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DAHER-SOCATA
Factory Tour and TBM900 Test Flight

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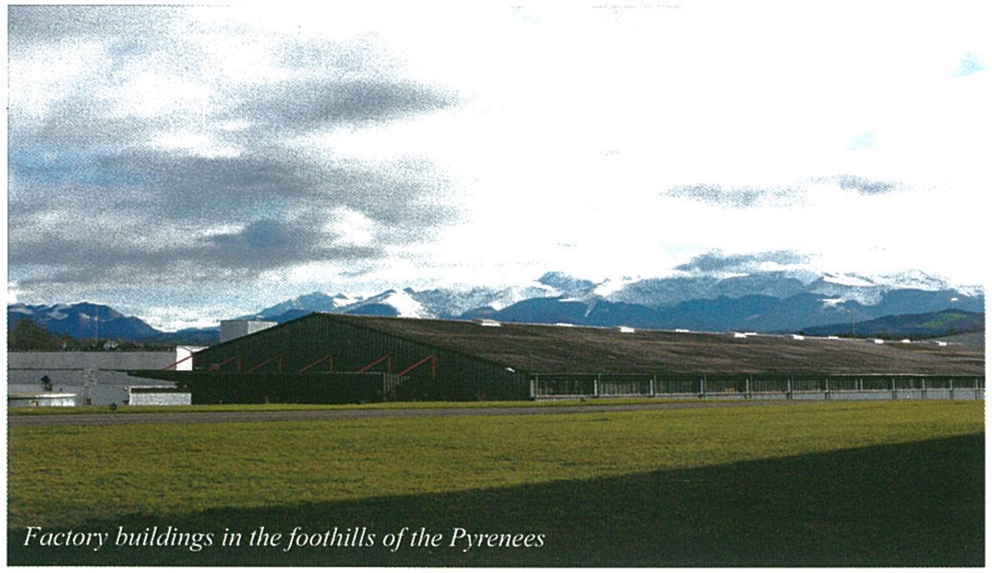
Daher-Socata TBM900 Factory Tour

by Phil Caiger and Anthony Bowles

The story begins in early October 2014; Anthony was down at RGV at Gloucestershire Airfield. RGV maintain his Bonanza and he learnt that RGV were becoming a UK service centre for the Daher-Socata TBM turboprop aircraft. To this end Julian Fitter, one of RGV's engineers, was going out to Tarbes in mid November to do a month's maintenance course and Julian suggested to Anthony that he may like to come and visit him in Tarbes and he would see what he could to organise a factory tour. Anthony, not being one to pass up an opportunity to do something aviation related, emailed Julian once he was on his course to see what could be arranged and an invitation came back to tour the aircraft factory in Tarbes on a couple of days in December. Anthony's Bonanza was then on scheduled maintenance but Phil needed no persuasion to get his PA46 Mirage out of its hangar for the trip. So, on the morning of 10th December, we set off from Biggin Hill and after an uneventful flight, arrived 2¾ hours later in Tarbes, in the foothills of the Pyrenees where we were greeted on the apron by International Sales Director, Mark Diaz and Caroline Van Berkel who had been watching the progress of our flight on FlightRadar24.com. Almost as soon as we had disembarked, Mark announced that our test flight had been booked for 4pm and following a quick coffee in the pilots lounge, Mark led us out on the start of our factory tour. So, not only did we get a tour of their fascinating factory but also an hour flying their fabulous new aircraft, the TMB900.



Factory buildings in the foothills of the Pyrenees

The Factory Tour

The factory in Tarbes has a long history; it started in 1911 as Morane-Saulnier, later changed its name to Socata (an abbreviation for Societe de Construction d'Avions de Tourisme et d'Affaires) and became part of EADS in 2000 before its acquisition by Daher in 2009. The factory and Tarbes itself largely survived the early part of the second world war as they were not considered a strategic target thanks to their location, well away from occupied France. It was a "safe haven" for all those who tried to escape occupied France to Spain, including Allied aviators shot down over France's territory. Many of the aircraft were captured when the German army advanced on the area after 1942 and when Focke-Wulf decided to use the factory to restore FW 190 fighters to war status, the Allies decided to destroy the factory and the grass strip used by Luftwaffe's JG 101. Prior to its capture, many of the aircraft designs were taken by the workers up into the Pyrenees and hidden. Occasionally, plans are still discovered by hikers in the mountains, returned to the factory and restored. The construction of a number of the factory buildings on low lying terrain obscures them from view and perhaps helped save them from allied bombing. In fact, there was only one raid against the factory, on the night of 10th March 1944, when 23 RAF Lancaster bombers dropped around 1000 bombs.

