FLIGHT INTERNATIONAL

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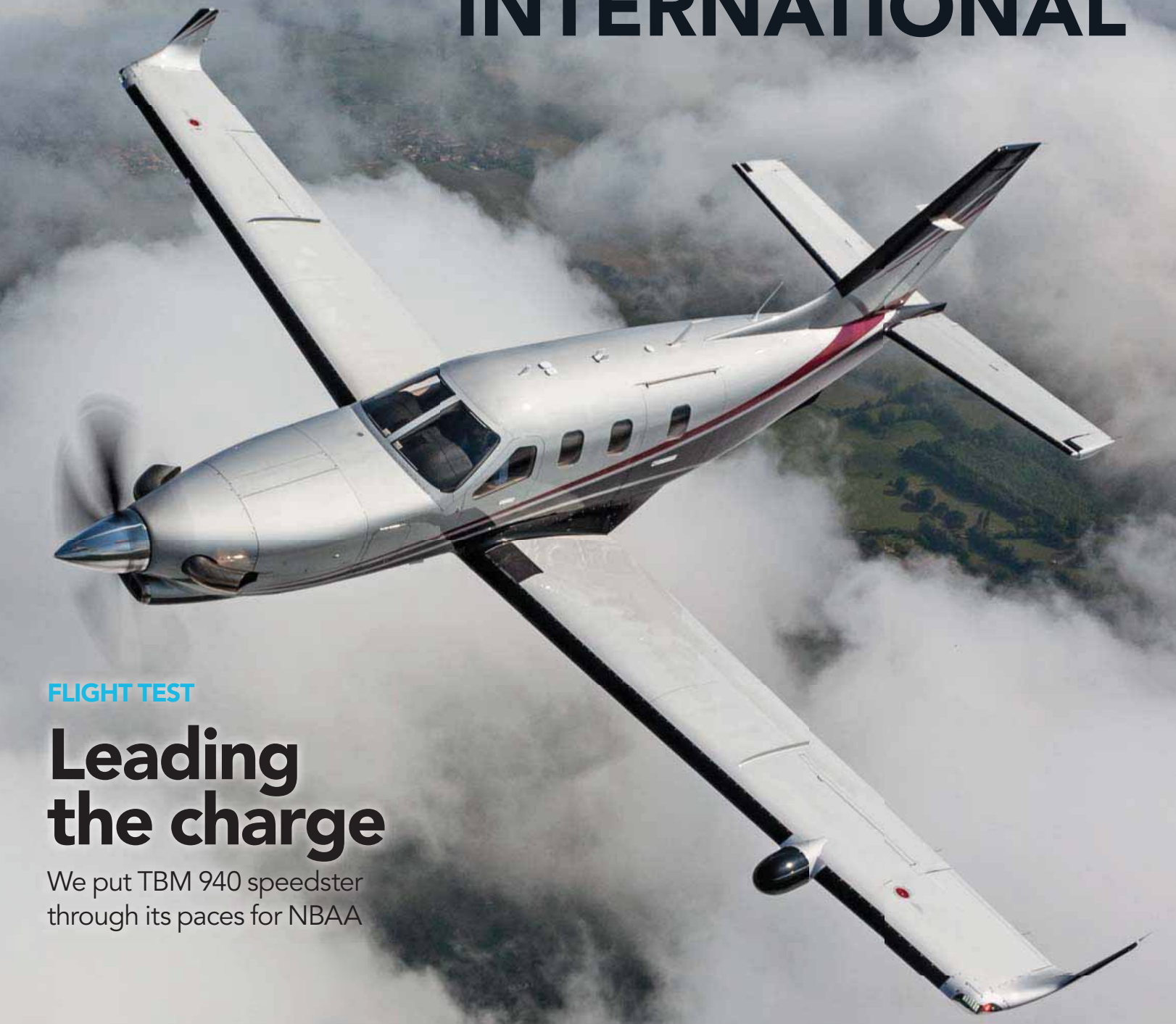

