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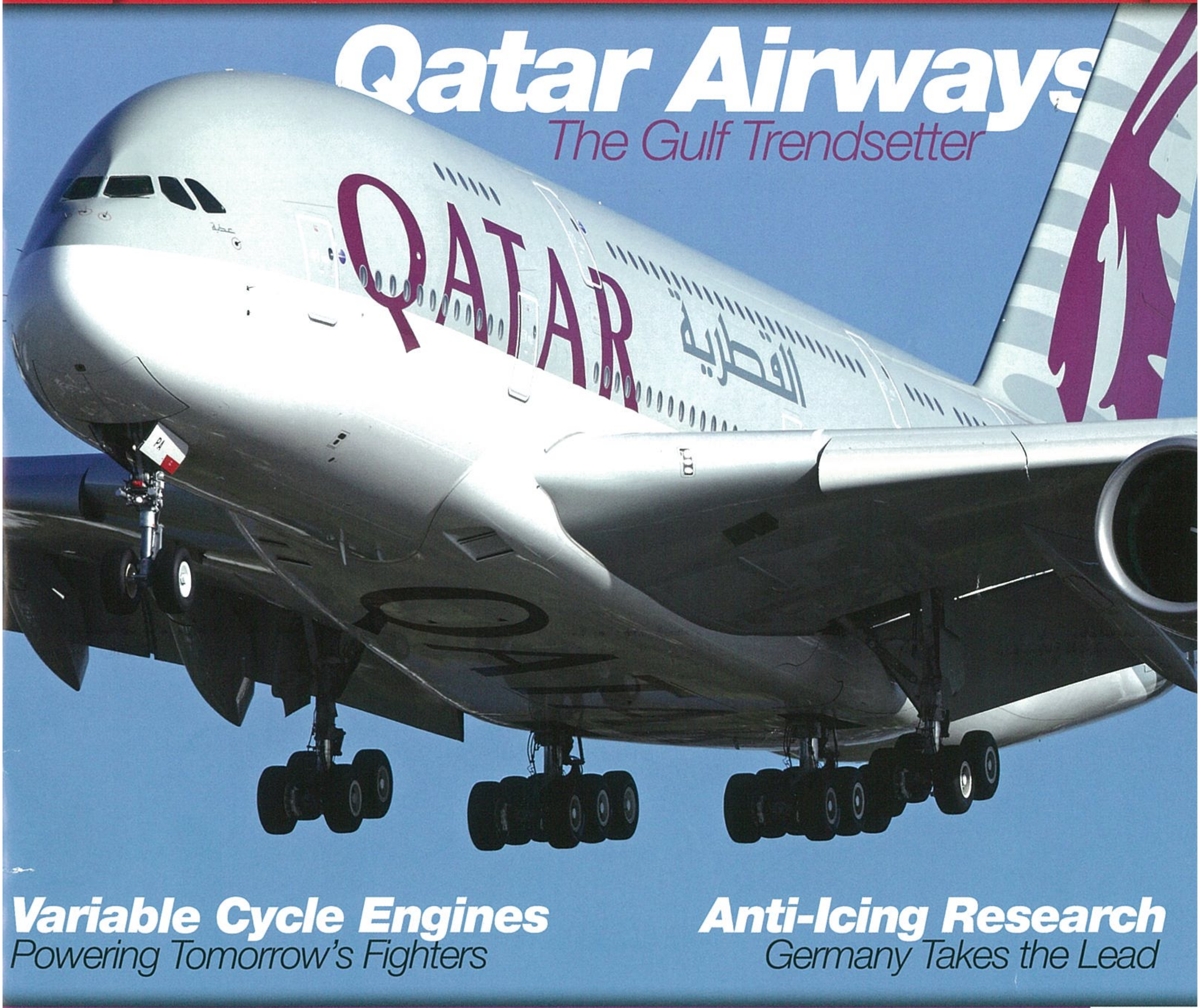

