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Socata TBM 850
All Torqued Up

Extreme Makeover
OLD BARON, NEW ENGINES p. 97

Landmark Accidents
THE DISAPPEARING HOLE p. 82

Stay Proficient
ONE HOUR A MONTH p. 111

TBM 850

Socata's speedster

From 700 to 850 horsepower, with a flick of a switch

BY THOMAS A. HORNE

The dawn of the very light jet (VLJ) has shaken up general aviation in a way not seen since the 1960s, when the first business jets were introduced. The questions, then as now, are the same. Will the new class of designs perform—and sell—as predicted? What airplanes will survive the inevitable shakeout? And will the introduction of a new aircraft type spell the end of preceding models? To be blunt, will the advent of VLJs doom turboprops?

EADS Socata has responded to this crisis of relevance by introducing its new TBM 850. At this writing, Socata had committed to building 42 TBM 850s in 2006; 80 percent of this production run had already been sold.

The TBM 850 is a more powerful upgrade of the company's very popular TBM 700 series of single-engine turboprops. By boosting the TBM 700's power rating from 700 to 850 shp (shaft horsepower, the power delivered to the propeller shaft), Socata hopes to market the 850 as a more viable alternative to the VLJ craze. Maximum cruise speed of the TBM 850 is set at 317 KTAS at Flight Level 260 under standard atmospheric conditions. That's 27 knots faster than the TBM 700 under those conditions, and the extra power also significantly reduces time to climb. A TBM 850, for example, can climb from sea level to FL260 in just 15 minutes, and to FL310 in 20 minutes, under standard conditions. These represent 25-percent im-

PHOTOGRAPHY BY MIKE FIZER

provements over the TBM 700's climb performance. Under hot and high (international standard atmosphere plus 20 degrees) conditions the TBM 850 climbs to FL310 in half the time it takes the TBM 700. That's important because turbine aircraft burn much less fuel at altitude, so the faster you can climb to higher altitudes the lower your total fuel consumption.

As for the VLJ competition, Socata points out that the TBM 850 will burn much less fuel than a VLJ, and its sin-

gle engine will yield much lower direct operating costs than those of even the smallest twinjets. Also, Socata says that VLJs, with their optimum cruise altitudes in the 30,000-to-40,000-foot range, face an operating environment filled with much faster airliners. To avoid traffic conflicts, VLJs may face altitude restrictions that impact their fuel burns. This, coupled with a VLJ's range limitations (dictated by fuel capacity), means that for trips near their maximum published ranges, VLJs will have to fly slower, at reduced power settings—or make multiple fuel stops—to complete their missions.

By contrast, Socata argues that the TBM 850 thrives in the mid-20s, an altitude range that allows the airplane to fly at its top speeds, unencumbered by airliners, free of the need to wear an oxygen mask (a requirement for single-pilot flight above 35,000 feet), and complete its typical 500-nm mission within a few minutes of VLJs' block times on the same route. Factor in the increased cost of insurance and pilot

Most TBM 700s and 850s leave the factory with Honeywell Bendix / King's IHAS (integrated hazard avoidance system) 8000 avionics package. This $61,300 option includes TAS (traffic alert system), TAWS (terrain awareness warning system), and Stormscope information, presented on the centrally mounted Bendix / King KMD 850 multifunction display. Dual Garmin 530 GPS / nav / coms and a GTX 330 transponder with TIS (traffic information system) are standard.

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The pilot access door is a popular option ($75,000) that lets you get in the cockpit without threading your way past passengers, or confronting cargo in the cabin.

The aft cabin door opens wide for easy boarding of passengers and cargo.

training for the VLJ pilot, and the TBM 850 looks even better.

A new Pratt

At the heart of the TBM 850 is its Pratt & Whitney PT6A-66D engine. It has the potential, thermodynamically speaking, of putting out 1,825 horsepower. But it's been flat-rated to 850 shaft horsepower, which gives it tremendous margins against engine temperature limitations. This lets the engine put out its maximum power to higher altitudes, yield higher cruise speeds and climb rates under all temperature conditions, and still be loafing. A new compressor wheel featuring single-crystal metallurgy (instead of the forged metal used in previous engines) is part of the reason for the 850's ability to endure high temperatures and power settings.

The -66D also has two bleed-air lines, and a two-position bleed-air switch in the cockpit. The Auto switch position is for normal use in pressurizing, heating/cooling the cabin, and running the deice boots using less compressed bleed air from a P2.5 line from the engine's compressor section. The TBM 700 gets its normal bleed air from a single P3 line. Using the 850's P2.5 air means drawing bleed air from an earlier stage of the compressor. This conserves more bleed air for use in producing power, keeps ITTs lower, and boosts fuel efficiency. It also gives the 850 essentially the same fuel specifics as the 700 at higher altitudes.

