
# Bombardier Challenger 605

Attention to detail makes it the value leader in the long-range, wide-cabin class.

*By Fred George*

Step into the cabin of the new Challenger 605 and it's not hard to see why the Challenger has been the single best-selling model in the heavy-iron class for more than 10 years. If you're going to spend nine-plus hours in a long-range business aircraft, cabin comfort likely ranks high among your list of priorities. Cabin width is one of the key factors that determine cabin comfort and Challenger 600-series aircraft always have had the widest cabins in the large-cabin class.

The Challenger 605, the fifth iteration of the design, actually has a slightly wider usable interior because of more-efficient space utilization. The cabin interior incorporates dozens of improvements suggested by market focus groups. For instance, it has substantially larger cabin windows than early Challenger 600-series aircraft and they have been placed 2.5 inches higher on the sides of the fuselage for better outside viewing. It has a considerably more robust, Ethernet-based cabin management system adapted from Global series aircraft, along with an upgraded galley and larger video monitors, plus LED wash lighting, sturdier pull-out worktables and improved lavatory ergonomics. Speech Interference Level (SIL) is down to 55 dB in the mid-cabin area at 0.77 Mach and an active noise and vibration control system is optional.

Historically, such improvements typically add weight to the airframe, thereby decreasing tanks-full payload. Challenger operators, however, told Bombardier they didn't want to sacrifice range/payload flexibility. So Bombardier engineers embarked upon an aggressive weight reduction program for the Challenger 605 that actually netted a 200-plus pounds weight savings, in spite of its bigger cabin windows and plusher interior furnishings. The improvement enables operators to equip their aircraft with more options, carry an

Photographs courtesy of Bombardier Business Aircraft

extra passenger or load 200 pounds more fuel for range-critical missions.

Bombardier also asked pilots about what they wanted in the cockpits of their next long-range, widebody aircraft. The Challenger 605 incorporates many of those suggestions. Up front, the flight deck sports a new Rockwell Collins Pro Line 21 avionics package with four, large-format LCD screens. The displays have half again as much area as the six CRTs in the Challenger 604, as well as offering considerably higher resolution, more graphics capabilities, lower power consumption and longer life. The basic aircraft is certified with an EFB paperless charts capability and it has a right-side touch screen that allows remote control of cabin management system functions from the cockpit. It also has lighter weight and improved "align-on-the-fly" Honeywell IRSes, on-screen radio tuning and a three-in-one integrated standby instrument system.

The Challenger 605 also is the value leader in the large-cabin class. Glance please at the accompanying Comparison Profile, a chart that compares the Challenger 605 to other large-cabin aircraft with similar capabilities. The chart depicts a mixed bag of strengths and shortcomings, independent of acquisition cost. But when the Challenger 605's 24 percent lower price tag is used as the baseline, it clearly emerges as the value leader in the large-cabin class.

Priced at less than $28 million, the Challenger 605 is the least-expensive business aircraft that can fly five passengers 4,000 nm at long-range cruise. Fill all the seats and it can still fly nearly 3,900 nm. Speed up to 0.80 Mach and it can fly from New York to Tokyo in just over 15 hours, including a stopover in Anchorage for refueling and leg stretching. You can fly from New York to Delhi, with a stopover at Le Bourget, in virtually the same time.

Few operators, though, are likely to fly such long missions. The Challenger 605's strong suit is airliner-like reliability and toughness so vital for everyday briefcase missions. Operational flexibility is its hallmark. This aircraft can dart between any two cities in the continental United States at 470 KTAS with eight passengers aboard. It also can operate out of small general aviation airports and fly 1,000 nm trips, needing less runway than most midsize jets, including the best-selling Hawker 800XP.

The Challenger 605 is an evolutionary development of the Challenger 604, but it incorporates dozens of small improvements that make it a better airplane. The highlights of all those detailed changes comprise the main thrust of this report.

*Larger and higher windows, new window reveals and better interior space utilization improve perceived and actual width of cabin, already the widest in the purpose-build large-cabin business jet class.*

### Cabin Environment and Passenger Amenities

For more than a quarter century, Challenger 600-series aircraft have been renowned for passenger comfort. The Challenger 605 takes this concept to the next level by incorporating several enhancements recommended by Bombardier's own business aircraft users and operators, according to Eric Martel, vice president and general manager of the Challenger and Global product lines. "The 'principal' [executive] buys the aircraft," he said. "Customers gave us plenty of feedback during focus group sessions. We listened."

Topping their list of priorities was the need for a more-robust cabin management system, greater reliability of cabin systems and easier removal and replacement of cabin equipment during routine maintenance procedures. These goals dictated an airliner-design approach to the Challenger 605's cabin completion. As a result, Bombardier tapped C & D Aerospace, long-time cabin completions partner for the CRJ product line, to help design and to supply most of the interior components for the Challenger 605. All the furnishings feature "fast-in, fast-out" removal/replacement designs.

This is in stark contrast to the Challenger 604. "It was built as a green aircraft to which an interior was added. The Challenger 605 [production line] has a lot

*Standard cabin features a forward, four-seat club section, two facing chairs and a three-place divan. Foldout worktables are sturdier and have more usable surface area than those in earlier Challengers.*

## Challenger 605

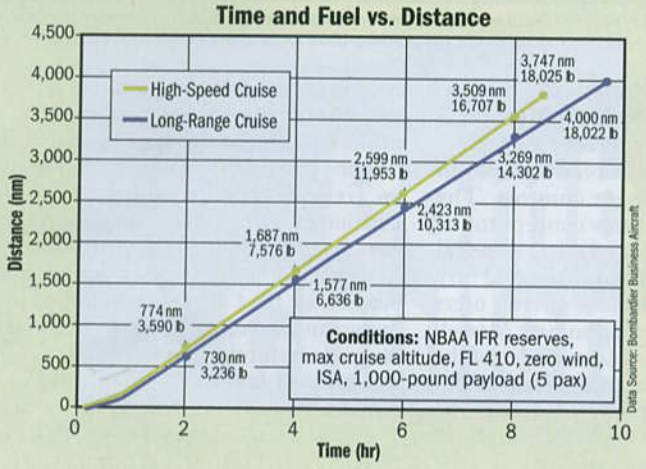
These graphs are designed to illustrate the performance of the Challenger 605 under a variety of range, payload, speed and density altitude conditions. Do not use these data for flight planning purposes because they are gross approximations of actual aircraft performance.

