Business & commercial Aviation
PILOT REPORT

B/CA Analysis: Piaggio's Avanti

A widebody cabin and jet-like performance should help this unconventional airplane succeed.

By RICHARD N. AARONS

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B/CA flew Piaggio Avanti P180 prototypes twice during the airplane's certification flight test program, but in a sense, our most recent experience in an Avanti was a commencement. B/CA editors were the first journalists to fly a fully outfitted production version of the aircraft. Our recent flights in Avanti serial number four occurred as AMR-Avanti Sales North America in Wichita began training its demonstration crews, as FlightSafety International began writing procedures manuals, as mechanics at AMR COMBS Indianapolis started studying maintenance schedules and as final agreements were reached among the Italian and U.S. firms to fabricate, sell and support this unconventional twin-turboprop pusher.

We were impressed both times we flew the early prototypes. It was obvious the engineers had been meeting most of their goals and making appropriate alterations in the few areas where design targets were being missed. But even with that background, we were surprised with the completed production aircraft. The Avanti is a quick, roomy, efficient business transport that brings true lightjet performance to the turboprop arena. It delivers unchallenged passenger comfort, missing the mark only in a few fixable areas. We'll explore this in a moment.

CATCHING THE EYE

Much of the Avanti story is in its unusual configuration-three lifting surfaces and pusher turboprops. In a conventional aircraft, the main wing must support the aircraft weight plus a relatively large negative lift component from the horizontal tail, which is necessary to overcome the normal nose-down pitching moment. This negative lift can be as much as 10 percent of the aircraft's weight in cruise, and 20 percent in approach. The main wing of a conventional airplane, therefore, must be built to support 110 to 120 percent of the weight of the airplane plus safety factors.

Avanti flight loads, on the other hand, are distributed almost entirely between the forward and main wings, with the horizontal tail providing only minor positive or negative trimming loads. Thus, the total lift produced by the forward and main wings is only that required to support the aircraft's weight. This lift requirement demands less wing area with several related benefits such as lower profile drag, less induced drag and lower structural weight.

The pusher powerplant configuration keeps the propellers as far away from the cabin as possible and helps smooth airflow over the wing.

Certainly the eye is captured by this remarkable configuration. And once you force yourself to consider the fuselage beyond the unusual wing/ powerplant arrangement, you're in for another surprise. There's no constant section anywhere in the fuselage. Avanti designers began with a large passenger space and built an aerodynamic shape around it. It's pointy at the front and back and absolutely smooth everywhere. The nose cone and forward wings are composite, as

are the empennage and nacelles. The main fuselage and main wing are light alloy. It's impossible to tell where Piaggio's workmanship ends and the completion center's paint and putty begin. The result is sports car perfection.

The maintenance implications of some of that sports car perfection are unknown. For example, the composite forward wing is without blemish because it's internally heated. Electric heater strips (anti/deice) are imbedded in the leading edges. The forward wing is low, making it a likely target for hangar rash. The combination could threaten expensive field repairs, but only field experience will tell how these factors work out.

Walk-around is eased by the relatively low stance of the Avanti. Most of the stuff pilots like to touch is reachable without a stepladder. Oil and other consumables can be checked at ground level by direct-reading gauges, and optional single-point refueling should produce quick, no-hassle turnarounds.

The 44-cubic-foot empennage baggage area is easily accessible from the ramp. It is 6.3 feet long and digests with ease full baggage for six and a couple of golf bags to boot.

The bottom half of the passenger door drops down to provide an easily negotiable two-step airstair. The top half of the passenger door is hinged at the forward side and opens conventionally. There's a through-the-looking-glass quality when boarding the Avanti. From the outside, this airplane looks small. It's an illusion. As you climb aboard you have a sense of entering a wide, light, open and airy space. And, indeed, you are. The Avanti passenger cabin is 6.0 feet wide. That's as wide as the British Aerospace 800 cabin and only a tenth of an inch narrower than the Dassault Falcon 60 cabin. The Avanti aisle-to-ceiling height is 5.8 feet. Cabin length is 14.6 feet- plenty of room for an aft club with a comfortable side-facing seat opposite the entry door and a full aft-facing seat adjacent to the door.

The first production aircraft is outfitted with an enclosed full-size aft lavatory; five full-size, fully articulating, lateral tracking seats; and a single side-facing seat. It also has a refreshment center, two folding tables, aft-cabin pyramid cabinets and a cabin flight-data readout.

At least 60 percent of Avanti buyers are expected to ride in the passenger cabin (as opposed to the cockpit) most of the time. They'll be delighted. The cabin is quiet enough for normal voice conversations in all configurations. It's also remarkably vibration free. We've flown fanjet-powered business aircraft that at cruise are noisier and have more vibration than the P180. In our opinion, the Avanti provides all the passenger comforts of a jet in a turboprop-powered fuselage. Many turboprop designers have attempted this feat. None have been as successful as Piaggio.

