Gulfstream's Generous G150

With its ingenious extra girth, the G100's successor now boasts a best-in-class cabin cross-section to complement best-in-class cruise performance as well.

By Fred George

Step aboard Gulfstream's new G150 and you might find it difficult to believe that it's a direct descendant of the super-lean G100, the cruise performance leader in the midsize class. While closely based on the G100 type design, the G150 offers passengers a full foot more cabin width and 2 inches more height than its predecessor. Like the G100, the G150 can carry four passengers 2,700 nm at long-range cruise or dash more than 2,400 nm at high-speed cruise with the same payload. But unlike the G100, the G150 has a transcontinental cabin to match its coast-to-coast range.

The G100/Astra family was a frequent first-place finisher in midsize performance and the last-place finisher in sales during its 20-year production run. Cabin size was its downfall. So, Gulfstream decided to take drastic action after acquiring the Israel Aircraft Industry (IAI) made jet and squarely address the model's shortcomings. As a result, the last G100 aircraft will roll off the Tel Aviv assembly line in early 2006. The G150, which was "stretched" in width, now boasts 25 percent more cabin volume, making it much more competitive in the midsize class. When the first customers receive their airplanes in third quarter 2006, they'll find cabin comfort more befitting of a Gulfstream product.

Some circular cross-section midsize aircraft still boast slightly wider cabins than the G150's. But Gulfstream's newest model

has a uniquely shaped fuselage with relatively flat sidewalls and an arched top section. This design offers 2 inches more headroom and considerably more shoulder room for passengers seated in forward- and aft-facing chairs than most tube-shaped competitors. The advantage in available head and shoulder room is even more apparent when one is seated on a side-facing divan. Few people on the G150's divan will be forced to bow their heads as they might aboard a circular-shaped midsize aircraft.

Other features also contribute to the G150's improved cabin environment. The newest Gulfstream has the G200's larger oval cabin windows that let in considerably more ambient light than the G100's rectangular transparencies. Passenger seats have been redesigned with armrests that rotate down from the seat back, rather than popping up from the sides of the seat cushion. The seat cushions now measure 22.5 inches wide, resulting in five inches more available width for the hips. The G150 also has the widest floor in the midsize class, helping to prevent passengers' feet from falling down into the dropped aisle.

Compared with the G100, the G150's heated aft exterior baggage compartment is 13 cubic feet larger, now providing 55 cubic feet of storage. Forward and aft interior closets provide another 25 cubic feet of luggage storage. Among the G150's midsize competitors, total luggage and baggage storage volume is exceeded only by the Citation Sovereign.

With all the G150's apparent assets, it's reasonable to ask why the program is nearly a year late. Gulfstream and partner IAI launched the G150 program in September 2002, with 50 orders and 50 options placed by NetJets. But in spring 2003 the program was put on a nine-month hold because of the record downturn in the business aircraft market in the wake of 9/11.

Following the first sign of recovery in late 2003, the G150 development program resumed full speed ahead. Assembly of the first of two flight-test aircraft began in April 2004, and the G150 program is now proceeding apace. Static testing is complete, including a 160-percent overload of the wing. Serial number 201 was rolled out in January 2005, and it first flew in May 2005 on a four-hour, 13-minute mission with Ronen Shapira, IAI's chief pilot, and Yoram Geva, G150 senior test pilot, at the controls. As of Aug. 31, s.n. 201 had flown 230 hours on 67 missions. Serial number 202, the second flight-test aircraft, made its first flight during the first week of September. The development program is on track as measured by hours flown and test cards completed.

Gulfstream and IAI officials, as a result, are confident they can earn type certification by first quarter 2006, paving the way for initial G150 customer deliveries in the third quarter. The aircraft's range and speed targets are being achieved. Its engines are meeting required performance, and systems reliability has been excellent, enabling two flight-test missions to be completed practically every workday. There's a "road map" in place to meet weight target goals.

So, when Gulfstream invited *B&CA* to fly the G150 in late August, we jumped at the opportunity, and on Aug. 31 became the first to fly the aircraft outside of company and government pilots. Although it was only its 66th flight, the G150 more than met our expectations.

Structure, Systems and MSG-3 Maintainability

The G150 is being certified as a derivative model that will be added to the type certificate of G100/Westwind Astra. To preserve the G100's wing strength margins, the G150's VMO was reduced from 350 KCAS to 330 KCAS and its MMO was pulled back from 0.87 Mach to 0.85 Mach. The forward and aft c.g. limits also were slightly reduced to preserve the G100's stability and control characteristics.

Like the G100 and G200 — also made by IAI — the G150's primary airframe is a conventional, damage-tolerant, aluminum monocoque structure assembled using traditional construction processes. Similar to

The cabin has foldout worktables, remote entertainment system controls and an optional Iridium satcom phone system with a cordless handset.

Gulfstream G150

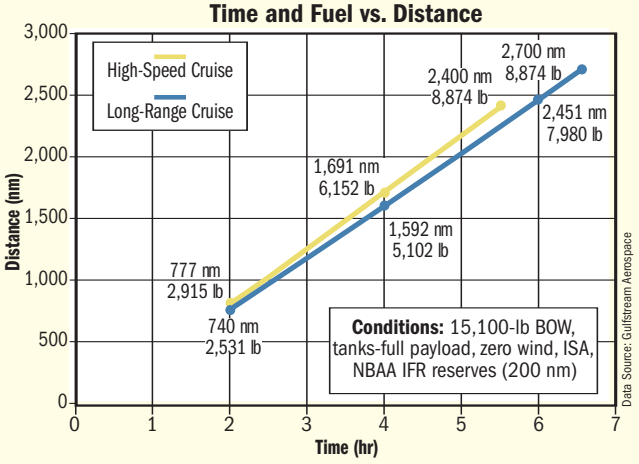
These graphs are designed to illustrate the performance of the Gulfstream G150 under a variety of range, payload, speed and density altitude conditions. Do not use these data for flight planning purposes because they are gross approximations of actual aircraft performance.

