USED TURBINE REVIEW

THE MERLIN IIIs

Big and bold, these workhorses ask a lot but deliver the goods.

BY THOMAS A. HORNE

Let's say you want a big, powerful turboprop that stands tall on the ramp, cruises at 280 to 290 KTAS, has a range of up to 2,700 nautical miles, and can carry up to eight passengers in a fair amount of comfort. A look at today's used market shows that the Merlin III series of turboprop twins are the only ones that can fill this kind of tall order. These aircraft have a near-optimal combination of attributes: strength, power, comfort, range, and fuel efficiency. ■ The Merlin IIIs—which include the models III, IIIA, IIIB, and IIIC—have justly deserved reputations as fire-breathing workhorses. The III and IIIA have 840-shaft-horsepower Garrett TPE331-3U-303G engines. The IIIB and IIIC have 900-shp Garrett TPE331-10U-501G powerplants. All of the III series have maximum gross takeoff weights of 12,500 pounds—right at the upper limit for FAR Part 23 certification. A version of the Merlin IIIC was even certified for a maximum gross takeoff weight of 13,230 pounds under special rules—SFAR 41.

Many Merlin IIIs work as corporate shuttles or serve in an on-demand charter capacity. What makes the Merlin so adept at these roles? Apart from the speed, operators appreciate the large fuel capacity and useful load. The Merlin III's fuel capacity is a whopping 662 gallons, or about 4,416

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pounds. The rest of the series carries 648 gallons of usable fuel, or about 4,322 pounds. Useful loads average between 4,700 and 5,200 pounds.

This fuel load gives the Merlin driver plenty of flexibility. You can fill up the tanks and fly a Merlin III nearly 2,700 nm if there is just one aboard; this makes the Merlin great as a ferry vehicle. It also comes in handy for multi-leg trips where passenger loads are light for the first and/or second legs. At each subsequent stop, you can pick up more passengers as fuel is consumed—all the while tankering enough fuel to eliminate the need to gas up for the leg to the final destination. Or you can fly with partial fuel and still carry a respectable load a good distance. With eight aboard a Merlin IIIB, for example, you can still fly 1,434 nm with reserves. With six aboard, IFR range rises to 1,680 nm. With just three aboard, IFR range leaps to 2,000 nm.

So it's no wonder that the Merlin legend includes long legs as well as speed. But is it the airplane for you? Yes, if you'll be flying often—with a two-pilot crew—and your mission requirements frequently include

multi-passenger flights over long distances. No, if you think this is just another turboprop twin. While it may be perfectly legal to earn your multi-engine rating in a Piper Seminole and then take on a Merlin all by your lonesome, it's not wise. The Merlin can be a bear to fly. When the heat is on, a Merlin neophyte will wish for two heads and four arms to keep things under control. The Merlin's utility comes at a price, and that price is pilot work load, systems complexity, and great attention to maintenance.

Any pilot new to the Merlin is bound to be a bit overwhelmed. Approach it on the ramp, and you're immediately aware of the airplane's sheer size and solidity. There are dual wheels all around, four-blade propellers (in the IIIBs and IIICs), and a massive vertical stabilizer that stands 17 feet tall. It's five big steps up the airstair door, then a 15-foot-long walk through the cabin to the cockpit.

The cockpit is big and wide and loaded with quite a variety of switches and gauges. On the left sidewall panel are nine essential bus transfer switches; circuit breakers for the left essential electrical bus (circuit breakers for the right essential bus and nonessential bus are on the right sidewall panel); ammeters for checking generator output; a voltmeter and voltage selector switch for checking the output of each of the airplane's five sources of electrical power (left and right generators, left and right batteries, and auxiliary power unit); and switches for testing the stability augmentation system (SAS—which in this airplane comprises a stick-pusher) and the Garrett engines' negative torque sensing (NTS) feature.

