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Visibly different

Fast, thoughtfully designed and beautifully made, the TBM 900 is well within the flying capabilities of the private pilot

Words *Dave Unwin* **Photos** *Jim Lawrence and Daher Airplane Business Unit*

As the TBM 900 taxies regally across the tarmac at Sebring airport in Florida, it looks every inch a thoroughbred – and also distinctly European. From the tip of the spinner to the top of the fin it is a very elegant design. I already know it should fly as well as it looks, as I'd greatly enjoyed flying my first TBM, a 700, twelve years ago. Consequently, I am very much looking forward to renewing the acquaintance with this powerful French turboprop.

TBMs are very interesting machines as despite the pressurised cabin, turboprop engine and stunning performance, one of their biggest selling points is that they are certified for single-pilot operation and are very much aimed at the owner-pilot. For example, the 900 stalls at around 65kt, and multiplying that value by 1.3 confirms that Vref is about 85 – which is only fifteen knots quicker than the approach speed for a fully-loaded Cessna 182.

As it draws up in front of the FBO and the swiftly fanning propeller slows to a stop, I can see that the 900 looks quite different to earlier TBMs. It features large (61cm) up-swept winglets and an unusual looking five-blade prop, which seems to be set closer to the air intake. That air intake is also a different shape; the exhausts appear to have been altered and the small bump on the cowling that covers the prop governor is missing.

Photographer Jim Lawrence and I meet Michel Adam de Villiers, VP of Sales for Daher Airplane Business Unit, and Wayman Luy, Socata North America Inc's Chief Pilot. After an agreeable breakfast Wayman briefs me on the 900. He really knows his stuff, and confirms that my initial impressions are accurate: this is a very different aircraft to earlier TBMs, even though the Pratt & Whitney PT6A under the curvaceous cowling is essentially the same as that fitted to the 700 and 850.

Interestingly, the engine (a PT6A-66D) is actually capable of producing up to 1,825 shaft horsepower at sea level. However, it is flat rated to a maximum of 850shp. The reasons for flat rating an engine are twofold. First, 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 output diminishes. However, if the engine is only producing around fifty per cent 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 half of its full potential, I'd be very surprised if one ever fails to make TBO.

I ask Wayman about the various changes I've spotted, and he explains that several years ago Socata decided to undertake a comprehensive examination of the aircraft's aerodynamics. By creating a numerical model of the aircraft and then using a computational fluid dynamics programme it was possible to study localised airflow in tremendous detail. This revealed that the prop, cowling, exhausts, air intake and plenum were all far from optimal. Basically, the prop disc was too far forward of the air intake (which wasn't the ideal shape and size) with the net result that not only was the turbulent airflow creating unnecessary drag, but the engine wasn't 'breathing' satisfactorily due to the uneven airflow entering the induction plenum.

Furthermore, the exhaust ducts generated turbulent flow in the exhaust ➔

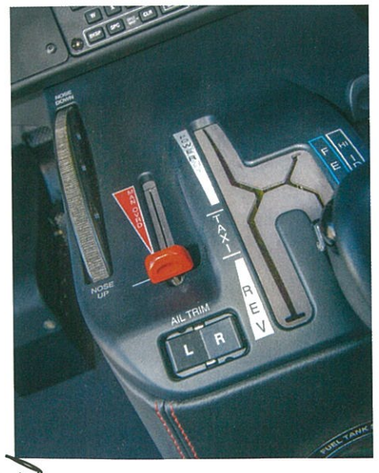
Above: huge central MFD with large PFDs each side. Electronic standby AI, and master caution and warning lights sit above the pilot's PFD. Unusually, the trim switch on the yoke controls elevator and rudder

Below (left to right): when in flight, the fuel selector automatically switches tanks every ten minutes; the red lever is the engine 'Manual Override' control; single power lever controls engine, propeller and fuel. The rocker switch is for aileron trim.

stream as they were not the most advantageous shape. Of course, the previous models were far from wrong; it is just that the incredibly accurate data derived from the CFD analysis indicated that these areas could be improved. All of these issues were addressed and, along with adding new inboard main undercarriage doors and installing a new five-blade prop, these changes greatly enhanced the performance. In fact they have raised the max cruise from the 850's 320 to a hugely impressive 330kt, even though the power-to-weight ratio is the same. Finally, the new prop means that, producing only 76.4dB(A) at takeoff, the 900 is even quieter than the 850, which was quite quiet in the first place.