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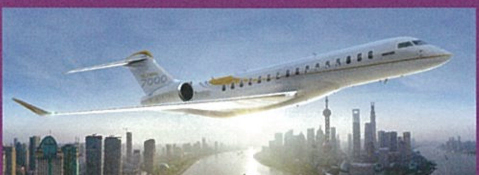

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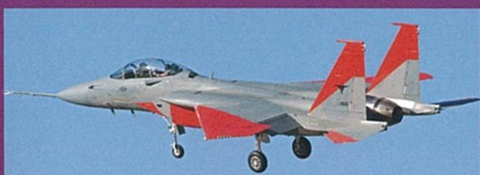

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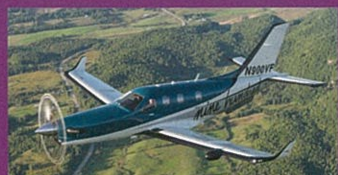


TBM900
A Real Thoroughbred

Thoroughbred TBM

All photos Jim Lawrence/Daher Airplane Business Unit

The TBM 900 brings high performance to the GA market. Dave Unwin flew the powerful French turboprop

As the TBM 900 taxies regally across the tarmac at Sebring Airport in Florida, it looks every inch a thoroughbred. From the tip of the spinner to the top of the fin it is a very elegant design. I'd greatly enjoyed flying my first TBM (a -700C2) 12 years ago and then an 850 five years later, and I was very much looking forward to renewing my acquaintance with this powerful French turboprop.

TBMs are interesting machines – despite the pressurised cabin, turboprop engine and stunning performance, they are certified for single pilot operation and are very much aimed at the owner-pilot. The 900 stalls at around 65kts (120km/h) and the Vref (landing reference speed) is about 85kts (157km/h), only 15kts (27km/h) quicker than the approach speed for a fully loaded Cessna 182.

The 900 looks quite different to the earlier TBMs. It features large (610mm/24in) swept-up winglets and an unusual looking five-blade prop, which seems to be set closer to the air intake than on previous machines. The intake is also a different shape; the exhausts appear altered and the small bump on the cowling that previously covered the prop governor is also absent. Photographer Jim Lawrence and I meet Michel Adam de Villiers, Vice-President of Sales for Daher Airplane Business Unit, and Wayman Luy, Socata North America's Chief Pilot.

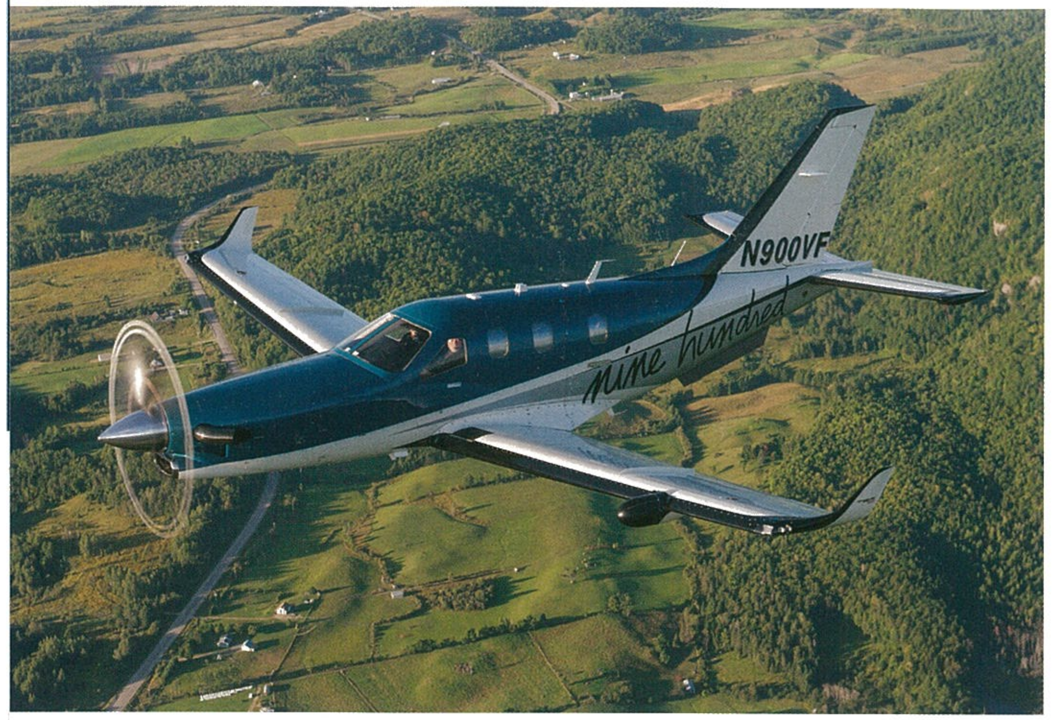
After an agreeable breakfast, Wayman briefs me on the 900. He confirms my initial impressions; this is a very different aircraft to earlier TBMs, even though the Pratt & Whitney PT6A-66D under the curvaceous cowling is essentially the same as that fitted to the 700 and 850. The engine is actually capable of producing up to 1,825shp (1,500kW) at sea level, although it is flat rated to a maximum of 850shp (634kW).