**Time and Fuel vs. Distance —** This graph shows the relationship distance flown, block time and fuel consumption. The Challenger 605's 0.74 Mach long-range cruise yields about 6 percent better fuel efficiency than cruising at 0.80 Mach. Most operators are likely to cruise at 0.80 Mach on all but the longest range missions. Bombardier's 26,985-pound estimated BOW is representative of a baseline, but well-equipped aircraft with nine passenger chairs. Other configurations and optional equipment can have a substantial impact on the aircraft's 1,000-pound tanks-full payload.

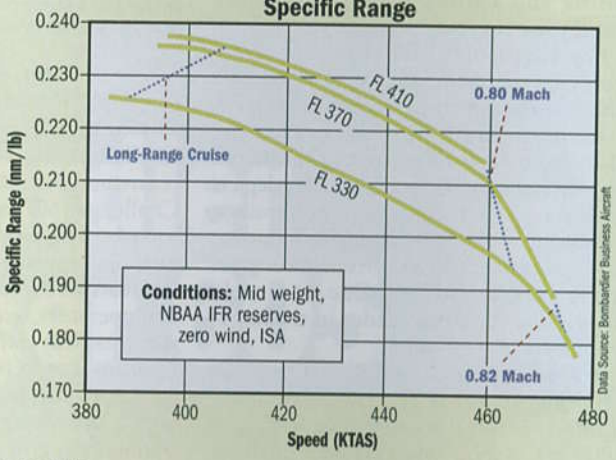
**Specific Range (Mid-Range Weight, ISA) —** This graph shows the relationship between cruise speed and fuel consumption for the Challenger 605 at representative cruise altitudes for 40,000-pound, mid-weight aircraft. We did not have the opportunity to verify these data during our evaluation flight. The Challenger 605 has virtually identical cruise performance as the Challenger 604 because both aircraft share the same wing and engines.

**Range/Payload Profile —** The purpose of this graph is to provide simulations of various trips under a variety of payload and two airport density altitude conditions, with the goal of flying the longest distance at 0.74 Mach. Each of the four range/payload lines was plotted from multiple data points by Bombardier Business Aircraft performance engineers, ending at the maximum range for each payload condition. The time and fuel burn dashed lines are based upon 0.74 Mach long-range cruise based upon the Time and Fuel vs. Distance graph. Runway distances for sea-level standard day and for *B&CA*'s 5,000-foot elevation, ISA+20°C airport accompany the takeoff weights, using the optimum flap configuration in light of FAR Part 25 runway and second-segment OEI climb performance requirements.

### Time and Fuel vs. Distance

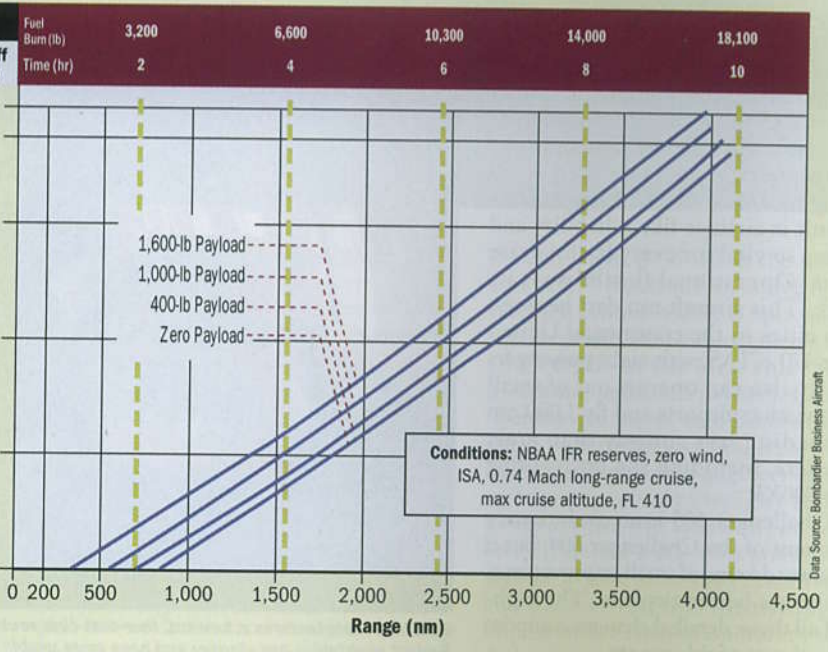



### Specific Range

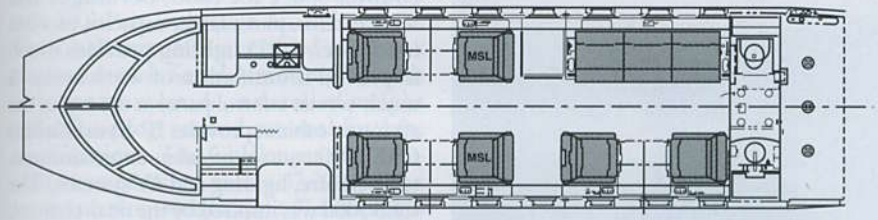



### Range/Payload Profile

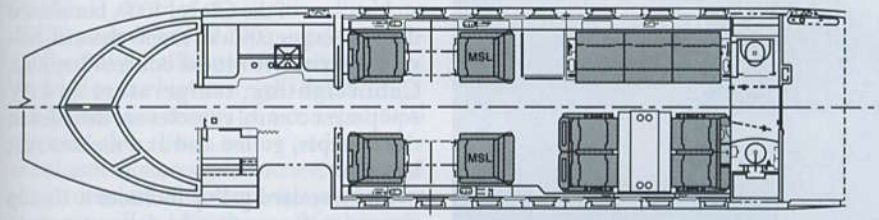
| Balanced Field Length (ft) | | |
|---|---|---|
| SL ISA | 5,000 ft ISA+20°C | Gross Takeoff Weight (lb) |
| 5,839 | 9,397 | 48,200 |
| 5,792 | 9,315 | 48,000 |
| 4,940 | 7,747 | 44,000 |
| 4,219 | 6,426 | 40,000 |
| 3,600 | 5,229 | 36,000 |
| 3,401 | 4,532 | 32,000 |