FROM THE COCKPIT

All airplanes are compromises, and some of the negative aspects of the Avanti compromise show up in the cockpit. The pointy forward fuselage, so good at keeping drag at a minimum, also keeps cockpit space at a minimum. While the passengers enjoy BAe 125 spaciousness, the crew will have to work themselves into Learjet 30-series snugness. Avanti's demonstrator is equipped with all the optional bells and whistles, including a Global Wulfsberg GNS-X that pushes the center console to the cockpit/cabin bulkhead line. Climbing over this installation into the seats without wiping out a bunch of expensive knobs is a trick even for an agile pilot. Seat pans on future production Avantis will lift to a vertical position to facilitate entry. Centerline ceiling handles would help, we think.

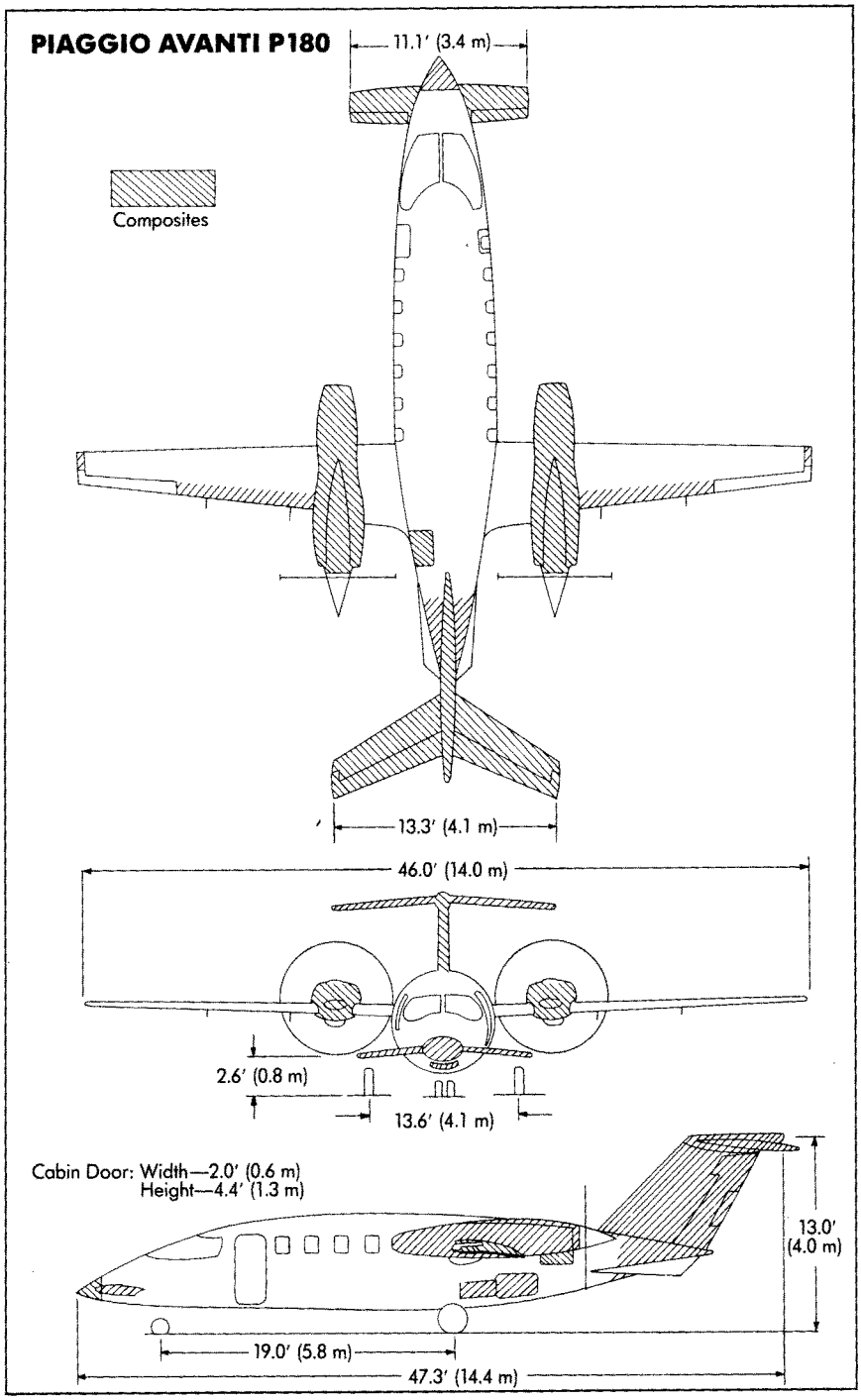
In any case, the cockpit situation improves once you settle into the seat. Forward and side visibility out of the panoramic windows are excellent. This is a major improvement over the prototypes, which had visibility-killing support channels at the ten- and two-o'clock positions. All circuit breakers are on the pilot and copilot side panels. The instrument panel is set up for single-pilot operation, and all important switches, knobs, breakers and controls can be reached easily from the left seat. Switch grouping is excellent. As you explore the photo of the panel, you'll see that switches are thoughtfully grouped by function. We especially liked the Collins APS-65 autopilot mode-selector on the glare shield with its big, highly readable mode annunciators. On the not-so-nice list is the pilot's oxygen mask that can jab you in the arm, and the emergency brake handle that can poke the copilot in the right leg.