There are two reasons for flat rating. Firstly, any air-breathing engine produces the most power at sea level on a cold day, because the air it needs to 'breathe' is at its most dense. As the aircraft climbs the air density reduces and the power produced diminishes. However, if the engine is only producing around 50% of its potential output at sea level, then it is possible to maintain the same power output all the way up to cruise altitude. The other main advantage is that the engine is always running well below its maximum, which obviously greatly increases its life. And as the PT6A-66D fitted to the TBM 900 never runs at even 50% of its full potential, I'd be very surprised if one ever failed to make its time before overhaul.

Computational Fluid Dynamics

Wayman explains that several years ago Socata comprehensively examined the aircraft's aerodynamics. By creating a numerical model and using computational fluid dynamics (CFD), it was possible to study localised airflow in tremendous detail. This revealed the positions of the prop, cowling, exhausts, air intake and plenum were all far from optimum.

The prop disc was too far forward of the air intake, which also wasn't the ideal shape and size. The net result was that turbulent airflow was creating unnecessary drag, and the engine wasn't 'breathing' satisfactorily due to the uneven airflow entering the



induction plenum. Furthermore, the exhaust pipes generated turbulent flow in the exhaust stream because they were not the most advantageous shape.

All of these issues were addressed, and along with adding new inboard main undercarriage doors and installing a new five-blade prop, the changes greatly enhanced performance.

Maximum cruise speed has been raised from the 850's 320kts (592km/h) to 330kts (611km/h), even though the power-to-weight ratio is the same. The new prop means that at only 76.4 decibels at take-off the 900 is even quieter than the 850, which was pretty quiet in the first place.

Walk Around

Access to the engine is good, as the new carbon fibre cowling has large 'gull wing' doors on either side that open wide and are held in place by sturdy support struts. The firewall is formed from a single sheet of titanium, while the governor has been replaced by an electrical system with mechanical stops and the starter/generator increased from a 200-amp unit to 300 amps. There is now no speed restriction on the use of the inertial separator.

The robust undercarriage features mainwheels with a relatively wide track that retract inwards while the nosewheel retracts backwards. Twin doors cover the entire nosewheel assembly when retracted, but the doors on the main undercarriage only cover half of each wheel, which are fitted with huge hydraulic disc brakes. Taxi and landing lights consist of blocks of LEDs mounted in the wingtips. The wings have a fair amount of dihedral, flush-riveted skins, big winglets, fences at approximately mid-span, huge Fowler flaps (that extend over about 70% of the wing's trailing edge), small Frise ailerons and upper-surface slotted spoilers (aka spoilerons), which are connected to the ailerons. The very large flaps keep the stalling speed down; the inevitable side effect is the ailerons are somewhat short, with a consequent degradation of control around the lateral axis. The spoilerons provide an elegant solution.

