FLIGHT TEST REPORT
M20TN ACCLAIM TYPE S

by **Trey Hughes**
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Well, the Mooney Airplane Company has made me eat my words and change my opinion. For years, I touted (or spouted) the M20R as the best thing to come out of Kerrville since the M20J in 1977. I actually think of the Ovation first introduced in 1994, as the 201 on steroids, and have predicted that given the long-term success of the company, the Ovation would out-sell the J by a large margin. I now sing a different tune after flying the newest thing to come from the brilliant engineering minds in Kerrville. This may well be the best thing to come from Mooney ever!

The M20TN – for Turbonormalized – made its debut amid excitement and fanfare at the EAA Sun-N-Fun airshow in April 2006. The Mooney Acclaim replaced the venerable M20M Bravo as the high altitude, high-speed flagship of the Mooney product line. First discussions about a replacement for the Bravo occurred in the late 90s as the brainchild of then Director of Engineering Tom Bowen. With the success that Teledyne Continental was having with their IO-550 engine in other airframe applications, it was seen as the logical replacement for the Lycoming TSIO-540. It was no secret that the relationship between Lycoming and Mooney suffered under the Paul Dopp era, and Mooney was looking for a replacement engine supplier. With the success of the Ovation, the 550 made sense, and Mooney investigated the twin-turbocharged big block Continental for use in the long-body Mooney airframe.

During the bankruptcy, the project was shelved until 2003 when it was resurrected by then Mooney VP of Marketing Nicolas Chabbert. With the work of some brilliant folks in Kerrville including; Dan Apel (a young engineer who was hired at Mooney after the AASI acquisition), Director of Engineering Bill Eldred, Bill Craig (Structures), Ken Robinson (Electrical), Doug Smith (Interior/Exterior Design), Herbie Witt (Mechanical), Brent Buckner and Heather Hughes; Mooney completed the certification of the M20TN in December 2006 making Mooney an "all continental" airplane manufacturer.

Based on the long-body design, the M20TN is actually a whole new airframe incorporating the best of the M20R and M20M. It has an all new firewall to accommodate the twin-turbo plumbing along with the M20M fuel system increased to 100 useable gallons of low-lead beneath new avgas-specific fuel fillers and caps

The biggest secret to the Acclaim's fantastic performance is a completely new cowl design. It contains no induction air inlet (intake air enters the engine through an inlet behind the prop spinner) or intercooler scoops which add front-end drag. Since the intercoolers are mounted on top of the engine adjacent to each bank of cylinders, cooling air for the intercoolers is the same air used to keep the cylinders cool.

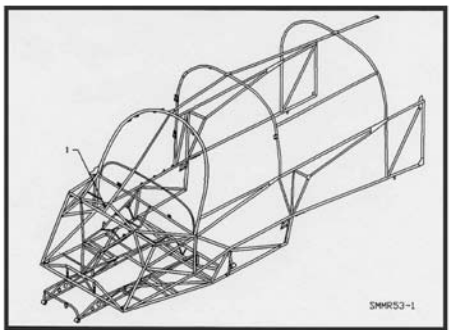
It also is without cowl flaps which along with the cooling air inlets on the Bravo are a huge source of cooling drag. The TN and the TN Type S show Mooney's attention to aerodynamics and not just pure horsepower for performance

increases. The engine cooling air inlets are specially designed to aid cooling airflow without the high pressure drag found with other inlet designs. In addition, in the Acclaim Type S, Mooney has further improved the airflow pattern inside the top cowling to further reduce pressures (cooling drag) and improve cylinder cooling air distribution. In the case of the Acclaim Type S, Mooney has returned to what it was known for under Al – increased performance through improved efficiency.

When the Acclaim was first introduced and I got my first flight with a factory test pilot I knew that MAPA would need to do a pilot report on this exciting new airplane so that our membership would get the true scoop on the TN without the marketing hype. However, the early versions came equipped with the STEC 55X autopilot which in my opinion lacked the performance to keep up with this Mooney. While the STEC is a great autopilot in most applications, since it is a rate-based design it worked too slow for an airplane as quick as the Acclaim. Bendix-King's tremendous KFC225, which was the Mooney standard since the early 2000s, was not certified with the Garmin G1000 Integrated Avionics Suite that is found in all Mooneys now. And since Garmin was slow in certifying their new GFC 700 AFCS (Automatic Flight Control System), the STEC was the only option for Mooney who had a large backlog of orders pending. Not wanting to delay the certification any longer than necessary, MAC decided not to wait on the Garmin AFCS (it's a good thing too since the Garmin autopilot did not get full certification until 2007) and certified the Acclaim with the 55X.