Time and Fuel vs. Distance — This graph shows the relationship between distance flown, block time and fuel consumption for the G150 at high-speed and long-range cruise with full tanks and an 800-pound (four-passenger) payload. High-speed cruise is flown at 0.80 Mach (459 KTAS), and 0.75 Mach (430 KTAS) is used for long-range cruise. Both profiles assume optimum cruise altitude.

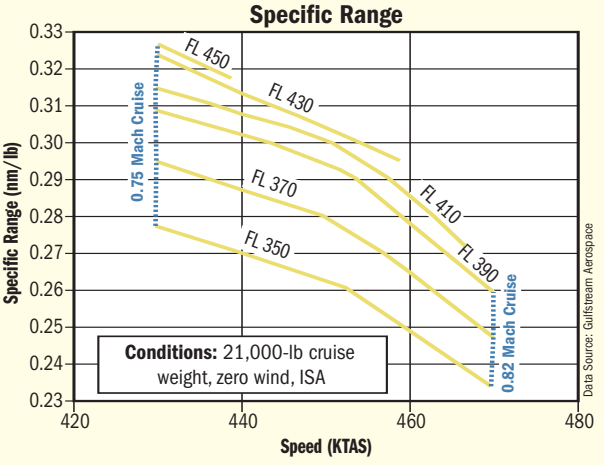
Specific Range (Mid-Range Weight, ISA) — This graph shows the relationship between cruise speed and fuel consumption for the G150 at representative cruise altitudes for a 21,000-pound aircraft. The data were supplied by Gulfstream Aerospace performance engineers. *B&CA* believes Gulfstream's performance estimates are conservative, based upon our demonstration flight observations.

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 high-speed cruise. Each of the four payload/range lines was plotted from multiple data points by Gulfstream's performance engineers, ending at the maximum range for each payload condition. The graph illustrates that the G150 can carry four passengers 2,700 miles and eight passengers 2,400 miles at the 430 KTAS long-range cruise speed. The two columns on the left side of the chart illustrate the G150's FAR Part 25 takeoff field length performance for sea-level standard day and for *B&CA*'s 5,000-foot elevation, ISA+20°C airport conditions.

Time and Fuel vs. Distance

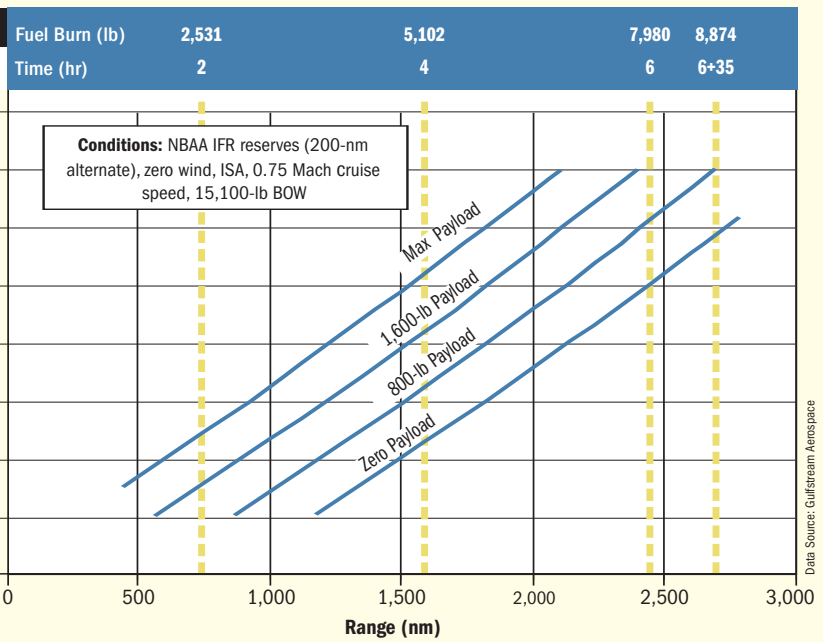


Specific Range



Range/Payload Profile

Takeoff Field Length (ft)		
SL ISA	5,000 ft ISA+20C	Gross Takeoff Weight (lb)
5,830	9,750	27,000
		26,000
4,880	7,580	25,000
		24,000
4,100	6,350	23,000
		22,000
3,650	5,140	21,000
		20,000
		19,000



the G100, the fuselage is built from cross-sectional frames, longerons and stressed skins, but it's stretched 16 inches aft of the wing to balance the weight of the wider and heavier fuselage. The stretch also improves pitch and yaw stability and control characteristics because the tail is pushed farther aft, thereby increasing the moment arm.

The G150 shares its first-generation, super-critical wing with the G100 and G200 aircraft. Aerodynamically, it's closely related to the wing of current-production Dassault Falcon aircraft, but it's smaller in scale. The wing has 34 degrees of inboard section leading edge and 25 degrees of outboard leading edge sweep. The wing is quite flexible from root to tip, making for a smoother ride in turbulence. The G150's long-range cruise sweet spot is 0.75 Mach, but it's capable of speeds up to 0.80 Mach with only a 10-percent increase in fuel consumption.