There is a bulbous radar pod mounted on the port wing, but apart from that it's astonishing just how smooth the wing and fuselage are. As Wayman and I walk towards the tail I notice several small yellow arrows along the fuselage. He explains that as TBMs are built to extremely high tolerances, the arrows are used in conjunction with lasers to ensure the fuselage is aligned correctly in the jig during construction. The 900 has the same pair of ventral strakes directly beneath the swept-back fin as on earlier TBMs, although it seems to me that the dorsal fillet immediately in front of it is larger. The rudder and elevators are both mass and aerodynamically balanced, with the elevators actuated by dual pushrods while the rudder is cable operated. Anti-ice protection is provided by pneumatic boots on the leading edges of the wings, tailplane and fin, while the prop blades, pitot tubes, stall warner and windshields are heated electrically. The engine intake lip is heated by bleed air and features an inertial separator. Viewed from the front, the spinner is noticeably angled downwards and to the right.

As with all the TBMs I've tested, the build quality is exceptional, but as well as being well made, it is also very thoughtfully designed. For example, the tow bar is carried in its own specially moulded box, which slides into a dedicated stowage area; there is a mirror built into the emergency locator transmitter bay and another (along with a light) in the nosewheel well to check the fuel filter.

The next big change Wayman points out is the dedicated pilot door. Previously an option on the 700 and 850, it is standard on the 900 and confers several significant advantages. Having their own door enables a pilot to ensure the big main door is secure and, if being used as a small freighter, lets operators fill the cabin to capacity without having to leave space for the aisle. Most small freighters run out of space before they exceed their maximum all-up weight (MAUW). The test aircraft was configured in a very luxurious club class, but it can be easily reconfigured.

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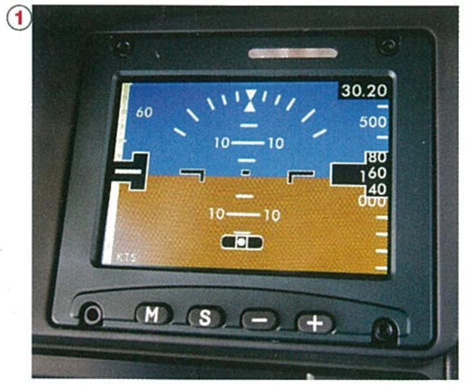


1 There is an electronic standby AI above the pilot's primary flight display. **2** The five-blade prop is new and the engine intake has been redesigned from previous TBMs. When viewed from the front the spinner is angled down and to the right.

Controls and Instruments

With the sumptuous seat and rudder pedals set, I begin to acquaint myself with the layout of the controls and instruments. Compared with earlier TBMs I'd flown, the cockpit is very different.

It is completely glass, with a 15in (381mm) multi-function display (MFD) in the centre and two large primary flight displays (PFDs) either side. Sensibly sited directly above each PFD are an electronic standby airspeed indicator that includes airspeed and altitude, plus orange Master Caution and red Master Warning annunciator lights. Above the MFD is the autopilot control panel; controls for the environmental control system and an alphanumeric keypad for the fully integrated Garmin G1000 are underneath.

The centre console carries the elevator trim wheel and a rocker switch for aileron trim, a flap switch and fuel selector, the red Manual Override control and the all-new single power lever. This controls the engine, propeller and fuel through a quadrant that resembles a lower case 'h'. To start the engine, you simply click the Start switch in the overhead panel to On and at 13% Ng (gas generator speed) move the power lever forward to Lo-Idle. Once the engine has lit and the interstage turbine temperature is stable, the lever can go further forward to Hi-Idle. Then you raise the leather-covered 'crown' on top of the lever and slide it across to the left. This unfeathers the prop (automatically governed at 2,000rpm) and by moving the lever fore-and-aft you have forward thrust, 'Beta' (this flattens the prop pitch, which produces less thrust for taxi) and then reverse. It's a brilliant idea; it's impossible to grab the wrong lever when there's only one lever to grab!