The Tarbes factory has long been associated with the construction of GA aircraft; following the successful production of the Rallye series of aircraft in the 1960/70's period, design work for the TB ("Tarbes") series began in the late 1970's with production of the TB9, TB10, TB20 and TB21 taking place from 1980 onwards until production ceased in the early 2000's.

The TBM series of aircraft derives from a partnership in the 1980's between Mooney in the US and Socata and was originally based on the joint venture plan to build a turboprop version of the Mooney 301 airframe; "TBM" derives from the partnership with "TB" representing Tarbes as the place of construction and "M" representing the Mooney input. The prototype TBM700 had its maiden flight in July 1988 with French certification achieved at the end of January 1990 and FAA certification at the end of August 1990. In 1991, financial pressure led to the Mooney's withdrawal from the joint venture. In 2006, the TBM700 was succeeded by the TBM850; essentially the same airframe but powered by a more powerful version of the ubiquitous Pratt & Witney PT6A turboprop engine, giving a higher cruise speed. In 2008, glass was introduced into the cockpit with a full Garmin G1000 setup, giving a PFD for both pilot and co-pilot and a large MFD in the centre of the cockpit. In early 2014, the design was further tweaked and the aircraft became the TBM900 incorporating a significant number of improvements mentioned in a later paragraph.

Our tour started at one end of one of the old glass roofed factory building where various grades and thicknesses of aluminium are delivered and then progress along the length of the factory gaining in complexity. Daher-Socata utilises a mixture of the latest technology robotics and highly skilled manual labour, the latter being increasingly hard to source and the former steadily taking hold of all of the manufacturing processes. The raw materials are initially selected and cut by robot and then dispersed to be formed into shapes for myriad functions - from large sheets loaded onto huge presses to make body panels to small plates and brackets, bent and shaped by hand. Various presses and jigs, interspersed with CNC machines, are sited along the length of the factory floor and the parts moved by trolley or winch between them. The variety of aircraft for which Daher-Socata manufactures parts was a complete surprise to us and yet, as we walked along the factory floor, immediately apparent due to both the size of some of the parts, as well as the colour coding used to distinguish parts from one manufacturer to another. Apart from the TBM where Daher-Socata build the entire airframe, the company is a major sub-contractor for several other aircraft manufacturers and fabricates parts for the Dassault Falcon 5X, 7X and 8X, Airbus Helicopters and Airbus A320, A330, A350 and A380. At the time of writing, they have just added the new all-electric Airbus E-Fan. In order to optimise the riveting process, as much use as possible is made of cleverly designed vertical jigs which have the added benefit of minimising floor footprint when compared to traditional horizontal jigs.

Aircraft panel (above) produced using the press below

In the past, composite manufactured parts were tested for faults not visible to the naked eye by a skilled worker, tapping the metal lightly with a hammer and using his trained ear to listen for subtle differences in sound. Today, this has been replaced by a robot that progressively scans the entire surface with an ultrasonic sensor and uses a jet of water sprayed over the surface to mask the background noise of the factory. A report detailing conformity is then produced automatically. Such is the efficiency of the process that all the parts can be analysed in this way rather than just a sample. It also reflects customer demand for 100% traceability and testing of all component parts.

All component parts are primed in a colour specific to the end user customer; for example all Airbus parts are painted in blue, TBM painted green, etc. to aid recognition as they progress through the assembly process. The internal surfaces on the TBM are painted light grey to facilitate future inspection of the assembled aircraft.

In adjacent factory buildings the various sub-assemblies are assembled into larger components which then become much more recognisable, even to an inexperienced eye, for example: the huge undercarriage doors and nose assembly for the Airbus A380, composite wing fairings for various Airbus models, tail boom and complete floor sections and bodies for Airbus Helicopters, the entire upper body including cut-outs for passenger windows for the Dassault Falcon, etc. An entire building is dedicated to the assembly of the Falcon Jets fuselage. To each assembly is taped an ever thickening wad of paper documentation, part of the traceability process referred to earlier. In the case of assemblies manufactured for OEM use, the assemblies are then taken out of the factory and loaded into individually designed transport crates and subsequently onto lorries for onward transport. The crates even include inspection windows so that customs officials in foreign countries do not have to open the crates to check the content matches the accompanying documentation.

Watch your thumbs!