When the GFC 700 was finally ready and certified in Mooneys, we decided to wait to do the pilot report after Garmin and Mooney certified the WAAS-version of the G1000 which was to be ready "any day now." Any day now turned into almost a year and once WAAS was done, Mooney was working on an up-dated version of the Acclaim called the Type S which included the aero work that has already been described and boosted an increase in TAS at altitude. So we again decided to wait a little more so that we could get it all – the GFC 700, G1000 with WAAS and the Type S mods. I'm glad we did. Now, let's look at the Acclaim.

The Acclaim – officially M20TN – is a typical long-body Mooney that will fit inside a t-hanger that is at least 26' 8" long by 36' 6" wide. The top of the pivoting tail is 8' 6" above the ramp. It is basically all metal, with a fuselage that has a welded, tubular-steel cabin frame covered with non-structural aluminum skins. It has seating for a pilot and up to 3 passengers.



The TN is built with Mooney's world famous tapered full-cantilever, all aluminum, laminar-flow wing that varies from a NACA 63_2-215 at the root to a NACA 64_1-412 at the tip. The wing has been modified by an inboard leading edge cuff and is formed with wrap around, stretched formed aluminum skins. Flush riveting is used on the forward top and bottom 2/3s of the wing chord to improve laminar airflow dynamics.

Typically Mooney, the empennage consists of the vertical and horizontal stabilizer assembly and rudder as well as elevator surfaces with pitch trim provided by pivoting the entire assembly. In addition to the pitch trim system, the Acclaim – like all long-body Mooneys – has an electrically operated rudder trim system installed that allows the pilot to reduce the amount of rudder pedal pressure needed to compensate for the large yaw forces during takeoff and climb. Pitch and rudder trim position are shown on the G1000 MFD.

The landing gear is electrically retracted and extended with a "Voice alert" warning system. Position is verified by a **GEAR DOWN** (green) light, a **GEAR UNSAFE** (red) warning light as well as a gear position indicator on the floorboard between the pilot and co-pilot seats.

But, what's it really like to fly? Along with Mooney test pilot Steve Masters, I was going to see what M20TN S/N 31-0094, N994TN would really do when flown by a normal or nearly normal pilot. I took Steve along for several reasons. First, it is difficult to get a Mooney, even the heavier Acclaim, anyway near real flying weight with only one person on board. Second, with Steve flying (like you and I fly, not as a test pilot) it was easier for me to record data and take pictures. Finally, I'm not real sure Mooney wanted to entrust their new Acclaim to me alone.

N994TN was the 94th Acclaim to come down the production line and as an unsold airplane (at the time I'm writing this) it was not heavily optioned. With an empty weight of 2411 pounds and a maximum takeoff weight of 3368 pounds, we had a 957 pound useful load. The empty weight included the AmSafe Seat Restraints, pedal extensions and a 77 cu. ft. oxygen system. If we had wanted full fuel, our payload would have been 375 pounds – two 150 pounders and a little baggage. With this fuel and cabin load, we would have (according to the flight manual) been able to travel 930 NM at Best Power – 30.5"/2500 RPM – in 4.3 hours (no wind) with 45 minutes reserve fuel. But since this report is about "real world" flying, we are going to see for ourselves.

Steve and I preflighted, no real differences from other Mooneys here,

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and after computing weight and balance and takeoff performance we were quickly ready to go. The conditions in Kerrville were: OAT 32-degrees C, almost 90-degrees F (hot!), wind from the SE at 16 gusting to 21 and a density altitude of 4000 feet. With Steve and I on board –neither of whom you could call "slim", 70 gallons of 100LL and 10 pounds of stuff in the back we tipped the scales at 3248 pounds. This was 120 pounds below the maximum takeoff weight of 3368 pounds and would have allowed us to carry another 20.6 gallons of fuel if we had wanted. Since LL is still pricey in 2008, we elected not to tanker any more than we needed for this flight. Also, our takeoff weight was only 48 pounds above the maximum landing weight of 3200 pounds, so we only needed to burn off slightly more than 8 gallons before we could return to land except for an emergency situation.

When we fired up the Acclaim, the SafeTaxi™ showed exactly where we were on the Kerrville airport. Having airport diagrams and approach places available on the Multifunction Display (MFD) greatly aids a pilot's situational awareness.

Our computed takeoff distance was 2300 feet to get to 50' AGL including 1600 feet of ground roll. I'll tell you this, these numbers don't impress as much as the actual happening. When we advanced the power for a normal (rolling) takeoff, we were airborne in just 20 seconds! After verifying a positive rate of climb, the altimeter was going up and the VSI showed – 1500 fpm yikes! – we retracted the gear and flaps and settled into a normal cruise climb of 120 KIAS. Through 6000 feet MSL our climb rate averaged 1500 fpm settling down to 1200 fpm all the way to our first level-off altitude of 10,500 feet for our first set of speed runs.