The main parts of the wing are front and rear spars, chord-wise ribs and upper/lower stressed skins. Each wing also has a rear subspar that provides the aft attachment point for the main landing gear. The assembly is quite flexible, producing a soft ride in turbulence. But it's also very strong. The G150's wing survived the 160-percent ultimate overload during static testing because by that point the static test fixture had run out of travel.

The G150 is intended to carry four passengers with full fuel, so the fare-paying folks shouldn't want for legroom in the main cabin.

Many secondary airframe structures including the radome, gear, baggage compartment and access doors, plus winglets, wing leading edges and some flight control surfaces are built from fiberglass, Kevlar and carbon fiber composites.

Gulfstream and IAI wanted to preserve the G100's cruise performance capabilities in the G150 in spite of its considerably larger fuselage and even though it uses essentially the same engines. The G150's BOW also is 565 pounds higher than that of the G100. So, drag reduction became an obsession in Savannah and Tel Aviv from

Gulfstream G150

Price as Equipped $13,500,000

Characteristics

Seating . . . . . 2+6/8
Wing Loading 69.0
Power Loading 2.94
Noise (EPNdB) . . . . . TBD

Dimensions (ft/m)

External
See Three-View
Internal
Length 17.7/5.4
Height 5.8/1.8
Width (Maximum) 5.8/1.8

Power

Engines . . . . 2 Honeywell TFE731-40AR-200G
Output (lb) . . . . . 4,420 ea.
Flat Rating OAT°C . . . . . ISA+27°C
TBO (hr) 3,600

Weights (lb/kg)

Max Ramp 26,150/11,862
Max Takeoff 26,000/11,794
Max Landing 21,700/9,843
Zero Fuel 17,500/7,938c
BOW 15,100/6,849
Max Payload 2,400/1,089
Useful Load 11,050/5,012
Executive Payload 1,200/544
Max Fuel 10,250/4,649
Payload With Max Fuel 800/363
Fuel With Max Payload 8,650/3,924
Fuel With Executive Payload 9,850/4,468

Limits

MMO 0.850
FL/VMO . . . . . FL 300/300
PSI 8.8

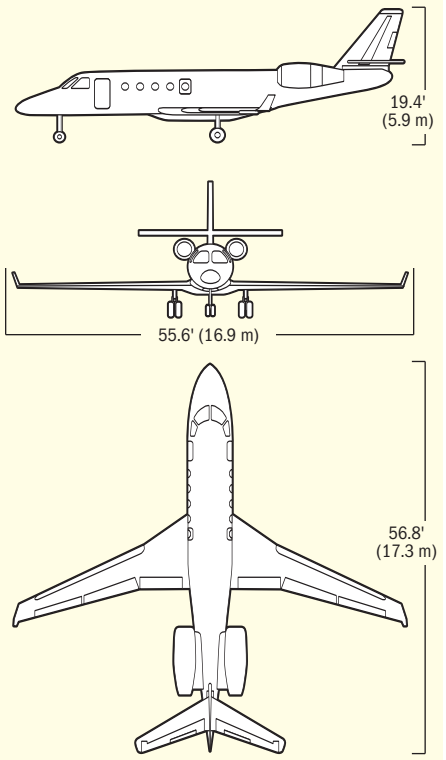
Ceilings (ft/m)

Certificated 45,000/13,716
All-Engine Service . . . . . TBD
Engine-Out Service . . . . . TBD
Sea Level Cabin 23,000/7,010

Certification

FAR Part 25 . . . . . .Pending

All data preliminary



Cabin Considerations

No aspect of the G150 is receiving more attention from Gulfstream engineers than the cabin environment. The G150 will arrive at Gulfstream's Dallas completion center as a green airplane, manufactured by IAI, weighing less than 13,000 pounds. In Dallas, Gulfstream will add the APU, the interior furnishings and exterior paint. The G150 then will emerge ready for customer delivery.

Six-, seven- and eight-seat cabin seating configurations are available. The seven-seat layout, featuring four club seats in the aft cabin, an additional forward-facing chair on the right side and a two-place divan on the left up front, currently is the most popular design with customers. Long-life LEDs are used for all interior lights. The cabin has foldout worktables, remote entertainment system controls and an optional Iridium satcom phone system with a cordless handset.

The front of the cabin has a coat and crew storage closet, plus a galley on the right side. The top of the closet has a 15-inch, swing-out video monitor. The galley features two hot liquid containers, a drip tray with overboard drain, large ice drawer and space for beverage containers and miniature bottles. A 115 VAC outlet is provided.

Just aft of the entry door on the left side, there's a second coat closet. There's a full-width aft lav at the rear of the cabin with externally serviced toilet, vanity and sink, large wardrobe closet and a second 115 VAC power outlet. An optional belted potty seat is available.

the launch of the program. Gulfstream and IAI engineers completely redesigned the nose of the aircraft, windshields and wing-to-fuselage fairings. Details learned from the G450 development program, such as CFD-designed engine pylon fairings, were applied to the G150.

The team also covered control surface hinges, installed gap seals, fitted the aircraft with flush door openers and bolted on low-drag antennas, among dozens of small improvements. Vortex generators were installed in the inside radius junction of the winglets to the wings to prevent high-speed flow separation. The G150, as a result, will preserve almost all of the G100's range performance, Gulfstream officials predict confidently.

Stan Dixon, G150 program director, explained that improving systems reliability and maintainability has been a prime focus from program launch. The G150 will be an MSG 3 aircraft, the product of a two-year refinement process involving customers, maintenance technicians and designers. Basic scheduled maintenance intervals have been extended from 250 hours to 500 hours, essentially transforming the events into annual inspections for most operators.