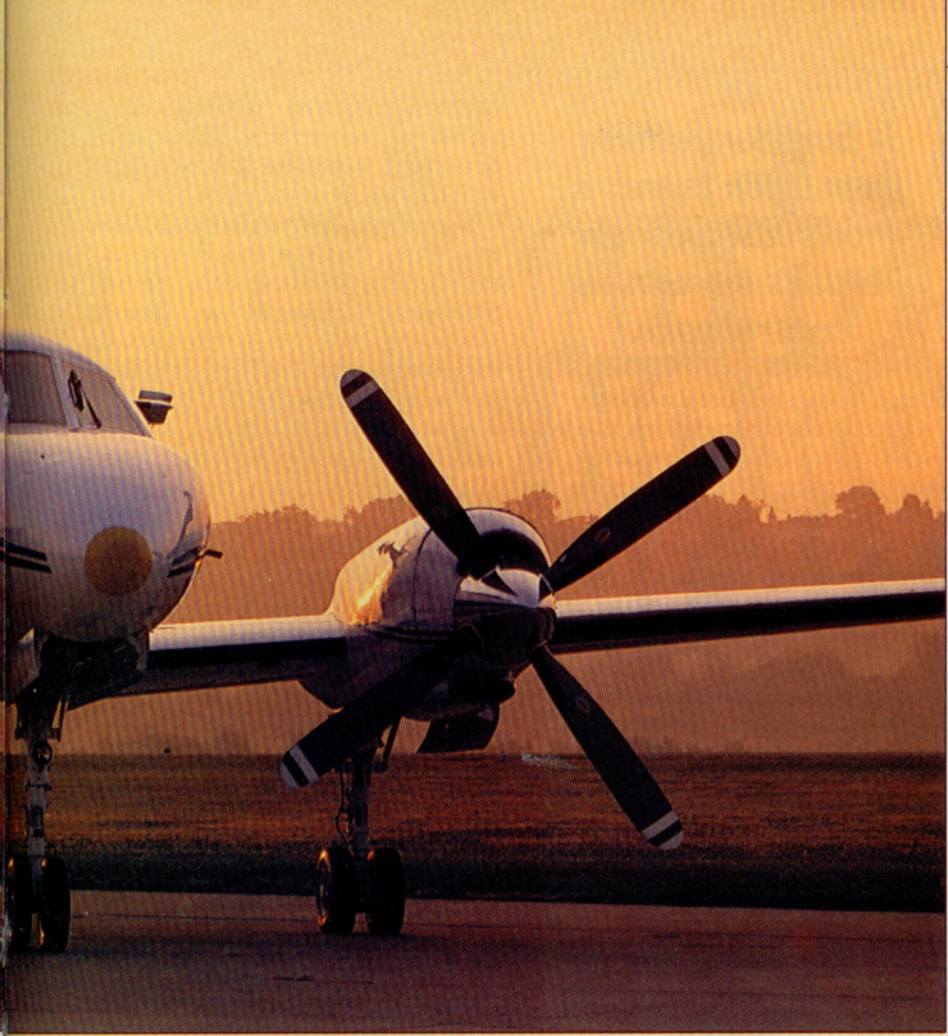
In the event of a power loss, a Garrett turboprop engine would develop huge amounts of drag—and a 200-knot V_{MC}—if the windmilling propeller were allowed to drive the rest of the engine components. The NTS's job is to sense when the propeller begins to do just that. The moment the NTS senses a loss of thrust, it automatically drives the propeller toward the feather position; the blade pitch will settle at about 60 degrees. Though the actual act of feathering—which takes the propeller blade angle to 89 degrees—rests with the pilot, the NTS goes a long way to reducing the drag of a dead or sick engine and the work load of the poor pilot who's faced with controlling the airplane. That's why NTS is a no-go item. The NTS is also tied into a rudder bias system that helps the pilot maintain directional control in engine-out situations.

Also on the left sidewall panel are cabin pressurization controls, switches for selecting the start modes (batteries in parallel or series operation; the latter for cold conditions when more power is needed to turn all the Garrett's gears and wheels), and even more switches for testing the engine temperature-limiting and single-redline computer functions. A small button labeled "Park" is part of a group of three switches dealing with the nosewheel steering system. Push this button, and the nosewheel is free to swing through a 60-degree arc, allowing for sharp turns in tight quarters. In normal operation, the nosewheel turns just 10 degrees either side of center.

There are a few more controls and switches, but you get the idea. For a single sidewall panel, there's a lot going on. It's a strong hint that the Merlin's systems complexity matches the airplane's size.

The instrument panel is fairly straightforward for a turboprop, but all along the Merlin's subpanel are white, panel-style electrical switches. They all look the same, which could cause confusion for those new to the type. Here, you'll find the ice protection switches, battery, generator, exterior light, inverter, and windshield wiper controls, to name just a few. A cluster of four buttons make the Garretts start and stop. Two toggle switches control engine bleed air valves.

