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FLIGHT TEST

PRECISION APPROACH

Pilatus makes its Swiss army knife of the sky an even sharper ride

UPGRADED PC-12 POWERS AHEAD

Pilatus launched its turboprop single in 1991 with modest sales expectations, but a quarter of a century and a string of updates later it is still in high demand; now, with engine update and other subtle but potent enhancements, its NG is sharper than ever

MICHAEL GERZANICS DENVER

When the PC-12 was announced in 1989, manufacturer Pilatus anticipated a market for approximately 200 aircraft. But while many were convinced it would be a niche product, the versatile PC-12 has become one of the most successful turboprop singles in history; since its first flight in May 1991, more than 1,400 of the type have been sold.

As with most long-running serial production aircraft, the PC-12 has benefited from numerous improvements since launch. The first PC-12 (SN101-400) had a Pratt & Whitney Canada PT6A-67B, a conventional round-dial cockpit and a maximum take-off weight (MTOW) of 4,100kg (9,030lb), later increased to 4,500kg. The first major advance came with SN401, which featured an updated cockpit.

I flew this variant in 2004, and noted its flight deck reminded me of early model Boeing 737-300s. Small screen electronic primary flight and horizontal situation displays were installed, but conventional round-dial airspeed, altimeter and vertical velocity indicators remained. A Honeywell Bendix/King KMD-850 multi-function display and LCD engine instrument system made it a poor man's glass cockpit.

Jon Youngblut/Pilatus

With SN684, Pilatus increased the weight to 4,700kg and made refinements to the flight control system. Production of this variant ended with SN880.

In 2008, Pilatus fielded the PC-12NG (Next Generation), with production starting at SN1001. This was the most significant update to the now well-established "niche" aircraft. The flight deck received a well-deserved makeover with the installation of a Honeywell Primus Apex glass flight deck. Fellow *Flight International* test pilot Peter Collins flew this model in 2008, commenting: "The Apex system makes for a modern, well laid-out, uncluttered cockpit." Under the cowling, a more powerful PT6A-67P turbine was installed, improving runway and cruise performance. The Swiss are not renowned for being fashion leaders, but more glass and more horsepower are two things that will never go out of style.

PC-12NG IMPROVED

For 2016, Pilatus has further sharpened the Swiss army knife of aircraft. The biggest and most obvious enhancement is the addition of a composite five-bladed scimitar propeller. Aside from giving the big single a rakish appearance, it shortens the PC-12's time to climb by about 10%. Numerous minor aerodynamic refinements help the PC-12 cleanly slice through the air. The propeller and aero tweaks combine in equal measure, according to Pilatus's chief US pilot Jed Johnson, to give the aircraft a maximum cruise speed of 285KTAS (527km/h). The 5kt speed bump, over the previous model, slightly closes the gap with the smaller and less cavernous Daher TBM900, which boasts a maximum cruise speed of 330KTAS.

Another notable upgrade was to the Primus Apex flight deck. Build 10 of the software improved system functionality and capabilities. One particularly useful addition is an FMS altitude temperature compensation capability. This allows vertical navigation approaches at extreme temperatures – more than a nice-to-have if your destination is only served by GPS-based approaches.

Johnson was the safety pilot for my preview flight out of Rocky Mountain Metropolitan airport (KBJC) to and from Pagosa Springs (KPSO). He has been associated with Pilatus for nearly 20 years, and has the distinction of having sold more than 150 PC-12s, amassing nearly 8,000h on the type. During the pre-flight safety inspection he pointed out NG features. To counter propeller-induced "P-factor," the engine is mounted canted, 3° to the right and 3° downwards. Vibrations from the PT6A-67P are dampened by polymer mounting bushings. As can be expected, these bushings get a workout, and there are dedicated NACA ducts on the cowling to direct cooling air to them.

Engine oil is checked through a sight gauge, with an electronic level sensor relaying information to the system's multi-function display. The PT6 has proven to be an extremely reliable engine, with an inflight shutdown rate of less than one every 651,126h (on a 12-month rolling average). The number-one cause of engine failure has been oil starvation, frequently the result of an improperly closed oil fill cap – though Johnson says the -67P's cap is nearly impossible to install incorrectly. Should the statistically nearly impossible happen, the PT6A-67P's oil filler check valve will prevent oil from being syphoned from an open filler.