LED position lights replace the incandescent units. Gulfstream, though, chose to retain incandescent bulbs for the landing and taxi lights, instead of upgrading to next-generation HID, xenon plasma units. All external light mountings have been modified to improve maintenance access.

Most of the G150's systems are carried over from the G100 and a few are borrowed from the G200. Some systems are modified or upgraded for Gulfstream's newest model. The G150's fuel system, for instance, carries over the G100 design with the exception of a larger aft fuselage bladder tank and elimination of fuselage-to-wing tank transfer valves. Taking advantage of the 16-inch aft fuselage stretch, the fuselage bladder has been enlarged to hold 5,248 pounds of fuel, almost 400 pounds more than the tank of the G100. There's no need for a supplemental center fuel extender tank in the baggage compartment to achieve maximum range.

The fuselage fuel tank forms the center of the 10,250-pound capacity fuel system. A single point pressure refueling (SPPR) receptacle, aft of the right wing root, is used to replenish the fuselage bladder tank. There is no fuel quantity preselect feature on the SPPR panel, but the crew can shut off pressure refueling with a switch in the cockpit when the desired fuel level is achieved. Alternatively, one can use a nozzle to refill the fuselage tank through a port mounted high on the right side of the aft fuselage.

Fuel from the fuselage tank flows first into main wing tanks and then into the center wing tank in the belly. The fuel usage sequence essentially is reversed so that main wing fuel is last to be burned and the c.g. migrates forward during flight. The upshot? If you load the aircraft so that its zero fuel c.g. is in the middle to forward part of the envelope, adding full fuel won't push it out of the aft c.g. limits.

Jet pumps, using motive flow from the engine-driven fuel pumps, supply fuel to the engines and move it to the feeder tanks. Interconnect valves, between the left and right sides of the fuel system, allow the fuel level to be balanced, if necessary. DC electric boost pumps in the feeders supply fuel for engine start, fuel jettison and defueling. The fuel system must be completely drained on one side to change a fuel boost pump — not a maintenance-friendly design feature.

Left and right engine-driven DC starter-generators, fitted with long-life brushes and maintenance-free ceramic bearings, power the split-buss electrical system. Standard equipment includes Honeywell's well-proven RE100 APU, which uses the same starter-generator as the engines. The APU is installed with an effective hush kit, it's approved for unattended operation, and it can be operated up to FL 300. Two nickel cadmium batteries, mounted below the floor of the aft baggage compartment, supply

power for APU and/or engine start. A separate emergency avionics battery is installed outboard of the aft coat closet inside the cabin. All AC-powered systems have been eliminated from the G150. However, a 115 VAC 60 Hz inverter powers outlets in the cabin for the convenience of passengers.

The primary flight controls, with the exception of the hydraulically powered ailerons, are manually operated. The G150 uses the G200's artificial control feel unit to simulate aero loads in the roll axis. The ailerons can be manually actuated in the event of a hydraulic failure. The span of the elevator servo tab has been increased by 50 percent and it now has variable gearing. These changes reduce pitch control effort by almost one-half, a welcome change from the hefty pitch forces of the G100/Astra. All three control axes use electric motors for trim. An emergency-use-only, high-speed aux horizontal stab trim system provides pitch control in the event of an elevator jam. The G150's left- and right-side aileron controls may be split for jammed control protection, and the G200-design gust lock is fitted to it.

The slats and flaps are actuated by DC electric motors that drive gear boxes, flex shafts and ballscrew actuators. A large portion of G100 operators' complaints were related to problems with the slat and flap systems, so Gulfstream redesigned both systems with more robust components and the G200's shallower bend geometry in the flex shafts to increase reliability. At slow speeds and high angles of attack, the slats automatically deploy to enhance stall characteristics.

The G150 is fitted with three-position, hydraulically powered, eight-panel flight and ground spoilers. The panels are substantially stiffer than those of the G100, preventing them from floating up at high speed and creating drag when they're stowed. The eight-panel design allows each panel to deploy to 45 degrees for optimum effectiveness and yet meet the FAA's requirement for roll controllability with one panel malfunctioning. The G100's four-panel spoilers were limited to 20 degrees of extension because of the asymmetric deployment controllability requirement. When used as flight spoilers, the G150's inboard half of the panels first are extended. At full deployment, all eight panels extend, creating very effective lift dumping and modest buffet. Automatic rejected takeoff and landing ground lift dump modes are also available.

The G100's rugged landing gear is carried over to the G150 with a few changes. The main landing gear are moved inboard slightly to compensate for the additional fuselage width. The nosegear geometry, doors and steering systems have been changed. Caster has been reduced to improve directional stability on the ground. The nosewheel strut has been made compatible with conventional tow bars, eliminating the need for a special adapter head. There are four nosegear doors instead of two, enabling the aft nosegear doors to close fully when the gear is extended, thereby reducing drag. The G150 gets a new digital nosewheel steering control system with full steering authority through the tiller and three-degree steering authority through the rudder pedals. Brawn for turning the wheels is supplied by hydraulic pressure. It's very smooth and the addition of rudder pedal steering enhances directional control on both runways and taxiways. The hydraulically powered wheel brakes, fitted with long-life steel discs, are actuated by an anti-skid brake control unit in the nose bay, mechanically linked to the rudder pedals.