As if all this might be bewildering, check out the center console. A few things will be familiar—the power and propeller levers, the landing gear switch, and the trim wheels—but there are a few eye-catching extras. Two large red knobs let you cut off fuel to, and feather, the engines. A paddle-shaped trim selector switch gives pitch trim control to either the pilot or copilot, and a small toggle switch in front of the right prop control turns on the Garretts' alcohol/water injection (AWI) system. This optional system directs a spray mixture of alcohol and water into the engine compressor inlets. A throwback to the very early days of the turboprop era, water injection provides extra engine power under hot and high conditions. The



water lowers exhaust gas and turbine temperatures, letting the pilot apply more power (as reflected on the engine torquemeters) without running the risk of over-temping the engines.

No manual pitch trim wheel, you say? That's because pitch trim is all-electric and driven by dual trim actuators, backed up by an auxiliary system for emergency use.

It all adds up to a pretty quirky office arrangement, one that even veteran Merlin pilots agree can be challenging.

For our familiarization flights, Larry Davis, chief pilot of Cincinnati's Lunken-based A/M Transport, Incorporated, took us up in the company's 1980 Merlin IIIB. A/M bought its Merlin in 1991 for $695,000, which brings up another appealing attribute of the series. Depending on age (the III series was built from 1970 to 1983) and condition, used Merlins sell for anywhere between $250,000 (for a high-time 1970 III with engines close to their 5,400-hour time between overhauls) and $990,000 (for a 1983 IIIC with SFAR 41 approval). For such a large, versatile airplane, a used Merlin can be a tempting alternative to buying a newer but more expensive airplane of comparable ability.

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The Merlin door bears structural loads and must be closed before the airplane is towed. The nosewheel steering button comes in real handy at the start of the takeoff run.

Starting the Merlin is a snap. Just push the start button, and an automatic start sequence begins. Keep one hand on the appropriate red fuel-cutoff/feather knob in case the EGT passes the 770-degree-Celsius redline for starts, signaling a hot start.

Most Merlins, and many other Garrett-powered airplanes, are fitted out with a single-redline (SRL) system. This is a system that automatically calculates engine redline for nonstandard density altitudes and a variety of other variables, and a feature that's needed to preserve the correct relationship between turbine inlet temperature and EGT. For the pilot, the SRL operates unobtrusively. It takes airspeed, ambient pressure, engine inlet temperature, engine rpm, and EGT readings and computes a corrected EGT. Under standard conditions, a 650-degree-Celsius redline applies, and it's marked on each engine's EGT gauge. Regardless of ambient conditions, the pilot uses the same, unwavering redline as marked on the gauges—even though the real, computed redline may be lower. In the event that the SRL fails its preflight check, the pilot must consult a chart to determine the correct redline, bearing in mind that a 560-degree redline limitation now applies.

With the propellers in low rpm, taxiing is via electrically actuated, hydraulically powered rudder pedal steering. The result is delayed-action power steering. Soon, I'm weaving my way toward Lunken's Runway 20R.

For takeoff, the propeller controls are set at high rpm. Propeller rpm rises from 1,330 to the maximum of 1,591 rpm. Now the rudder steering is disabled, unless the nosewheel steering button on the left power lever is depressed. In the absence of this mode of steering, alternate steering power during the takeoff run is available either by differential braking or through aerodynamic steering as the airplane builds speed.

Following Davis's suggestions, I bring the power up to 20 to 30 percent torque. The "Beast" (Davis's word) comes to life with such vigor that the thing started creeping forward, even though I am standing on the brakes.

Davis is a friendly, patient type, but now his voice takes on a certain urgency as the time to launch this 1,800-shp, six-ton hulk draws ever nearer. We've already been through the litany: Power up to 75 or 80 percent torque, he'll call airspeed alive; check that the EGT doesn't exceed the 650-degree redline; let go of the steering button as we blast toward the 80-KIAS speed for beginning the rotation; lift off, positive rate; trim for the 135-KIAS blueline; gear and flaps up; then climb out at a more normal climb speed of 175 KIAS.

The acceleration is terrific, and soon we're airborne. A pair of blue Bypass annunciators illuminate, signaling that I've added a bit too much torque. This is another part of the engine temperature-limiting system, and lighted annunciators mean that fuel is being bypassed away from the combustion chambers. Like the single-redline system and the water injection, this fuel bypassing is a way of preventing an engine over-temp. Pulling back slightly on the power levers stops the bypassing and makes the lights go out.

If function follows form, then there's a good reason for the Merlin's monstrous control yoke. This is an airplane you muscle across the sky. While pitch and rudder forces seem about right for an airplane of this size,

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aileron forces are more than hefty.