Once level at 10.5 we accelerated and let the engine stabilize as we set power on the "Engine" page of the G1000 Multi Function Display (MFD) for Max Cruise (30.5"/2500 RPM) and then leaned for Best Power of 50-degrees Rich-of-Peak (ROP) TIT using the G1000's "lean find" feature. With the TIT well below the 1750-degrees F Redline at 1638-degrees F, our fuel flow stabilized at 21.9 GPH and the TAS displayed on the G1000 Primary Flight Display (PFD), computed by the Air Data Computer – ADC from pitot and static inputs, showed 204 knots.

Of course since we are on a flight test, I had to prove the accuracy of the computed TAS so we set-up for a speed run using the GPS ground speed recorded on the 4 cardinal compass points (N, E, S and W). While this method of computing TAS is not 100% accurate, it is close enough of us to use. Here's what we got at 10,500'.

Altitude	IOAT	Power	Direction	IAS	GPS GS
10,500	+ 13 C	30.5/2500	E	168	205
			S		209
			W		207
			N		204
				TAS	206

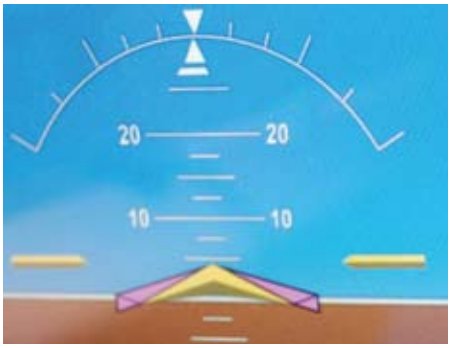
So, at 10.5 we actually beat the ADC by 2 knots. And this is 206 KTAS at almost ISA + 20 degrees!

After completing this speed run, we again made a cruise climb to our next target altitude of 17,500 feet for our second TAS check. Steve pitched the nose to about 5-degrees up, waited until the airspeed tape showed 120 IAS and engaged the Flight Level Change (FLC) function of the Garmin GFC 700 AFCS.

Frankly, this is exactly what the G1000-equipped Mooneys have needed since day one. This system is so accurate and precise, the airplane never waivers during any coupled flight operation. As a full-function, two-axis automatic flight control system it will do almost anything asked except land the Mooney.

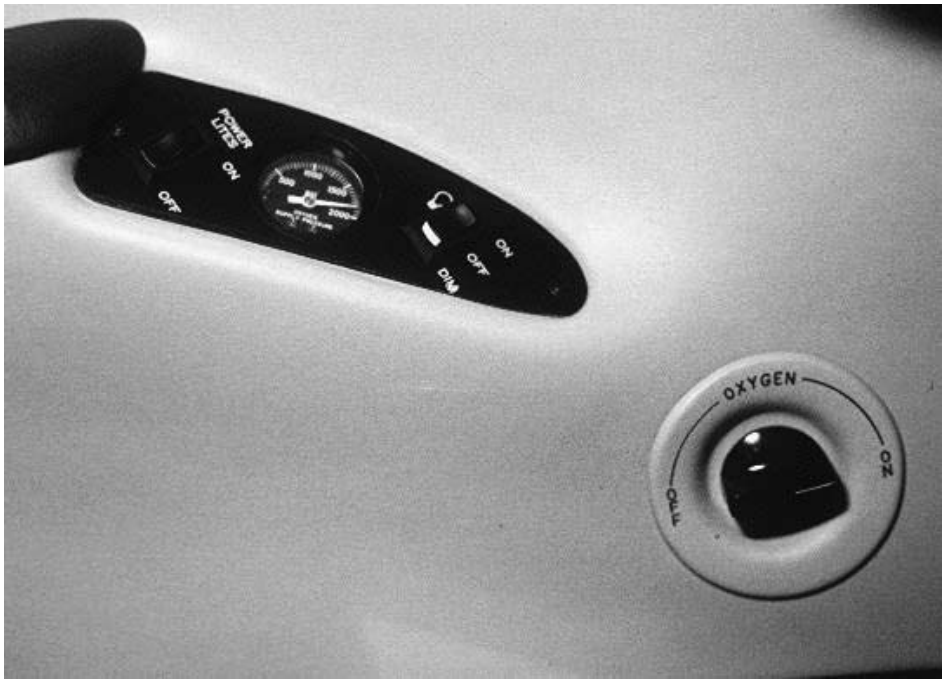
Controlled by "soft-keys" located on the lower left corner of the MFD, the GFC 700 will accomplish tasks for aircraft control and let the pilot focus on being a "systems manager' thus saving valuable brain cells for future use. And believe me, it flies much more accurately than any human pilot could. The only down side is that it can't read a pilots mind and will do exactly as it is told regardless of whether that is what the operator really wants.

