TEST

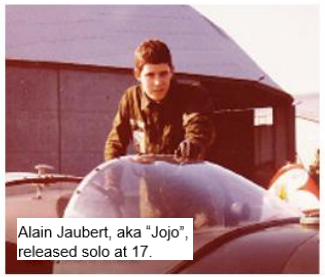
DAHER TBM 960
La (R)-évolution

Issue in English

Good reasons to buy a TBM 960 in an aeroclub!

The title is purely provocative, yet it piqued your curiosity. Who wouldn't dream of it? 700, 850, 900, 910, 930, 940, 960... with each TBM version, isn't the aircraft manufacturer Daher showing us the direction in which light aviation is heading? After twenty-two years in the flight test department, and on the eve of his retirement, Alain Jaubert, in-house test pilot, takes us on a memorable flight to explore the TBM 960's complete envelope in all its nooks and crannies: a flight to remember.

Texte : Jean-Marie Urlacher. Photos : Jean-Marie Urlacher/ Daher. Remerciements : Alain Jaubert, Philippe de Segovia.



Alain Jaubert, aka “Jojo”, released solo at 17.

"Jojo" is Alain Jaubert. A real character. 16,000 flying hours, including 8,000 hours on TBMs and 5,000 hours on helicopters.

To pay for his license, he worked on roofs in the summer with his carpenter father. Then he took to the skies.

Released solo at 17 on the Rallye de l'AC de l'Agenais, a “100 S” (F-BUXA).

At 18, he began his career in the French Air Force and continued it in the Alat. He was certified as a reconnaissance helicopter pilot in 1982, before becoming an instructor.

In 1995, he qualified as a professional IFR pilot on the TB-20, and was then posted to Rennes, with the mission of demonstrating to headquarters that the TBM 700 had a place in the army, or else had to be withdrawn.

He took part in every mission imaginable. “We were flying 700 hours a year, and we were discovering the fabulous potential of this aircraft”, he recalls. He completed his army service on Pilatus PC-6 and Gazelle aircraft with the Montauban transport and equipment delivery squadron.

In 2003, he joined Socata and flight tests as a liaison pilot and instructor. He has trained over 150 customers. Jojo's passion is teaching and sharing.

In 2008, he moved over to “production”, carrying out acceptance and tuning flights on new TBMs, fresh off the assembly line. In the United States, Europe, Malaysia, Singapore, Australia, South Africa and at the Paris Air Show, “Jojo” plays an active role in promoting the TBM, but not only that. “I've also flown all the delivery and reception flights for the French Air Force's Fennec helicopters, whose cockpits were retrofitted in Tarbes.

On the eve of his retirement and after twenty-two years of service, he offers us the greatest gift of all: the TBM 960 on a platter. His strength lies in having known and participated in the development of the entire TBM range, from the 700 to the 960.

"AVIS SAPIENS SAPIENS"

“For one hundred and thirteen years (since the Morane-Saulnier adventure began in 1911), the Tarbais manufacturer has paved the way for the Darwinian evolution of avis sapiens sapiens legerum: "the modern light aircraft".

Since 1988, the TBM has achieved unrivalled levels of performance, safety and sophistication. Each time a new version of the TBM is released, we always wonder what else the aircraft manufacturer can improve on. Every time, the design office surprises us.

If the culture of secrecy is a religion in Tarbes, there's always an interesting surprise when the doors of the Daher-Socata church open to a new opus.

Although the TBM "Type Certificate" has been the same for thirty-six years, the models have evolved and remained at the cutting edge of modernity.

Since 2022, the TBM 960 brings together all the evolutions of the previous versions, but also brings new innovations:

a new 895 hp Pratt & Whitney turbine (PT6E66XT) finally controlled by a FADEC (Full Authority Digital Engine Control). This is a new electronic control system called EPECS (Engine and Propeller Electronic Control System): a (r)evolution in aircraft handling, as we shall see in flight.

Inside, progress has been made in terms of cabin comfort: touch-screen temperature control, ambient light control via dimmable windows, and several cosmetic details (LED reading lights, cup holders, mini-tablets, headphone holders, USB and 115 V power sockets, etc.).