Starting the Pratt & Whitney PT6A-66 powerplants is simply a matter of selecting START, bringing the propeller levers out of the fuel cutoff detent and monitoring the rest of the automatic sequencing. The engines are flat-rated at 850 shp each. Rated power can be maintained to approximately 25,000 feet on a standard day.

The Avanti's electro-hydraulic nose-gear steering system is controlled by means of the rudder pedals. It is a system that only Learjet (dual authority steering) or Aero Commander (heel-toe hydraulic boosted steering) pilots could love, and it's getting some needed attention now from Piaggio engineers. Basically, the nose wheel is moved left and right by a hydraulic steering actuator that is controlled by a closed-loop electrical circuit.

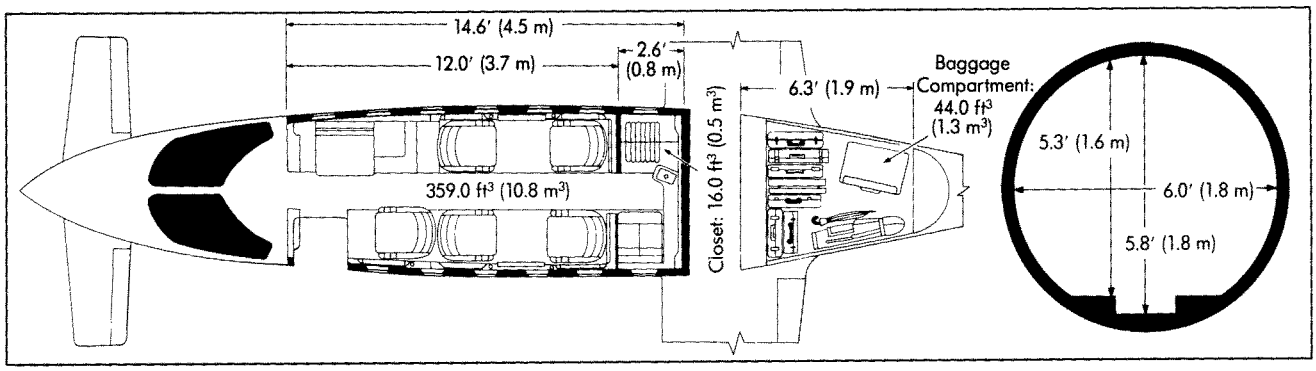
The steering system has three modes: disengaged, low gain (TAKEOFF) and high gain (TAXI). When the steering system is disengaged, the hydraulic actuator simply acts as a shimmy damper. The system engages after the steering control push-button on the left horn of the pilot control wheel has been actuated. The button is

PIAGGIO AVANTI P180



SPECIFICATIONS
PIAGGIO AVANTI P180

Manufacturer	Rinaldo Piaggio S.P.A.
Model	Avanti P180
Description	Twin-turboprop pusher business transport
Powerplants	2 P&W PT6A-66 engines flat rated to 850 shp ea. Hartzell 5-blade, full-feather, reversing props
Seating	1 pilot/7-9 passengers
Certification	U.S. FAR 23 1990
List price	$4.13 million
Dimensions	see three-views
Weights and Loadings (lb/kg)	
Max ramp	10,900/4,944
Max takeoff	10,810/4,903
Max landing	10,270/4,658
Zero fuel	9,500/4,309
BOW (one pilot)	7,400/3,364
Max fuel	2,630/1,193
Useful load	3,500/1,591
Max payload	2,100/956
Payload w/max fuel	870/395
Fuel w/max payload	1,400/636
Wing area	172.22 sq.ft.
Wing Loading	62.77 lb/sq.ft.
Limits	
V_{MO} (KIAS)	280
M_{MO} (Mach)	7.0
V_A	195
V_{MCA} (KIAS)	100
V_{FE} (app) (KIAS)	175
V_{FE} (full) (KIAS)	165
V_{LO} (KIAS)	175
V_{LE} (KIAS)	185
Max Cert. Alt.	41,000 ft.
Pressurization	9.0 psi
Airport Performance	see charts
Climb	
Rate, all engine (fpm/mpm)	3,000/914
Rate, engine out (fpm/mpm)	900/274
Service Ceiling, all engine	41,000
Service Ceiling, engine out	26,000
Cruise Performance	see charts



used thereafter to toggle between TAXI and TAKEOFF gains. In the TAXI mode, the nose gear can be steered up to 50 degrees in both directions. Steering action begins with any movement of the rudder pedals.