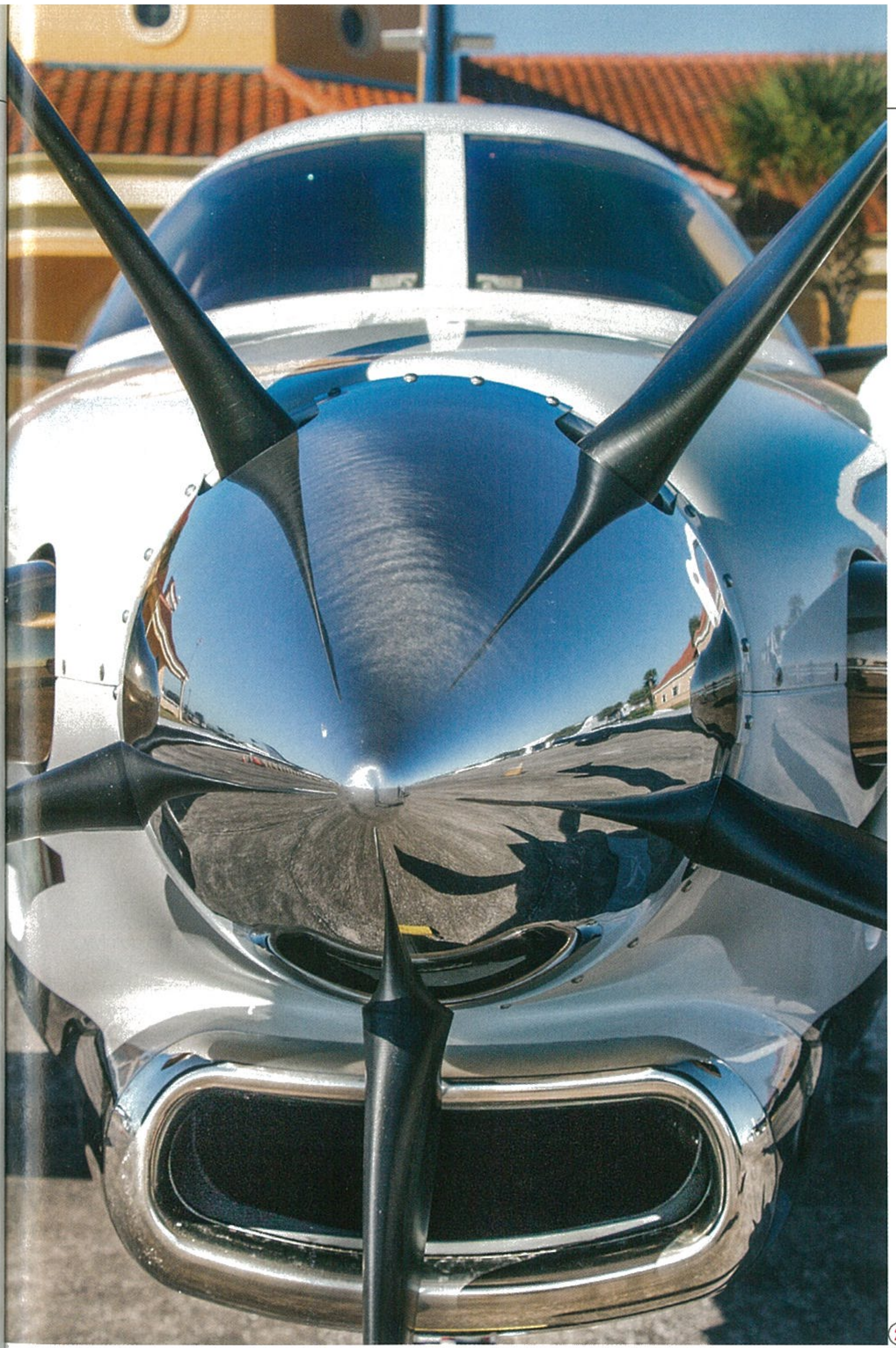
Running through the post-start electronic checklist I find myself wondering whether the MFD is actually too big as it almost draws the eye away from the PFD. Flap and trim positions are shown on the MFD, but the undercarriage uses lights co-located with the lever, which I prefer. The lever illuminates when the wheels are in transit.