Daher has skilfully found a way to create a range effect and feed this "perceived obsolescence" which inevitably highlights the latest model on sale to customers.

The principle works well: of the 1,216 TBMs manufactured, 140 TBM 960s have been delivered and 200 ordered to date.

Finally, over three decades of development, we can see that there are several successive ages, like those of Darwinian evolution.

First, the age of riveted metal, then the age of the turbine.

The marriage of the Mooney 301 and the Socata brought the TBM into the class of 300 kt aircraft: the age of performance.

“Between the TBM 700 and the 960, there's a 30 kt difference, which is a considerable gain,” Alain analyses.

The age of electronics has followed, and with it advances in avionics and piloting aids.

New safety barriers appeared (HomeSafe, EDM help in case of depressurization, LvL if loss of control...), as did passive protections (ESP/EDM/USP, stick shaker...).

All in all, the TBM 960's technological bricks significantly reduce the pilot's workload (e-copilot, autothrottle, etc.).

All that remained was to fine-tune the interior for the passenger experience: the age of comfort.

"A TIMBERED ENVELOPE"

At the Daher facilities in Tarbes, where I meet Philippe de Segovia, the TBMs are being born more than ever.

More than 350 machines will emerge from this “proudly made in France” nursery.

The success of the 960 can be seen on the assembly line: all positions are occupied.

Today's test of the 960 will have a special flavor, as I'm flying with “Jojo”.

At the briefing, we plan to explore the full envelope of the 960's flight envelope: take-off, then a continuous climb at maximum speed to FL 310, a cruising level-off, a descent to FL 280 for a maximum speed reading, a rapid so-called emergency descent to FL 150 to simulate depressurization, handling evolutions, tight turns, stalls in all configurations between FL 150 and FL 100, then a return to Tarbes for an ILS and a high-speed approach for a complete.

This is always an exciting program for a light aircraft pilot, as it's a chance to read dreamlike values on the instruments.

The major advance of the 960 is its FADEC. Surprisingly, it didn't appear earlier on TBMs, but first you had to tick the auto throttle box (auto throttle managed via the Garmin G3000's integrated system) and the electronic control box: a major step forward.

What is FADEC?

It is an electronic system interfacing between the cockpit and the aircraft engine.

It ensures flow regulation (ideal fuel supply, acceleration/deceleration control), automatic starting, transmission of engine parameters to cockpit instruments, thrust management and protection of operational limits.

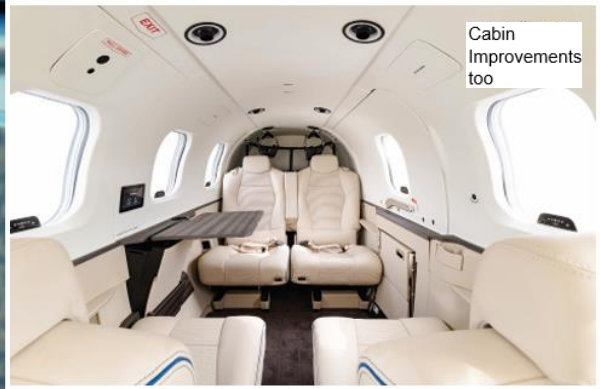
The FADEC is therefore of vital importance in: reducing the pilot's workload and acting as guardian angel of the engine's integrity by preventing any unfortunate overshoot in torque, NG (compressor speed) and ITT temperature. The auto throttle offers a second level of protection for the engine, as it also reads the

16,000 FH including 8,000 hrs of TBM for “Jojo”.