Composites

An important part of Daher-Socata is the fabrication of aircraft components using the latest composite materials technology and the following morning we were given a tour of the composites building. The composite assemblies start life as carpet-sized rolls of flexible black carbon fibre and black and red glass fibre sheets which are cut and pressed by hand into moulds in a "clean" room – this is a very precise process and the workers have laser guidelines projected from the roof onto the moulds to ensure that each piece of fibre is cut and positioned precisely. The largest pieces, which include the A350 undercarriage doors, are cut and positioned by a huge robot – which cost more than a TBM900 on its own! Previously, the thin sheets were typically strengthened using a "honey comb" section of Nomex, which is bonded to the moulded sheets. On the A350 doors, carbon fibre omega shaped ribs have replaced Nomex which results in an extremely strong structure when compared to the equivalent in aluminium or even steel. On some aircraft parts, as carbon fibre is brittle, to make it more flexible, glass fibre is added to the layers of carbon fibre.

The pressed moulds are then taken to the autoclave section, assembled on a railed trailer and then positioned in one of several room-sized autoclaves to be carefully heated to up to 250°C and pressurised at 10 bars for several hours in an inert gas environment to ensure no water vapour or other impurities can adversely affect the panel. Once ready, the panels are left to cool and then transported on a flatbed to CNC cutting and milling machines where the edges are trimmed and all the holes are cut. Each panel is sited on a jig which is either custom-made for that particular panel or is part of a clever system of vertical supports which enables almost any shape panel to be held in position. The supports are first positioned by the robot before the panel is put in place. Once machined, tracing documentation is attached to the panel and it moves on to the next process – often aluminium ribs or other parts manufactured elsewhere in the factory are attached to make the final assembly. Several body parts of the TBM900, including the panels surrounding the engine are manufactured in this way, which help to give it the performance improvement compared to the earlier all-aluminium models. This technology is an impressive capability and enables Daher-Socata to form shapes that are not only stronger and lighter than those made from aluminium but also more complex shapes that simply cannot be manufactured from aluminium.

Some parts are still manufactured by hand

Assembly

The various sub-assemblies come together to form the complete aircraft. The TBMs wing spar is manufactured from a single piece of aluminium. External surfaces and body panels are butt joined rather than overlapped and flush riveted to maintain a smooth airflow, the cable control systems for flight control surfaces, pitot/static system and other systems are installed. All the joints and rivets are filled and coated in a smooth epoxy which is then sanded to a fine finish. Once the airframe, less wings, is complete, the aircraft is moved into the paint shop. Typically, aircraft are painted in one of a few standard colour schemes although it is possible to have a customised design at an additional cost. The aircraft are painted above a pool of water to aid settlement of dust – the quality of the paint finish is taken very seriously and it is noticeable how much better the finish is when compared to, say, a Piper. On the TBM there is no sign whatsoever of the flush rivets whereas on a Piper Mirage, for example, the flush rivets can still be seen through the paint.

Much of the electrical system is assembled and tested before installation in the painted airframe; the wiring loom is manufactured by hand from individual cables of various thicknesses and colours on a huge table, marked out to show where each cable and connector is positioned. There is only enough room for one table so, in the unlikely event a new loom is needed for an older model TBM, a significant lead


Fitting the pilot's door

time would result.

Once the painting process has been completed, final assembly can begin; installation of the wiring loom and many varied systems including the Garmin G1000 avionics are installed and configured. The engine, wings, elevator, undercarriage, etc. are joined to the body and the aircraft starts to look complete. The pilot's door, introduced in the TBM850 as an optional extra, is now standard fitment on the TBM900.

Garmin G1000 installation and configuration

The completed TBM900 includes many small but significant improvements over earlier models of TBM – some are immediately apparent, the most obvious being the new 5 blade composite propeller, stylish winglets and redesigned engine air intake. The propeller has significantly improved climb performance, in fact in our test flight we achieved 31,000ft in only 15 minutes, 3 minutes faster than the official figure and the winglets are claimed to improve low speed handling. The new propeller resulted in a complete redesign of the air inlet undertaken jointly by Daher-Socata and Pratt and Whitney and resulted in improved looks and increased engine power. Some improvements are less obvious, for example, the exhaust stacks are longer and straighter increasing thrust from the engine which is significant at high altitude and the small fin on the left hand side of the body, just in front and slightly below the leading edge of the wing, improves stall characteristics.

Once assembly is complete, the aircraft is taken outside and the engine test-run and configured. Once this is completed, the final engine panels are put in place and all aircraft are designated with a F-WWxx callsign so that test flights may be carried out.