FLIGHT TEST

Leading the charge

We put TBM 940 speedster through its paces for NBAA

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9 770015 371310 42

Wow, how?
Questions remain over defunct Icelandic carrier's comeback 13

ACES high
US Air Force boosts Collins with ejection seat deal 20

110 YEARS 1909-2019

Power of one

Turboprop-single family has been a market success since launch in 1988, amassing sales of more than 900 units across three variants

Daher has delivered a compelling offer for owner-flyers, with a range of enhancements on the TBM 940 providing an edge over the piston-twin segment. We put it through its paces

MICHAEL GERZANICS POMPANO BEACH

The single-engined turboprop market is populated by numerous aircraft of varying configurations. In broad strokes, it can be broken down into two segments: fast, low-winged aircraft and slower, more spacious high-winged designs.

In the West, these diverse offerings share a single critical component – their engine. Pratt & Whitney Canada's PT6 family of turboprop engines is the bedrock upon which this segment has been built. "The PT6A continues to be the only engine to achieve Single Engine Instrumental Flight Rules (IFR) status for passenger revenue activity in North America, Australia, Europe and New Zealand," the manufacturer says. In effect, the PT6 engine single-handedly killed the high-end piston-twin segment.

In addition, increased horsepower levels have allowed single-engined designs to make inroads into the twin-turbine segment.

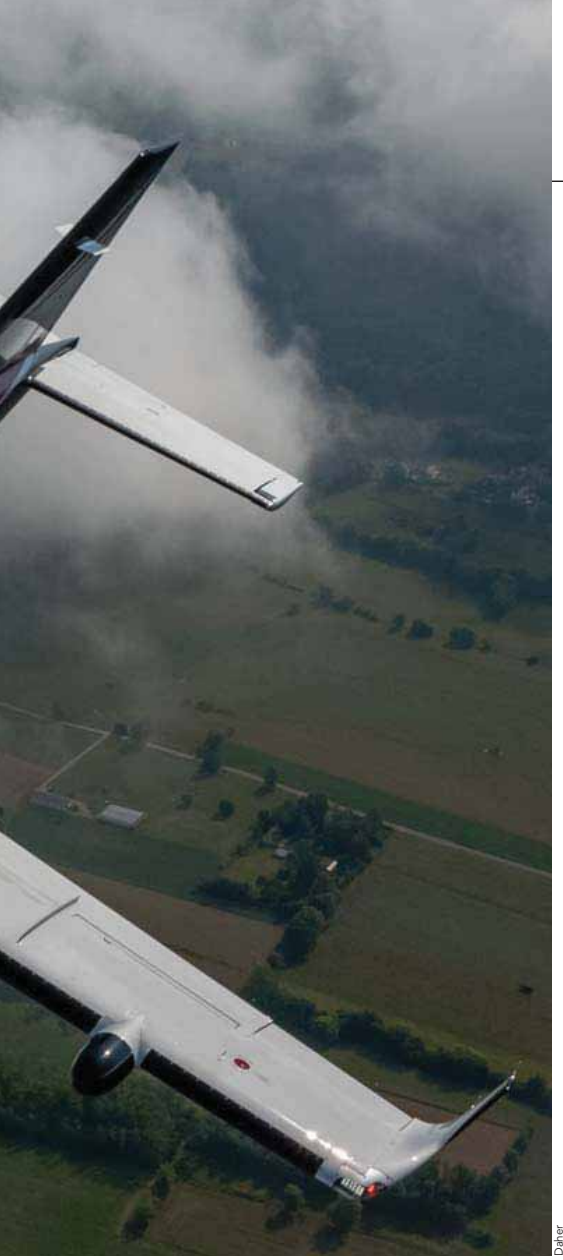
The growth of the single-engined turboprop segment is based on the near-bulletproof reliability and scalability of the PT6 family. This paradigm shift from piston-twins to turbine-singles is conceptually on par with extended twin-engine operations authorisations all but killing off three- and four-engined civil transport aircraft.

But the fact that any number of used light business jets and the new Cirrus VisionJet are available for less than the cost of new single-engined turboprops prompts the question: why the robust market for them?