The bleed air switch's Hi position selects the second, P3.0, bleed-air line for the kind of larger airflows that might be needed at high altitude, or when heating a cold-soaked cabin.

A new fuel control unit is another big plus for the 850. It has a bigger bellows, and can move more fuel—a necessity for the more powerful engine. A side benefit is a more responsive thrust lever.

Torque limiting: It's up to you

At first glance, the TBM 850's cockpit looks identical to that of the TBM 700. But there's one major difference: the flap switch. It has one more detent, forward of the Up position, labeled "850." When you select this flap setting, you are arming the engine to go to its full 850-shp power rating. But you're also disarming the engine's torque limiting system.

In the flaps Up (UP), Takeoff (TO), or Landing (LDG) positions, the 850's engine employs torque limiting to keep the engine from producing more than 700 shaft horsepower, and from subjecting the propeller shaft to damaging torque forces. The torque-limiting system—common in the vast majority of turboprops—acts like a governor on the fuel control unit, and uses bleed air to control the fuel-metering valve.

Let's say you carelessly ram the power lever forward during takeoff, with the flaps set in the TO position. When the torque limiter senses that you've reached torque limits (100 percent on the torque gauge), fuel flow is reduced, torque is kept under control, and horsepower is limited to 700 shaft horsepower. For this reason, you're basically flying a TBM 700 every time you take off. And this is normal procedure.

It's during the climbout that you move the flap switch to the 850 position. Now the torque limits are increased to 121.4 percent, and you've got the full 850 shaft horsepower available. But this move also cuts the torque limiter out of the loop, and now *you* are the torque limiter. Now's the time to make careful movements of the thrust lever so as to keep from exceeding the new torque limits, and keep from destroying engine and/or propeller gearbox components.

As you climb, torque limits must be consulted by checking tables in the performance section of the 850's pilot's operating handbook. The torque limits drop with altitude, so you must fly by the book. Simply pushing the thrust lever up to the top of the torquemeter's green arc as you climb can over-torque the engine and cause serious damage. It's the price you pay for having all that extra power.

The procedure on the prelanding checklist is to return the flap switch to the UP position by 1,500 feet agl or so. Now you've got torque limiting, and a return to a maximum of 700 shaft horsepower. The idea is to have torque limiting online in case of a go-around or missed approach. Takeoffs with the flap switch in the 850 position are prohibited.

The only downside to the return to torque limiting is if a break had oc-

The club-style passenger area (top) has been changed slightly to give more shoulder room, and a single storage cabinet is now standard. A second cabinet with a CD player is a $5,600 option. Aft seats (above) fold forward for loading the aft baggage compartment.

The TBM 850 is a comfortable, fast, capable airplane—and the ultimate speed demon of single-engine turboprops.

The center pedestal (left) includes trim and flap position indicators. The flap switch is used to select 850 shaft horsepower. In the UP position (below, left) horsepower is limited to 700 shp. In the 850 position (below, right) 850 shp is available, but torque limiting is not.

curred in one of the bleed-air lines. The pressure in this line, called the *Py line*, acts as the reference pressure between the torque limiter, the propeller governor, and the fuel control unit. In the extremely unlikely event of a break in the Py line (it's a stout line, and a break has never occurred in a TBM 700 or TBM 850), the fuel control unit will "think" that the pilot has moved the thrust lever to flight idle.

The result: an immediate rollback to flight idle, and a power-off, emergency landing. The rollback can occur so quickly that the pilot probably won't act fast enough to engage the manual override (MOR) lever that lets the pilot directly control the fuel control unit for engine power. The idea is that if a break occurred, and the engine had rolled back at 1,500 feet agl, the pilot would still have enough altitude to be able to make a dead-stick landing out of the pattern—or from the final approach fix on an instrument approach.

Flying N850TB

Enough of the scary talk. The truth is that the TBM 850 is a comfortable, fast, capable airplane—and the ultimate speed demon of single-engine turboprops. I flew the first production aircraft—serial number 346, registered as N850TB—to get a firsthand look at the TBM 700's replacement. With me was Alan Griffin, Socata's chief pilot.