There are two 3,000-psi hydraulic systems. The main system, powered by left

The G150's Planeview

The G150's Planeview system is hosted by Rockwell Collins' Pro Line 21 avionics aboard the G150. But without looking at the labels on the avionics boxes, it would be hard to tell the system is manufactured in Cedar Rapids, Iowa. The G150's displays bear scant resemblance to conventional Pro Line 21 systems. The PFD ADIs, for instance, have edge-to-edge sky/earth horizon references. The aircraft symbols have been made larger and shaped more like real airplanes. TCAS resolution advisory guidance cues have been added to the ADI. Gulfstream's signature sidewall-mounted cursor control device will be installed on each side of the cockpit. FMS and E-chart databases may be updated in one's office or on the road by accessing a link to a secure Web site. The databases then may be downloaded to USB-compatible memory sticks that plug into the aircraft's avionics system.

Standard equipment includes four 10-by-12-inch portrait configuration displays with EICAS, dual FMS-6100s with GPS sensors, dual AHRS and a full suite of Pro Line 21 radios. The basic package also includes a TWR-850 Doppler weather radar, Collins TCAS 4000 and Honeywell E-GPWS, plus dual Mode S transponders, ADF radio and a radio altimeter, along with HF transceiver with SELCAL, cockpit voice recorder and Thales solid-state integrated electronic standby instrument.

Optional equipment includes dual Honeywell Laseref V units, second ADF and HF radios and single or dual Collins integrated flight information system boxes with E-charts, plus AFIS, L-3 Stormscope and a flight data recorder.

Notably, all standard and optional equipment has been tested for functionality and compatibility aboard an "iron bird" lab mock-up at Rockwell Collins' facility in Cedar Rapids. In addition, the G150 is being electrically, structurally and electronically provisioned for other popular options, such as an Iridium satcom phone system.

The G150 first flew in May 2005 on a four-hour, 13-minute mission with Ronen Shapira, IAI's chief pilot, and Yoram Geva, G150 senior test pilot, at the controls.

and right engine-driven pumps, supplies one set of aileron power control units (PCUs), landing gear actuators, wheel brakes, nosewheel steering and spoilers. The aux system, powered by a DC electrical pump, supplies the emergency and parking brakes, thrust reversers and a second set of aileron PCUs. Hydraulic fluid cooling is accomplished by routing the aileron PCU lines through the wing fuel tanks. Both systems are filled with Skydrol phosphate ester fluid. In the event both hydraulic systems fail, the landing gear can be extended with emergency pneumatics, the ailerons revert to manual control, and the wheel brakes may be actuated through the rudder pedals using residual accumulator pressure.

The G100's ice protection system is used aboard the G150, but low-profile Goodrich silver Estane pneumatic boots, instead of black rubber boots, are fitted to the wing and horizontal stab leading edges. The G150's four glass-faced windshield panes are electrically anti-iced, with bleed air heating available as a backup on the front panels. A rain-repellent coating eliminates the need for the G100's windshield wipers. The probes are electrically heated and engine nacelle inlets are heated by bleed air for ice protection.

Engine bleed air, routed through a precooler in the aft equipment bay, also is used for cabin pressurization, heating and air-conditioning. A set-and-forget digital pressurization controller, borrowed from the G200, modulates cabin altitude. The RE100 APU provides bleed air for ground heating and air-conditioning prior to engine start. Its bleed air output also is routed via the pre-cooler for better air-conditioner performance. Cabin air-conditioning is provided by a three-wheel air cycle machine, using higher pressure for increased cooling capacity. The G450's temperature controller is fitted to the G150, but it's a single-zone system with partial temperature control in the cabin.

Dried bleed air also is tapped off the hydraulic accumulators to inflate one of two cabin door seals. The change prevents potentially damaging moisture intrusion and freezing inside the door seal.

A 77-cubic-foot oxygen bottle, mounted in the nose below the avionics bay, is standard. A 115-cubic-foot bottle, fitting into the same enclosure, is an option.

TFE731-40 Engines

Gulfstream and IAI chose to retain the G100's 4,250 pounds-thrust Honeywell TFE731-40R-200G turbofans aboard the G150 to expedite the development program and save the weight associated with fitting the aircraft with a more powerful engine. For the G150, Honeywell increased the takeoff thrust by 5 percent to 4,420 pounds of thrust and raised the ITT limits by means of a "throttle-push" made possible by a DEEC software change. Climb thrust also is increased by 6 to 7 percent and cruise thrust is pumped up by 4 percent. However, the takeoff thrust flat rating decreases to ISA+10°C from ISA+14°C. The revised engine is rebadged as the TFE731-40AR-200G model.

It's reasonable to ask why Gulfstream didn't opt to fit the G150 with Honeywell's new TFE731-50 turbofans. They seemed to be the most logical choice because they produce 4,900 pounds of thrust for takeoff with a considerably higher flat rating. The -50 engines also will have a 10,000-hour TBO. But they're also substantially heavier than the -40s, so Gulfstream elected not to use them.

Flying Impressions

For an aircraft that first flew this past May, s.n. 201 was remarkably mature, even for a derivative. We strapped into the left seat accompanied by Shapira in the right seat and Scott Evans, G150 chief pilot, as safety pilot in the jump seat. Danny Meidan, IAI's senior flight-test engineer, headed up the team in the telemetry room. The telemetry crew would record hundreds of performance parameters during our demonstration flight and remain in constant radio contact. Meidan became a virtual fourth crewmember in the cockpit, just as he had during *B&CA*'s May 1998 IAI Galaxy flight.