In the TAKEOFF mode, steering is limited to 20 degrees left or right. Initial rudder pedal movement, corresponding to six degrees of rudder travel, does not move the nose gear. This steering delay enables the pilot to operate the rudder on crosswind takeoffs or landings while maintaining the nose wheels in a centered position. Actually, this arrangement provides a precise and desirable steering system during close-quarter taxi. However, takeoff ground control requires minor pilot compensation, and landing ground roll requires significant pilot compensation, especially in crosswind conditions. Admittedly, we gave the system quite a workout both in Dallas and Wichita where, on the day of our evaluation, winds were 28 knots gusting to 38 with a significant crosswind component.

Takeoff acceleration is brisk and jet-like. Our first takeoff was at 9,800 pounds. Rotation forces are heavier than those we've experienced in other aircraft in this class-a function of its configuration we were told. A 200-knot climb gave us a comfortable seven-degree deck angle and 2,500-fpm climb with excellent visibility. At 160 KIAS we could have gotten well over 3,000 fpm, but we would have rolled our passengers down the aisle with the high deck angle, and reduced forward visibility significantly.

Unfortunately, ATC interrupted us several times on our climb to FL 310-mostly with misunderstandings about what kind of Piaggio we were in and questioning whether we really wanted to go to FL 310. In any event, the airplane popped right on up and gave us 1,500 fpm as we went through FL 300. Our first leg was from DFW to ICT. We trimmed up for high-speed (NORMAL) cruise and got 388 knots burning 690 pounds total. Conditions were about ISA + 5°C. That performance was a little better than the book promised.

Indeed, Avanti pilots are finding that all performance is bettering the book by two to three percent, and that also was our finding. While at altitude, we tried some two-G steep turns and some fairly abrupt maneuvers. The Avanti's high-altitude feel is rock solid and its buffet boundaries are wide.

Like the jets it flies with, the Avanti has a low drag profile and can be difficult to decelerate. While it doesn't have spoilers, its propellers can be an effective brake when pulled back to flight idle. We accomplished our air work at middle altitudes-8,000 to 16,000 feet.

The airplane is entirely stable and pleasant to fly in all situations. Control forces are relatively light, and control harmony is good. Long-term phugoid is positive with a 40-second period. Stalls are entirely conventional. There are no pushers, shakers or other devices. Aerodynamic warning-a shaking of the forward wing- occurs about five knots before a gentle break. The control surfaces provide plenty of power for engine-out maneuvering from just above stall to engine-out cruise speeds.

The Avanti's only unusual handling aspect is its 21-second flap extension time, which is due to the sequencing between the flaps on the forward and main wings. The Avanti has four flap subsystems- main wing inboard and outboard flaps and forward wing left and right flaps. The sequencing is necessary to prevent exaggerated pitch-trim changes.

The flap selector has three positions-UP, MID (takeoff) and DN (landing). Moving the flap lever from UP to MID starts the extension process. The main wing outboard flaps start traveling while the inboard flaps and the forward wing flaps rest in the clean setting. After nine seconds, the forward wing flaps run out for one second then stop; the inboard flaps remain in the clean setting; the main wing outboard flaps continue moving. After another five seconds, the inboard flaps start to move; the forward wing flaps restart; and the main wing outboard flap motion continues. After a further two seconds all the flap sections will reach the takeoff (MID) position.

When the flap control lever is moved from MID to DN all the flap surfaces simultaneously move and reach full extension in five seconds. Flap retraction requires five seconds from the DN to MID setting and 15 seconds from the MID to the UP setting. All flap subsystems start retracting simultaneously.

