

GIFT GUIDE 2018: IDEAS FOR EVERY PILOT

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PILATUS PC-24

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SINCE 1927
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PILATUS PC-24

SWISS AIRPLANE MAKER ATTACKS THE BIZJET MARKET
WITH ITS SUPER VERSATILE JET

BY PIA BERGQVIST

The sound of bells emanating from the cows and goats that graze in the lower parts of the picturesque valley below Mount Pilatus can't be heard at its peak, which sits at 7,000 feet. But as I take in the view of the bright-green fields and the snow-capped Alps and breathe in the crisp high Alpine air, my mind keeps playing the soundtrack from the movie *The Sound of Music*. It's almost too good to be true.

It takes about five hours for an average hiker to climb from the valley floor southwest of Lucerne, Switzerland, to Pilatus' peak. My time

in Switzerland was limited, so I jumped on the train in Alpnachstad, the steepest cogwheel train in the world, which takes tourists on a relaxing 30-minute climb. The scenic peak can also be reached through a combination gondola-cable-car trip from Kriens, on the opposite side of the mountain, also a 30-minute ride. If you'd rather explore the mountain from above, the climb from Buochs Airport by Pilatus PC-24 is about one minute.

The mountainous beauty that surrounds the area where the PC-24 was birthed must have helped inspire the engineers to create this stunning engineering marvel. Named the Super

The mountains around Samedan Airport (LSZS), near St. Moritz, provided a stunning backdrop for the PC-24.

Versatile Jet, the PC-24 can do more than bizjet designers have ever dared to dream. Whether you want to dress it up for VIP transport, haul cargo, move medical passengers or head to the backcountry, this airplane will do it all. A backcountry bizjet? Why not?

Constructed chiefly from aluminum, the PC-24 is powered by two Williams FJ44-4A turbofan engines, each producing 3,420 pounds of thrust. The flight deck of the PC-24 flows around four 12-inch

PHOTO COURTESY PILATUS AIRCRAFT

displays from the Honeywell Primus Epic 2.0 family. With software designed by Pilatus, the company renamed it the Honeywell ACE, for Advanced Cockpit Environment.

The PC-24 achieved FAA and EASA certification about a year ago, meeting the schedule that was set when the company first announced the airplane in 2013 — a feat not many aircraft manufacturers can brag about. So far, the twinjet has been certified for single-pilot operations, flight into known icing and RVSM. When I was in Stans in early October, Pilatus had delivered 10 PC-24s and expected to hand over another 13 by the end of this year, an impressive number in the airplane's first year on the market.

I asked Pilatus vice president of research and development and deputy CEO Bruno Cervia how on earth the company made that happen for its very first business jet.

“Ninety percent of the success is preparation,” he said.

The development of the PC-24 started with a request from customers. They wanted a PC-12, Pilatus' highly successful single-engine turboprop, with an added 100 knots of speed. “It was not 10 or 20 knots, it was 100 knots,” Cervia said.

Several configurations were considered, Cervia said, including another turboprop and a single-engine jet. However, the consensus was that a traditional twinjet would be the best way to go to meet customer expectations.

The leap from a single-engine turboprop with a massive cargo door that can land at relatively short, unpaved runways to a business jet with the same capability was Beamonesque. The cargo door proved to be one of



THE PC-24'S LOGO IS A CRYSTAL, AND EACH AIRPLANE HOUSES A UNIQUE STONE HARVESTED FROM THE SWISS ALPS.



While the configuration of the cabin is limited only by the customer's imagination, the most common cabin configuration features six or eight executive seats.

the biggest challenges, Cervia said, because the engines had to be mounted far aft of the wing, which in turn made center of gravity a source of challenge. Some designers might have given up, but Cervia said his team saw the bright side of the adversity. “Any challenge in the preliminary design phase is

fantastic because it means it will be very difficult for any competitor to catch up,” he said.