Access to the engine is good, as the new carbon fibre cowling has large 'gull wing' doors on either side which 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 200amp unit to 300 amps. There is now no speed restriction on operation of the inertial separator, designed to protect the engine from ice and debris.

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 of the wheels, which are fitted with huge hydraulic disc brakes. The taxi and landing lights consist of blocks of LEDs mounted in the wingtips. The wings are interesting; they have a fair amount of dihedral, flush-



Top: Most of the switches for the electrical services are contained in a panel above the windshield

Above left: An alphanumeric keypad for Garmin G1000 and control panel for the Environmental Control System

Above right: The electronic standby AI also displays airspeed and altitude

Inset below: emergency oxygen mask

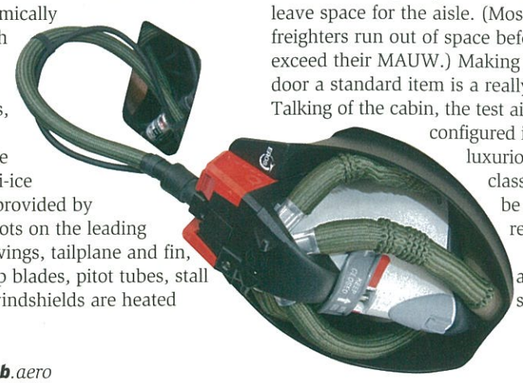
riveted skins, now with big winglets, fences at approximately mid-span, huge Fowler flaps (which extend over about 70% of the wing's trailing edge) small Frise ailerons and upper-surface slotted spoilers (AKA spoilerons) which are interconnected to the ailerons.

The very large flaps are required to keep the stalling speed down, and the inevitable side effect has been that the ailerons are somewhat on the short side, potentially degradating 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, the smoothness of the wing and fuselage is astonishing.

As we walk towards the tail I notice several small yellow arrows along the fuselage and Wayman explains that TBMs are built to extremely high tolerances, and these markers are used in conjunction with lasers to ensure the fuselage is aligned correctly in the jigs during construction.

The 900 has the same pair of ventral strakes directly beneath the sweptback fin as in 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. When viewed from the front the spinner is noticeably angled down and to the right.