There are a range of factors owner-operators, who dominate this segment, consider before making a purchase decision. Range no doubt figures predominantly in many calculations. On paper, jets are competitive with turboprop offerings, but require higher altitudes to be efficient. Airspace congestion, however, can make reaching optimum altitudes for jets problematic, so their real-world range can be shorter. Jets also have higher direct operating costs, however.

Runway performance and training requirements are also two factors that fuel the single-engined turboprop segment, because runway length for turboprops is shorter than that needed for jets. Finally, jets require a type rating and lengthy annual proficiency training and check ride. Training requirements for small turboprops are mostly driven by underwriter demands, not government regulations, and can have a smaller annual footprint.

Over the past several years, I have been fortunate to have flown two of the three most commercially significant aircraft in the low-wing single-engined turboprop segment, the Piper M600 and Pilatus PC-12NG. The missing link, which launched the high-speed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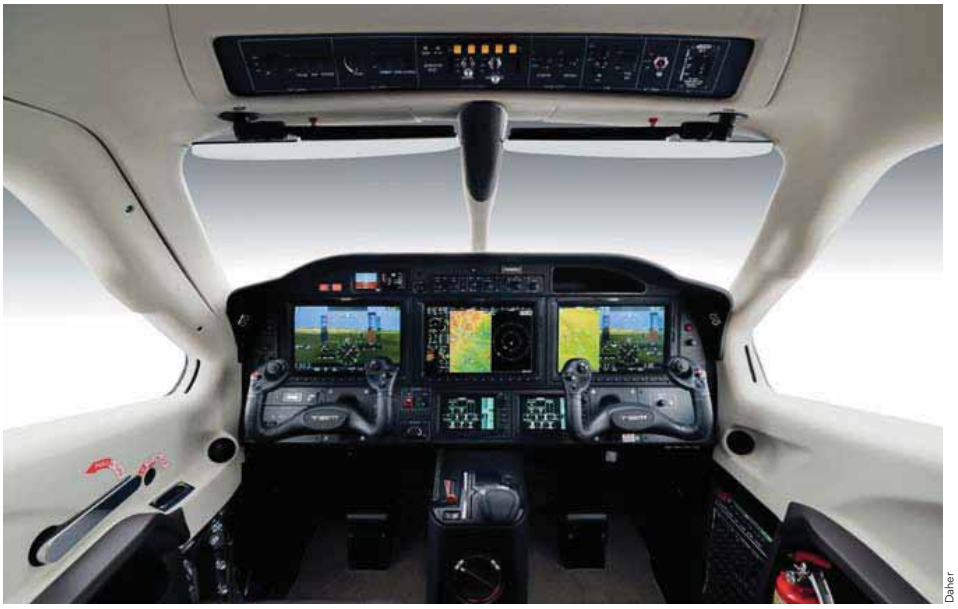
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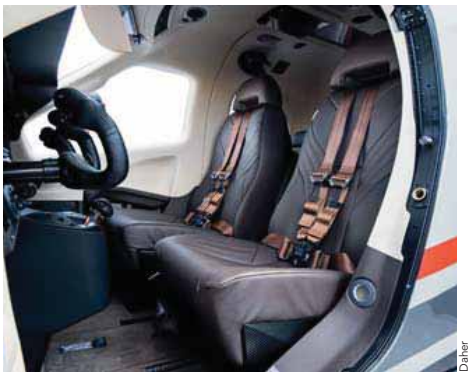
Capable Garmin 3000 autopilot makes type safe in challenging single-pilot situations

TBM 940 versus alternatives

	TBM 940	Cirrus G2 VisionJet	Piper M600	PC-12NG+
Range	1,466nm	920nm	1,406nm	1,810nm
Maximum altitude	31,000ft	31,000ft	30,000ft	30,000ft
Maximum cruise speed	330kt	311kt	274kt	285kt
Useful load	1,275kg	1,117kg	1,089kg	1,755kg
Maximum take-off weight	3,354kg	2,727kg	2,722kg	4,740kg
Take-off distance	726m	973m	803m	793m
Landing distance	741m	918m	810m	661m
Price	$4.35m	$2.75m	$2.93m	$4.98m
Stall speed	65kt	67kt	62kt	67kt

Source: manufacturers *NBAA IFR four occupants **2019 BCA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Large pilot door gives easy cockpit access

segment, was the offering from TBM (now Daher).