While the idea of the PC-24 was revolutionary, the technologies that went into the design were not. Cervia said the way to get a cutting-edge airplane to market on time is to incorporate several new, but proven, technologies. “You have to look for the best ingredients. It's like cooking. There is no difference. Fresh ingredients. That's what you need,” he said.

Pilatus didn't make a stew or chili without a recipe by throwing together a proof of concept and hoping for the best. A lot of research and thinking went into the initial design phase to hit the sweet spot in the market and minimize any modifications that would otherwise have to be made in the development phase or later. From day one, the FAA's and EASA's certification authorities, Pilatus' suppliers, and customers such as Royal Flying Doctor Service of Australia and fractional-ownership firm PlaneSense, both of which have operated PC-12s for decades, were involved in the process.

“Our innovation process is basically holistic,” Cervia said. That means taking every aspect of the aircraft into consideration from the beginning. Pieces of the puzzle such as the CrystalCare program, the comprehensive PC-24 support program that takes any guessing game out of maintenance, were considered long before the first test article started taking shape. Even the flight test cards were optimized in the initial design phase. And plans for the fatigue test program were planned so by the time the first customer received a PC-24,

PHOTO COURTESY PILATUS AIRCRAFT



The Matterhorn is one of the most famous landmarks of the Swiss Alps, where the PC-24 was conceived.

the testing for three times the 30,000-hour time limit was complete.

“The time you spend before you pump up the resources is low cost and high value,” Cervia said.

Heritage of the PC-24

My trip to Switzerland started with a quick visit to Flugplatz Reichenbach, an airport nestled into the scenic Kandertal Valley, where Reno air racer Peter Balmer hosts skydivers and tourists from all over the world through his companies Skydive Switzerland and Scenic Air. One of Pilatus’ most successful models — the PC-6 — landed and dropped off a load of smiling tourists while I was there. For nearly 60 years since its development, the PC-6 has been hailed as one of the best STOL performers ever built. It was taken out of production this year.

Also parked outside one of two hangars in Reichenbach was a 1950 Pilatus P-2, the company’s first successful airplane model. Pilatus started as a maintenance facility for the Swiss air force in 1939, and after a couple of design attempts, it introduced the P-2 in 1945. The Swiss air force quickly adopted it as a trainer, and while it wasn’t produced in big numbers, it proved itself as a successful product. The air force kept it employed until 1981. Swiss air force pilots still train in Pilatus airplanes: the PC-6, PC-7, PC-9 and PC-21.

As a private company, Pilatus is self-funded and has used the success of one model to pay for the development of the next — a business model still used to this day. The company has also diversified by producing both military and civilian airplanes. Civilian aircraft models are generally identified with even model numbers, the military ones odd.

The steepest cogwheel train in the world runs from Alpnachstad to the peak of Mount Pilatus, from which the Swiss airplane manufacturer got its name.

The 485 hp inverted V-12 Argus engine provided terrific performance for Swiss air force pilots flying the P-2.



PIA BERGQVIST (3), OPPOSITE: PATRICK LAMBERTZ



Whether military or civilian, the aircraft models are mixed inside two 87,200-square-foot hangars (one completed in 2012, the other in 2017) in Stans. Small trains bring parts and tools to each production station. The “train stations” have names, and I’m sure the trains are as punctual as those of the Swiss public transport system.

With the ramp-up of PC-24 production, a 118,000-square-foot hangar is under construction on the other side of the runway. North American customers get their airplanes from the U.S. base in Broomfield, Colorado, where paint and interior work is done on both the PC-12 and PC-24 in a 118,000-square-foot facility, which opened this fall.

A new approach was used for the design and construction of the PC-24. Cervia said biological science was used as part of the aerodynamic design. “It’s Darwinian evolution applied to aerodynamics,” he said. “We wanted an airplane designed by

PILATUS IS SELF-FUNDED AND HAS USED THE SUCCESS OF ONE MODEL TO PAY FOR THE DEVELOPMENT OF THE NEXT.

nature. It comes from the evolution of millions of years and many months in the computer.”