The major advance of the 960, it is the introduction of FADEC.

parameters and can automatically engage in prevention to avoid overshooting or an inconsistent flight situation.
The kinematics of the throttle have changed: it is no longer an H-shaped movement as on previous models, but a classic forward/reverse. In fact, the old position allowing the propeller to be feathered in the event of engine failure no longer exists, as the FADEC will now do the job automatically.
Today, the 960 ventilates itself automatically and manages the entire start-up sequence.
There's no longer any need to worry about opening the fuel at the right moment, or about welding the turbine.
The automated start-up sequence took less than two minutes. It couldn't be simpler.
The inertial separator is switched ON before driving. This is a flap located in the engine air intake, used to filter the air admitted to the compressor to prevent the ingestion of foreign bodies that could damage it. It's used when taxiing, taking off and landing, and whenever you're flying in an icing atmosphere (clouds). It is removed when the sky is clear, to gain power.

Tarbes, 29°C, wind 310°, 8 to 14 kt, runway 20 in use, QNH 1,015, we're cleared to taxi.
Two on board, no baggage, full tanks (290 gallons).
The MTOW depends on the center of gravity. It can be 3,354 kg or 3,454 kg, depending on the center of gravity.
According to Alain, the TBM 960 has the same performance as its predecessors (from the "900" series) to within 2/3 kt, but much better than the TBM 700 and 850.
It's the systems management that's going to change the way we fly! We're going to do a factory check-out flight. Alain has to make sure that the aircraft has been built to standard,


Cabin Improvements too


Throttle return to “I” position thanks to FADEC


Garmin’s highly intuitive avionics

that all systems are functioning and performance is accurate. It gauges flight control qualities and settings.
So, we're going to explore the full potential of the flight envelope.
To do this, Daher's flight test department has an agreement with air traffic control at Mont-de-Marsan, Toulouse and Bordeaux (CCER, "Centre de contrôle essais reception") to have a protected evolution block and carry out all these unusual maneuvers without the risk of conflicting traffic.
We're lined up, ready, flaps 10°, and Alain suggests I push the throttle all the way forward from zero to the mechanical stop.
In the past, this power-up had to be measured precisely to avoid over-torque. But thanks to FADEC and the autothrottle, there's no risk.
The motor will give its best according to the joystick setting.
The new 895 hp turbine (45 hp more than the TBM 940) keeps 850 true horsepower in high-altitude terrain or high temperatures, without reaching the ITT temperature limit. Torque 100%, 90 kt rotation, positive vario, brakes, landing gear retracted, 115 kt flaps retracted, 124 kt (Vy), the 960 climbs to an outrageous 2,400 ft/min. You'll never look at your aircraft's instruments in the same way again.
We cut the inertial separator at 6,000 ft in clear sky, and the turbine recovers power.
We've already been cleared to FL 280 by the air traffic controller, and we're soon on our way to Mont-de-Marsan.
From take-off to FL 310, the on-board chronometer reads a cheeky 18 minutes! For any light aircraft pilot, the TBM is the aircraft of superlatives.
FL 310 is the “ceiling pressure” for the TBM. It's a level that allows you to be above the "weather", i.e. above most meteorological phenomena and icing.
We report a TAS of 320 kt, 2,000 rpm at the propeller, for 220 l/h. Cabin altitude is 9,700 ft. But the best performance level for this aircraft is at FL 270/FL 280.

INTERCEPTED BY RAFALE

Just as we're concentrating on taking our parameters, a radio message wakes up the helmets: “N331KT de Marsan, do you accept an interception exercise?”
I glance at Alain. I can see the corners of his mouth moving towards the “smile” position. “Affirm 331KT.” Alain understood.
He's known the test air traffic controllers at the Mont-de-Marsan CER for twenty-two years now: Denis, Patrice, André, Sylvain, Aurore, Jérôme, Frédéric...
On his last flight before retirement, they wink at him.

The radio still cracking: A Rafale in high-speed approach, 40 Nm in your eleven hours." It doesn't take long for the screeching bird of prey to come into imperial wingtip position. The fighter carries out the usual checks. After the check, he flaps his wings and gives us a magnificent barrel roll around the 960, heading west at Mach 0.54. Thanks to the pilot, whom we don't know, but who may recognize himself as you read this! The emotion is palpable in the cockpit, and like a good professional Alain gets back to business.

We descend to FL 280, the appropriate flight level for optimum cruising performance. We let the plane get up to speed, recording 326 kt of TAS and 64 USG/h, or 240 l/h at a cabin altitude of 8,200 ft.

