MOONEY BRAVO

COOLER HEADS PREVAIL

With additional oil cooling, the TLS becomes the Bravo

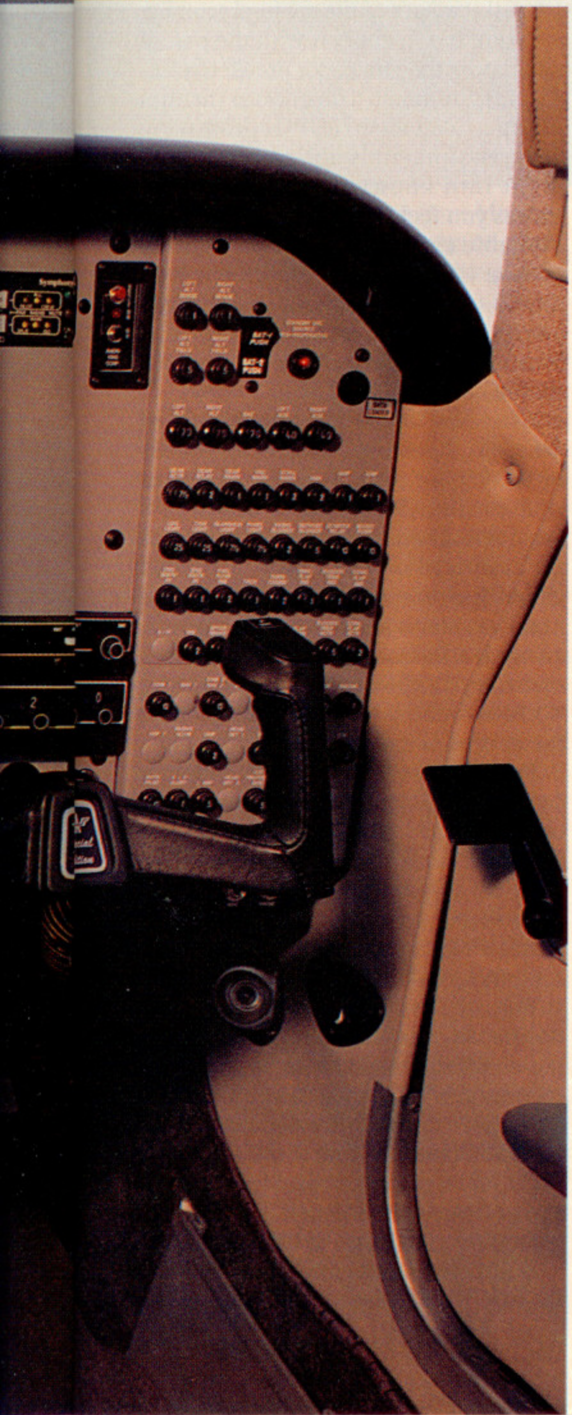
BY MARC E. COOK

Toss those aerodynamics texts, pitch that trusty slide rule, and send home the brainiac with the expensive degree in the next office. Here is what all that pesky airplane-design stuff boils down to—there are only two ways to make an airplane faster. Give it better aerodynamics (less overall drag, more efficient use of the engine's cooling air) or give it more power. When, in the mid-1980s, Mooney undertook to create a new top-line model, the only practical avenue was to add more power. After all, the basic Mooney wing and airframe had worked exceedingly well

PHOTOGRAPHY BY MICHAEL P. COLLINS


N2063W
Mooney TLSBravo


N2063W
ALT
VERTICAL SPEED
RPM
Special Edition
CHECK LIST



with up to 210 horsepower, and the costs associated with creating a new or substantially revised airframe far outstripped those of bolting on a larger engine—still do.

So when Mooney set about designing the turbocharged TLS on a stretched M20 airframe penned for the now-defunct Porsche-powered PFM, the company's engineers knew that it would need as much of the new Lycoming TIO-540's power as possible to ensure that the model would show its backward tail to the competition. Mooney and Lycoming agreed to allow this parallel-valve, six-cylinder engine to be rated at almost 90 percent of its maximum rated output in cruise, with the mixture leaned very aggressively to preserve fuel economy. (The TLS is among the few turbo airplanes to carry a 1,750-degree-Fahrenheit turbine-inlet temperature redline; far more common is a limit of 1,650 degrees.) For almost all of its other engines Lycoming recommends a maximum cruise at 75 percent.