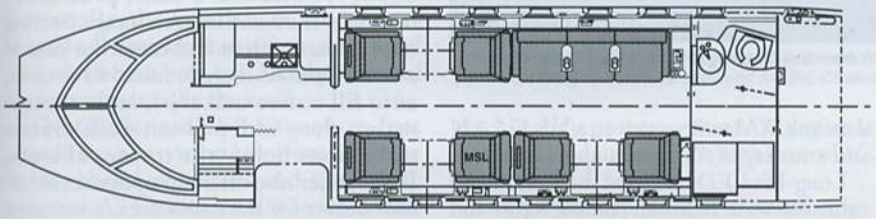
Plan 1




Plan 2




Plan 3




## Challenger 605

**B&CA Equipped Price** .....$27,381,000

**Characteristics**

Seating .....2+9/19
Wing Loading .....92.6
Power Loading .....2.76
Noise (Takeoff) (EPNdB) .....81.2

**Dimensions (ft/m)**

External
*Length* .....68.4/20.8
*Height* .....20.7/6.3
*Span* .....64.3/19.6
Internal
*Length* .....25.5/7.8
*Height* .....6.1/1.9
*Width (Maximum)* .....8.2/2.5

**Power**

Engine .....2 GE CF34-3B
Thrust (lb ea.) .....8,729
SL Flat Rating .....ISA+15°C
Inspection Interval (hr) .....OC

**Weights (lb/kg)**

Max Ramp .....48,300/21,909
Max Takeoff .....48,200/21,863
Max Landing .....38,000/17,237
Zero Fuel .....32,000c/14,515c
BOW .....26,985/12,240
Max Payload .....5,015/2,275
Useful Load .....21,315/9,668
Executive Payload .....1,800/816
Max Fuel .....19,850/9,004
Payload With Max Fuel .....1,465/665
Fuel With Max Payload .....16,300/7,394
Fuel With Exec. Payload .....19,515/8,852

**Limits**

MMO .....0.850
Trans. Alt. FL/VMO .....FL 222/348
PSI .....8.8

**Climb**

Time to FL 370 .....21 min.
FAR Part 25
OEI Rate (fpm/mpm) .....581/177
FAR Part 25
OEI Gradient (ft/nm, m/km) ..231/70.4

**Ceilings (ft/m)**

Certificated .....41,000/12,497
All-Engine Service .....38,250/11,659
OEI Service .....20,000/6,096
Sea Level Cabin .....23,200/7,071

**Certification** .....FAR Part 25, 1980/83/87/95/2006

of 'repatriation' of completion processes that prevent taking three steps forward and then two steps backward during outfitting," Martel explained. Bombardier adopted CRJ team completion practices and carefully studied Toyota's lean manufacturing processes at its Nagoya assembly plant. This helps to standardize both green manufacturing and completion processes, but it hasn't resulted in cookie-cutter, look-alike cabin interiors. Bombardier offers customers a long list of factory-standard options for the Challenger 605, plus there are many choices of fabrics, carpets and cabinet finishes. Most business aircraft manufacturers now have adopted similar practices that streamline completion processes. Now green aircraft are provisioned with structural components and systems needed for both standard and optional equipment that will be installed during completion.

Challenger 605 buyers are offered a choice of three standardized cabin layouts, all of which feature a forward galley, a four-chair, forward club seating section, a three-place divan in the aft right section of the main seating area and an aft lavatory, as shown in the accompanying line drawings. Plan 1, the cabin configuration of the aircraft we flew for this report, features two facing chairs in the aft left section of the cabin, across from the right-side divan. Plan 2 substitutes a four-chair conference seating section across from the divan, thereby increasing weight by 132 pounds. Plan 3 is quite similar to Plan 1, but the length of the main seating area is shortened by 18 inches to make room for a larger and 160-pound heavier aft lavatory. The shorter seating section of Plan 3 also restricts the legroom, reclining movement and travel of facing pairs of chairs.

The most obvious change to the Challenger 605's interior is its 30-percent brighter ambient lighting, made possible by the larger 10-inch-wide by 16-inch-tall cabin windows and Global 5000-inspired, wide-angle window reveals. The window upgrade concept originated with Pierre Beaudoin, president of Bombardier Business Aircraft. He realized that more natural light would give the illusion of a larger cabin. Now, seated and standing passengers don't have to bend down to see out of the cabin windows. If there's too much natural light, manually operated accordion window shades may be lowered to darken the cabin. Powered shades are optional, but they add 39 pounds to empty weight.

Redesigned cabin interior walls increase usable cabin by 1.1 inches. In addition, the overhead passenger service unit panels have been recontoured to increase available


*The Challenger 605's conical tail cone distinguishes it from the Challenger 604, which has a "boat tail" tail cone.*

headroom by two inches when passengers are seated. Bombardier advertises that the cabin has 6.1 feet of headroom. Our tape measure indicated that it was just less than six feet.

Advertised cabin width at 8.2 feet also was somewhat optimistic. It was 7.9 feet, according to our measurement. Between the lower sidewalls at knee level, the maximum width was 6.9 feet. That's somewhat wider than in the Challenger 604 because C & D Aerospace designed slimmer sidewall pockets for the folding worktables. C & D also engineered higher side ledges and made the worktables much sturdier so that they don't wobble. In addition, when the tables are extended, their outboard edges are flush with the side ledges, thus extending usable work surface area.

Furnishings throughout the cabin are top notch. All the cabinet surfaces have relatively large-radius corners, providing a "soft edge" quality. The wood veneers are finished with a high-gloss clear coat. Individual lighting control and flight attendant call panels have back-lighted buttons within easy thumb reach below the side ledges. The front and rear bulkheads have standard 18-inch monitors, with 21-inch monitors offered as options, adding just eight pounds to empty weight. Each passenger seat has its own audio jack and audio source selector switch. Standard equipment includes an Iridium satcom system, a dual-disc DVD/CD player located in the forward wardrobe closet and an MP3 interface. Individual 10.4-inch monitors (seven pounds each) for each single seat are available as optional equipment. Other equipment options include an Inmarsat satcom system, Swift64 data link, XM radio receiver, a Wi-Fi LAN and a variety of AV system upgrades.