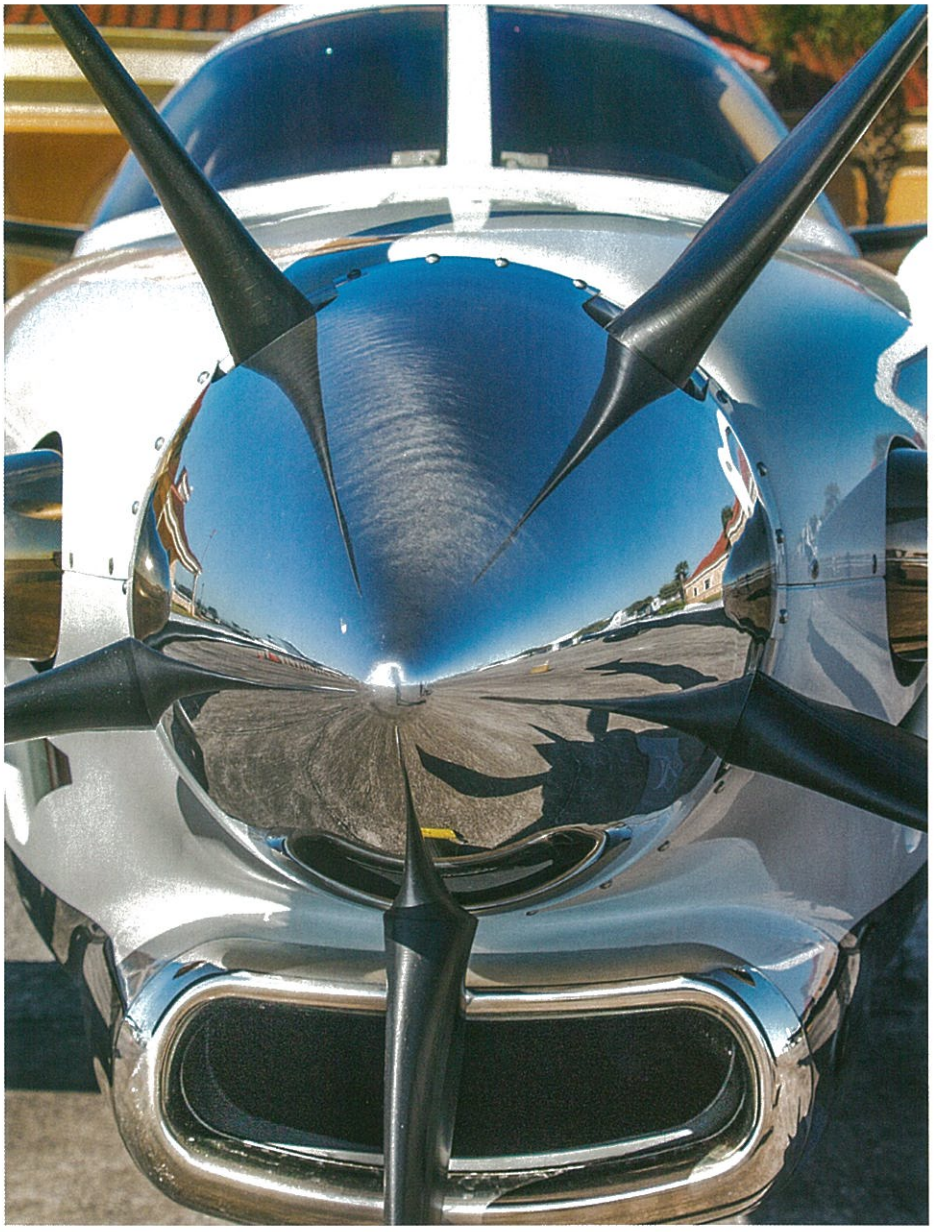
As with past TBMs I've tested, the build quality is exceptional, but as well as being well made it is also thoughtfully designed. For example, the tow bar is carried in its own specially moulded box which slides into a dedicated stowage area, there is a mirror built into the ELT bay and another, along with a light, set in the nosewheel well so you can check the fuel filter.

The next big change that 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. Possessing a – shall we say – 'fuller figure', I always find the transition from cabin to cockpit a bit of a squeeze (to be fair, on the 900 the seats are slightly narrower and the centre console shorter) and much prefer having my own door. Of course this arrangement also allows the pilot to ensure before boarding that the big main door is secure.

Finally, if the 900 is being used as a small freighter, it allows operators to fill the cabin to capacity without having to leave space for the aisle. (Most small freighters run out of space before they exceed their MAUW.) Making the pilot's door a standard item is a really good idea. Talking of the cabin, the test aircraft's was configured in a very luxurious club class, but it can be easily reconfigured. While adjusting my seat and rudder pedals it strikes me that the field of view is slightly compromised by the tall glareshield, but Wayman assures me that this isn't the case in flight. So, with the sumptuous seat and rudder pedals set, I begin to acquaint myself with the layout of the controls and instruments. Although externally there are a number of changes from earlier TBMs, some subtle and some significant, the cockpit is very different.

Unsurprisingly, it's all glass. It has a massive (15 inch) MFD in the centre and two large PFDs each side. Sensibly sited directly above the pilot's PFD are an electronic standby AI that includes airspeed and altitude, plus orange 'Master Caution' and red 'Master Warning' annunciator lights. Above the MFD is the autopilot control panel, while the control panel for the ECS and an alphanumeric keypad for the fully integrated Garmin G1000 are underneath.

The next big difference is in the centre console, which 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 (turbine speed) move the



The five-blade prop is new and the engine intake has been redesigned. Note that when viewed from the front the spinner is angled down and to the right.

power lever forward to 'Lo-Idle'. Once the engine has lit and the ITT 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) or reverse. It's a brilliant idea, brilliantly executed. It's impossible to grab the wrong lever when there's only one lever to grab!