Such an immodest maximum cruise power setting, together with the high TITs involved, raised more than a few eyebrows—particularly when the airplane was asked to deliver maximum cruise at FL250, where the TLS would crank along at almost 220 knots true. But the new TLS owners were too wowed by the speed and the published 2,000-hour TBO to care much about the high fuel flows (20.5 gph at max cruise) and the risk of running an engine so hard at altitude—the worst combination of conditions for a piston powerplant. High-altitude air is so thin—even though it's usually quite cold—that it's a poor conductor of heat; and, predictably, air-cooled engines suffer.

These new owners were not aided by misinformation about the TLS's engine. In describing the TLS, many aviation writers mistakenly called its Lycoming a kissing cousin of the 350-hp TIO-540 as used in the Piper Navajo Chieftain, among other large airplanes. Surely, went the logic, an engine capable of 350 hp will be well under its potential at 270 hp in the TLS, and 90 percent of that for cruise should pose no serious threat to reliability. Unfortunately, the scribes were wrong. These two engine iterations have remarkably little in common. Indeed, the parallel-valve engine used in the TLS is normally rated at 260 hp without a turbo (but at higher rpm with a greater compression ratio). The 300-hp engine you'd see on, say, a Piper Saratoga is, like the Navajo's engine, a wholly different beast. So this lightweight version of the 540-cubic-inch six-cylinder is anything but loafing in the TLS, to say nothing of running all day long at a heretofore unseen maximum allowable output with POH-specified aggressive leaning techniques.

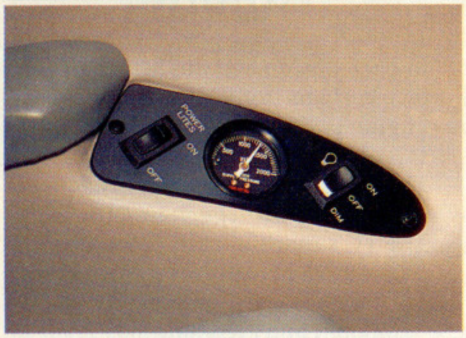
The results, in hindsight, were predictable. A great many TLS owners realized that their new airplanes needed extensive top-end work at 400 to 500 hours—a few more, according to maintenance sources, with as few as 200 hours since new. Exhaust-valve guides bore the brunt of the wear, with a predictable rise in oil consumption and dropping compression scores—there's good news in that these failure modes tend not to lead to the catastrophic. After the warm glow of having a new airplane wore off, many owners discovered that, at about a quarter of the way to TBO, the top end was just plain worn out. Perhaps ironically, the same basic engine is used in the Socata Trinidad TC—without an intercooler and rated at 250 hp—and it has a much rosier maintenance record. The main difference? The TC's manual calls for maximum cruise at 75 percent power, leaned to a TIT limit of 1,650 degrees.

Mooney's Bravo/Ovation panel will hold all the avionics that you can afford.

Mooney and Lycoming have come up with a solution to the TLS's top-end woes in the new Bravo. A feature pulled from the engine-maker's history books—oil-cooled exhaust-valve guides—is aimed at giving this highly stressed engine a chance to live. Lycoming fitted the TIO-540-A1FB with this supplemental cooling system because it had worked so well on the 380-hp TIO-541 Beech Duke engines.

In concept, this so-called *wet-head* conversion is straightforward. Engine oil is fed under pressure to a gallery in each cylinder head adjacent to the exhaust-valve guide. The guide itself has a small groove cut into the outer diameter. This additional oil flow surrounds the guide, wicks away the heat, and then flows through the rocker boxes (where it can take some more top-end BTUs with it) and then through the normal drainback tubes to the sump. This oil is not intended to lubricate the *inside* of the valve guide. Bundle-of-snakes oil lines are the only external clues to the change from A1FA to A1FB, as the Bravo engine is dubbed. Through the end of 1997, Mooney will offer the package to TLS owners at a reasonable price of $5,500, which includes six new cylinders, all the associated hardware, and an allowance for up to 40 hours of labor.