Almost immediately, we were impressed with the G150's cockpit room, seat comfort and excellent outside visibility through the new, larger windows. The reshaped nose enables the crew to see ahead at relatively high pitch attitudes. There's ample head, shoulder, elbow and leg room, reminding us of the G200 cockpit. The right-side forward closet, when installed, will provide ample nav publication storage for operators who don't opt for the full electronic flight bag capability. The overhead panel design has been changed for improved functionality.

Evans and others have completely redesigned the crew chairs for greater comfort and easier operation. The lap belt buckles, for example, have been moved to the outboard strap so that they don't slam into the center console when the crew exits the cockpit. The seat cushions, backs and headrests each are independently adjustable in height.

Our second impression was how intuitive the Planeview cockpit appeared. Based upon a Rockwell Collins Pro Line 21 system using the four largest general aviation displays, Planeview provides far more useful information than is available in the cock-

pits of the G100 and current production G200 aircraft. The EICAS, for instance, substantially improves engine and systems status awareness compared with the G100's clocks, dials and warning lights design.

The aircraft was connected to ground power, so there was no need to fire up the RE100 APU prior to engine start. Shapira ran through the prestart checklists and programmed the twin Rockwell Collins FMS-6100 boxes. We positioned the throttles to idle, initiated the start sequence and let the DEECs handle all the start chores.

Our ramp weight was 21,485 pounds, including 6,000 pounds of fuel, enough to fly almost 1,500 nm at long-range cruise and land with NBAA IFR reserves. For the G150, IAI and Gulfstream added the G200-style limited-authority nosewheel steering through the rudder pedals, while retaining the tiller for tight turns. Rolling out of the chocks, the tiller-controlled nosewheel steering system was quite smooth and precise. The rudder pedal steering allowed us easily to track the centerlines of the taxiways. Braking action was very smooth and yet powerful when needed. Shapira extended the slats, set the flaps to 20 and manually dialed in 115 KIAS for V1, 121 KIAS for VR and 128 KIAS for V2. Computed one-engine-inoperative en route climb speed was 160 KIAS. Ben Gurion International's ATIS reported altimeter 29.92, OAT of 86°F and light winds out of the south.

Once cleared for departure on Runway 26, we held the brakes and pushed the throttles to the stops. When the engines stabilized at takeoff thrust, we released the brakes. Directional control was easy because of the G150's new pedal-controlled nosewheel steering. There was no need to resort to tiller-controlled NWS. Rotation forces at 121 KIAS seemed high and liftoff was delayed. That's because we'd not set in enough nose-up trim. Using telemetry, Meidan reported rotation forces averaging 48 pounds of pull and a takeoff distance to 35 feet agl at 3,615 feet. Our takeoff distance would have been a few hundred feet shorter if we had set the proper pitch trim.

Climbing through 400 feet, we turned left for noise abatement and reduced thrust to climb. We retracted the flaps and slats at 1,000 feet, noting a mild and gradual pitch up with flap retraction. The G150's flap movement between the 12 degrees and retracted positions has been slowed to lessen the resulting pitch change and improve passenger comfort. As expected, we raised the nose a few degrees to compensate for flap retraction.

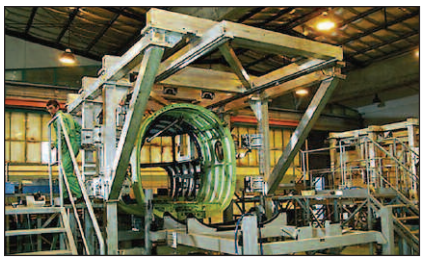
On the way up to FL 410, we found control harmony to be excellent. We checked short period stability in pitch and roll axes, finding it also to be excellent. Outside air temperatures averaged 15 degrees above standard for most of the climb, sapping engine performance. Using the recommended 250 KIAS/0.70 Mach climb schedule, we reached FL 410 about 27 minutes after takeoff and burned 1,100 pounds during the climb.

Checking max cruise performance at FL 410 in ISA+2°C conditions, the aircraft stabilized at 464 KTAS about four minutes after level off. Fuel burn was 1,430 pph at a weight of 20,200 pounds, yielding a specific range better than 0.32 nm/pound. Whoa. No wonder Gulfstream officials are confident about their range predictions. That's about 15 percent better fuel mileage than shown on the accompanying Specific Range Chart in this report.

Next, we checked high-speed buffet margins. In a gradual wind-up turn, the G150's wing didn't start rumbling until we reached 1.65 g's at FL 410. Then it was time to check long period pitch stability. We pulled up the nose to slow the aircraft 10 percent below its 235 KIAS trim speed and let go. The pitch oscillation cycle was 55 seconds, according to Meidan's telemetry data, and well damped, in large part because of the aircraft's Mach trim system.

We turned off the yaw damper and gently pulsed the rudder to excite yaw-roll coupling (Dutch roll). The period was about 3.5 seconds per cycle. Even though the yaw damper is required at these altitudes, the G150 exhibited positive yaw-roll damping, albeit at a relatively forward c.g. of 26.8 percent, according to telemetry.

Descending to 15,000 feet for air work at MMO/VMO, the G150 remained well composed with no airframe rumble and just increased airflow noise in the cockpit. Extending the inboard pairs of flight spoilers caused very mild nose-up pitching but practically no airframe buffeting. Extending all the flight spoilers caused a mild nose-down pitching moment, modest airframe buffet and very effective lift dumping. Descent rates of 12,000 to 13,000 fpm are possible using full spoilers at redline airspeeds.



Similar to the G100, the fuselage is built from cross-sectional frames, longerons and stressed skins.