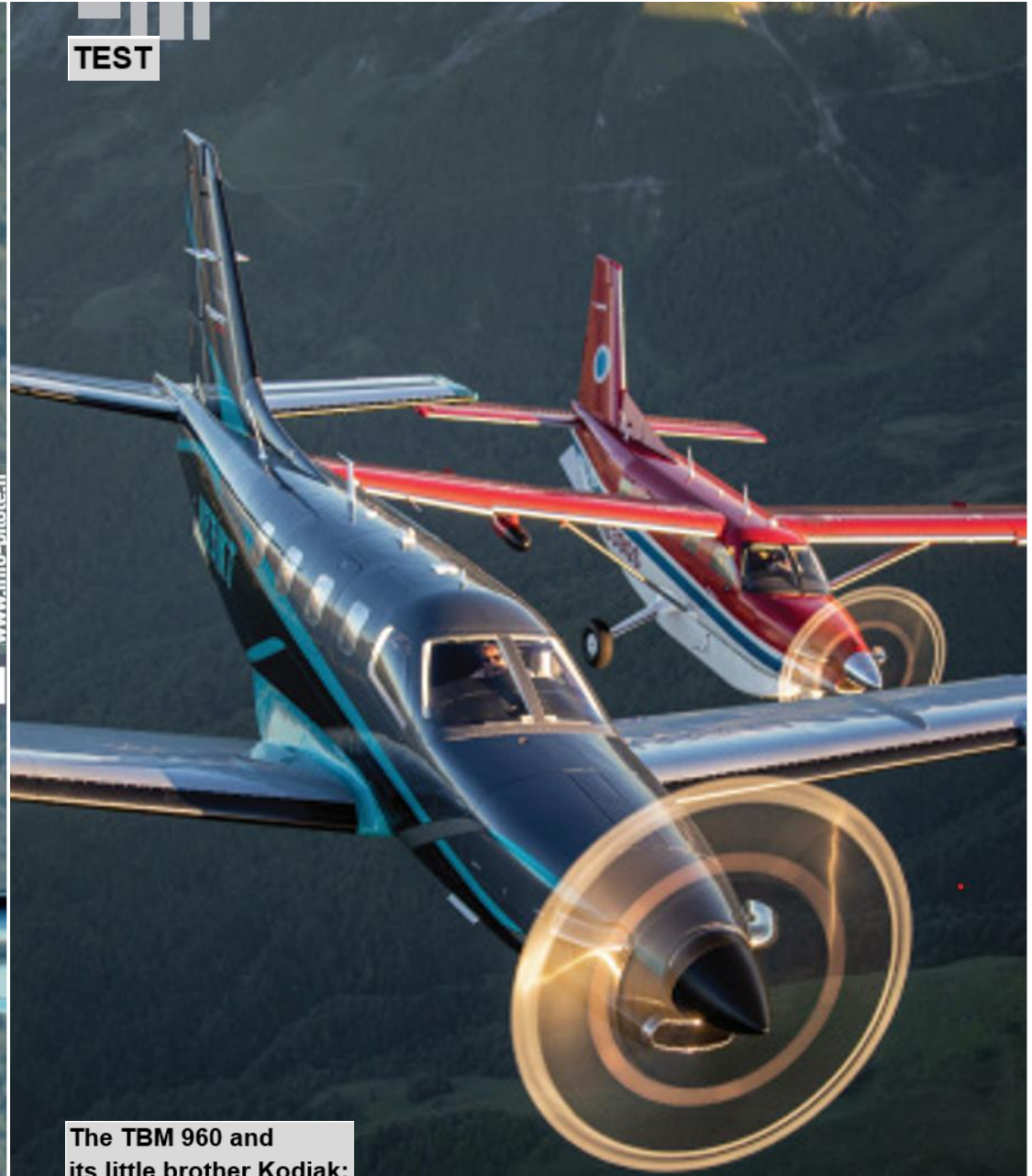
Competing jets fly only a few knots faster (around 340 kt), but consume twice as much fuel! Even if the 330 kt of the commercial brochure is generally reached under optimum temperature conditions, we're not far from it today.