Long-life LEDs are used throughout the cabin for wash lighting, reading lights and galley illumination. LEDs typically have a 5,000- to 10,000-hour MTBF. Elimination of trouble-prone fluorescent lights both reduces power consumption and increases dispatch reliability.

Up front, the galley has been extensively revamped, with inputs from professional cabin crew members, such as Bombardier's own Debra Franz, senior coordinator flight services. Franz suggested a horseshoe shape to the galley for easier access. There are large capacity forward and aft symmetrical tower cabinets and two tiers of shelving in the middle, inspired by the design of the Global series aircraft family. The new design increases available cabinet and counter space for food, beverages and service items, plus a larger capacity, two-bin ice drawer. LED lighting provides much improved illumination of work areas. A touch-screen control panel at the top of the aft tower cabinet provides IP-based Collins CES 5000 control of cabin entertainment, temperature, lighting and AV systems. The CES 5000 was inspired by the dual-channel, fail-operational, Airshow 21 cabin control architecture of the Global 5000, but aboard the Challenger 605 it's a single-channel, fail-safe system with local control backup. Cabin lighting, temperature and AV equipment control consoles are installed in the cockpit, galley and at a master seat location.

The standard galley includes a 10-cup manual coffee maker, high-temperature oven, ice and trash bins, plus food, beverage, china and utensil storage. Serving ware items are front and center for ease of access. Options include microwave oven, auto fill coffee maker(s), and espresso maker, along with pull-out work counter extensions below the tower cabinets. Bombardier also offers an optional electric foot heater for the galley area, a welcome addition for ground operations in cold weather.

Aft of the main seating area, the Challenger 605 has a redesigned lavatory with improved ergonomics to accommodate a range of people sizes from the 95th percentile male to the 5 percentile female. The toilet's height, footprint and seat size, for instance, have been reduced for better access and seated comfort. The tilt of the mirror is adjustable throughout a wide range and the wash basin is larger.

## Structure and Systems

The Challenger 605 shares its FAA CL600-2B16 type certificate with the Challenger

*The 36-inch-wide by 70-inch-tall air-stair door has lighted stairs and two sturdy, chromed handrails for steady boarding in slippery conditions.*

604, approved in May 1995 in accordance with FAR Part 25 through Amendment 78. The Challenger 605 is certified as a block point change at Serial Number 5701 with an avionics upgrade, a detailed weight reduction program and external fuselage modifications. The Challenger 604 originally was certified with a 47,700-pound maximum ramp weight and a 47,600-pound MTOW, but later versions incorporate SB604-11-00 that raises those limits to 48,300 pounds and 48,200 pounds, respectively. All Challenger 605 aircraft are certified to the higher weight limits.

The basic airframe is a conventional stressed skin, hoop frame and stringer aluminum monocoque structure, with steel alloys, titanium and composites used where they can offer advantages of strength, weight, durability or heat resistance. Externally, the Challenger 605's cone-shaped tail distinguishes it from the Model 604, which has a boat-tail. All other external features are virtually the same.

The Challenger 605's 520-square-foot aluminum alloy wing has front and rear spars, chord-wise ribs and span-wise stringers. All Challenger 600-series aircraft feature a first-generation super-critical airfoil based on a Richard Whitcomb NASA-Ames design, 8.5 aspect ratio and 25-percent quarter chord sweep angle. Winglets improve lift to induced drag characteristics.

Passengers enter the aircraft by means of a conventional 36-inch-wide by 70-inch-tall Type I air-stair door that has dual, sturdy handrails and an extending support foot that sits on the ramp when the door is fully open. Stair lights illuminate the boarding ladder for safe use at night. A pressure-relief panel in the door opens to assure that all cabin pressure is vented prior to the door fully unlocking. The door is counter-balanced by gas struts and mechanical springs, making it relatively easy to close by hand from inside or outside the aircraft. An electrically powered door assist system also can be used to raise the door.

A 20-inch-wide by 36-inch-tall Type III overwing emergency exit on the right side of the fuselage and a left-side 43-inch-wide by 33-inch-tall aft baggage compartment door provide emergency egress.

Aircraft systems are very much like those of airliners, including Bombardier's own regional jets. The electrical system, for instance, has twin, self-excited, constant-speed 115/200 VAC, 400 Hz, 30 KVA AC generators powered by the engines. The APU powers a third 30 KVA AC generator and the emergency-use-only ram-air turbine has a 15 KVA generator. Most high-power electrical equipment, such as electrically powered hydraulic pumps, flap motors, windshield and probe heaters, plus most galley power, optional Inmarsat satcom and landing/taxi lights, are AC powered.

*The Challenger 605's engines and wings are unchanged from the Challenger 604, thus the performance graphs we've provided for the Challenger 605 are carried over from our Model 604 report.*

DC power, supplied by four transformer-rectifier units in the nose compartment, is used for the fuel pumps, most avionics including standard Iridium satcom and the cabin management system, along with nav lights, most sensors, protection and control circuits, along with backup and emergency power systems. Two batteries, one in the nose for emergency power and a larger one in the tail to start the APU, provide backup DC electrical power.

Both AC and DC systems feature three-tier automatic load shedding to reduce workload during both normal and abnormal operations.

The Challenger 604's fuel system is carried over unchanged to the Challenger 605. Left and right wing tanks hold 9,675 pounds, three aux belly tanks carry 7,115 pounds and a tail-cone tank plus twin saddle tanks in the aft equipment bay hold an additional 3,122 pounds. Total usable fuel is 19,850 pounds.

Jet pumps normally supply fuel to the engines and transfer most fuel from tank to tank, with motive flow provided by surplus fuel pressure from the engine-driven fuel pumps. DC-powered fuel boost pumps are used for engine starting and serve as a backup to the jet pumps. Fuel transfer is automatic, with fuel feeding first from the main wing tanks. After the wings are partially depleted, aux belly tank fuel is burned. Using AC-powered fuel pumps, the tail tanks transfer to the aux belly tanks to keep them full as long as possible. With all fuselage tank fuel depleted, wing tank fuel is burned.