The TBM 700 started out as a collaborative effort between France's Socata and Mooney of the USA, first flying in 1988. Over the ensuing years, and after Mooney's withdrawal in 1991, improvements to the original design were made.

Three major variants have been fielded: the original 700 series with a 700shp (520kW) engine; the 850, with a more powerful 850shp engine; and the current 900. The 900 series offered several refinements that pushed top speed up to 330kt (610km/h). Along the way, the cockpit was also updated. The original "steam-gauge" flightdeck was replaced by a Garmin G1000 suite in the 850, with a G3000 debuting in the 900 series. Since its launch, the TBM has been a market success, with over 900 aircraft delivered.

COMPETITIVE EDGE

Like the other aircraft in this segment, the TBM 940 is certificated for single-pilot operations. What is remarkable, according to TBM sales director Philippe de Segovia, is that 90% of TBMs are flown by owner-operators. This percentage is much higher than that for the larger PC-12, which, historically, according to Pilatus marketing vice-president Tom Aniello, has been between 20% and 30% of sales.

Owner-operators were early adopters of the PC-12, says Aniello, with its current market a more diverse mix of aeromedical, charter, corporate, fractional, government and special-missions operators. Piper's M600, like the TBM, is primarily a personal aircraft, with 85% flown by owner-operators.

Flight International last reported on TBM's turbine single in 2014, when Peter Collins flew the TBM 900, the first of the latest series. Collins extolled the aircraft's improvements over its predecessors, which included the G1000 avionics suite and increased thrust from the PT6 powerplant.

Increased available horsepower and aerodynamic tweaks pushed its maximum cruise speed to 330kt, eclipsing that offered by the VisionJet by 30kt. Collins coined the phrase "very fast turboprop," which was an apt description. Recently, *Flight International* was invited to Daher's Pompano Beach facility in Florida to experience first-hand the TBM 940's upgraded features.

During the pre-flight briefing, Daher demonstration pilot Wayman Luy highlighted some of the new features. The TBM series operates at jet speeds, yet has been safely operated by a single-pilot since its certification. An autopilot is essential for challenging single-pilot operations, with the TBM 940 having a very capable Garmin. »

» To simplify thrust control, a single-lever throttle debuted in the TBM 900. In a first, Daher has fielded an autothrottle for the TBM 940. Developed in conjunction with P&WC and Garmin, it promises precise speed control throughout the flight envelope. To further ease pilot workload with regard to power control, Daher has also implemented a single engine indicator (SEI).

There are four parameters of interest when managing a turboprop: torque (TRQ), gas generator rpm (NG), interstage turbine temperature (ITT), and propeller (PROP) rpm. The SEI display has boxes along its top to display digital read-outs of these parameters. Below the boxes is a large analogue arc that displays the priority/most critical parameter of the first three (with PROP rpm displayed only digitally).

During engine start, ITT is displayed. Once the engine is running, TRQ is displayed. If there is an excursion into the yellow or red arcs by a background parameter, it will be displayed in place of the primary parameter. The pilot only has one lever to move, or none with the autothrottle engaged, and one gauge to monitor for power control.

Our preview aircraft was a European Union Aviation Safety Agency-certificated production model with French registration F-HGDA. Daher is aiming for US Federal Aviation Administration validation in the third quarter of this year.