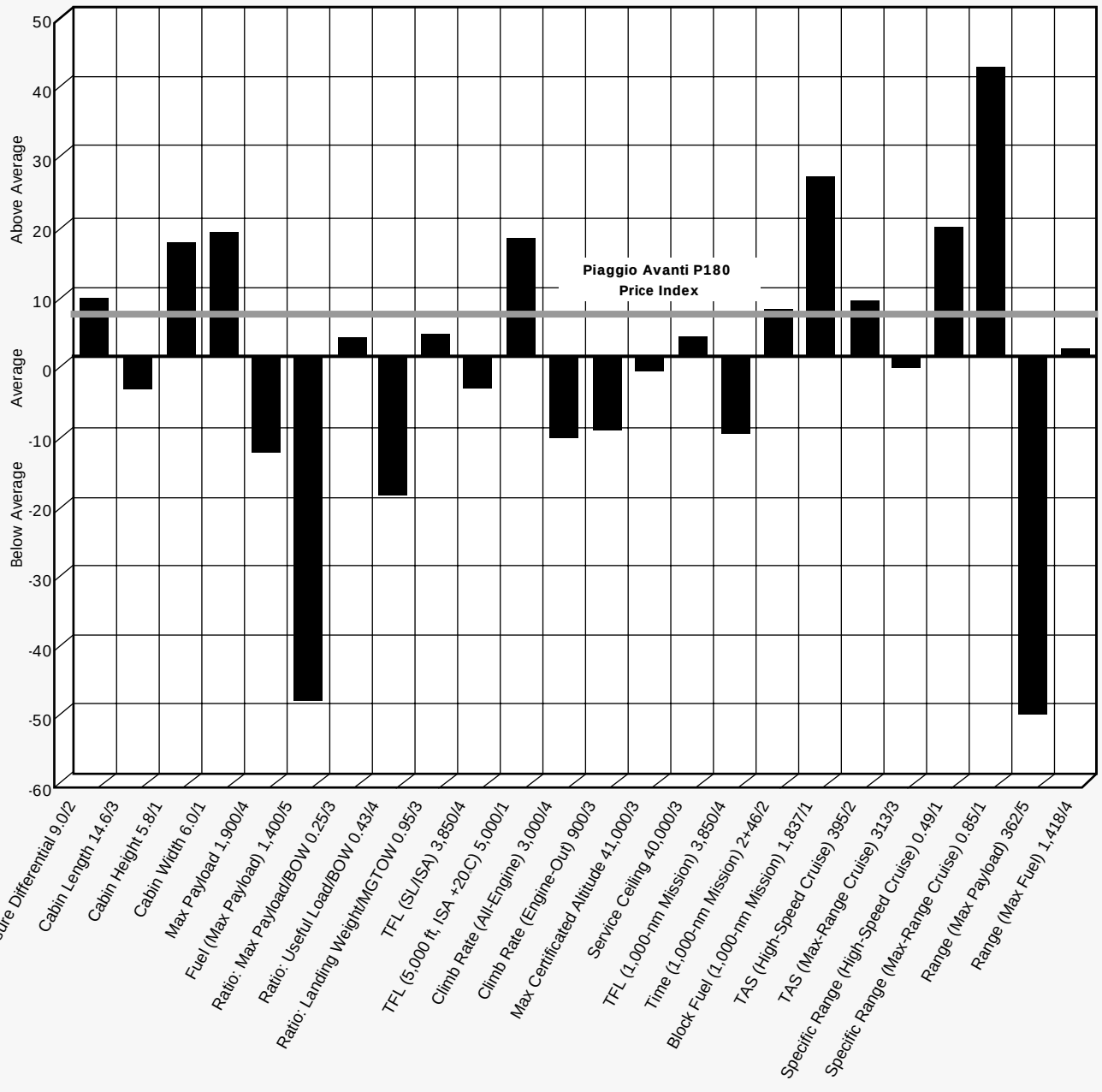
We ran the flaps up and down several times with our hands off the controls. While trim changes are noticeable, they don't require pilot intervention. The pilot compensation that is required is to stay well ahead of the aircraft. It takes a while to get it reconfigured, and this must be kept in mind during a hurried approach.

When all is said and done, we liked flying this airplane and we bet you will too. Some of its systems are a bit unconventional, but pilots transitioning up from cabin-class pistons shouldn't run into challenges beyond those typically encountered when graduating to any high-speed, high-altitude aircraft. While the cockpit is a bit tight, the panel is well executed and the Collins EFIS is terrific. The APS-65 flight control system is nicely tuned to the Avanti's characteristics.

We flew the airplane for an hour or so at night. Cockpit lighting is perfectly balanced. The electroluminescent panels and EFIS work together with no bright or dark spots. Even middle-age eyes can read the labeling across the cockpit.

Pilot Report

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



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

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

For this Comparison Profile®, we present selected parameters of the Piaggio Avanti P180 in relation to a competitive group consisting of the Beech King Air 350, Beech Starship 1, Cessna Citation II and the Learjet 31/ER. It should be understood that this Comparison Profile is meant to illustrate relative strengths and compromises of the subject aircraft; it is not a means of comparing specific aircraft to each other.

Piaggio Avanti P180

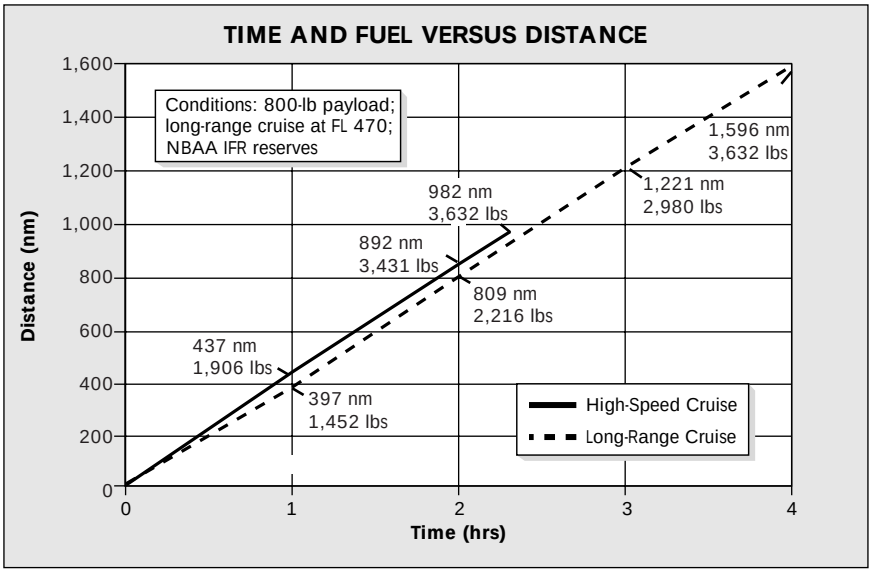
These three graphs are designed to be used together to give you a broad picture of aircraft performance. For a complete operational analysis, consult the manufacturer's performance charts.