Mooney intends the Bravo to be a traveling airplane, and the company graciously lent me the use of N2063W for a coast-to-coast-to-coast trip. In the past, Mooney has fitted TLSs with avionics packages that bordered on the fantastic. By comparison, 63W was modestly dressed. An AlliedSignal Bendix/King stack centers the suite, with a KLN 89B IFR-approved GPS, KX 165 and KX 155 navcoms, KT 76 transponder, KN 64 DME, KMA 24 audio panel, and KFC 150 autopilot/flight-director with altitude preselect integrated with the KCS 55 horizontal situation indicator. A BFGoodrich WX1000+ Stormscope, Shadin fuel computer, and DRE stereo intercom round out the options. Standard in the Bravo are dual batteries; twin 24-volt, 70-amp alternators; electrically operated speed brakes; a built-in oxygen system; and backup vacuum pump. Those dual batteries are there mainly to offset the weight of the six-jug Lycoming up front, but in concert with the pair of alternators they make for excellent electrical redundancy. The backup vacuum pump is also electric. Weeping-wing deice equipment is optional, allowing flight into known icing conditions. Unless you feel that you really need the available electronic flight instrument system (EFIS), these accouterments should suit you just fine. In fact, the only item missing here is some kind of engine monitor—no turbocharged airplane should be without one.



The Bravo's leather interior is superb, its built in oxygen system a nice touch.

Starting with a base price of $364,950, this Bravo's bottom line swells by $53,750 for the advanced avionics in what's called the Classic/Plus group—basic IFR instrumentation and avionics are standard on the Bravo. A second glideslope receiver and nav head, Bose headset, electric prop deicing boots, an upgrade from the Classic/Plus's standard WX950 Stormscope to the WX1000+, and leather seats help boost the final number to $436,700.

For this sum, you get a tremendously capable airplane. As a big fan of turbocharging, I'm usually the first to defend its cost and complexity. When you have a country to cross, the ability to top weather, move into more favorable winds aloft, and just generally enjoy a smoother, cooler ride pays off big time.

For the first leg out of Long Beach, California, the Bravo managed an initial climb rate of 950 fpm by using the recommended cruise-climb parameters of 120 knots indicated, 34 inches manifold pressure, and 2,400 rpm. Fuel burn, according to the Shadin, was about 26 gph at full rich, and 23 gph leaned to 1,600 degrees TIT. The Bravo will maintain a strong rate of climb through 18,000 feet, above which the

climb rate dips below 500 fpm. Mooney lists the Bravo's maximum rate of climb from sea level—using full power and a high-deck-angle 105 knots indicated—as better than 1,100 fpm. Weight plays a big part in climb performance; leave 250 pounds of stuff at home and you'll pick up 100 fpm at most altitudes.

November 63W weighed a smidgen more than 2,400 pounds empty, leaving 968 pounds in the useful load column. Top off the tanks (89 gallons usable) and you could still carry 434 pounds in the cabin. I flew the airplane solo most of the trip, so typical operating weights were around 3,150 pounds, well shy of the maximum takeoff weight of 3,368 pounds and still under the max landing weight of 3,200 pounds. As a result, the speeds and climb rates noted on the journey generally were better than those in the handbook.

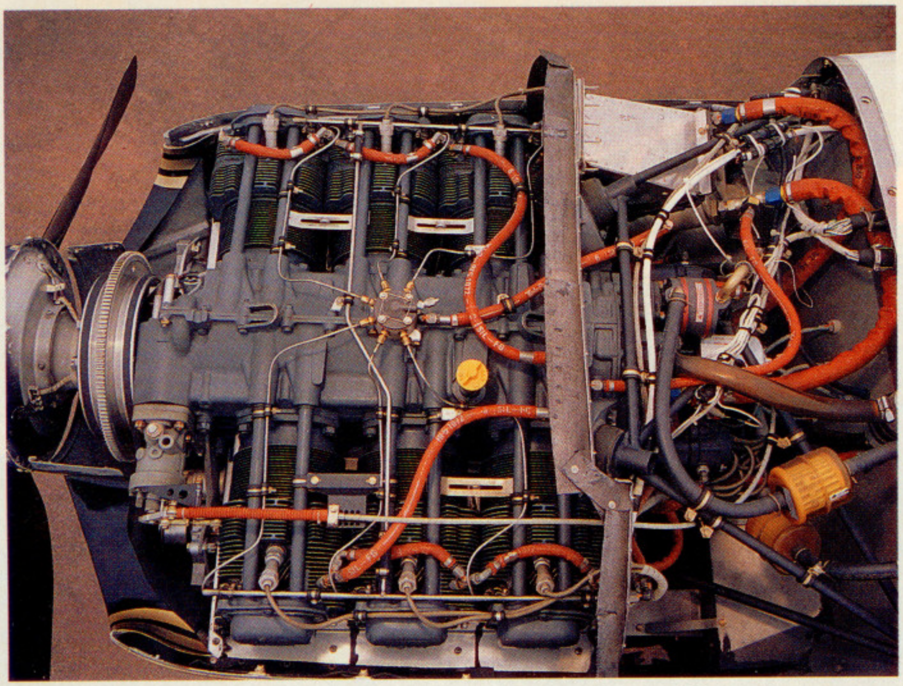
Leveled off in cruise, the Bravo cuts loose with some impressive numbers. Because the weather was beautiful, I started the trip at 17,500 feet, VFR; temperature aloft was some 15 degrees Celsius above standard. Leaving climb power set (34 inches/2,400 rpm, also the maximum-cruise setting) and allowing the airplane to accelerate leaves little to do but close the electric cowl flaps and commence the trim dance—Mooney fits the Bravo with rudder trim, so you get to fine-tune in two axes. Even when leaned to peak TIT—usually very close to the 1,750-degree redline—the Bravo will hit the magic 200 KTAS on 17.5 gph; with the red knob pushed in to best-power mixture (1,650 degrees TIT), the M20M goes about four knots faster on 20.6 gph. At FL250, the Bravo will cruise at 215 KTAS on 20.5 gph—no peak TIT allowed above 22,000 feet to keep engine temps in check.