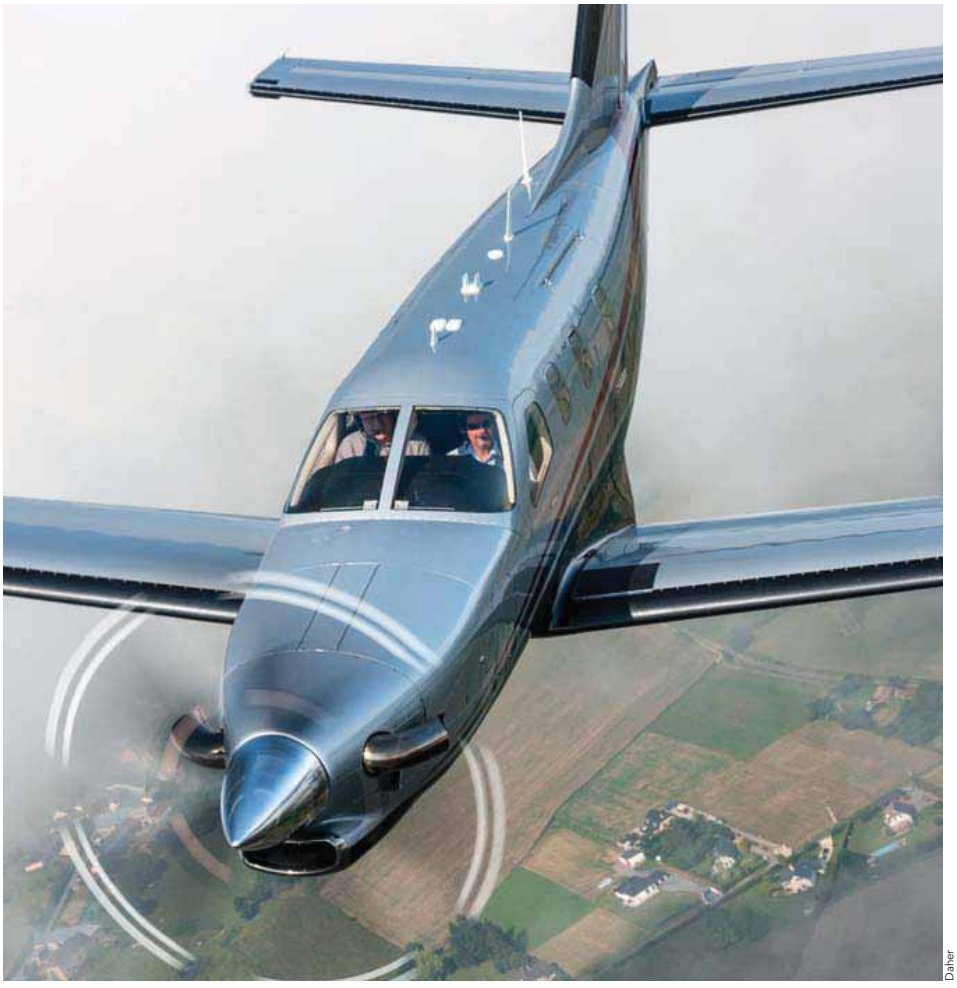
I followed Luy as he conducted the preflight walk-around. I noted the redesigned engine air inlet, new on the TBM 900. The inlet is 40% larger than the one on the TBM 850, the freed up airflow giving an effective 80shp boost with no increase in fuel flow. In his flight test, Collins noted that this shortened the TBM 900's take-off roll by 20% compared with the TBM 850.

I also noted that all leading edges are booted, giving the TBM flight into known icing conditions capability. New for the TBM 940 is an ice detector that can automatically energise the de-icing systems and shut them off when ice is no longer detected.

While not as large as that found on the PC-12, the TBM 940 has a good-sized pilot access door that allows direct entry to the flightdeck. Once Luy was seated in the right-hand seat, I used the polished retractable boarding step and settled in on the left.

The TBM 940 retains the very capable G3000 avionics suite, first offered in the TBM 930. The three large 12in displays are interchangeable, with bezel buttons along the bottom edge. Two large touchscreen controllers just forward of the centre pedestal eased pilot interface with the avionics system.

As it was a relatively hot and humid day, I watched Luy as he expeditiously started the PT6. Once it reached IDLE, he turned on the TBM 940's efficient air-conditioning pack, which rapidly cooled off the cockpit. Luy loaded the route using the touchscreen controller. Once ready to taxi, I moved the throttle from the CONDITION side to the left-hand THRUST mode side of the quadrant.



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Improved horsepower and aerodynamics have pushed maximum cruise speed to 330kt

After releasing the parking brake, minimum taxi power smartly started us rolling. During the taxi to runway 15, I found the nose wheel steering allowed accurate tracking of taxiway centrelines.