The wing is void of any stall strips or vortex generators that engineers sometimes have to add to modify

Pilatus started its successful line of airplane models with the stunning P-2.

the airflow over the lifting surfaces, a testament to meticulous computer analysis and wind-tunnel testing. There aren’t even rivets on the wings.

But how is that possible if the PC-24 is mostly made of aluminum? Each PC-24 wing skin, including the necessary ribs and spars, is milled from a 3,970-pound piece of aluminum. When the milling machine is done, a 185-pound piece of

art emerges.

Some creative ways were found to help give the PC-24 top performance. While barely noticeable, the aft portion of each engine cowl is angled down. “I wanted to have thrust



- A** Four 12-inch screens from Honeywell's Epic family provide the basis for the PC-24's Advanced Cockpit Environment.
- B** The top MFD screen provides the pilot with flight-plan status, navigation and airspace data, weather and more, while the lower section displays systems status.
- C** Data manipulation can be accomplished in several ways, with buttons around the screens, a keypad below the MFDs or with a cursor control device below the throttles.
- D** The pilot's job is made easy with faDEC-controlled Williams FJ44 engines and autothrottles.
- E** In the highly unlikely event of a complete failure of the Honeywell ACE system, an L3 electronic standby instrument provides critical flight data.
- F** ACE is run by dissimilar computers that are placed in separate locations to provide complete redundancy (not pictured).



PILATUS PC-24

Standard equipment includes executive interior, externally serviced pressure lavatory, single-point refueling, autothrottles and inertial reference system.

BASE PRICE \$8.9 MILLION

PRICE TYPICALLY EQUIPPED \$9.4 MILLION

ENGINES (2) WILLIAMS FJ44-4A-QPM

TBO 5,000 HOURS

THRUST (PER ENGINE) 3,420 LB.

SEATS 2 CREW AND UP TO 9 PASSENGERS

WINGSPAN 55 FT. 9 IN.

LENGTH 55 FT. 2 IN.

HEIGHT 17 FT. 4 IN.

CABIN HEIGHT 5 FT. 1 IN. (FLAT FLOOR)

CABIN WIDTH 5 FT. 7 IN.

CABIN VOLUME 501 CU. FT. (INCLUDING BAGGAGE AREA)

CARGO DOOR WIDTH 4 FT. 1 IN.

CARGO DOOR HEIGHT 4 FT. 3 IN.

BAGGAGE COMPARTMENT 90 CU. FT. (INTERNAL, HEATED AND PRESSURIZED)

MAX TAKEOFF WEIGHT 18,300 LB.

MAX LANDING WEIGHT 16,900 LB.

BASIC OPERATING WEIGHT 11,720 LB.;

6-SEAT EXEC CONFIG., INCLUDING ONE PILOT

MAX PAYLOAD 2,500 LB.

MAX FUEL PAYLOAD 715 LB.

MAX USABLE FUEL 5,965 LB.

MAX OPERATING ALTITUDE FL 450

CABIN ALTITUDE AT MAX ALTITUDE 8,000 FT.

TAKEOFF DISTANCE 2,930 FT. BALANCED

FIELD LENGTH @ MGTOW, SL, ISA

LANDING DISTANCE 2,375 FT. @ MLW, SL, IS,

OVER 50-FT. OBSTACLE

MAX RANGE 2,000 NM WITH 4 PAX, NBAA

MAX CRUISE SPEED 440 KTAS

LONG RANGE CRUISE SPEED 360 KTAS

STALL SPEED 82 KIAS @ MLW

MMO MACH 0.74

vectoring," Cervia said. I must have giggled a bit because Cervia continued, "It's not a joke." When full power is applied, the thrust gets deflected by the Coanda effect, helping the PC-24 get off the ground quicker. "It's the first business jet with vectoring thrust, and it doesn't cost you too much, it's just the shape," Cervia said. The engines are mounted through pylons onto a fuselage shape that helps reduce drag.