Emergency descent" involves simulating depressurization. If this were to happen, the aim would be to return to a flight level "acceptable" to the human body at around FL 150.

With the throttle fully reduced, we're looking for 250 kt of descent. Vario at 7,000 ft/min, in less than 2 minutes we had swallowed the 13,000 ft gap. Cabin pressurization followed. Had there been a real depressurization in flight, the EDM (Emergency Descend Mode) would have activated automatically as soon as our cabin pressure exceeded 10,500 ft. The autopilot would have turned 90° left to exit the airway and avoid a conflicting trajectory with the aircraft below us on the same route, assumed a nose-down attitude at 250 kt and stabilized at level 150. Then, if the pilot hadn't acted quickly at FL 150 (by disconnecting the AP, which he could then reactivate), the "autoland" function would have kicked in, and the TBM would have landed on a suitable runway of its own accord. In fact, depressurization can cause the pilot (perhaps the only one on board) to lose consciousness, and the automatic system is designed for this eventuality.

We start the handling exercises. The ailerons are just as effective at high speed as they are at low. We begin a series of smooth stalls from 110 kt, gear up. Nose-up effort is progressive as deceleration progresses. A very slight buffeting appears as we pass 95 kt. At full throttle, we reduce speed by 1 kt per second to 79 kt, before the aircraft bows gently. You can keep the nose up with a bit of muscle, which causes small roll oscillations, controllable thanks to the spoilers. The 960 has kept perfectly the flying qualities of a light flying club aircraft.

TBMs are the ultimate culmination of developments in light aviation. What will be the next innovations?



The TBM 960 and its little brother Kodiak: the Daher family.

Extending the landing gear and flaps does not produce any noticeable torque. With flaps 10° and gear down, deceleration starts at 100 kt. The characteristics and controllability are of the same quality, with the alarm at 85 kt and 75 kt as minimum speed. Landing configuration, flaps 34° and gear down, the characteristics are broadly the same, with the alarm at 75 kt and only 64 kt as the minimum speed readout, but the aircraft systematically goes off on the left wing. Alain had warned me. He takes the controls again for a few seconds to check the roll: "I'll have to have the spoilers adjusted when we get back to the factory. There's a very slight asymmetry." Twenty-two years in flight testing... experience speaks for itself!

Back to Tarbes for an ILS. Once again, the 960's automated systems take the plane to the runway. Typically, I think of a company director returning to base after a long day's work.

The contributions of avionics and the various pilot assistance systems will be invaluable. Not only do they increase safety by increasing the margin against limits, but they also leave more brain time available to deal with the weather, passengers, arrival procedures... and to stand back from the cockpit.

For this first ILS approach, we'll be using autopilot and auto throttle. A point before the glide, gear down and flaps 10° below 178 kt. I extend full flaps (34°) below 122 kt and maintain 85 kt on final. By way of comparison, a TB 20 on final is 74 kt. At the simulated "minimums", 1,440 ft QNH, go-around, I press the TO/GA button on the left of the throttle lever and the auto throttle restores 100% power, all by itself, the PA displays 10° nose-up attitude. Flaps to take-off, landing gear retracted, at 115 kt the flaps also retracted and Alain engaged Nav mode, the aircraft followed the standard go-around path of the missed approach all by itself! Fabulous! "When you remember the IFR procedures by hand in the early days of the TBM 700, it was like night and day," recalls Alain! In the early days of the Alat, we didn't even have GPS! Now, the plane does almost everything by itself.

At the end of the standard missed approach, Alain suggests that I make a second ILS approach on autopilot, without using the auto throttle, but it will be a high-speed approach ending with a touch-and-go, then a classic lap and full landing. "For the fast approach, the principle is simple: we keep max power, which gives around 240 kt on final glide. At 4 nautical miles from the threshold, you put the throttle in your pocket.