Running through the post-start checks on the electronic checklist I find myself wondering whether the MFD is actually too big! It really is huge, and 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. However, both the fuel flow and quantity are displayed in US gallons, whereas in most turbine-powered aircraft the fuel is measured by mass and not volume. However, I think the reason Socata designed the system like this is because many potential TBM purchasers would be transitioning up from a complex piston-powered aircraft (which would indicate fuel quantity and flow by volume).

Another unusual feature is that amongst the seven switches fitted to the yoke, one combination switch trims the elevator and rudder. As the powerful engine turns a big five-bladed propeller and operates over a very wide (approx 260kt IAS) speed range, you don't need a degree in aeronautics to appreciate that rudder trim is important. The TBM series remains 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) is for the trim button to be almost where your thumb rests naturally. However, I soon adjust to it.

Once we are rolling, I draw the power lever right back and ensure that it is on the idle stop. Nevertheless, the 900 still wants to taxi faster than I want to, so to avoid constantly riding the brakes I pull the power lever back into 'Beta'. Taxying is very straightforward. The nosewheel steers through the rudder pedals 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. Furthermore, should your 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 extracted. The two wing tanks have a combined total of 1,140 litres, and only 44 litres is unusable. At the run-up point I set the trims and flaps and conclude the pre takeoff checks. As mentioned earlier, 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 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, stand on the brakes and slowly increase the power to 40% torque. Then I release the brakes and push the power right up, without exceeding 100%. The big turboprop literally bounds forward and surges down the runway. The speed tape comes alive almost immediately and in less time than it takes to type this sentence we are racing past the Vr of 85kt 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.

It's impossible to grab the wrong lever when there's only one lever to grab!

The most impressive aspect is how many airfields are available to the TBM 900

Above: The Fowler flaps extend over about 70% of the wing's trailing edge. Note the ventral strakes and wide-track undercarriage.

Everything happens so quickly that I honestly don't know how much runway we use, but at our relatively light weight I doubt it is more than 500 metres. The extra power available for takeoff 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.

However, the biggest disappointment is that the engine doesn't have FADEC (fully automated digital engine control). This criticism is aimed at Pratt & Whitney, not Daher, but in an aircraft this sophisticated, setting power accurately really shouldn't be a manual operation. There should simply be detents in the power lever quadrant for takeoff and climb. When taking off in a strong cross wind, 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 IMC and busy traffic.

In fact, having retracted the undercarriage and flaps and engaged the yaw damper, I check the torque while adjusting the power and momentarily misinterpret the command bars on the PFD. However, that error could also be because I am a bit rusty with 'glass'. Anyway, as we rocket skyward at 125kt and over 2,000fpm I get my scan going and hand-fly up to 20,000ft, before engaging the autopilot.

Once level at FL280 Wayman demonstrates just how flexible this machine is. Want to save time? Push the power up and the TAS is an incredible 330kt, while the fuel burn is still pretty reasonable at around 245lit/hr. Want to save fuel? Pull the power back and the fuel flow drops to 148lit/hr, while the TAS is still 252kt. Obviously the 'range ring' on the G1000 expands exponentially when you slow down, but possibly the most impressive aspect of the TBM 900 (to me, anyway) is just how many of the airfields within range are available to us. The POH claims that less than 750 metres is required for both takeoff and landing at MAUW, and that includes clearing a 50ft obstacle! There are very few public-use airports in the States that are less than 1,000 metres, and it is this flexibility where the 900 really scores over light jets.

The original plan was to fly down to the 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 nudging 360kt, or six miles a minute, and when you think we could be moving up to six people through the sky in club-class comfort at Mach 0.5, while burning less than 250lit/hr, it really is quite remarkable. However, what I find even more remarkable is just how tractable the 900 is.

Most turbine-powered aircraft are restricted by a Vmo that is an indicated airspeed value which varies with altitude. However, the TBM is so strong that its Vmo is fixed at 270kt, irrespective of altitude. Consequently, the red line on the speed tape can be viewed as being more like a Vne than a Vmo – a big plus when you have to descend quickly. And should a rapid descent be required then, with the prop automatically governed at 2,000rpm, pulling the power lever right back makes the prop blades go to 'fine pitch' to maintain turbine rpm. The prop disc then becomes a giant airbrake, allowing for impressive rates of descent.