> **The current NG is no doubt a better aircraft than the one I had flown 11 years earlier**

While not as aggressively shaped as the propellers on the Airbus A400M, the PC-12's five-bladed prop was fascinating to look at.

Jon Youngblut/Pilatus

Gerzanics *(left)* and Johnson: more glass and more horsepower never go out of fashion

The blades are very thin, designed to have a uniform thrust/lift distribution along the span. If this sounds vaguely familiar, thank the elliptical wing of Supermarine's Spitfire.

The straight wing has an aspect ratio of approximately 10.27, with large fowler flaps that extend inward from the wing root underneath the fuselage. Pilatus made the flaps as large as possible to reduce stall speed. For single-engined aircraft, US federal aviation regulations dictate a stall speed of 61KIAS, to make a crash more survivable, but even with the large flaps, the PC-12NG's is 67KIAS (at MTOW). So, to attain certification, the US Federal Aviation Administration allowed Pilatus to use an equivalent level of safety (ELOS): a 26*g* cockpit and 19*g* cabin seats, which would dissipate energy in the event of a forced landing.

CABIN CLASS COMFORT

After we rounded the right wing tip, with its 10" radar pod, Johnson pointed out some of the aerodynamic tweaks that helped boost the PC-12NG's top end. Gap seals were added to the trailing edge of the wing. Flap fairings were refined and external antennas moved and oriented to reduce drag. As with all PC-12s, flush rivets are employed forward of the fuselage's aft pressure bulkhead. Rivets aft of the bulkhead have exposed heads as they are in an area of turbulent flow. On the left side of the aircraft was a most impressive feature, the 1.35m x 1.32m (height x width) cargo door that opens into the 9.34m^3 cabin. The PC-12's cargo door is larger than that available on the Beechcraft King Air 350, which is only 1.24m x 1.32m. Its cabin is also taller and wider than the much more expensive type. The King Air's cabin, however, is 0.78m longer than the PC-12's and has a volume of 10m^3. While few PC-12 customers cross shop the King Air, the relative cabin size illustrates just how big the PC-12 is.

After closing the electrically actuated cargo door, we rounded the left wing and entered the aircraft via the forward door. The manually-operated counterbalanced cabin entry door has four integral steps and features LED lighting. Opposite the entry door is a small cabinet with a chemical flush toilet. With an endur-

PC-12NG SPECIFICATIONS	
Crew	2*
Passengers	9 max
Wing span	16.28m
Length	14.40m
Height	4.26m
MTOW	4,740kg
Engine	1 x P&WC PT6A-67P
Power	1,200shp (SL to ISA +35°C)
Take-off distance	793m
Ceiling	30,000ft
Range (HSC)	3,417km (MTOW, VFR reserves)
Landing distance	661m (MLW, SL, ISA)

SOURCE: Pilatus *single pilot certificated

ance of over 5h, it is a feature that ensures aircraft range is not limited by human factors. As with a "large" aircraft, after entry the pilots turn left and the passengers turn right. As can be expected, the "Executive" cabin of the $4.9 million turboprop was well-appointed. The preview PC-12 aircraft, N285KT (SN1589), was configured with a 6+2 interior: club section forward and two forward-facing executive seats aft. Two more forward-facing standard seats are further aft, just forward of the netted internal baggage storage area. The large size and flat floor combine to make the PC-12 a versatile utility vehicle. Up to nine standard seats can be fitted, and in the combi configuration nearly two-thirds of the cabin is available for cargo aft of four standard seats. The versatility of the PC-12 is further highlighted by its growing use as an air ambulance. According to Tom Aniello, vice-president of marketing for Pilatus, there are approximately 125 PC-12s in dedicated air ambulance service. In the medical evacuation configuration, two litter patients can be carried in pressurised comfort.