Taxi speed was easily controlled by modulating the throttle in the taxi range. Holding short of the runway, the flaps were set to TO (10°). In airline operations, flaps are set to the TO position and checked prior to taxi. They are checked again before line-up in an effort to prevent flaps-up take-offs. Perhaps Daher might consider revising its normal procedures to incorporate this safety methodology?

TAKE-OFF ROLL

Once lined up and cleared for take-off I advanced the throttle until the autothrottle engaged and set 100% TRQ. A bit of right rudder was needed to keep the TBM 940 tracking down the centreline. Light yoke forces were needed to establish a 10° nose-high take-off attitude at 85kt indicated airspeed (KIAS – Vr). Once airborne, I retracted the gear and selected flaps up, accelerating through 115KIAS.

On the preview day, take-off roll was just over 700m (2,300ft) at 91KIAS. Book data on the ISA +20°C (68°F) day is a ground run of about 500m and total distance over a 50ft obstacle of 736m. Once clean, I used rudder trim to null out pedal forces.

One thing Daher has done is put the rudder trim switch on the outboard horn of the control yoke. The combined pitch and rudder trim switch fell readily to thumb, with no searching for rudder trim on the centre pedestal. Functionality prevailed over convention by replacing the seldom-used aileron trim with the oft-used rudder trim.

The autothrottle kept climb power set as I used the autopilot in heading and navigation lateral modes to comply with air traffic control directions, which hindered our climb performance.

In less than 20min we were level at flight level 280 (28,000ft), just below reduced vertical separation minima altitudes in the crowded Florida airspace. Book data on a standard day shows the TBM levelling at FL280 64nm

(119km) down range after 17min 30s. Once level, I noted a cabin altitude of 7,600ft for the 6.2 Delta PSI pressurisation system. After turning the autothrottle off, I set maximum cruise power (84% TRQ). Fuel flow was 59USgal (223 litres)/h with the TBM 940 stabilising at 185KIAS.

Hotter-than-standard conditions of ISA +13°C on the test day limited our maximum speed to 304kt. At standard day conditions for our weight, the book shows the TBM 940 whistling along at 326kt. Like many aircraft, the TBM 940's autopilot has an emergency descent mode designed to take the aircraft to a safe altitude in the event of cabin depressurisation. What makes it particularly powerful in the TBM 940 is that it uses the autothrottle to retard power to IDLE and speed the descent to safety.

Rather than watching the emergency descent mode take the TBM 940 to medium altitude for evaluation of its low-speed handling qualities, I elected to hand fly it. During the power-on descent, we accelerated to Vmo, 266KIAS. At the limit, I found the aircraft crisply responded to control inputs in all three axes. The descent was then continued at IDLE power, levelling the aircraft at 10,500ft.

The G3000 suite has many safety features to include electronic stability (ESP) and underspeed protection (USP). ESP is operative at all times, using autopilot servos to keep the TBM 940 from over banking or pitching. USP is only operative with the autopilot engaged, and will nudge the nose down to prevent a stall.

I hand flew the TBM 940 in a clean configuration as I slowed it for the first of three stalls. Ignoring the aural warning and tactile stick shaker, I held the yoke aft until there was an airframe shudder followed by the nose dropping in a wings-level attitude. I relaxed yoke back pressure and slightly advanced the throttle to recover to the normal flight regime. The next two stalls were with flaps extended, the first in TO configuration and the last in landing configuration. In both these configurations there was ample warning of the approaching stall.

When the pitch break occurred, however, the TBM dropped a wing and rolled to the left. Luy said this was most likely due to the radar pod mounted on the left wing's leading edge. Regardless, the roll was easily arrested once yoke back pressure was released and the recovery started. During all three stalls, the aircraft responded predictably to all control inputs.

Satisfied with the TBM 940's slow-speed handling, I retracted the gear and flaps and headed the aircraft towards Pahokee/Palm Beach Glades airport, at the southeast corner of Lake Okeechobee. The autopilot and autothrottle were engaged and with Luy's help I loaded the RNAV (GPS) 36 approach.