Need to really come down fast – For example, in the event of a pressurisation failure? Even more drag can be added by lowering the undercarriage and the first stage of flap, as the limiting speed for both is a usefully high 178kt. Speaking of pressurisation, the ECS is integrated with the G1000 and can maintain cabin altitude at around 9,000ft even when the aircraft is at its certified operating ceiling of 31,000ft.

As we descend through 12,000ft we pop out into clear air between two layers of cloud, so Wayman cancels our 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 did have a fairly forward C of G (and you don't really want light pitch forces when you're clipping along at 330kt.)

I note that I seem to have to use the rudder trim less than on earlier TBMs

One thing I note is that 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 do 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. It's interesting to note how little rudder is required in the turn, despite the fact that the wings have a relatively high aspect ratio. This is because the ailerons/spoilerons and rudder are interconnected. All three primary controls are nicely balanced, well weighted, and – most importantly – agreeably harmonised.

Visibility throughout the turn – and indeed every phase of flight – is excellent. The pilots' seats are situated just in front of the leading edge and their location, combined with the large windscreen, confers a fine field of view. As Wayman predicted you don't notice the glareshield in flight. An examination of the stick-free stability reveals the longitudinal and directional stability to be positive and it is neutral laterally. The slow-speed handling is exemplary, as full lateral control is available post-stall due to the spoilerons.

Back at Sebring I turn downwind for Runway 19 with the power at 55% and trimmed for 120kt. Then abeam the numbers, set the flaps to 'TO', lower the undercarriage and turn base. On final, it's flaps to 'LDG', ease the power lever back to 25% torque and trim for 90kt. Interestingly, the engine's response to adjustments of the power lever seems 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 90kt with a Vref of 85. Then on very short final, simultaneously ease the power back while trimming the nose up. This way, it practically lands itself, although obviously if you decided 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!

Having made a mess of the initial climb-out, I taxi back for another go, and this time all goes well, and an accurate circuit is capped with an even better landing. Wayman is very complimentary about my handling, and even the lineman comments on how smooth he thought it looked as he chocks the wheels. I'm very pleased, of course, but really most of the credit should go to Wayman, who is an excellent instructor.

The 900 is an amazing aircraft; quite possibly one of the most impressive I've ever flown. How many aeroplanes do you know that can clear a 50ft obstacle using only 750m, fly over 1700nm in fewer than seven hours, land over a 50ft obstacle and stop on a 750m runway, with 45 minutes of fuel still in the tank! The outstanding tractability is what's 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, the reason why this aircraft impressed me so isn't because of the spectacular performance or opulent cabin. For me, the most remarkable thing about it is that it really is within the capability of many private pilots. The takeoff and landing speeds are not excessively high and the systems are so beautifully designed that single-pilot IFR isn't quite as challenging as it could be.

All this does, of course, come at a price – one that contains a lot of zeroes! But if you can afford it then the TBM 900 might just be the ultimate private aeroplane. ■

SPECIFICATION

DAHER-SOCATA TBM 900

Standard equipment: $3,599,024
With Special 'Elite' Package: $3,798,414

DIMENSIONS

Wingspan	12.83m
Length	10.73m
Height	4.35m
Wing area	18.3sqm

WEIGHTS AND LOADINGS

Empty weight	2,099kg
Max AUW	3,370kg
Useful load	1,271kg
Power loading	5.29kg/kW
Wing loading	183.3kg/sq m
Fuel capacity	1,140 lit

PERFORMANCE

Vmo	270kt
Cruise (TAS)	330kt
Stall	65kt
Climb	2,050fpm
Take off (to 15m)	726m
Land (over 50m)	741m

ENGINE AND PROPELLER

Engine: Pratt & Whitney Canada PT6A-66D turboprop, flat-rated at 850shp (634kW)
Propeller: Hartzell composite five-blade, constant-speed, reversible

MANUFACTURER

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Web: *www.tbm.aero*

Above: a big change is the separate pilot's door that was an option on the 700 and 850; it is standard on the 900
Left: the top-hinged cabin door is big enough to enable even quite large items of freight to be loaded