PRIMUS APEX FORWARD

The flight deck of my preview aircraft was very similar to the one flown by Collins in 2008, but Pilatus and Honeywell have improved the Apex system, now up to Build 10. Four identical 10" LCD displays with integral bezel buttons were in a T configuration: primary flight displays outboard and two multi-function displays stacked in the centre.

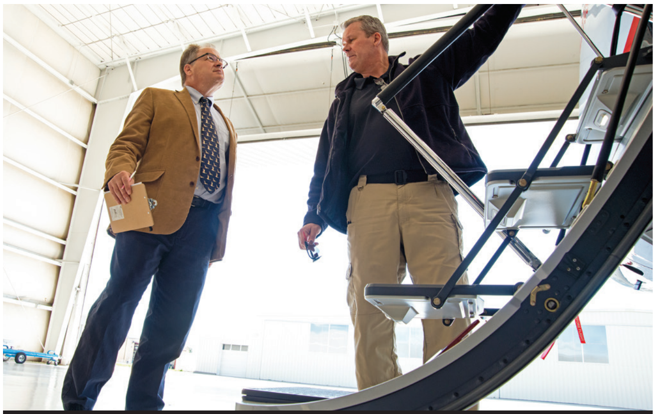
Apex is a flight management system similar to those found on larger business and transport aircraft. I immediately felt at ease using it, as Johnson directed the pre-flight setup. While I am far from an expert on the linage of the Apex system, four features caught my attention. The first was a cursor control device (CCD) with a track ball located at the aft end of the centre pedestal. It fell easily to hand and was intuitive to operate. Four buttons on the multi-function controller, or a side tap of the scroll wheel on the CCD, changed the "active" window. The CCD allowed graphical flight plan changes en route to and from KPSO, a capability I first experienced in Dassault's EASy and Gulfstream's PlaneView flight decks. The second was the wireless capability resident in Apex Build 10. While not demonstrated during my visit, databases and canned flight plans can be updated rapidly without a hard connection while on the ground. A vertical situation display was a handy addition to the flight deck displays. The fourth and final feature that stood out was the Smartview synthetic vision system.

NOT MUCH BOOT REQUIRED

Johnson guided me through the start procedure for the 1,200shp (895kW) PT6 from the right seat. Once it was running, the dual electrical generators automatically came on line. Post-start and pre-taxi flows were a snap to accomplish. Once the parking brake was released, a slight bump of the power control lever got the big single moving. With the condition lever in the ground idle detent, prop speed was slowed to 1,000rpm, facilitating a nice taxi pace. Rudder pedal-actuated nose wheel steering allowed me to track taxiway

1.35m x 1.32m cargo door opens onto PC-12's generous cabin


Cleaner aerodynamics help boost cruise speed to 285KTAS


The cabin entry door has four integral steps and LED lighting


New composite propeller cuts time to climb by about 10%

Jon Youngblut/Pilatus

centrelines as we made our way to runway 30R for take-off, and flaps were set to a mid position of 15°. Turning on the runway, I moved the condition lever to the flight idle detent, where it would remain until landing. Cleared for take-off, I rapidly advanced the power control lever to the stop. Acceleration was rapid and about 20kg of right pedal pressure was needed to keep tracking down the runway. While the NG is single-pilot certificated, Johnson did call "rotate" at 80KIAS. After retraction of the electronically-actuated landing gear, I followed the flight director guidance during the climb. Flaps were retracted at 100KIAS and a climb speed of 130KIAS was established. Pitch force changes were negligible during clean up and acceleration.

ATC provided vectors to intercept our route to KPSO, approximately 180nm (333km) SSW. I hand-flew the aircraft and used these turns to evaluate the NG's control forces and harmony. During my first flight in the PC-12 I remarked: "Roll control forces were heavy at all speeds, and increased as speed increased." In the intervening years, Pilatus had added Flettner tabs and servo tabs on the ailerons, and on this flight I found roll forces to be much lighter and well-harmonised with pitch forces. With the yaw damper on, the NG can be flown with one's feet on the floor, as it did a good job of countering adverse yaw during the hand-flown manoeuvres. P-factor-induced yaw tendencies are also countered by the yaw damper, making the PC-12 fly like a jet.