Mooney did the right thing in 1989 by fitting the TLS (and hence today's Bravo) with a high-caliber automatic turbo system. The Garrett AiResearch TA-04 turbo is managed by sophisticated density/differential controllers and breathes through an air-to-air intercooler. The turbo's operation couldn't be more seamless. Even at high ambient temperatures there was always boost for the taking, and there's little need to tweak the throttle knob during a protracted climb. (A far cry from my Mooney 231 days of constant fiddling to maintain a desired amount of boost, thanks to its fixed wastegate and too-small turbo.) Uprated turbine casings and a more durable exhaust system allow for the 1,750-degree TIT limit.

In the high-power cruise regime, the Bravo's new oil cooling is readily apparent on the engine instruments. Higher oil temperature—by 10 to 15 degrees—is the norm, accompanied by slightly lower cylinder-head temps than before. In addition, changes in power or airspeed take longer to show up on the CHT gauge, the result of the oil's providing a bit of thermal stability to the heads. (That doesn't mean you can just chop power and point the nose at terra firma and not see the CHT needle budge, but the engine seems more temperature-stable.)

At 17,500 feet the Bravo's cylinder-head temperature remained below 400 degrees only at the best-power mixture. Leaned to peak, it would creep to 410 degrees unless the cowl flaps were cracked open—neither Lycoming nor Mooney specifically allow lean-of-peak operation. I tried a few more power settings; each successively lower power setting produced, predictably, less speed on less fuel and reduced engine temperatures. These settings including 32 inches/2,400 rpm (198 KTAS, 16.4 gph), 30 inches/2,400 rpm (189 KTAS, 14.9 gph), and 27 inches/2,200 rpm (172 KTAS, 13.3 gph). There are no percentages of power listed in the power-setting tables, but based on the fuel flows, the 30 inches/2,400 rpm looks to be the 75-percent-power combination. While Mooney has worked hard on getting the shakes out of this installation—and has for the most part succeeded—there was a noticeable shudder in the airframe at lower engine speeds, rendering the 2,200 rpm setting less comfortable than the higher prop speeds.

At the fuel stop in Amarillo, Texas, 3.9 hours after takeoff, the Bravo took 68 gallons, for a block-to-block average of 17.4 gph and 212 knots for the 825-nm trip. A short hop into Ada, Oklahoma, for an overnight and then a fuel stop at Kentucky's Sturgis Municipal the next day completed the trip into AOPA's



Frederick, Maryland, headquarters. All told, the Bravo posted a total flying time of 10.7 hours, for an average of 194 knots over the ground.

Most of the quicker airplanes can tackle a two-day continent crossing without torturing their occupants, but the Bravo's speed, altitude capability, sophisticated and smooth autopilot, and weather-avoidance gear add up to a conveyance that makes such long-distance travel not just endurable, but enjoyable. This point was brought into focus on my return trip. Meetings had delayed my departure from Frederick and—coupled with obligations for the airplane—called for a one-day, into-the-wind westward thrash.

