressing the go-around button on the left throttle, in preparation for takeoff roll, caused the flight-director pitch command to synchronize to 14 degrees nose up.

The integrated avionics processing system (IAPS) monitors the engines during takeoff, and it automatically reduces the pitch command to 11 degrees in the event of an engine failure.

Engine acceleration response is predictably slow at low rpm, but it becomes quite lively above 75 percent N1 fan speed. The throttles have long travel—even at high power settings—making it easy to set the precise rpm desired.

The pitch forces at rotation were notable, but not heavy. In our view, the force feels not as light as a Falcon 900B, but not as heavy as a Gulfstream IVSP. Using less than 10 pounds of force on the yoke produces very small pitch movement—a numbness in response. Push or pull the yoke with more force, and the nose responds crisply, yielding much the same feel as other airplanes we've flown that are equipped with powered flight controls. Bombardier officials claim that the non-lineal pitch response prevents pilot-induced oscillations and results in a smoother ride for the passengers.

The Challenger 604's roll-control force and response rates are quite harmonious with the pitch-control force, but no on-center numbness is apparent. The rudder pedals have a soft feel when yawing the aircraft, foretelling of docile yaw control characteristics in case of a one-engine inoperative (OEI) takeoff.

As one might expect in a large business aircraft, the 604's short- and long-period stability characteristics make it a good instrument platform. The phugoid, or long-period pitch cycle, for example, was 94 seconds with positive damping. The on-center softness in pitch response, though, requires conscious attention to nose attitude.

The CF34 engines are mounted high on the fuselage, hinting at large pitch changes with power changes. Such is not the case. According to Adkins, aerodynamic tests of the wing revealed that high thrust settings also cause the fans to greatly increase the air flow over the inboard top sections of the wing. That increases lift. The downward nose push of the engine thrust, thus, is counterbalanced by the upward nose push of the increased wing lift. The result is very mild power versus pitch response.

Climbing from Wichita (elevation 1,270 feet, ISA+11°C) to FL 350 (ISA+15°C) at 250 KIAS/0.70 Mach took 17 minutes, and the aircraft burned 1,450 pounds. The cruise design point of the wing is 0.76 Mach, but we elected to accelerate to 0.80 Mach. That cruise speed required a fuel flow of 2,500 pph at an aircraft weight of 38,000 pounds.

During a few steep turns at FL 350, we experienced the onset of buffet at 1.6 g and a weight of 37,650 pounds. Adkins commented that turns up to 58-degrees bank angle may be performed without buffet, suggesting that the aircraft has a generous Mach-buffet boundary, even at the maximum certified altitude.

Descending for a series of approaches at Salina, Kansas, we found the aircraft to be stable and controllable up to 390 KIAS. (The aircraft has been flown to 0.94 Mach and 465 KCAS during the flight-test development program.)

Configuration changes produced docile responses. Extending the flight spoilers produces a very mild nose-up pitching moment and a substantial increase in the rate of descent. Extending or retracting the landing gear produces almost no change in nose attitude. The large, trailing edge flaps, in contrast, produce some ballooning and nose-down pitch change when extended to 20 to 30 degrees. Beyond that, the flaps produce a substantial increase in drag when extended to 40 degrees, requiring a large increase in thrust setting to maintain level flight.

Stalls are quite straightforward. Trim the aircraft for 1.3 Vs, decelerate at one degree per second and wait for the stall warning. We elected to hold nose attitude through the audible stall warning, and then the stick shaker. When the stick puller "fired"—that's as far as non-test pilots should ever pull on the yoke—we allowed it to push the nose down to well below the horizon, and initiated stall recovery with full thrust.

The AVSAT 6000 adds a new level of capability to the Challenger 604. We programmed it for a multiple-waypoint VNAV descent, and also explored its automatic FMS-to-NAV (long-range NAV to ILS) transition feature. The comparatively short length of our flight prevented a more in-depth evaluation.