During the first part of the climb I had inadvertently left the power off to my Bose noise cancelling headset. While far from quiet, the ambient noise level in the cockpit was not too tiresome. One of the benefits of the new, stiffer five-bladed propeller – aside from a 10% faster time to climb – is a 2-3dB reduction in cockpit/cabin noise levels. With the noise cancelling turned on, the NG was much quieter than the cockpit in my normal ride, a 737-700. We levelled at FL230 about 14min after brake release. ATC vectors and altitude hold-downs prevented collection of precise climb data, but observed performance agreed well with Pilatus book numbers.

One safety enhancing feature is a "Nearest Airport" tab on the map display

At FL240 I set maximum continuous power (780°C interstage turbine temperature) and let the aircraft accelerate to its maximum speed. The 3,924kg NG stabilised at 184KIAS. At a static air temperature of 26°C, a fuel flow of 417PPH gave us a true airspeed of 272kt. Pilatus does publish a long-range cruise speed for the NG, but it is seldom used as the meagre


Jon Youngblut/Pilatus

One benefit of the new, stiffer five-bladed propeller is a 2-3dB cockpit/cabin noise reduction

fuel savings are outweighed by the cost of extra time on the engine and propeller.

With the capable autopilot engaged at cruise altitude, I took time to familiarise myself with the Apex avionics suite. One safety enhancing feature is a "Nearest Airport" tab on the map display. Using the CCD I clicked on it, and the US Air Force Academy airfield, KAFF, was shown as the nearest. It had a 4,500ft-long runway and was only 14nm away. With a 16:1 glide ratio, the NG can go about 3nm for each 1,000ft of altitude, making it well within reach. Had a longer runway been desired, we could have scrolled down a bit and highlighted KCOS, another 11nm off.

DOUBLE PUSHER

As we approached KPSO we descended to 16,000ft mean sea level (MSL), where Johnson cancelled our instrument flight rules clearance. Once level in the medium altitude block, we slowed for two approach to stalls. Both were accomplished with power set at idle and a descent rate to establish a 1kt/s bleed rate. The first was in a clean configuration, with the aural stall warning activating at 92KIAS. The stick pusher activated at 86KIAS, pushing the yoke forward with 18kg of force. Lowering the nose and advancing the power control lever speedily recovered the NG to the normal flight envelope. The second manoeuvre was in a landing configuration, gear down and flaps set to 40°. As the 3,856kg NG slowed, the aural warning sounded at 68KIAS, with the pusher firing at 62KIAS. The 18kg force was more than enough to pull the yoke forward, but other than recovering the NG I increased the aft yoke input. The pusher fired again, but this time 50% more forcefully – a less than subtle cue for even the most inattentive of pilots. During the stall manoeuvres the NG remained rock steady and displayed no tendency to drop a wing. As before, relaxing back pressure and advancing the power control lever recovered the NG to normal flight. The yaw damper did an admirable job of keeping the nose pointed forward as engine power increased at such low speeds.

SAFETY GLIDE

Satisfied with the NG's slow-speed flying qualities, we cleaned the aircraft up and climbed to FL210 as we continued towards Pagosa Springs. During this segment of the flight Johnson discussed how to handle a power loss and forced landing. Unlike the Lockheed Martin F-16, in which I had performed hundreds of simulated flame-out landings (and one real one) from an overhead 360° approach, Johnson recommended a straight in one for the PC-12. He had observed

At the core of the PC-12NG is a minimalistic aircraft

Jon Youngblut/Pilatus

that, without frequent practice, pilots flew the 360° overhead pattern too tight and consequently could run off the end of what was a suitably long runway. Johnson "failed" the engine, setting 2.1psi torque to simulate a feathered propeller. I continued towards the field and slowed to 105KIAS, with resulting sink rate of 800ft/min. In the flight management system I put in an 8° gradient path to runway 19's threshold (7,664ft MSL), on a 192° track.