Overhead the initial approach fix (PASAE) the aircraft tracked outbound on a teardrop path. At the appropriate time it reversed course so as to roll out on a 001° track to the final approach fix (HOREP). The aircraft was fully configured, gear down and flaps to landing, just prior to the final approach fix. The autopilot followed the lateral path and vertical track, while the autothrottle precisely maintained the set target speed of 90KIAS.

At the minimums call, I pushed the throttle-mounted go-around (GA) button. The autopilot rotated the aircraft to establish a climb, as the autothrottle set GA power. With a positive climb established, I retracted the gear, followed by the flaps, accelerating through 115KIAS.

The powerful G3000 flightdeck and first-in-class autothrottle combine to make the type a dream for single-pilot operation

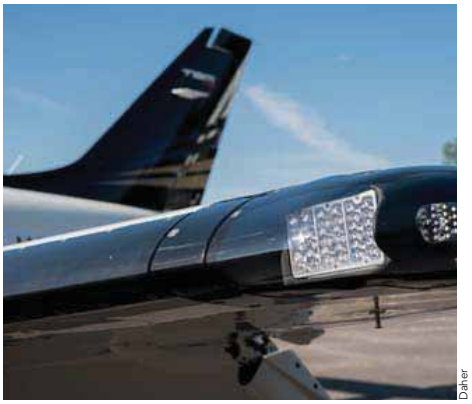
I have done thousands of approaches in my career and only a small number have ended up in a go-around. As crazy as it sounds, this is a routine manoeuvre that can be anything but routine. Having a fully coupled go-around capability is a great safety enhancing feature, especially in an aircraft often flown by non-professional pilots.

FLAME-OUT LANDING

After the go-around we initially headed directly for Pompano Beach. At 5,500ft while just south of the town of Belle Glade, Luy pulled the throttle back and said we had "lost" the engine, a less than three in 1 million flight hour occurrence. He set 7% TRQ to simulate a feathered propeller and I slowed the TBM 940 to 120KIAS, its best glide speed.

We had just passed a small strip and I turned north and pointed at it. Luy said it was Belle Glade State Airport (X10): a 1,053m paved strip that supports crop dusters employed in sugar cane production. Daher does not have a published flame-out landing pattern for the TBM 940, but Luy and I had discussed his technique for one should air start attempts fail. From the south, we were ideally situated for a left-hand 270 overhead pattern, as the winds favoured runway 09.

In the turn to downwind I extended the flaps to TO. Abeam the end of the runway I lowered the gear and extended the flaps to LND as we slowed to 90KIAS. We were a little high on final and touched down a bit long of the touchdown zone. Moderate wheel braking and reverse thrust, however, rapidly slowed us down to taxi speed.



Daher

Booted leading edges offer anti-icing aid

The next manoeuvre was a daunting one, turning the TBM 940 around on the narrow 15m-wide runway. Keeping a bit of momentum, I applied full left nose wheel steering and a few taps of the left wheel brake to swing the aircraft around for taxi back to the west end of the runway. At the end I again offset to the right-hand edge of the runway before beginning what felt like a pirouette to line up in the take-off direction. The flame-out landing had been a joy to fly, but I must admit the two tight hook turns on the runway brought a smile to my face.

Take-off from X10 and transit to Pompano Beach for our final approach gave a bit of time to explore some of the TBM 940's other features. I especially liked the synthetic vision display on the primary flight display with its depiction of the several high towers along our route of flight.

The display of traffic in its relative position also helped us set our eyes on possible conflicts early. The final approach was a straight-in visual to runway 15. Once alighted, I grounded the nose gear and applied moderate-effort wheel braking. Combined with the highly effective reverse thrust, the TBM 940 was stopped on the runway after a short ground run. Taxi back and shutdown at Daher's ramp were unremarkable, my 1h 54min flight in the TBM 940 all too short.

Daher's TBM 940 is the latest iteration of its highly successful single-engined turboprop line. The powerful G3000 flightdeck and first-in-class autothrottle combine to make the type a dream for single-pilot operation. The powerful PT6 turbine provides "thrust you can trust", letting this turboprop-single operate more safely than the piston-twins driven out of the marketplace. Offering six seats and a top speed of 330kt, it has become a top choice for pilots seeking a personal chariot with long legs and good hot-and-high runway performance. ■