Normal refueling is done through a single-point pressure refueling receptacle in the right wing root. Bring your calculator to convert gallons or liters on the truck into pounds or kilograms in the airplane. Individual tanks can be selected for refueling, but there is no provision for pre-selection of precise refueling quantity. However, buyers can order a second tank selection switch panel, with integral fuel weight quantity indicators, as an option for the cockpit. That's one we recommend, especially as it eliminates the need to covert liquid volume into fuel weight.

The aircraft also can be refueled using over-wing ports. But only 93 percent of the wing and aux belly tanks can be refilled that way, and the tail tanks remain empty. This reduces maximum range to about 3,400 nm.

All Challengers have fully powered, triple-redundant hydraulically actuated primary flight controls. Triplication of function eliminates the need for a mechanical backup. Artificial control feel spring boxes provide feedback in all three axes, with variable feel in the pitch axis tied to horizontal stabilizer position. Anti-jam disconnection is provided in both roll and pitch axes. Secondary flight controls include an electrically actuated trimmable horizontal tail and inboard/outboard flaps, plus hydraulically actuated flight and ground spoilers. The aircraft is not equipped with roll spoilers. Pitch trim is manually controlled by switches on the yokes or automatically by the aircraft's autopilot and Mach trim systems. The rudder and aileron trim switches are located on the center console.

A stall protection system, using angle-of-attack, flap, altitude and longitudinal accel-

## Rockwell Collins Pro Line 21 Avionics

The Challenger 605's Rockwell Collins Pro Line 21 avionics suite is considerably more capable, more reliable, weighs less and draws less power than the Pro Line 4 package installed in the Challenger 604. The four 10- by-12-inch LCD screens offer 55 percent more display area than the six 7.25-inch square CRT displays in the Challenger 604. The new LCDs offer improved pixel resolution, color contrast and considerably greater reliability. The entire layout is a close relative of the Pro Line 21 cockpit in the Challenger 300.

The PFDs feature an edge-to-edge artificial horizon on the ADI display in keeping with contemporary EFIS design practice. The ADI now has an integral flight path vector symbol that enhances hand flying precision. Remember the Challenger 604's stand-alone angle-of-attack gauges spaced well away from the PFDs? They're now gone. Angle-of-attack indicator tapes, driven by a third AOA probe and incorporating flap position compensation, are displayed outside of the airspeed tape on the PFDs. In addition, TAWS, TCAS and weather graphics now can be overlaid on the HSI sections of the PFDs. The baro set knobs have been relocated to a heads-up position in the glareshield panel, away from their heads-down location on the Challenger 604.

The MFDs similarly are improved. The crew has the option of dedicating the top block of the MFD for radio tuning status. The tuning knobs are located on the center console. The new MFDs are large enough to display all CAS messages in a single column. The CAS messages are context filtered, so fewer overstating-the-obvious alerts pop up. There's also room to display engine instruments, secondary flight control and trim position indications, and a graphic synoptic diagram for a specific system on the MFDs. Described in only in words, that seems like a lot of data to cram into a single display.

Either XM satellite radio weather or Universal Weather data link services are optional. The XM radio package requires an additional satellite radio receiver. A second XM radio receiver must be ordered as an option for the cabin AV system.

The standard package includes Collins Pro Line 21 radios with com/nav/ADF/HF transceiver/DME and Mode S transponder functions, dual upgraded DADCs and dual FMS-6000 units with full 3-D non-precision nav capability, plus dual Honeywell LASER V IRSes, Collins TDR-850 solid-state Doppler turbulence detection radar and Collins TCAS II, along with Honeywell E-GPWS, cockpit voice recorder, digital flight data recorder and Iridium satcom. A Class 3 EFB e-chart function is standard, so there's little point in ordering the enlarged chart book storage locker for the cockpit. A Thales solid-state, LCD screen integrated standby instrument and GPS clock also are included.

Options include Inmarsat satcom, third FMS-6000, third VHF comm transceiver (required for optional Universal Weather data link) and third Laseref V, plus with a lightning detection system, runway awareness and alerting system, enhanced map graphics and second radio altimeter. A second, left-side cockpit touch screen is optional and it's very handy for displaying e-charts if that function cannot be provided by the MFD. The pilot in the left seat would have to look all the way over to the right cockpit touch screen for the e-chart, if the MFD e-chart function were not available.

Bombardier is looking at several new HUD options, but the firm isn't ready to make any public announcements. However, it's highly likely that one of the new LCD projector HUDs will be selected, one that offers considerably better resolution, crisper imagery and improved reliability.

The end result is more standard and optional capabilities, plus much less avionics system weight. Just as importantly, the addition of Pro Line 21 CNS radios, improved Honeywell Laseref V IRSes, better DADCs and fewer control panels should improve overall avionics system MTBF by 25 percent, according to Bombardier officials.

eration inputs, provides aural, visual and tactile stall warnings. A stick pusher forces the yoke forward to prevent inadvertent entry into a deep stall.

There are three, 3,000 psi hydraulic systems, each with a main and a backup pump. Systems 1 and 2 have engine-driven main and AC electrically powered backup hydraulic pumps. These two systems power the primary flight controls and certain spoiler panels. System 2 also powers the emergency landing gear extension system and outboard wheel brakes. System 3, powered by AC electric main and backup pumps, powers the primary flight controls and inboard wheel brakes, plus utility functions such as landing gear actuation, nosewheel steering and gear doors.

The Challenger 605 has trailing link landing gear and a straight-leg nose gear. Proximity switches detect gear extended/retracted positions, eliminating trouble-prone "squat switches." When retracted, the nose gear is completely enclosed, but only the struts of the main gear are covered by gear doors. The outboard tires and wheels are exposed, but they're streamlined into the wheel wells with brush seals.

The main wheels have long-life carbon heat packs and a dual-channel, digital anti-skid system. In the event all hydraulic power is lost, accumulators provide up to six brake applications with differential braking and anti-skid. There are no brake temperature sensors, but the wheel wells have an over-temperature monitoring system.