Reassuringly, the synthetic vision system depiction showed us clearing high terrain between us and the field. On the vertical and horizontal situation displays I monitored our descent and as we approached the 8° path, I lowered the landing gear and extended the flaps to 30°. As we tracked the 8° path, the airspeed settled at 115-120KIAS. In a glider one often uses speed brakes to modulate the glide; in the PC-12 we used the flaps. The 30° position is an intermediate one bracketed by 15° and 40° settings. Find yourself a bit steep, extend more flaps; shallow, just retract them.

The initial part of the manoeuvre was flown using the flight management system's vertical navigation feature, but as we descended through 10,000ft MSL, I transitioned to visual references. I aimed just short of the threshold, placing it about halfway up the windscreen. The airspeed held steady and just as I was about to shift my aim point to the opposite end of the runway for the flare manoeuvre, Johnson pushed the power control lever to make it a low approach.

The gear was retracted and flaps set to 15° for the downwind leg of the visual circuit. Flown at 1,000ft above ground level, I put the runway about two-thirds of the way out the wing to establish a good lateral offset. Abeam the threshold I extended the gear and set the flaps to 40°. I flew the final turn at 100KIAS and slowed to the final approach speed of 85KIAS – as indicated by dynamic speed bug – as we rolled out on final. Following the visual approach slope indicator 3° glide path required a bit of power, the NG in a 3° nose-low attitude. Passing about 30ft I slowly retarded the power control lever and initiated the flare manoeuvre. The initial roundout was a bit high, but I milked it quickly down to the runway. It would be hard to criticise my landing, as the NG's trailing link main gear made it look good.

Once on the runway I used light toe braking and moderate reverse beta to slow. Passing 50KIAS I came out of reverse beta and slowed for runway turn-off with toe braking alone. Shut down and post flights were rapidly accomplished on the ramp at Pagosa Springs.

RETURN TO ROCKY MOUNTAIN

After a break for a photo shoot and addition of 200gal of Jet A, Johnson and I settled back into the NG for the quick leg back to KBJC. Take-off and climb to altitude were uneventful and once level at FL230, I unstrapped from the left seat to do a quick survey of the passenger cabin. Before I left the flight deck I noted the 0.40 bar pressurisation system was maintaining a cabin altitude of 7,000ft. At the NG's ceiling of 30,000ft, a 10,000ft cabin altitude is maintained. Once in the cabin I closed the hard partition doors that separate the flight deck and cabin. Ambient noise level allowed for comfortable conversation with the three passengers on our flight, but subjectively it was louder than a typical light jet's cabin. The further aft in the cabin, the quieter it was, not that there was a bad seat in the house.

Back in the left seat, we set the NG up for the POWDR 8 arrival and an ILS approach to runway 30R. Programming the FMS was intuitive, with Johnson pointing out neat features. Approach plates and charts can be displayed on both multi-function displays (top and bottom) allowing the standard terminal arrival and approach plates to be presented at the same time. Approximately 30nm from the field, the flight management auto-tuned the ILS frequency, further reducing what was already a low pilot workload. Had there been convective activity in the area we could have monitored it with either the onboard weather radar or downlinked XM radar display.

Ultimately, arrival flow into Denver International airport prohibited an approach to 30R, so my last approach and landing was a visual to a full stop on runway 12L.

CONCLUSION

After shutdown on Pilatus's ramp, I reflected back on both this day's and my previous flight in the PC-12. The current NG is no doubt a better aircraft than the one I had flown 11 years earlier. The five-bladed composite scimitar propeller combines with the more powerful PT6A-67P to give marked improvements to field, climb and cruise performance. The updated Apex flight deck, with its Smartview synthetic vision system, was very capable and showed its mettle in routine and simulated emergency situations. The PC-12NG is a success because at its core it is a minimalistic aircraft. It needs only a single engine to outperform numerous turbine twins. It is single-pilot certificated, catering to owner-operators and flight departments. It has one large cabin that can be configured for any number of purposes. Since its launch in 1989 the PC-12 has proven itself one very successful aircraft. Sometimes, less is more. ■


Jon Youngblut/Pilatus

With its new propeller and more powerful engine, the PC-12 outperforms many turbine twins