While some manufacturers limit anti-ice use above certain altitudes, when the engines produce insufficient power to provide bleed air to heat the leading edges, Pilatus selected pneumatic boots to provide ice protection for the horizontal tail surfaces, allowing the wing anti-ice to be used all the way up

to FL 450.

One customer request that Pilatus wasn't able to fulfill was the availability of an auxiliary power unit. An APU would add too much weight, Cervia said. But, as a compromise, Pilatus worked with Williams to develop what has been called Quiet Power Mode,

"YOU HAVE TO LOOK FOR THE BEST INGREDIENTS. IT'S LIKE COOKING."

—BRUNO CERVIA, PILATUS

which essentially turns the right engine into an APU of sorts. In QPM, the engine runs in sub-idle, which lowers the noise and fuel burn and doesn't add to the hourly tally for the engine.

One limitation that makes it a bit less useful is that the sub-idle mode doesn't charge the battery. When I tested it, I had to first run the engine at idle to bring the battery power up.

Sitting Pretty

The flat floor in the PC-24 didn't allow my 5-foot-7-inch frame to stand up straight, but once I was seated the cabin provided a very comfortable environment. The seats can swivel in multiple directions, and armrests fold down on both sides of the executive seats.

Cabin passengers can entertain themselves through a smart device, such as a phone or tablet, that connects to the airplane's server through a browser rather than an app. Passengers can follow along on the

flight in Airshow, adjust cabin lights and temperatures, access media on the server and more. In the most common cabin configuration, there are multiple international 115-volt power ports, side pockets with USB ports, cup holders, storage compartments and a small closet by the entrance.

The cockpit can be closed off from the main cabin for privacy, and there is an externally serviceable lavatory at the main entrance that can be completely enclosed.

The name of the game inside the cabin is, as the PC-24's moniker implies, versatility. It can be configured for cargo, medical evacuations or as many as 10 seats for commuter services. However, the most common configurations are either six or eight seats in a club configuration. A

six-plus-two arrangement includes two seats that can quickly be removed if more luggage space is needed. However, at 90 cubic feet, the baggage compartment is nearly as large as some New York City apartments, and the equally massive cargo door is big enough to load a standard pallet.

Loading is made easy since the engine cowl and the trailing edge of the wing, which is straight and at a 90-degree angle to the fuselage, are well out of the way.

Let's Go Flying!

Pilots' seats in midsize and larger business jets are notoriously difficult to get into due to the large center console. The seats in the PC-24 are no exception, though they are comfortable and fully adjustable. Pilatus test

PC-24 TRAINING AT FLIGHTSAFETY



Pilatus chose FlightSafety International as the training provider for the PC-24 type rating. The initial type-rating course runs 18 days and uses FlightSafety's Operational Day Flow concept. It puts pilots in a virtual cockpit from day one, using desktop trainers that help teach the operations and systems of the airplane through flight scenarios. Pilots transition to a graphical flight simulator — a full graphical representation of the airplane that serves as a cockpit and systems trainer.

The most realistic training happens in the full-motion level-D qualified simulator, which teaches pilots to fly the

airplane and get prepared for scenarios that would be too dangerous to practice in the airplane, such as a catastrophic engine failures on takeoff. The PC-24 automatically provides 50 pounds of rudder pressure into the failed engine, though a lopsided workout is still required to keep the airplane flying.