Leveling at 15,000 feet, we checked pitch control forces in a wind-up turn. This maneuver demonstrated the considerable reduction in pitch control force associated with the G150's new elevator servo tab system. It was not difficult to hold back enough pressure to sustain a 2.0- to 2.5-g turn at 270 KIAS.

Full aerodynamic stalls in all configurations cause all smiles aboard the G150, at least if you're in the cockpit. The automatic slat extension system was not yet calibrated, so Shapira extended the high lift devices

Similar to the G100, the G150's fuselage is built from cross-sectional frames, longerons and stressed skins, but it's stretched 16 inches aft of the wing to balance the weight of the wider and heavier fuselage.

manually for the clean stall as the aircraft slowed. At a weight of 19,800 pounds, the aircraft stalled at 111 KIAS. Holding back fully on the yoke causes the aircraft to enter into a gentle pitch rocking motion with virtually no tendency to roll off. Let go, add thrust and stall recovery is initiated almost immediately. Stalls at slats full and flaps 20 (normal takeoff configuration) or 40 (landing configuration) are just as docile. Both stalls occurred at 97 KIAS. Holding full aft on the yoke just causes the onset of gentle pitch rocking. As soon as pitch attitude is relaxed and thrust is applied, the aircraft recovers very quickly.

We headed to Ben Gurion International for pattern work and accelerated to near redline airspeed, setting up for a straight-in ILS to Runway 12. The G150 has a slippery airframe, so it's best to anticipate the need to slow well in advance of the approach. However, it also has a relatively high 250-knot slat extension speed, so there's little need to use the flight spoilers for normal approach descents. Extending the slats, though, does require an increase in pitch attitude to maintain altitude. Most of the corresponding nose-down change in pitch attitude, caused by extending the first 12 degrees of flaps, is mitigated by their slow extension speed. Extending the flaps to 20 to 40, which occurs at a greater rate, requires less noticeable pitch change to maintain altitude.

The G150 is stable on approach and very easy to control with pleasant control forces in all three axes. Shapira bugged our VREF landing speed at 122 KIAS, based upon using full slats/40 flaps, 1.28 times stall speed and a weight of 19,100 pounds. Throttle response from the TFE731 engines is excellent, proportionate to throttle movement and easy to modulate.

At 50 feet agl, we commenced a very slow throttle reduction and retarded them to idle at 10 feet during the flare. Although we decelerated below VREF at that point, we still had too much speed for touchdown. The aircraft floated for quite some time until the rubber actually contacted the runway. The trailing link landing gear proved quite forgiving as we settled on to the pavement. Full thrust reverse is limited to 50 percent N1 rpm to lessen tail buffeting and improve passenger comfort. As a result, deceleration without the brakes is modest, at best. Directional control was excellent, thanks to the three degrees of nosewheel steering authority that's available through the rudder pedals.

After we rolled onto the parallel taxiway, Shapira configured the aircraft for takeoff with slats/flaps 20 and set V speeds at 111 KIAS for V1, 118 KIAS for rotation, 125 KIAS for V2 and 155 KIAS for VENR, based upon a 19,000-pound takeoff weight. This would be a simulated one-engine-inoperative takeoff. And, yes, this time we set the proper pitch trim for takeoff. We positioned the aircraft on Runway 26 once again and were cleared for takeoff. This time, though, Shapira pulled back the right thrust lever to idle just after we reached V1 to simulate an engine failure. Moderate rudder pressure was all that was needed to maintain directional control even though the G150 has no rudder boost or rudder bias system. Admittedly, the left engine was producing only 3,800 pounds of installed thrust due to the 90°F OAT. We rotated and increased rudder pressure to maintain balanced flight. Pitch force at rotation was very pleasant. We retracted the landing gear with a positive rate of climb and held V2 until reaching 400 feet agl.

Leveling off about 1,000 feet above the runway, Ben Gurion Tower cleared us to land on Runway 12. We executed a right teardrop maneuver to align the aircraft with the runway centerline. Visibility out the right cockpit side window was excellent from the left seat. We configured the aircraft at slats/flaps 40, the recommended configuration for an OEI landing. This time, we reduced thrust to idle at 50 feet agl and let the aircraft slow down a bit before starting the flare. There was much less float, but still plenty of residual speed to cushion the touchdown.

Using thrust reverse on the left engine helped to decelerate the aircraft during roll-

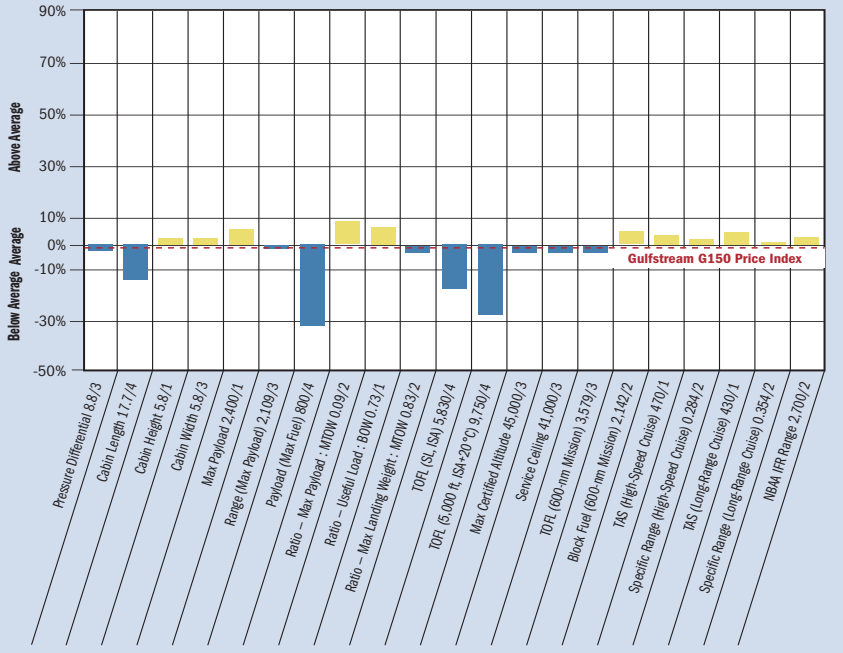
Gulfstream G150 Comparison Profile®

(Percent Relative to Average)

Tradeoffs are a reality of aircraft design, although engineers attempt to optimize the blend of capabilities, performance and passenger comfort.