Launching into pale, predawn light, I pointed the Bravo in the general direction of California and, 4.7 hours later, touched down in Butler, Missouri, for fuel. With the Lycoming cranking along at the more moderate 30 inches/2,400 rpm setting—in an effort to extend the Bravo's range a bit—the Shadin typically showed a consumption rate of 15 gph at 16,500 feet. Later in the trip, to maintain visual surveillance on thunderstorms and to avoid the usual turbulence of the desert southwest, I climbed the airplane to FL200 and then to FL220. Even at this comparatively modest power setting, the Bravo trued 192 knots. By midafternoon—with a second stop in Albuquerque for fuel—I was back in Long Beach, a bit tired of sitting in one place and raspy-voiced from being on oxygen during most of the trip, but certainly not ready to crawl into bed for a week. In fact, the Bravo was easily the most comfortable nonpressurized long-distance traveler I've enjoyed. Better, in many ways, than the fondly remembered Mooney 231 that was my ride for three years.

Inevitably, the Mooney faithful compare the Bravo to the more traditional M20s, particularly the vaunted 252—now returned as the Encore. Yes, the Bravo's Lycoming is thirstier and rougher than the smaller Continental in the 231/252 and Encore; and, yes, the Bravo's full-fuel payload is no better than those of the smaller airplanes. But the performance is there for the taking. At comparable percentages of power, the Bravo and the Encore remain separated by about 15 knots. The Bravo's extra power makes for better high-altitude climb and slightly improves runway performance.

Current owners of wet-head TLSs and potential customers for the Bravo might be asking the same question: Does the oil-cooling scheme make the turbo Lycoming worthy of its 2,000-hour TBO? Too early to tell, but the initial indications are promising. The question remaining to be answered is this: Now that the exhaust valve guides are cooler, what is the next-weakest link in the chain? Bravo (and wet-head TLS) owners then face a dilemma square-on: Do you throttle back a bit—to, say, 75 percent of maximum for cruise—and sacrifice about 10 knots for the possibility of greater engine longevity? Or, do you run at maximum cruise—because, as one TLS owner told me, "I didn't buy the airplane to go slow"—and hope the additional oil cooling does the trick? □

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Mooney TLS Bravo
Base price: $364,950
Price as tested: $436,700

Specifications

Powerplant	Textron-Lycoming TIO-540-A1FB, 270 hp @ 2,575 rpm
Recommended TBO	2,000 hr
Propeller	Hartzell, three-blade, constant-speed, 75-in dia
Length	26 ft 6 in
Height	8 ft 4 in
Wingspan	36 ft 1 in
Wing area	174.8 sq ft
Wing loading	19.26 lb/sq ft
Power loading	11.85 lb/hp
Seats	4
Cabin length	10 ft 6 in
Cabin width	43 in
Cabin height	44 in
Empty weight, as tested	2,401 lb
Maximum gross weight	3,368 lb
Useful load, as tested	967 lb
Payload w/full fuel, as tested	433 lb
Max landing weight	3,200 lb
Fuel capacity, std	95 gal (89 gal usable) 570 lb (532 lb usable)
Oil capacity	10 qt
Baggage capacity	120 lb, 20.9 cu ft

Performance

Takeoff distance, ground roll	1,000 ft
Takeoff distance over 50-ft obstacle	2,200 ft
Max demonstrated crosswind component	13 kt
Rate of climb, sea level	1,010 fpm
Max level speed, sea level	168 kt
Max level speed	214 kt
Cruise speed/endurance w/45-min rsv, std fuel (fuel consumption)	
@ 89% power, best power mixture	
25,000 ft	214 KTAS/3.7 hr (123 pph/20.5 gph)
10,000 ft	188 KTAS/3.7 hr (122 pph/20.4 gph)
@ 60% power, best economy	
25,000 ft	187 KTAS/4.8 hr (80 pph/13.3 gph)
10,000 ft	168 KTAS/5.3 hr (77 pph/12.8 gph)
Max operating altitude	25,000 ft
Landing distance over 50-ft obstacle	2,500 ft
Landing distance, ground roll	1,200 ft

Limiting and Recommended Airspeeds

V_X (best angle of climb)	85 KIAS
V_Y (best rate of climb)	105 KIAS
V_A (design maneuvering)	127 KIAS
V_{FE} (max flap extended)	110 KIAS
V_{LE} (max gear extended)	165 KIAS
V_{LO} (max gear operating)	
Extend	140 KIAS
Retract	106 KIAS
V_{NO} (max structural cruising)	174 KIAS
V_{NE} (never exceed)	195 KIAS
V_{S1} (stall, clean)	67 KIAS
V_{SO} (stall, in landing configuration)	59 KIAS

For more information, contact Mooney Aircraft Corporation, Louis Schreiner Airport, Kerrville, Texas 78029; telephone 800/456-3033 or 830/896-8181; fax 830/896-7333; Web (www.mooney.com).

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.