FlightSafety offers the PC-24 program at its training facility in Dallas. A second level-D simulator is in construction at FlightSafety's manufacturing facility in Tulsa, Oklahoma. It will go to the FlightSafety Learning Center in Paris, which is expected to start offering the PC-24 type-rating program by the end of next year.

pilot Matthew Hartcop and I pretzeled ourselves into the right and left seats while a photographer comfortably slid into one of the executive seats in the back. With 5,201 pounds of fuel, we were at a total weight of 17,771 pounds. Considering the available space, useful load is one of the PC-24's only shortcomings, but we could have brought more than 500 additional pounds of people or gear in this

cruise and approach. The only tricky part in the beginning is making sure the screen you're attempting to manipulate is active. The frame of the active screen is highlighted, but it takes a bit to get used to. Flipping from screen to screen can be done in multiple ways too, whether by arrow buttons or a button on the side of the cursor control device, which I became friendly with quickly. While it's a highly capable

airplane, the first production version of the PC-24, and we were well within the wide CG envelope, though slightly above the max landing weight had we been inclined to land right away.

Hartcop had entered the flight plan into Honeywell's Flight Bag Pro app, and uploaded it into the ACE panel in seconds. Like most advanced glass-panel flight decks, the Honeywell system makes it easy for the pilot to determine whether the systems are ready to fly with green, yellow or red indications along with CAS messages.

ACE also allows for multiple ways to enter data, whether through a keyboard, buttons along the screens or a center-mounted mouselike cursor control device. There are no touch-screen features. Intuitive menus are set up for flight planning, departure,

PHOTO COURTESY PILATUS AIRCRAFT



system with all the functionality you could dream of, the processing speed could use some improvement.

With a few quick clicks and switches on the overhead panel, the engines were spooled up and we were ready to go. The taxiway that leads from the factory to Runway 6-24 at Buochs Airfield (LSZC) crosses a road. With a discreet frequency and three clicks on the push-to-talk button, I activated a traffic light to stop the road traffic and allow us to cross. I couldn't help but give the waiting cars a quick wave as we taxied by.

We back-taxed to take off from Runway 24. Turning around on the 130-foot-wide runway was no problem using differential braking and power. My back was pushed into the seat as the Williams engines launched the stunning jet forward. We had not completed the climb checklist before we were above the peak of Mount Pilatus. The imposing Alps, covered by the first fresh coat of snow of the season,

soon shrank below us.

The plan was to climb all the way to FL 450 to see how long it would take with a fairly heavy load from the 1,475-foot elevation at LSZC. But with complex restricted airspace surrounding the area, indicated by a mess of lines on the MFD that trivialized the

THE PC-24 PROTESTED WITH A SLIGHT VIBRATION IN THE WING, BUT IT HUNG ON TO THE THIN AIR.

airspace around the Los Angeles area, where I normally fly, the controller made us stay below FL 200.

Hand-flying the PC-24 is lovely at lower speeds, though I would have preferred to see a sidestick. Cervia said a sidestick would require fly-by-wire controls, and the business case was not there. The sidestick fly-by-wire-controlled Embraer Legacy 450 is about 20 percent bigger and not a

Sixty degrees of bank at FL 450 is not something you see every day in a bizjet.

whole lot faster than the PC-24, but it costs more than 50 percent more. With direct links from the yoke to the controls, the amount of muscle required to maneuver the PC-24 increases with speed.

Of course, at higher speeds, most pilots will use the automation. The autopilot will fly coupled approaches and missed approaches, and autothrottles can take over power management. An emergency descent mode, which we tested from FL 450, activates if the cabin altitude goes above 10,000 feet. A stall shaker, followed by a pusher, will help prevent stalls. Airbrakes automatically deploy if the speed reaches beyond V_{MO} or M_{MO} or upon landing; there is, however, no reverse thrust.

We played around with steep turns, slow flight and stalls. The shaker warned me a few knots before the



The PC-24 is expected to be certified for unpaved runways by the year's end.

redline on the speed tape, and the stick pusher activated once inside the red. The airplane felt more stable and controllable at slower speeds than I would have imagined for a large, fast jet. After some maneuvering and an ILS into nearby Emmen Airport (LSME), we took off again toward famed ski resort St. Moritz.