Up to seven degrees of steering is available through the rudder pedals by means of the digitally controlled, hydraulically actuated steer-by-wire system. The tiller provides up to 55 degrees of steering authority. Differential braking can increase steering authority up to 99 degrees.

Dual air-cycle machines, or "packs," refrigerate 10th stage engine compressor bleed air, APU bleed air or external high pressure air for air-conditioning of the cabin, cockpit and avionics. The packs have a high-flow rate function for ground cooling or single-pack operation and a normal flow function for dual pack operation in flight. Bleed air also is the primary source for cabin and cockpit heating. The Challenger 605 has two-zone cockpit and cabin temperature control, with cabin temperature being selectable in the cockpit, at the cabin management system control panel in the galley or at the master seat control panel in the cabin.

The cockpit also has a foot warmer mat system and there is an optional electric heater for the galley service area. The 8.8 psid pressurization system provides a 6,600-foot cabin altitude at the aircraft's 41,000-

foot maximum cruise altitude. System control is semi-automatic, but there is no interface between the FMS and the cabin pressure controller. However, the flight crew only needs to set in the landing field elevation and barometric pressure.

Engine bleed air, tapped off the 14th compressor stage, is used for wing leading edge and engine cowl anti-icing. The APU cannot be tapped for anti-ice bleed air. The windshields, probes, static ports and angle-of-attack vanes are electrically heated. The aircraft is equipped with an ice detector, an important safety device. But the ice detector won't provide much protection until the aircraft gets airborne, thus exposing the ice detector to the slipstream. Challenger 600 series aircraft have been involved in a number of icing-related takeoff mishaps during the past three decades, in large part due to the aircraft's relatively high wing loading and contamination-sensitive supercritical airfoil. The onus is on the flight crew to check for ice contamination prior to takeoff and to ensure the aircraft is properly deiced.

Each engine has a dual zone fire detection system. Two halon 1301 fire bottles can be used to extinguish fires on either engine. The APU has its own fire detection system and single-shot fire bottle. Both the lavatory and baggage compartment have fire/smoke detection systems. The main landing gear wheel wells also have overheat detectors. The lavatory also has a halon 1211 fire extinguisher that automatically discharges into the trash container at a temperature threshold. There is an optional overheat detector for the galley that triggers a warning on the EICAS. Portable fire extinguishers are mounted in the cockpit and cabin.

Honeywell provides the 36-150(CL) APU for the Challenger 605, capable of providing bleed air for engine starting and air-conditioning up to 15,000 feet and backup AC electrical power up to 20,000 feet.

Internal and external lighting are strong suits of this aircraft. In addition to the usual nav, logo, beacon, strobe and landing taxi lights, the aircraft has boarding area illumination, cargo compartment and nosewheel well lights , plus avionics bay, pilot foot well and aft equipment bay lights. Bombardier, though, has yet to make the transition from incandescent bulbs to long-life LED and HID (xenon) external lights. Most lights in the cockpit, with the exception of fluorescent flood lights, are LEDs, including the back lights for the annunciator switches.

## Flying the Challenger 605

In late March, we belted into the left seat of Bombardier's Challenger 605 demo aircraft, s.n. 5701, on Bombardier's ramp at Montreal-Trudeau Airport, accompanied by Dennis Simmons, senior demo pilot, in the right seat and Mike Goggins along as safety pilot on the jump seat. Equipped with optional Collins SRT2100 satcom, various additional equipment items and a full complement of china in the galley, BOW was 27,552 pounds. With the third crewmember, the computed zero fuel weight was 27,752 pounds. The potential tanks full payload was 698 pounds, and thus short of the full fuel, five passenger capability advertised by Bombardier. But this aircraft was loaded with plenty of optional equipment.

**B&CA** ***Senior Editor Fred George (left) gets an inflight briefing on the Challenger 605's new Collins Pro Line 21 avionics from Dennis Simmons, a senior demonstration pilot with Bombardier Business Aircraft.***

Simmons loaded the aircraft with 10,500 pounds of fuel, so the ramp weight was 38,252 pounds. We started the APU prior to the preflight inspection to warm the cabin on the chilly 20°F (-6.6°C) day. The preflight inspection is a straightforward procedure. The aft equipment bay is well illuminated with work lights, so it's easy to check fluid levels and pressures. The Challenger 605 has a remote engine oil replenishment system in the aft equipment bay, so there's no need to use a ladder during preflight, unless engine duct covers have to be removed.

The latest Challenger has flying characteristics identical to those of the Challenger 604. And those traits are virtually the same as all General Electric-powered Challengers since 1983, when the first Challenger 601 fitted with CF-34 turbofans made its entry into service. What's different about the Challenger 605 is the large-scale improvements in situational awareness made possible by the Pro Line 21 cockpit and standard-kit, enhanced-function SafeFlight autothrottle system (ATS). The ATS is fully integrated with the FMS, among other aircraft systems, providing almost hands-off functionality from takeoff to landing flare. The ATS not only reduces workload, it actually can save up to 200 pounds of fuel on a 4,000-nm trip, Bombardier officials claim.

With the widest fuselage in class, the Challenger 605's cockpit provides easy access and plenty of room while seated, in spite of its triple-wide center console. The windshields and side windows are large, providing excellent visibility for maneuvering on the ramp and during circling approaches. The steeply sloping nose allows excellent forward visibility, as well.

Simmons called up the performance management pages of the FMS-6000 and typed in the -6.6° OAT, wind direction and speed, and choice of Runway 24L. The FMS computed takeoff V speeds of 116 KIAS for $V_1$, 122 KIAS for rotation, 132 KIAS for $V_2$ and 158 KIAS for flap retraction, with a takeoff distance of 3,924 feet, based on a 38,000-pound takeoff weight and flaps 20 degrees configuration. The FMS also computed the appropriate N1 takeoff power setting and sent that command to the ATS.

Starting the engines is easy. We turned on the fuel pump switches, thereby activating them before the jet pumps became functional after start. Pressing an engine start button automatically directs APU bleed air to the appropriate engine starter and shuts off airflow to the packs. At 55 percent N2 turbine RPM, airflow to the starter terminates automatically.