As on nearly all turbine-powered aircraft, the switches for most of the electrical systems – such as the lights, starter and generator – are in a neat overhead panel. Both the fuel flow and quantity are displayed in US gallons (in most turbine-powered aircraft fuel is measured by weight, not volume). Socata designed the system in this way because many potential TBM 900 purchasers would be transitioning up from a complex piston-powered aircraft, which indicate fuel quantity and flow by volume.

Another unusual feature among the seven switches fitted to the yoke, is that one trims the elevator and rudder. As the powerful engine turns a big five-bladed propeller and operates over a very wide (approx 260kts/481km/h IAS) speed range, rudder trim is important and the TBM series remain the only aircraft in my logbook fitted with a yoke-mounted rudder trim. Initially, I find this switch a bit of a stretch, as in my opinion a good 'rule of thumb' (see what I did there) for the trim button is that it should be almost where your thumb rests naturally. However, I soon adjust to it.

Taxiing is very straightforward. The nosewheel steers through the rudder pedal and is nice and precise, while the hydraulic brakes are powerful and progressive.

Another neat feature is that the fuel tank selector automatically switches between the wing-mounted tanks to prevent a lateral imbalance. Every five minutes when on the ground, and ten in flight, it changes tanks. Should the fuel situation have deteriorated to the point that both tanks are showing Low Fuel warnings on the MFD, the fuel selector automatically switches from tank to tank every 75 seconds to ensure every last drop of Jet A-1 is used. The two wing tanks have a combined total of 1,140 litres (250 imp gallons) and only 44 litres (9.6 imp gallons) is unusable.



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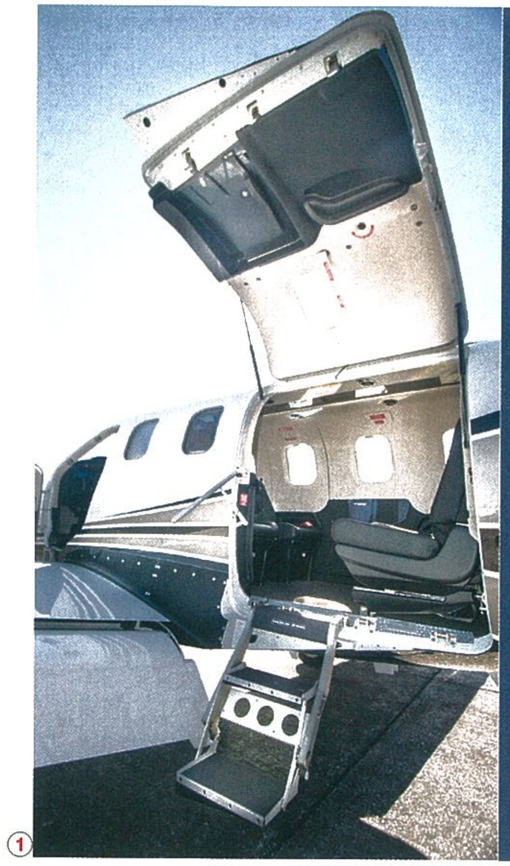
Flight

At the run-up point I set the trims and flaps and conclude the pre-take-off checks. The yoke-mounted rudder trim is indicative of how important it is that the rudder is correctly trimmed, so I take care to make certain the rudder trim indicator is pointing to 'T/O'. Unlike the 850 (which had the power artificially constrained to 700shp/522kW until the flaps were up), the various aerodynamic tweaks and a new torque limiter mean you have full power from the start.