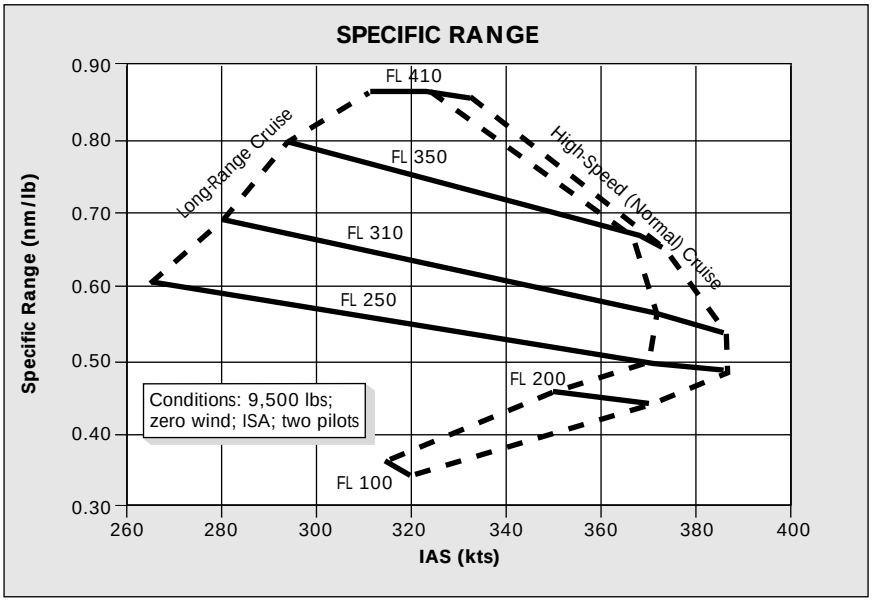
Time and Fuel Versus Distance—This graph shows the plot of two missions, one flown at high-speed cruise and the other at maximum-range cruise. The numbers at the time hacks present cumulative miles flown and fuel burned. While the intermediate points on these lines are only accurate for the full trip, they can give the user a rough idea of time and fuel for trips of intermediate length.

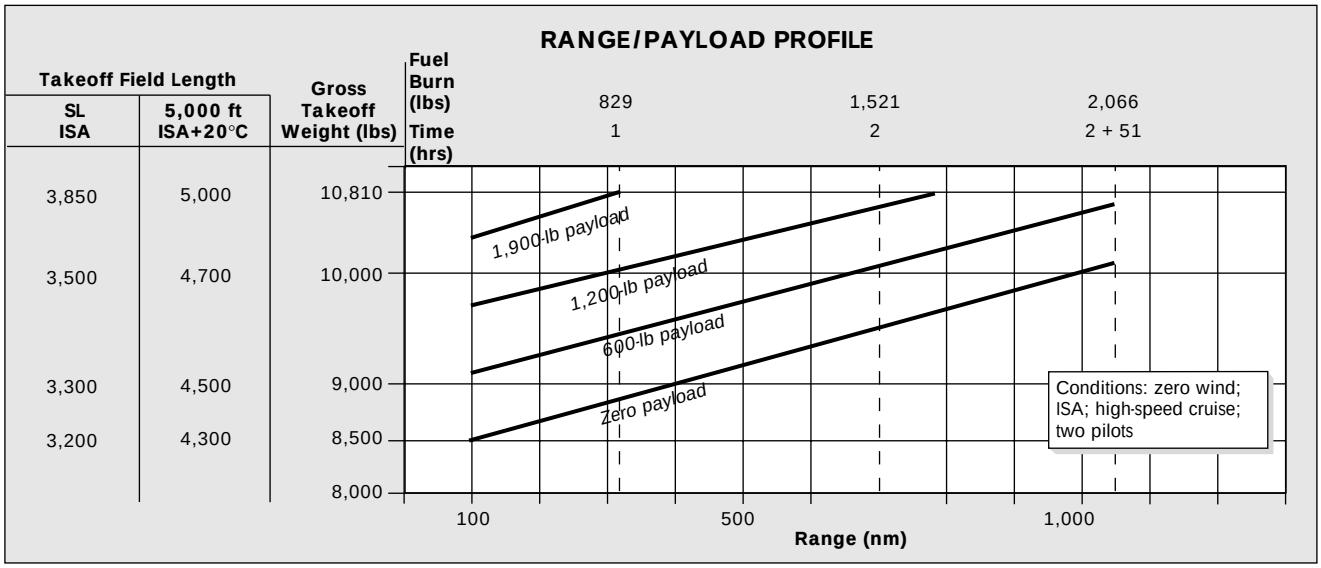
Specific Range—The specific range of an aircraft, a measure of its fuel efficiency, is a ratio of nautical miles flown per pound of fuel burned. Relatively large specific range numbers indicate high mileage yield on the fuel investment; small specific range numbers suggest less-efficient fuel burns. This graph shows specific range values at five altitudes for the Piaggio Avanti P180. For Example, at FL 310, the Avanti has a high-speed cruise of about 390 knots, generating some 0.550 nm/lb fuel burned. At FL 250, the Avanti will will deliver 390 knots, but fuel specifics will decrease to about 0.470 nm/lb fuel. Notice with the Avanti that high-speed cruise is the flight manual "normal" cruise power.