PRELIMINARY SPECIFICATIONS
CANADAIR CHALLENGER 604

B/CA Equipped Price	$20,500,000
Seating	2+9/19
Power	
Engine	2 GE CF34-3B
Output	8,729 lbs ea
TBO	6,000 hrs
Dimensions	See Three-Views
Weights (lb/kg)	
Max Ramp	47,700/21,637
Max Takeoff	47,600/21,591
Max Landing	38,000/17,237
Zero Fuel	32,000/14,515
BOW	26,630/12,079
Max Payload	5,370/2,436
Useful Load	21,070/9,557
Max Fuel	19,852/9,004
Payload–Max Fuel	1,218/552
Fuel–Max Payload	15,700/7,121
Limits	
M_{MO}	0.85
V_{MO}	345 KIAS
V_{FE} (app.)	230 KIAS
PSI	8.8
Climb	
All-Engine Rate (fpm/mpm)	4,150/1,265
Engine-Out Rate (fpm/mpm)	1,100/335
Engine-Out Gradient (ft/nm)	397
Ceilings (ft/m)	
Certificated	41,000/12,497
All-Engine Service	37,700/1,149
Engine-Out Service	23,300/7,102
Sea-Level Cabin	23,200/7,071
FAR Part 36 Noise Levels	Not Available
Airport Performance	See Charts
Range Performance	See Charts

Pressing on to traffic pattern work, we flew a series of landings at 36,000
to 34,500 pounds.
VREF landing spee
ranged from 128
126 KIAS. The exce
lent visibility fro
the cockpit make
landing-pattern
work easy, but we
were glad to have th
optional Collin
TCAS installed on th
aircraft.

Pilots new to Ch
lengers are in for a t
when they make
first landings in the
the threshold, you
the power to idle
might in a straight-w

na Citation); flare with a nearly flat nose attitude; and wait for the large-travel, trailing-link landing gear to cushion the touchdown like a feather bed.

Simulated OEI takeoffs require moderate rudder pressure to counter the yaw rate. At rotation, we noted that the IAPS reduced the flight-director pitch attitude to 11 degrees, and commanded the "operative" engine to go into the automatic power-reserve mode.

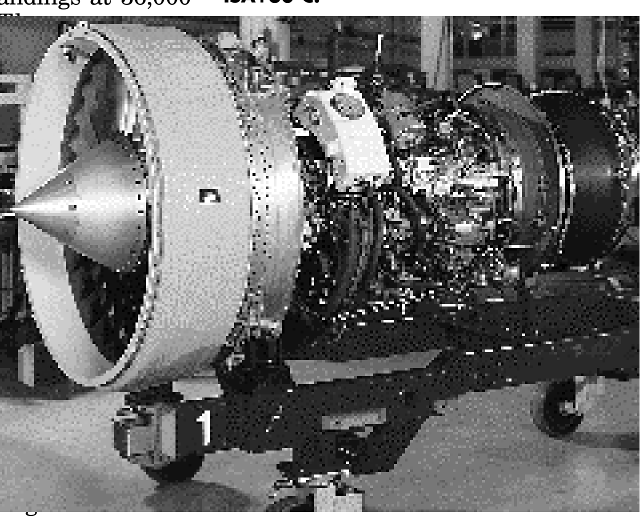
The wheel brakes are noticeably more powerful than those of previous Challengers. The thrust reversers have about 25-percent thrust efficiency, but no speed restrictions on use have been imposed.

Our overall impression of the Challenger 604 is exceptional mission flexibility. More thrust and more fuel enable it to fly between Paris and White Plains, New York at 0.80 Mach. Just as impressively, it flies everyday, bread-and-butter flights between Peoria, Illinois and Wichita with equal ease and utility.

The Challenger, positioned between Bombardier's Learjet 60 and its ultra-long-range Global Express, has carved out a niche in the market that others cannot fill, as evidenced by its sales popularity.

We believe the 604 will broaden that special area of demand. Production deliveries will begin in the second quarter of 1996. **B/CA**

The GE CF34-B, the latest version of the veteran CF34 turbofan engine, is fitted to the Challenger 604. With a more-robust core and a slightly higher air-flow rate, it produces 8,729 pounds thrust at ISA+30°C.



GE Aircraft Engines