After one of the most beautiful approaches I have ever had a chance to experience, flying into St. Moritz's Samedan Airport (LSZS), located at 5,600 feet, Hartcop demonstrated a short-field landing on Runway 3. We exited on a taxiway about halfway down the 5,900-foot runway. We could have easily pulled off closer to the departure end if there had been another taxiway there.

Flygprestanda's app, Guru2, which provides quick performance data for airports around the world, told us the takeoff distance to clear a 50-foot obstacle would be a mere 2,450 feet and our landing back at Buochs would be about the same. I turned my eyes skyward toward the towering snow-capped peaks. Hartcop said the plan was to take off from Runway 3, go straight down the valley for a short stretch and then essentially turn crosswind toward the mountains. Were we going to fly a bizjet through a narrow mountain canyon?

I had confidence in Hartcop and figured, at worst, we could always continue down the valley, so I pushed the throttles forward, rotated at 90 knots and pitched up to put the doughnut on the PFD around the flight-path target ball. Despite the higher altitude, we shot up like a rocket and were nearly at the top of the peaks before we even turned crosswind.

The Swiss controllers were more generous this time, and gave us a direct climb to FL 450. After flying for nearly two hours in the morning, our load was lighter and the climb performance was truly impressive. Fourteen minutes in, we were already at FL 400, and the PC-24 was still averaging about 1,000 fpm at 44,000 feet — about the same as my Mooney will do at sea level on a good

day. We climbed the 39,400 feet from LSZS to FL 450 in a mere 18 minutes.

Leveled off at FL 450, we were burning less than 1,000 pph in fuel and saw Mach 0.73, which translated to a true airspeed of 413 knots. Then the real kicker came. Hartcop, who is no stranger to the edge of the envelope after 11 years as a Pilatus test pilot, told me to put the airplane in a 60-degree bank with enough pull to maintain altitude — about 2 Gs'

not CAVU, we were fortunately graced with great weather conditions. We did several landings, which required a pattern that went around an entire mountain where we played with approaches with and without auto-throttles. With 33 degrees of flaps, the nose-down attitude during the approach is quite dramatic and allows for good visibility of the runway environment. I also had a chance to try a simulated single-engine climb,



worth. The PC-24 protested with a slight vibration in the wing, but it hung on to the thin air.

After a thrilling emergency descent at 10,000 fpm, it was time to head back to Buochs. The instrument approach into LSZC is an interesting one because it terminates in the middle of Lake Lucerne. Reasonable ceilings are required for a safe approach. While

The wing skins are milled from one aluminum piece, making the surface completely clean.

which produced about 2,000 fpm. Yup, there is plenty of power.

Getting Down and Dirty

Some PC-24 naysayers might be reeling in the fact that the cert for the part that truly sets the airplane apart

PHOTO COURTESY PILATUS AIRCRAFT



Double-slotted flaps and high-mounted engines prevent FOD contamination.



Low-pressure tires allow the PC-24 to land on unpaved runway surfaces.

— unpaved airfields — has not yet been signed off. However, Cervia said testing is complete and the paperwork is in progress. The testing was done on a variety of surfaces, such as grass, compact dirt, sand, stones and partially vegetated ground at airports in Canada, England, Italy and Switzerland. Cervia showed me an image of an airport in Italy where

some off-pavement landings were done with an evaluator from EASA. The ground was a messy mix of dirt and vegetation. "EASA's comment: ground handling and aircraft behavior — as paved," Cervia said. "I am expecting certification by the end of the year."

The unpaved-runway certification, along with steep-approach certification, also in progress, will give the PC-24 the ability to fly into

20,000 runways around the world, about twice that of its competitors, Pilatus claims.

Along with the beauty and precision that the Swiss are known for around the world, Pilatus delivered on the promise to its customers. The PC-24 provides the flexibility of a PC-12 NG, but the cruise speed is not 100 knots faster, as the customers requested. My personal comparison between the two airplanes (see PC-12 NG article from the August 2017 issue of *Flying*) produced a 150 ktas delta. It's almost too good to be true. 🍷