Range/Payload Profile—This graph is intended to enable you to make gross simulations of trips under a variety of payload and airport conditions. For this report we elected to use recommended cruise power settings. The payload lines–intended only for gross evaluation purposes–are generated from the endpoints. Time and fuel burns are plotted only for the longest mission. Keeping these limitations in mind, the chart can help you get a "feel" for the airplane's capability. For example, if you want to simulate an 500-nm trip with a 600-pound payload, you can approximate the time required as 1+25, the fuel needed as about 1,200 lbs and the standard-day runway required as about 3,400 feet. You also can see that a maximum-range, no-wind trip with a 600-pound payload will take 2+51, burning 2,066 pounds of fuel. Takeoff field length will be just under 3,800 feet.

Note— The numbers and plots presented on these graphs are approximate. No attempt has been made to optimize the climb or descent profiles. Do not use these data for flight planning purposes.







AVANTI OPERATING COSTS

GENERAL OPERATING DATA		
Average stage length (nm)	300	600
Average speed (KTS)	346	360
Average fuel flow (gph)	118.00	107.60
DIRECT OPERATING COSTS		
Fuel ($1.75 per gallon)	$206.50	$186.30
Labor ($49 per man hour)	88.20	88.20
Parts	72.00	72.00
Engine accrual	87.96	87.96
Prop overhaul	4.00	4.00
Miscellaneous	25.00	25.00
Total per hour	$483.66	$465.46
Total per nm	$1,398.00	$1,293.00
FIXED OPERATING COSTS		
Crew and benefits	$61,000.00	$61,000.00
Hangar rent	$14,700.00	$14,700.00
INSURANCE		
Hull (0.5 percent)	$20,000.00	$20,000.00
Admitted liability	2,000.00	2,000.00
Legal liability	3,500.00	3,500.00
Recurrent training	7,500.00	7,500.00
Miscellaneous	2,000.00	2,000.00
Total per year	$111,200.00	$111,200.00
ANNUAL OPERATING COSTS		
Nm traveled	150,000	150,000
Flight hours required	433.5	433.5
Fuel used (gallons)	51,156	44,833
Direct operating costs	$209,679.00	$193,942.00
Fixed operating costs	$111,200.00	$111,200.00
Total operating costs		
Per year	$320,879.00	$305,142.00
Per hour	$740.16	$732.34
Per nm	$2.14	$2.03

THE COMPARISON

Our Comparison Profile group comprises the Beech King Air 350 and Starship 1, the Cessna Citation II, the Learjet 31/ER and, of course, the Piaggio Avanti P180. These airplanes range in price from a low of $3.3 million (the Citation) to a high of $4.13 million (the Avanti). They all are designed to carry at least seven passengers in executive configuration. While most of these airplanes can be certified and flown single pilot, we based our weight buildups on two pilots-a more typical situation in actual service.

A glance at the comparison shows that Piaggio was quite successful in its attempt to generate "widebody" comfort in this class of aircraft. Note also that the Avanti's designers managed to keep efficiency high with excellent fuel specifics. Most of the other parameters hug the line. The jets in this comparison group force the performance averages pretty high, but the Avanti does better within this group on most parameters than do the other turboprops. (See "Inflight Report: Beech Starship 1," B/CA, September 1990, page 66.)

The only significant negatives for the Avanti in this comparison are fuel available with maximum payload and range with maximum payload. Obviously, both of these could be fixed with the addition of a couple hundred pounds of fuel. That's just what the Piaggio engineers are working on now. Presently, there's room for an extra 200 pounds of fuel in the wing and there may be enough structural strength in the wings and gear for paperwork weight increases, we are told. In any event, you should see the fuel/payload situation improve soon.