TBM900 Test Flight

Parked next to Phil's Mirage on the apron was N900XH, Daher-Socata's TBM900 demonstrator and chief test pilot Alain Jaubert. As Phil had just flown down to Tarbes, it seemed reasonable that Anthony should get the first turn flying the TBM900 so we climbed inside, out of the steady and persistent rain and Anthony took the left hand seat next to Alain. Alain went through the start procedure, which was very straight-forward and following a further briefing, taxied out to the runway. In fact, the engine controls have been simplified in the TBM900 with just one power lever controlling all functions. Startup in achieved with the lever in the right hand gate; when ready to taxi, the lever is moved to the left hand gate which effectively engages the propeller in appropriate pitch and then moved forwards or backwards as necessary to engage forward or beta thrust. Apparently, some purists miss a separate prop control, but it certainly made life simple for us. The aircraft management system prevents over torqueing the engine at any stage. There is a high degree of integration between aircraft systems and the G1000 which makes the aircraft appear simple and effortless to manage; flight plans, engine information, etc. are entered into the G1000 and the pressurisation control is then completely automatic, deriving its information from the airports entered into the flight plan. Fuel balancing between the two wing tanks is also automatic - switching every five minutes. The G1000 MFD includes both Jeppesen charts and "safe-taxi" charts which show the geo-referenced position of the aircraft overlaid on the chart in the same way as on the Avidyne EX500 and 600. Taxying at a sensible speed using only idle thrust would result in rapid brake wear so, instead, speed is managed by moving the thrust lever to control the use of forward and beta/reverse thrust and thereby minimise brake wear. Steering is light and an absolute pleasure compared to the heavy steering of the Mirage. For takeoff, like a piston engine, the power lever is simply pushed forward to 100% torque and can be left in that position for the entire climb to altitude. Acceleration down the runway is sparkling and climbing at a steady 124 KIAS, the rate of climb exceeded 2,250ft/min almost all the way to 31,000ft and took only 15 minutes.


Final assembly

After a very short while we were cruising at over 320KTAS at 31,000ft heading west just to the north of the Pyrenees and even with our partial fuel load, the G1000 showed a range which would have enabled us to reach Turkey or even Iceland albeit at a reduced speed.

The TBM has quick donning oxygen masks just above the pilot and co-pilots seats and airline style ones which drop down automatically for the rear passengers in the event of a loss of pressurisation. Nonetheless, Alain was keen to demonstrate just how quickly the TBM900 could descend in the event of a rapid loss of pressurisation and as Anthony pushed the nose over to point 25 degrees down, we lifted out of our seats(!) and descended at over 10,000ft per minute at a Vne -10 kts speed of 255 KIAS. In less than 2 minutes we levelled off at 15,000 ft and settled back down to perform some general handling all of which was straight forward and no different to our own aircraft.

The large flaps of the TBM enable it to achieve excellent low speed approach and landing performance but as a result, take up most of the length of the wing, leaving little space for the very small ailerons. In order to achieve good roll performance, when aileron is lowered on one wing a spoiler is simultaneously deployed on the opposite wing. This is not noticeable in ordinary flight except in the stall from which it is also possible to recover from wing drop by using aileron rather than rudder. The stall characteristics, as Anthony demonstrated, were perfectly standard and in normal flight recovery was easy. For steep turns, there was a handy little green prediction indicator on the PFD and as long as this was kept on the horizon, a perfectly level 60° turn could be accomplished, albeit with complaints about pulling 2G from the back.

While Alain took the controls, Anthony and Phil swapped places and after a bit of general handling and familiarisation, Phil descended to join the standard arrival

Sleek and stylish Garmin G1000 with huge central MFD

back towards the airport. Alain was keen to demonstrate how the aircraft could fit easily into an approach with fast jet aircraft and so engaged the autopilot on long final and maintained 250kts to 4 nm at which point the power was brought back to 13% and the aircraft slowed very rapidly to a much more normal 85kts approach speed, during which landing flap was deployed while the autopilot accurately followed the glide slope. Disengaging the autopilot for the flare and landing, Alain then used reverse thrust to demonstrate just how little distance the TBM needed to land and we came to rest only 300m down the runway.

We were both sold! The TBM900 is beautifully and solidly made, stylish and modern with stunning performance – fast cruise at high flight levels but with excellent low approach and stall speeds. Both of us found the aircraft very easy to fly and very much like our own respective aircraft; indeed we were told that Bonanza and Mirage pilots convert easily to the TBM whereas Cirrus pilots, in particular, find type conversion a little more testing!