With both engines running and the ACM packs back online, we turned on each engine's generator. This isolates the APU generator from the aircraft's electrical

## GE CF34-3B Turbofans

The CF34 began life as the TF34 aboard the Lockheed S-3A Viking and the Fairchild-Republic A-10 Thunderbolt II, so it was designed to be tough. It made its commercial debut as the 8,650-pound-thrust CF34-1A, certified in 1982, and was first used aboard the Challenger 601 in 1983. The -3B, certified in 1995, is the latest version of the basic engine and offers about 3 percent better specific fuel consumption in cruise than the -1A, plus it has more thrust and a higher flat rating. It features increased airflow through the compressor, better compressor and turbine aerodynamic efficiency, higher temperature limits and tighter clearance control. Two decades after introduction, though, the -3B is somewhat dated with respect to technology. But it's been well proven during airline use aboard the Bombardier CRJ200 since its introduction into service in 2001. It's rated at 8,729 pounds of thrust for takeoff to ISA+15°C and it has an APR rating of 9,220 pounds of thrust for emergency use.


The engine features a 49-inch titanium fan that's powered by a four-stage, low-pressure compressor. A 14-stage axial flow compressor, powered by a two-stage, high-pressure turbine provides a 21:1 pressure ratio. The bypass ratio is 6.2:1, which is comparatively high for this thrust class. Fan bypass flow and core exhaust flows do not mix, but instead they exit separately. The combination of high bypass ratio, relatively modest pressure ratio and lack of fan/core exhaust mixing results in a rather steep thrust lapse rate with altitude increase. The engines produce only 1,450 pounds of thrust at FL 410 at 0.74 Mach cruise, according to Bombardier officials.

However, the CF34-3B is environmentally friendly, easily passing both noise and exhaust emissions standards for this class of turbofan.

system, but it remains available as a standby source of electrical power, automatically used if needed. The APU also can be used to pressurize the cabin during takeoff to maximize propulsion engine performance during hot-and-high takeoffs. Use of the APU for cabin pressurization is required if engine bleed air is needed for wing leading edge or engine anti-ice protection. But neither of those conditions applied during our demo flight.

We released the parking brake and taxied to Runway 24L. We noted that the Challenger 605 had smooth and precise steering and braking action. There was no indication of brake squeal or chatter, even in comparatively cold weather conditions. The +/-7 degrees of nosewheel steering available through the rudder pedals eliminates the need for tiller use, except when making sharp turns.

Simmons pulled up the airport taxi diagram on screen, enabling us to visualize our position on the tarmac and plan our taxi route to the runway. Next, Simmons called up the departure procedure diagram on screen so that we could brief the procedure. We also previewed the ILS e-chart in preparation for a possible emergency return to the airport.

We pressed the TOGA button on the left throttle, setting a target pitch attitude of 14 degrees nose up. In the event of engine failure, the pitch target automatically reduces to 10 degrees. Cleared for takeoff, we advanced the throttles to 75 percent N1 thrust and the ATS engaged. Acceleration was brisk, considering the aircraft's relatively light weight and full 8,729 pounds of thrust available from each engine.

Pitch and roll control forces were moderate, but both the artificial pitch and roll control feel system had a little numbness in on-center feel. The CF34 engines, being high mounted on the fuselage, suggest that the aircraft might have strong thrust/pitch coupling, such as the Learjet 60's characteristics. That's not so. Early flight tests revealed that increasing thrust also sucks more air over the inboard sections of the wing, thereby increasing lift and causing nose pitch-up. This aerodynamic effect neutralizes most of the pitch down caused by thrust increase, making the aircraft easy to control.

Above 10,000 feet, we accelerated to the aircraft's normal 300 KIAS/0.80 Mach climb schedule. For long-range cruise, Simmons said that recommended climb speeds are reduced to 280 KIAS/0.74 Mach. Level at FL 390, we flew a couple of steep turns to check Mach buffet boundary characteristics at a weight of 36,000 pounds. Pitch forces were moderate, making the aircraft easy to control. Buffet onset occurred at 1.4 g, indicating that the aircraft had ample, though not generous, buffet boundaries at that speed, altitude and weight.

When we returned to Montreal-Trudeau for pattern work, the Challenger 605's new avionics suite showed off its best features. Simmons called up the ILS chart for Runway 24L, enabling us to review it prior to commencing the approach. We also used the digital flight guidance and ATS to maintain the desired lateral and vertical paths, and speeds.

The Challenger 605's edge-to-edge attitude indicator and large-format HSI on the PFD, along with moderate control forces and standard ATS, make it easy to fly the aircraft in instrument conditions, especially on approach. Simmons set the ATS target to 132 KIAS, five knots above the 127 KIAS VREF landing speed computed by the FMS, based upon a landing weight of 35,000 pounds and 45 degrees flap configuration. The FMS also computed a landing distance of 2,629 feet. ATS operation was smooth and precise on approach.

Approaching the landing flare at 50 feet agl, we disengaged the ATS and slowed to 127 KIAS. The Challenger 605's low-mounted wing provides plenty of ground effect cushion and the long-travel, trailing-link main landing gear result in consistently flattering touchdowns. But squeezing out a perfectly finessed landing also adds plenty to landing distance. The factored landing distance was 4,300 feet and we wouldn't have wanted less runway to assure comfort and relaxation for passengers.

Subsequent takeoffs and landings were performed in VFR conditions, using somewhat steeper than normal approaches for noise abatement in the vicinity of Montreal's sound-sensitive neighborhoods.

Our final landing was a maximum effort procedure, using minimal flare and full brake application. The aircraft's digital anti-skid effectively released brake pressure as the wheels locked up intermittently. But it wasn't as smooth and uniformly consistent in operation as the latest brake-by-wire systems.

Later that day, we had the opportunity to ride in the cabin of the Challenger 605 while Simmons and Goggins piloted the aircraft. We were impressed with cabin comfort and utility of the furnishings, along with the ergonomics of the galley, main passenger seating section and lavatory. Slipstream noise in the aircraft is quite low, especially with the sound curtain closed over the entry door. Fan noise from the CF34 engines was noticeable, but not objectionable. Those are long-time characteristics of all GE-powered Challengers.