And the GFC 700 is really a computer that controls a set of upside down command bars or "bat wings" on the attitude presentation of the PFD called the Flight Director (FD). These bat wings will pitch and bank to indicate the proper aircraft attitude in order to accomplish the requested flight operation – climb, descent, turn, navigate etc. The soft-keys on the MFD allow the pilot to program the various parameters that the FD will then indicate the proper aircraft position needed to accomplish the request task.



The pilot can request a climb to a specified altitude based on a desired pitch, a vertical speed or an indicated airspeed. Once the desired altitude is reached, the GFC 700 will indicate the proper pitch attitude to capture and maintain level flight. Should the Acclaim deviate from the selected altitude, the FD will show the pitch necessary for re-capture. Of course if the autopilot portion of the GFC 700 is engaged, then pilot action is not necessary as the A/P servos will operate the flight controls to make it all happen seamlessly.

During the climb to 17.5 we donned our masks and activated the built-in oxygen system to keep us both alert in the reduced oxygen environment and to stay in compliance with FAA regulations. The oxygen system is controlled and monitored by switches and indicators on the pilot's arm rest. The oxygen knob on the sidewall controls the "altitude compensating valve" on the 77 cu. ft. refillable bottle located in the tailcone.



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With the autopilot holding 120 KIAS, the TN was making quick work of the climb and maintained a steady 1200 fpm all the way to 17,500 feet where it smoothly leveled off. Again, Steve set recommended cruise power of 30.5"/2500 RPM, leaned for 50-degrees rich of peak TIT and the ADC showed 219 TAS on 21.4 GPH. When we ran the speed profile, here is what we got.

Altitude	IOAT	Power	Direction	IAS	GPS GS
17,500	- 4 C	30.5/2500	E	163	205
			S		223
			W		235
			N		223
				TAS	221

Again, 221 KTAS at ISA + 15 degrees – this is great performance.

Again, Steve programmed the GFC 700 for a climb to the thin air as we picked up the IFR flight plan from Houston Center that we had filed prior to leaving Kerrville. The controller was very cooperative as we asked for a block of airspace to make our speed runs at FL250, our final altitude. With the airspeed "bugged" at 130 with the FLC function of the Garmin, we were ascending at an average of 900 fpm until the A/P began the smooth level-off at 25,000.

We again ran the numbers and here's the table:

Altitude	IOAT	Power	Direction	IAS	GPS GS
25,000	- 18 C	30.5/2500	E	154	247
			S		239
			W		229
			N		237
				TAS	238

On the ADC we registered 235 so again our calculations were slightly better than the computer and this was even though the OAT was 17-degrees above standard.

All too soon it was time to return to earth and give this wonderful airplane back to Mooney. Center cleared us to SAT with the Center Point One arrival to expect the ILS approach to runway 12 R. With a few pushes and knob twists the arrival and approach were loaded into the G1000. We were given a crossing restriction to descend to, and cross the BENEY intersection at 6000 while we were only 37 miles away descending out of 15,000'. This task became easy as we set in the target altitude of 6000 feet at BENEY and coupled the A/P to the GPS and the GFC 700 flew the vertical track (remember this is a WAAS system with VNAV) just as if it were on an electronic glide path. With power set for a comfortable CHT (22.8"/2500 RPM, 396-degrees F CHT, 1561-degrees F TIT), the standard speed brakes helped us maintain the required 1565 fpm, 3.8-degree descent without exceeding any airspeed limitation and shock-cooling the engine.

Soon we intercepted the localizer and the G1000 smoothly transitioned from GPS to ILS GS and we slide down the electronic path slowing to match the big jet traffic (we were doing 242 knots across the ground prior to leveling off) into KSAT. The selected approach plate can be displayed on the MFD and if the Jeppesen (optional subscription) Services database is current, the airplane symbol is superimposed on it for reference during the approach. If the Garmin FliteCharts™ are available, then the approach plate is visible but the airplane is not referenced on the diagram. Both the Garmin and Jeppesen services require an annual subscription and scheduled updates (provided by the subscription) in order for the approach plates to be displayed on the MFD.

Before we landed however, I did get a chance to check some of the other pages on the MFD. With the WAAS, we could observe weather from the NEXRAD system via the XM WX service. In addition, we could check METARS, Cloud Tops and other weather features had they been important to our route of flight.

As we got closer to the airport the runways appeared on the airport diagram on the MFD along with traffic from the standard TIS equipment. It was also nice to see terrain and ground-based obstacles like towers with the TAWS B terrain awareness software.

Too soon we had the approach lights sliding under the nose and it was time to return N994TN back to Mooney. With the Type S aero-mods, the WAAS-certified G1000 and the GFC 700 AFCS this is one capable, fast Mooney. What's next? How about Synthetic Vision, but, that's for another pilot report.