Return trip

The winds were strong and unfortunately we had a consistent 50 kt headwind against us for our return to Biggin Hill, so our journey took 4½ hours culminating in a bumpy crosswind ILS approach to runway 21 as dusk fell – how we wished for the extra speed of the TBM900 but what a wonderful pre Christmas outing! Thanks to everyone at RGV and Daher-Socata who made our visit possible.

TBM 900 STATISTICS

POWERPLANT
Type: P&W Canada PT6A-66D turboprop
Thermodynamic power 1825 hp.
Nominal power 850 shp.
Usable fuel capacity 291 US gal. 1,100 liters

EXTERNAL DIMENSIONS
Wingspan 42.10 ft. 12.833 m.
Height 14.29 ft. 4.355 m.
Length 35.22 ft. 10.736 m.
Wheel base 9.56 ft. 2.914 m.
Tailplane span 16.36 ft. 4.988 m.

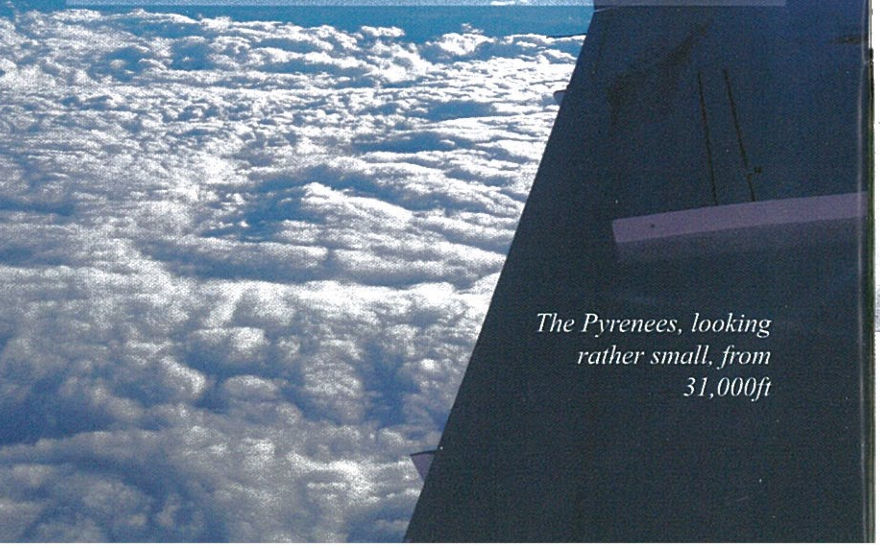
INTERNAL DIMENSIONS
Maximum cabin width 3 ft. 11.64 in. 1.21 m.
Maximum cabin length 13 ft. 3.45 in. 4.05 m.
Maximum cabin height 4 ft. 1.22 m.
Maximum volume in cabin 123 cu. ft. 3.5 cu. m.

LOADING
Basic empty weight 4,629 lb. 2,097 kg.
Maximum ramp weight (MRW) 7,430 lb. 3,370 kg.
Maximum takeoff weight 7,394 lb. 3,354 kg.
Maximum zero fuel weight 6,032 lb. 2,736 kg.
Maximum payload 1,410 lb. 639 kg.
Maximum payload with full fuel: 891 lb. 404 kg.
Maximum luggage in storage areas (4 seats): 507 lb. 230 kg.
Maximum luggage in storage areas (6 seats): 330 lb. 135 kg.
Maximum luggage volume (large net): 30¼ cu. ft. 0.989 cu. m.

PERFORMANCE (ISA conditions, MTOW, no wind)
Maximum cruise speed at long-range settings 252 KTAS 467 km/h
Maximum cruise speed at 28,000 ft. 330 KTAS 611 km/h
Time-to climb to 31,000 ft. 18 min. 45 sec.
Certified ceiling 31,000 ft. 9,449 m.

RUNWAY DISTANCES
(ISA conditions, MTOW, no wind, 50 ft. obstacle clearance)
Takeoff 2,380 ft. 726 m.
Landing 2,430 ft. 741 m.

Maximum range with maximum fuel
(ISA conditions, MTOW, no wind, one pilot, 45 min fuel reserve)
@ 31,000 ft.
252 KTAS cruise speed 1,730 NM 3,304 km
290 KTAS cruise speed 1,585 NM 2,935 km
326 KTAS cruise speed 1,440 NM 2,666 km



The Pyrenees, looking rather small, from 31,000ft