B&CA compares the subject aircraft, in this case the Gulfstream G150, to the composite characteristics of others in its class, computing the percentage differences for various parameters in order to portray the aircraft's relative strengths and weaknesses. We also include the absolute value of each parameter, along with the relative ranking, for the subject aircraft within the composite group.

This Comparison Profile compares the G150 to a composite group of four midsize light jets including it and Bombardier Learjet 60, Cessna Citation Sovereign and Raytheon Hawker 800XP. The Comparison Profile shows that the G150's strengths are fuel efficiency, cruise speed and maximum range. Compared to other aircraft in class, though, the G150 requires considerably more runway, also as shown on the Comparison Profile. The chart, however, doesn't tell the whole story. The G150's flexible wing offers a more comfortable ride in rough air than some competitors and Gulfstream's product support is tops in its class.



out. We taxied back to the ramp 1.6 hours after takeoff.

Our conclusions? The G150 is as pleasant to fly by hand as the best of the large-cabin Gulfstreams, and certainly more docile in full aerodynamic stalls. The control forces are well harmonized and it's quite stable throughout the flight envelope. It handles so well and so precisely that it's tough to surrender control to the autopilot. But RVSM airspace leaves us no option; autopilot must be used.

Its ground handling manners are just as refined, with very smooth nosewheel steering and braking action. Pilots and passengers alike should enjoy the ride aboard the G150. This is a midsize airplane that emulates the ride of a large-cabin jet.

Among the G150's midsize competitors, total luggage and baggage storage volume is exceeded only by the Citation Sovereign.

Price, Value and Utility

Glance at the accompanying Comparison Profile® and you'll see how the G150 stacks up against its main competitors, the Bombardier Learjet 60, Cessna Citation Sovereign and Raytheon Hawker 800XP. Its $13.5 million price is within a percent of the average, so it's not much of a factor. The G150's strengths are speed, range and cabin cross section. Its apparent tanks-full payload shortfall relative to the average is deceiving. If you offload fuel and trade it for payload, the G150 can fly the same payload almost the same distance as the composite average.

Cabin length isn't one of the G150's strong suits. At 17.7 feet, it's the second shortest in class. But the G150 is intended to carry four passengers with full fuel, so the fare-paying folks shouldn't want for legroom in the main cabin.

Runway performance might be the G150's Achilles' heel. Departing at MTOW from Westchester County Airport's 6,548-foot Runway 16/34, for example, might be a challenge on a hot summer day. Even more limiting will be Chicago's Palwaukee airport, with only 5,000 feet available on its longest runway. Popular general aviation airports, such as Santa Ana-Orange County, with a 5,700-foot runway; Burbank, with 5,801 feet available on Runway 8/26; and Carlsbad-Palomar, with 4,900 feet of runway, also will be limiting. Within the Gulfstream family, as a comparison, only the G200 needs more runway for a 1,000-nm trip, according to *B&CA*'s May 2005 *Purchase Planning Handbook*. When flying the G150 on long-range missions, plan on using at least 6,000-foot-long runways, assuming sea-level, standard-day conditions.

Operating out of popular high-elevation general aviation airports will be even more challenging for the G150. Pilots will have to take a close look at runway performance when departing Aspen, Eagle, Sun Valley and Telluride, among other mountain landing facilities. Boosting the thrust of the TFE731-40 engines by 5 percent reduced flat rating from ISA+14°C to ISA+10°C. That's especially noticeable when departing hot-and-high airports.

Such extreme examples aside, the G150 will be quite capable of operating from typical 4,000-foot general aviation airport runways on missions up to 2.5 hours in length, assuming standard day conditions. On everyday missions, passengers will enjoy one of the nicest cabin cross-sections in the midsize class, a far cry from the cramped quarters of the G100. The enlarged external baggage compartment, relative to the G100, is a welcome improvement. The standard RE100 APU will provide much improved air-conditioning performance on the ground and electrical power for autonomous operations. It's also very quiet compared with the G100's optional GTC36-150 unit.

Pilots will find this aircraft as nice to fly as any of its competitors, especially considering its top-of-class Planeview cockpit. Flight department managers will appreciate Gulfstream's product support and the G150's MSG-3 maintainability.

Stan Dixon and his team are working long hours to build reliability into the G150, so that it will live up to Gulfstream standards for gas-and-go dependability. The G100 has attained a 99.75-percent dispatch rate, Dixon claims. He wants to better that number for G150 operators.

Overall, the G150 is much more of a Gulfstream than the G100. Though a derivative of the G100, it's so much improved that it's hard not to believe the G150 is a clean-sheet design. Look for the G150 to make its official U.S. debut at the 2006 NBAA Convention in Orlando. **B&CA**

The G150 is fitted with three-position, hydraulically powered, eight-panel flight and ground spoilers.