Starting was PT6-simple. Flip on the battery toggle switch on the overhead panel, check for system voltage in the green arc, then move the starter toggle switch to ON. The engine begins to spool up, and when you reach a gas generator speed of 13 percent (as shown on the N_g gauge in the vertically stacked engine gauge cluster), move the condition lever to the LO IDLE position. A light off will be signaled by a rise in temperature on the ITT (interturbine temperature) gauge, and that wonderful turbine whine's change in pitch.

Takeoffs are uncomplicated, but there are a couple of extra checklist items. One is to set the rudder trim to compensate for the huge amounts of torque and p-factor during the takeoff run. You do this by pressing on a yoke-mounted panel switch. There's a TO trim position marking on the rudder trim indicator, but Griffin suggested we set rudder trim just shy of the TO mark. This, he said, would lessen yawing moments immediately after takeoff, when we'd be engaging the glareshield-mounted Bendix/King KFC 325 flight control system's yaw damper. Then we calculated our V_R (rotation speed) based on our takeoff weight. With four aboard and full fuel, that number was 85 knots. Then we did some final checks—one of them making sure the flaps were set at the TO position—and off we went.

At 85, a tug on the yoke sent the 850 skyward and we settled into a 2,000-fpm climb doing 130 KIAS. When we reached 2,000 feet or so, the flap switch was moved out of the UP detent, and into the 850 position. Now we had to be careful about adding power in the climb. Push the thrust lever forward too much, and torque could break limits. Out came the engine operation charts.

All turboprops have two engine limitations. At lower altitudes, torque is the limiting factor. But as torque inevitably falls off with altitude, ITTs climb in the thinner air. So up high, ITT becomes the chief limitation. For the 850's PT6A-66D, however, that huge 975-shaft-horsepower difference between its thermodynamic rating and its flat rating gives you comfortable margins against over-torquing down low and over-temping up high. If you do manage to over-torque the engine, you have 20 seconds to pull the power and correct the situation before informing maintenance. With the TBM 700, that grace period is a mere five seconds.

Passing through 17,000 feet and climbing at 160 KIAS, we still registered a 1,200-fpm climb. And by FL190 the climb rate was the same, and our ITT was a comfortable 781 degrees Celsius (redline is 840 degrees). By FL220, our torque limits had dropped to 110 foot-pounds, but the ITT stayed at 781.

After leveling off for cruise at FL280, I jotted down the numbers. At minus 27 degrees C (14 degrees higher than standard) outside air temperature, our torque was set at 103 percent, our propeller was turning 2,000 rpm, the N_g (compressor speed)was running at 103 percent (104.1 percent is redline), ITT was 800 degrees C, fuel burn was 57.8 gph, and our indicated and true airspeeds were 191 and 305 knots, respectively. Had temperatures been closer to standard, and had we been cruising at the 850's maximum operating altitude of FL310, the pilot's operating handbook says we would have been turning in 319-KTAS cruise speeds and burning 55.8 gph. And yes, TBM 850s can be equipped for RVSM (reduced vertical separation minimums) approval for flight above FL290.

Back in the pattern, the drill is to reduce power, extend flaps to the TO position once below 178 KIAS, extend the landing gear, then put down LDG flaps when below 122 KIAS and at 500 feet agl, when the TAWS (terrain awareness warning system, part of the optional IHAS 8000 package) gives its "500 feet" audio alert. It's also a good idea to open the induction system's inertial separator vane. This prevents the engine from ingesting any foreign particulates (dirt, debris) after touchdown.

We came over the numbers at 85 knots, touched down mains-first, let the nosewheel settle (it didn't take long), then pulled reverse thrust to shorten the landing rollout. Landings take practice to finesse. The TBMs have straight-legged, not trailing-link, landing gear—a design compromise that gives the airplane more room in the wings for fuel—so you have to be on speed and in the proper, nose-high attitude or firm arrivals result.

The TBM 850 should give VLJs a run for their money. With jetlike speeds, single-engine economy, and a great flight control system, it should make many prospective VLJ customers think twice. That said, Socata continues to garner the most sales from previous owners of Piper Malibus and Mirages,

The real deal

Learning in SimCom's advanced trainers

BY THOMAS B. HAINES

Prior to flying the Socata TBM 850 this spring, my most recent experience piloting the sporty TBM 700 was in 1998 when I flew a shiny new one from the Socata factory in the south of France to the company's U.S. headquarters near Miami. That 20-hour trip was a good introduction to the airplane, but eight years is eight years.

To prep for our flights in the 850, *AOPA Pilot* Editor at Large Tom Horne and I headed to Pan Am SimCom's Orlando training center to get current in the simulator before taking on the real thing. SimCom is Socata's authorized training center and provides TBM 700 simulators at its Orlando and Scottsdale, Arizona, locations. The training devices soon will be configurable to replicate the performance of the TBM 850.