Out on the runway I line up with the centreline, stand on the brakes and slowly increase the power to 40% torque, then release the brakes and push the power right up, without exceeding 100%. The big turboprop bounds forward and surges down the runway. The speed tape comes alive almost immediately and, in less time than it took to type this sentence, we race past the 85kts rotation speed and I ease the yoke back. Despite all the power there's absolutely no trouble tracking the centreline, which speaks volumes for the efficient rudder trim. Everything happens so quickly that I honestly



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TBM 900 SPECIFICATIONS

Manufacturer: *Daher Airplane Business Unit, Tarbes, France*

Price (with standard Equipment): *$3,599,024 or $3,798,414 (Special 'Elite' Package)*

Wingspan: *12.83m (42ft)*

Length: *10.73m (35.2ft)*

Height: *4.35m (14.2ft)*

Wing area: *18.3m² (1,96 sq ft)*

Empty weight: *2,099kg (4,627lb)*

Maximum all-up weight: *3,370kg (7,429lb)*

Useful load: *1,271kg (2,802lb)*

Power loading: *5.29kg/kW (11.6lb/kW)*

Wing loading: *183.27kg/m²*

Fuel capacity: 1,140 litres (250 imp gallons)

VMO *(maximum operating speed): 270kts (500km/h)*

Cruise speed: *330kts (611km/h)*

Stall speed: *65kts (120km/h)*

Climb rate: *2,050ft/min (624m/min)*

Take off to 15m *(49ft): 726m (2,381ft)*

Land over 15m: *741m (2,431ft)*

Engine: *Pratt & Whitney Canada PT6A-66D turboprop, flat-rated at 850shp (634kW)*

Propeller: *Hartzell composite five-blade, constant-speed, reversible, fully feathering*

don't know how much runway we used, but at our relatively light weight I doubt it was more than 500m (1,640ft). The extra power available for take-off has made a great aircraft even better, while the winglets and strakes all combine to ensure plenty of controllability at high power and slow speeds.

The biggest disappointment (and just as it was with the Piper M500, see *AIR International* May 2015) is there's no full authority digital engine control (FADEC). This criticism is aimed at Pratt & Whitney, not Daher, but in an aircraft as sophisticated as this you really shouldn't have to manually set the power. There should just be detents in the power lever quadrant for take-off and climb. When taking off in a strong crosswind, for example, you shouldn't have to monitor the torque, just concentrate on keeping straight. The same can be said when departing single-pilot into heavy instrument meteorological conditions and a busy traffic environment.

As we rocket skywards at 125kts (231km/h) and over 2,000ft/min (609.6m/min), I hand-fly up to 20,000ft (6,096m) before engaging the autopilot. Once level at FL280, Wayman demonstrates just how versatile this machine is. Want to save time? Push the power up and the true airspeed (TAS) is an incredible 330kts, while the fuel burn is still pretty reasonable at around 245 litres/hr. Want to save fuel? Pull the power back and the fuel flow drops to 148 litres/hr, while the TAS is still 252kts (466km/h).

The 'range ring' on the G1000 expands exponentially when you slow down, but possibly the most impressive aspect of the TBM 900 is just how many of the airports in range are available to us. The pilot operating handbook claims that less than 750m (2,460ft) is required for both take-off and landing at MAUW, and that includes clearing a 50ft (15m) obstacle! There are very few public airports in the US that are less than 1,000m (3,280ft), and it is this flexibility where the 900 really scores over light jets – which don't have anywhere near the range of the 900, nor can they use short runways.

The original plan was to fly down to the Florida Keys, but even at FL280 we're still firmly in the clag and the forecast hasn't improved, so we decide to head back to Sebring. As we've now got a decent tailwind we're really covering the ground and I initiate a gentle descent. Our groundspeed is now nudging 360kts (666km/h), or 6 miles a minute. We could be flying six people in club-class comfort at Mach 0.5 while burning less than 250 litres/hr – quite remarkable.