The three accompanying performance charts focus on Avanti operations. The "Specific Range" chart shows that the Avanti is right at home at high altitudes. Note the relatively low slope of the lines that connect long-range cruise and high-speed cruise at any given altitude. This airplane is made for high-altitude, high-speed operations. In fact, Avanti demo pilots flight plan the

airplane at 380 KTAS and attempt to gain high altitudes even on shorter trips.

The "Time and Fuel Versus Distance" chart shows how the Avanti works out on typical business missions with three passengers on board and NBAA IFR reserves. This airplane is well balanced for the 400- to 800-nm mission. The "Range/Payload Profile" does show, however, that this "typical" mission gets squeezed significantly as the payload increases.

THE BUSINESS SIDE

Just about the time the first production aircraft arrived in the United States, Piaggio and its North American partners finalized their business arrangements. These arrangements are a bit complicated, but they make sense when taken as a whole.

North American marketing and support are the responsibility of Wichita-based AMR-Avanti Sales N.A. This company, run by Robert W. "Bob" Westlake, vice president and general manager, is a division of AMR Services, a subsidiary of AMR Corporation, which also owns American Airlines. Other divisions in AMR Services are the Airline Services group and the familiar AMR COMBS FBOs. Working with Westlake are Karl Berg, vice president-sales and administration, and Terry Noss, sales engineer.

Two demo pilots and a newly formed service/support team complete this side of the Avanti arrangement. Ultimately, AMR-Avanti Sales N.A. will take delivery of completed P180s from Duncan-Piaggio Aircraft Limited, a newly formed company in Lincoln, Nebraska. Duncan-Piaggio is a joint venture of Rinaldo Piaggio S.p.A. and Duncan Aviation, the Lincoln-based FBO/completion center. Duncan-Piaggio will fabricate the airplanes from subassemblies made elsewhere. It also will install avionics and interiors.

Almost 80 percent of the Avanti's components and structures come from North America. The light alloy fuselage, from cockpit bulkhead to aft pressure bulkhead, will be made by Piaggio-USA in Wichita, a subsidiary of Piaggio. The composite nose cone, forward wing and empennage are made in Alabama by Sikorsky-Dow. The Pratt & Whitney PT6A-66s are made in Canada. The avionics come from Collins in Cedar Rapids.

The only major subassembly not made in North America is the wing and fuselage center section-roughly nine feet of fuselage from the aft pressure bulkhead rearward to the attach point for the all-composite empennage. This section, along with its fuel tanks and plumbing, will be made by Rinaldo Piaggio and shipped to Duncan-Piaggio.

Hands-on service and support will be provided initially by the AMR COMBS maintenance centers. The first facility to be brought up to speed is at Indianapolis. Other centers will follow in Denver; Memphis; Birmingham, Alabama; Grand Rapids, Michigan; Hartford, Connecticut; and Fort Lauderdale, Florida.

New York-based FlightSafety International is the official Avanti training organization and has people in Wichita now working on training and operations manuals. There is no word on how many Avantis will enter the North American fleet before FSI will construct a simulator.

While there certainly are a relatively large number of players in this program, AMR's Westlake told B/CA that most of them should be relatively invisible to potential customers. "We want to be the main point of contact for customers and operators," said Westlake. "We are here to solve their problems." For the record, then, Westlake and his sales and support groups can be reached at AMR-Avanti Sales N.A., 2120 Airport Road, Mid Continent Airport, Wichita, KS 67209. (316) 946-4050.

It will take six to nine months for Duncan-Piaggio to come up to speed. In the meantime, Avantis will be fabricated in Italy and ferried to Duncan for interior installation and paint.

Avanti production is now set at one per month. Berg told B/CA that number would be re-examined quarterly. Maximum possible production is eight units monthly, which is the fuselage fabrication capacity of the Wichita Piaggio-USA facility.

FINANCES

The Avanti carries a list price of $4.13 million. That includes complete interior and dual Collins EFIS flight displays, APS-65 flight control, ADS-85 air data and Pro Line II nav. comm and pulse radios.

The relatively short options list includes a $13,500 single-point refueling system, a $23,500 anti-skid braking system and a $3,500 engine-fire extinguishing system, all of which we recommend.

Additions to the avionics suite include the Global Wulfsberg GNS-X at $86,000-plus (depending on sensors), Collins WXR-840 turbulence detection radar at $17,500 and a stand-by gyro pack (another B/CA recommendation) at $14,000.

The expense breakdown in the accompanying "Avanti Operating Costs" analysis suggests that operating the Avanti will cost between $700 and $800 per hour in typical U.S. operations. The table assumes just more than 400 hours per year and is factored by stage length. Note also that fuel is assumed at $1.75 a gallon. Today's no discount retail cost averages between $2.25 and $2.50 per gallon. No warranty effects are included in DOCs in this table. The current warranty leaves the operator free of maintenance costs for the first two years. The program includes all airframe components, systems and subsystems right down to the brakes except for consumables. **B/CA**