Our instructor was Jerry Chipman, who, typical of SimCom instructors I have dealt with, comes with an enviable aviation pedigree. Chipman learned to fly 51 years ago and is retired from the U.S. Air Force after flying fighters and the U2 spy plane. He's also qualified in helicopters and seems to know every nuance of the TBM 700.

While ours was a custom one-day, um, crash course to get us proficient enough to fly with the Socata demo pilots, the typical TBM 700 or 850 pilot goes in for either a six-day initial training course or, for those with previous turboprop experience, a five-day upgrade course. Once you're proficient in the TBM, the company offers a three-day recurrent course or a two-day advanced refresher. The Orlando facility also provides a five-day maintenance initial course.

The TBM training device, like many of SimCom's other turboprop and piston-aircraft training devices, is built from a real airplane cockpit. The cockpit with an instructor cab built onto the back of it sits in a large room. Projectors driven by a bank of computers project environmental images on the walls around the cockpit. The cockpit doesn't move, but you wouldn't know it when you're inside. The moving images convince your brain that you are in fact moving. It's an amazing technology and extremely effective—and cost-effective—for training.

In addition to the non-motion devices, SimCom employs a host of full-motion simulators for the Beech King Air C90 and numerous business jets including several Cessna Citation models, Learjets, and the Raytheon Hawker 700/800 and 800XP.

For more information on SimCom courses, visit the Web site (www.simulator.com).

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SPECSHEET

EADS Socata TBM 850

Base price: $2.577 million
Average equipped price: $2.799 million

Specifications

Powerplant ......Pratt & Whitney PT6A-66D, ...850 shp
Recommended TBO......................3,000 hr
Length......................................34 ft 11 in
Height ....14 ft 4 in
Wingspan ....41 ft 7 in
Wing area ....193.75 sq ft
Wing loading ....38.1 lb/sq ft
Power loading ....8.7 lb/shp
Seats...6
Cabin length ....13 ft 3 in
Cabin width ....3 ft 11 in
Cabin height.......................................4 ft
Typical empty weight ....4,698 lb
Max ramp weight ....7,430 lb
Max takeoff weight......................7,394 lb
Max landing weight......................7,024 lb
Max useful load............................2,632 lb
Max payload w/full fuel ....849 lb
Fuel capacity, std ....290.6 gal (281.6 gal usable) 1,918 lb (1,858 lb usable)
Baggage capacity ....297 lb

Performance

Takeoff distance over 50-ft obstacle..2,840 ft
Ground run ....2,035 ft
Rate of climb, sea level ....2,005 fpm
Cruise speed/range w/45-min fuel reserve (fuel consumption), 26,000 ft
@Max cruise power setting...320 kt/1,365 nm (441 pph/66.6 gph)
@Long-range cruise power setting, 31,000 ft ......252 kt/1,520 nm (258 pph/39.2 gph)
Max operating altitude................31,000 ft
Sea-level cabin to ....14,390 ft
Landing distance over 50-ft obstacle..2,430 ft
Landing distance, ground roll ....1,840 ft

Limiting and Recommended Airspeeds

V_R (rotation) ....85 KIAS
V_X (best angle of climb)................95 KIAS
V_Y (best rate of climb) ....123 KIAS
V_A (design maneuvering) ....158 KIAS
V_{FE} (max flap extended)
TO flaps ....178 KIAS
LDG flaps ....122 KIAS
V_{LE} (max gear extended) ....178 KIAS
V_{LO} (max gear operating)
Extend ....178 KIAS
Retract ....128 KIAS
V_{MO} (max operating speed) ....266 KIAS
V_{S1} (stall, clean) ....81 KIAS
V_{SO} (stall, in landing configuration)...65 KIAS

For more information, contact Socata Aircraft Inc., North Perry Airport, 7501 South Airport Road, Pembroke Pines, Florida 33023; telephone 954/893-1400; fax 954/964-0805; e-mail sales@socata aircraft.com; www.socata.eads.net.

All specifications are based on manufacturer's calculations. All performance figures are based on standard day, standard atmosphere, sea level, gross weight conditions unless otherwise noted.

Beech Barons and Bonanzas, and—most recently—Cirruses and Columbias. Although the 850 is powerful, and high flying, these pilots will find it an easy step up the food chain after pilot training at SimCom's Orlando, Florida, training center. AOPA

E-mail the author at tom.horne@aopa.org.

Links to additional information about TBM 700s may be found on AOPA Online (www.aopa.org/pilot/links.shtml).