I do. The Tarbes runway soon appears in the windscreen. 178 kt, gear and flaps down 10°; 122 kt, landing flaps down 34°, the 960 decelerates enough to reach 85 kt on short final, shoulders in suspenders and touchdown just around the corner. Now that's ultra-efficient! "Touch and go, climb, downwind turn, 30% bearing, 130 kt, cross turn, gear down, all three greens, 10° flaps, I maintain 130 kt bearing with 50% torque. End of downwind, I display 20%, 122 kt flaps 34°, descent, last turn and final. If I didn't have the propeller in front of me, I'd think I was in a jet, the TBM behaves so much like one. Final touchdown on the studs, on the Garmin PFD screen the runway scrolls by, the plane is on the dotted line. A machine every bit as extraordinary as the instructor accompanying me. Thanks Alain!

AND OUR LIGHT AVIATION?

The many technological building blocks acquired over the years have enabled Daher to offer the market a state-of-the-art aircraft.

Today, a modern aircraft is one that offers "pilot assistance" systems to take the load off its driver. Faced with the complexity of airspace, customer demand and pressure from avionics manufacturers, aircraft manufacturers have no choice but to move in this direction.

The remarkable quality of the TBM's airframe and wing design must be emphasized, and thirty years after its conception, it still stands up to modernization. This is the ultimate development of the light aircraft, whose performance brings distances drastically closer, enabling it to compete with the very first jets in the time-distance-speed triangle, and inevitably to beat them on the operating cost front.

In a way, this aircraft is the culmination of the entire evolutionary chain of light aviation since the Morane Saulnier type H of 1913. As if, in the space of a century, we had witnessed the evolution from Homo habilis to Homo sapiens, the future will tell whether our aeroclub light aviation will follow the same evolution as the TBM.

Perhaps the pleasure of flying ultimately lies in the pleasure of hand-to-hand combat against the air. If we are to believe the Maya calendar: 2014, release of the TBM 900; 2017, the TBM 910; 2019, the TBM 930 and 940; 2022, the TBM 960... that's three-year steps.

Will a new nose come out of the Tarbes factory in 2025? What innovations will the design office have come up with? All bets are off.

Meanwhile, Alain Jaubert, Hawaiian shirt and straw hat by the pool, will be enjoying a well-deserved retirement.

Technical data

***TBM 960** - 6 passenger seats*

Construction: aluminum, composite
Certification: EASA (2 /03/2022) & FAA (24/06/ 2022)

Dimensions
Wingspan .....12.83 m
Length ..... 10,74 m
Height .....4,35 m

Engine/propeller/flaps/train
Engine: Pratt & Whitney PT6E-66XT controlled by FADEC Power .....895 hp
TBO .....engine5,000 h
Propeller .....Hartzell 5-blade composite "Raptor

Weights and capacities
Number of seats 6
Empty weight .....2,170 kg
Max. take-off weight .....from 3,354 kg to 3,454 kg .....depending on centering
Capacity .....1,140 l/ 1,106 l usable

Performance
VZ max, sea level, ISA conditions .....2 005 ft/min
Take-off distance (50 ft).....725 m .....(865 m for the TBM 850)
Landing distance (50 ft) .....740 m
Max. distance with 45 min..... reserve .....1,730 Nm (without wind)
Max. cruising speed.....330 ktas at FL 280, ...ISA conditions
Consumption at FL 280 .....242 l/h at 324 kt
Range at max. cruising speed .....4 h 00 .....(+ 30 min reserve)
Long-range autonomy .....7 h 40 (+30 min)

Characteristic speeds
Optimum climb speed (VOM) .....124 kt
Max. slope speed (VX).....100 kt
Smooth stall speed (VS1).....81 kt
Take-off flap stall speed ..... (VS1-10°) ..77 kt
Landing flap stall speed..... (VS0-34°).....65 kt
Maneuvering speed (VA).....158 kt
Maximum operating speed (MOS).....266 kt
Max. flap speed (VFE).....122 kt
Max. train out speed (VLE).....178 kt
Approach speed landing flaps .....85 kt

Price (prestige pack).....5 288 595 3

Plant
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