However, what I find even more outstanding is just how tractable the 900 is. Most turbine-powered aircraft are restricted by a maximum operating speed (VMO), which is an indicated airspeed value that varies with altitude. However, the TBM is so strong that its VMO is fixed at 270kts (500km/h), irrespective of altitude. The red line on the speed tape can be viewed as being more like a never exceed airspeed (VNE) than a VMO, a big plus when you have to descend quickly. And should a rapid descent be required then pulling the power lever right back with the prop automatically governed at 2,000rpm makes the prop blades automatically go to 'fine pitch' to maintain turbine rpm. The prop disc then becomes a giant airbrake, allowing for impressive rates of descent.

Handling

As we descend through 12,000ft (3,657m) we pop out into clear air between two layers of cloud, so Wayman cancels our instrument flight rules (IFR) flight plan, leaving me free to manoeuvre. I begin to experiment with the general handling, and am immediately impressed by how responsive the 900 is. The ailerons and their interconnected spoilers are smooth and effective, and although all the primary controls are purely mechanical (a combination of bell cranks, cables and pushrods) they are pleasantly light, with low breakout forces and very little 'stiction' in the control circuit. The elevator is slightly on the heavy side, but we have a fairly forward centre of gravity (and you don't really want light pitch forces when you're clipping along at 330kts). I seem to have to use the rudder trim less than on earlier TBMs. As expected, any variation of either airspeed or power (and all that torque, precession and P-factor created by the powerful engine and big prop produce considerable yawing moments), requires rudder trim to keep both the pedal forces neutral and the slip ball centred, but the 900 seems better damped in yaw. This is probably down to the big winglets, redesigned fin and a more efficient yaw damper. Little rudder is required in the turn, despite the wings having a relatively high aspect ratio. This is because the ailerons/

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1 The cabin door is large enough to enable even quite large freight to be loaded. **2** To keep the stalling speed down very large Fowler flaps are fitted, so upper-surface slotted spoilerons augment the ailerons for control around the lateral axis. **3** The large winglets, a new addition for this aircraft, distinguish the TBM 900 from its predecessors.

spoilerons and rudder are interconnected. All three primary controls are nicely balanced, well weighted and agreeably harmonised.

Visibility is excellent. The pilots' seats are situated just in front of the leading edge, which combined with the large windscreen confers a fine field of view. An examination of the stick-free stability reveals the longitudinal and directional stability to be positive and neutral laterally. The slow-speed handling is exemplary, as full lateral control is available post-stall because of the spoilerons.

Back at Sebring I turn downwind for runway 19 with the power at 55% and trimmed for 120kts (222km/h), then abeam the numbers set the flaps to 'TO', lower the undercarriage and turn base. On finals, its flaps to LDG (landing), ease the power lever back to 25% torque and trim for 90kts (166km/h). The engine's response to adjustments of the power lever seem much more linear than on some other PT6-powered machines that I have flown, while the extension of full flap pitches the nose down very nicely, for an excellent view of the runway. Wayman recommends an initial approach speed of 90kts with an 85kts Vref, and on very short final, to simultaneously ease the power back while trimming nose-up. As he predicted, it practically lands itself, although if you decide to go around you'd want to get some nose-down trim in quickly. Get the nosewheel on the ground, pull the power into reverse and the deceleration is as impressive as the acceleration.

The 900 is an amazing aircraft; quite possibly one of the most impressive I've ever flown. After all, how many aircraft of its class can clear a 50ft obstacle using only 750m, fly over 1,700nm (3,148km) in less than seven hours, land over a 50ft obstacle and stop on a 750m runway, with 45 minutes of fuel left in the tank?

And it's the outstanding tractability that is most impressive. When you're flying a jet, an abundance of airspeed or altitude can quickly become an embarrassment, but with the TBM you just pull the power back – that big prop disc is a very effective airbrake.

However, for me the most remarkable thing about it is that it really is within the capability of many GA pilots. The take-off and landing speeds are not excessively high and the systems are so beautifully designed that single-pilot instrumented flight rules isn't as challenging as it can be.

However, all of this comes at a price and one that contains a lot of zeroes! But for those who can afford it, the TBM 900 might just be the ultimate private aeroplane.

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