### Price and Value

Bombardier advertised both the original Challenger 604 and the new 605 as aircraft

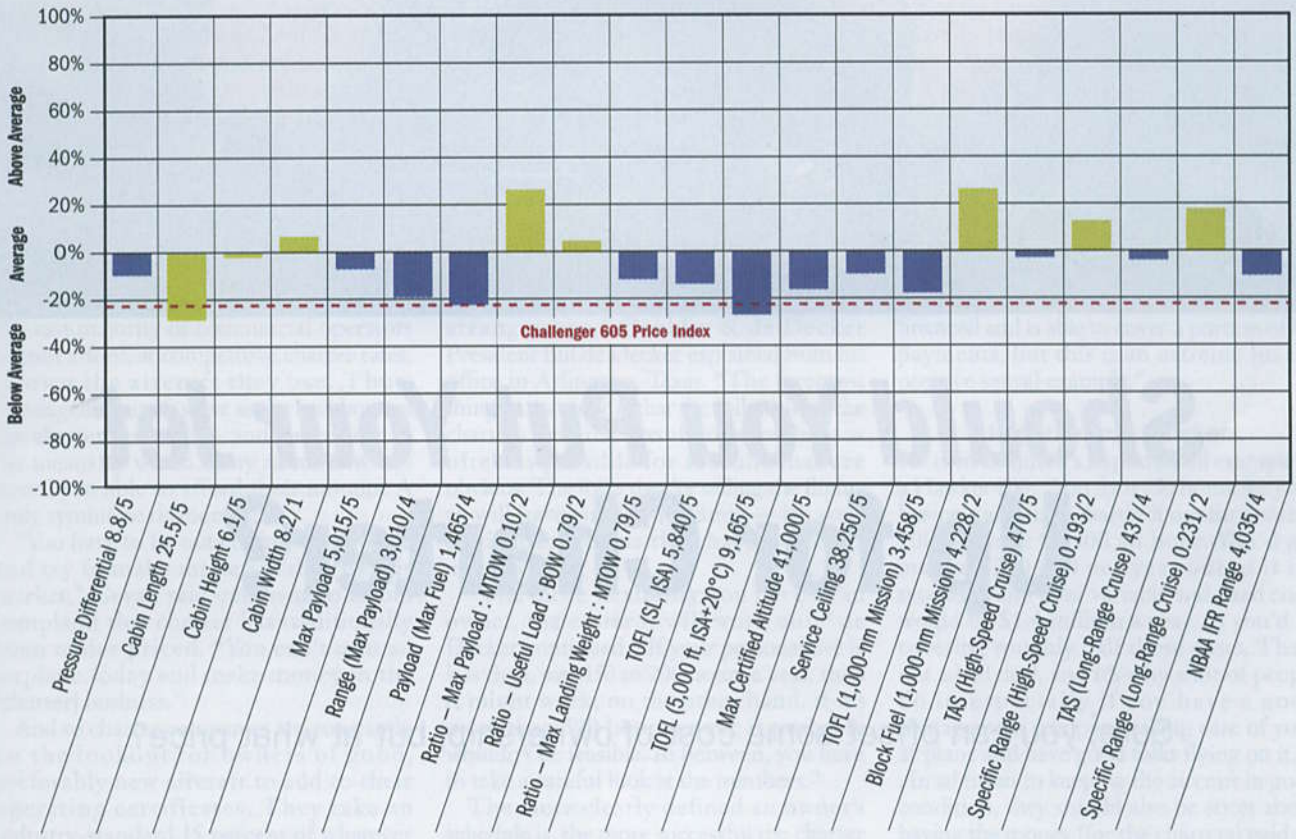
capable of carrying five passengers with full fuel. The Challenger 605's weight reduction program and Pro Line 21 avionics, among other improvements, reduce empty weight by 200-plus pounds. But when chock-full of optional equipment and carrying a flight attendant, the aircraft still is payload-challenged with full tanks. Challenger 605 aircraft with standard *B&CA* equipment roll out of the factory at 26,985 pounds. The maximum allowable BOW to preserve the full-tanks, five-passenger capability is 27,450 pounds. That weight limit easily can be exceeded when popular options are ordered. Serial number 5701, for instance, is configured with the lightest weight cabin configuration, but its extensive options list raises its BOW to 27,552 pounds — not including the flight attendant. Multi-channel satcom, Swift64 data link, DIRECTV, office equipment, avionics and galley options are more popular with large-cabin aircraft buyers than ever before, so there's no guarantee that typically equipped Challenger 605 aircraft will carry more than four passengers on the longest range missions.

However, each 100 pounds of extra empty weight or payload only results in a 19- to 22-nm range penalty, depending upon cruise speed. Many operators are likely to equip their aircraft with desirable comfort, convenience and utility items at the expense of some range/payload flexibility.

The Challenger 605 also offers improved dispatch reliability, resulting from better avionics and cabin systems, along with considerably better MSG3-inspired maintenance access. The Challenger 604's 99.8-percent dispatch reliability may seem like a serious shortcoming, once the Challenger 605 enters service later this year.

Quite clearly, the Challenger 605 is the most-capable Challenger 600-series aircraft yet produced. Other widebody aircraft may fly faster, farther or higher, but the Challenger 605 is hard to beat for cabin comfort, airline-proven systems and avionics capabilities. It also maintains this aircraft's value-for-the-money legacy, thus its lead as the best-seller in this class of aircraft is likely to continue. **B&CA**

**Comparison Profile**
**(Percent Relative to Average)**




Designers attempt to give exceptional capabilities in all areas, including price, but the laws of physics, thermodynamics and aerodynamics do not allow one aircraft to do all missions with equal efficiency. Trade-offs 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 specifications and performance attributes to the composite characteristics of other 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 report, 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 along with the absolute value of the specific parameter for the subject aircraft and its ranking relative to others in the composite group.

For the Challenger 605 Comparison Profile, we compared the aircraft to a composite group including the Bombardier Global 5000, Dassault Falcon Jet 900DX, and the Gulfstream 350 and 450. Please note that the Comparison Profile is meant to illustrate the relative strengths and compromises of the subject aircraft, rather than being a means of comparing specific aircraft models to each other.