In single-engine operations, this feature is particularly noteworthy. To prove the point, we set the airplane up at altitude for a simulated engine failure on takeoff. With gear and flaps down, we slowed to 90 KIAS—provoking the SAS to begin nudging nose down—then applied takeoff power. While climbing out at about 150 KIAS, Davis asked that the left engine be feathered.

The sudden loss of thrust was a real shocker. In no time flat, airspeed was bleeding away to blueline, and I was wishing for those four arms. The yoke was full over to the right; my right leg pushed the rudder to the floor and began shaking with the effort to keep the "Beast" on heading—this in spite of the extra 40 pounds of force applied by the rudder bias system.

Davis helped by raising the gear and flaps, but the end result was rather disappointing. After nailing blueline and waiting for what seemed like forever, the rate of climb finally rose from a sickly 200 feet per minute to a more respectable 700 fpm. The drag of the landing gear is immense, so if there's an engine failure right after takeoff, the Merlin won't be climbing for a while—in spite of the remaining 900 shp.

Stalls proved to be nothing out of the ordinary, but they do give a good demonstration of the SAS. As airspeed falls off, the glareshield-mounted angle-of-attack indicator heads for the red arc. Just prior to the stall, the stick-pusher reaches its maximum, applying 48 pounds of nose-down force. If you fight it, the Merlin buffets a few times, then noses over into a healthy descent rate. Stall recovery requires great gobs of power and precise air-

1980 Swearingen Merlin IIIB
Base price, new: $1,695,000
Current market value: $670,000–$750,000

Specifications

Powerplants	Two Garrett TPE331-10U-303G, 900 shp
Recommended TBO	3,600 hr
Propellers	Two Hartzell HC-B4TN-5EL full-feathering, reversible thrust, four-blade, 106-in diameter
Length	42 ft 2 in
Height	16 ft 10 in
Wingspan	46 ft 3 in
Wing area	277.5 sq ft
Wing loading	45 lb/sq ft
Power loading	6.94 lb/shp
Seats	8–11
Cabin length	17 ft 5 in
Cabin width	5 ft 2 in
Cabin height	4 ft 9 in
Empty weight	7,800 lb
Max ramp weight	12,600 lb
Useful load	4,700 lb
Payload w/full fuel	358 lb
Max takeoff weight	12,500 lb
Max landing weight	11,500 lb
Zero fuel weight	10,000 lb
Fuel capacity, std	650 gal (648 gal usable) 4,355 lb (4,342 lb usable)
Oil capacity, ea engine	3.6 qt
Baggage capacity	700 lb, 105 cu ft

Performance

Takeoff distance, ground roll	2,180 ft
Takeoff distance over 50-ft obstacle	3,219 ft
Accelerate-stop distance	4,060 ft
Accelerate-go distance	2,700 ft
Max demonstrated crosswind component	22 kt
Rate of climb, sea level	2,782 fpm
Single-engine ROC, sea level	723 fpm
Max cruise speed, 12,000 ft	309 kt
Cruise speed/endurance w/45-min rsv, std fuel (fuel consumption, ea engine)	
Max cruise power, five passengers 12,000 ft	290 kt/4.7 hr (109 gph/730 pph)
Long- range cruise power, five passengers 28,000 ft	269 kt/6.1 hr (71 gph/475 pph)
Long-range cruise, ferry profile, one passenger 29,000 ft	240 kt/9 hr (60 gph/400 pph)
Max operating altitude	31,000 ft
Single-engine service ceiling	16,500 ft
Landing distance over 50-ft obstacle	2,200 ft
Landing distance, ground roll	1,050 ft

Limiting and Recommended Airspeeds

V_{MC} (min control w/critical engine inoperative)	107 KIAS
V_{SSE} (min intentional one-engine operation)	125 KIAS
V_X (best angle of climb)	105 KIAS
V_Y (best rate of climb)	141 KIAS
V_{XSE} (best single-engine angle of climb)	116 KIAS
V_{YSE} (best single-engine rate of climb)	135 KIAS
V_A (design maneuvering)	190 KIAS
V_{FE} (max flap extended)	212 KIAS/8 degrees 177 KIAS/20 degrees 153 KIAS/40 degrees
V_{LE} (max gear extended)	173 KIAS
V_{LO} (max gear operating)	173 KIAS
V_{NO} (max structural cruising)	261 KIAS
V_{NE} (never exceed)	261 KIAS
V_R (rotation)	107 KIAS
V_{S1} (stall, clean)	99 KIAS
V_{SO} (stall, in landing configuration)	88 KIAS

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.

speed management to prevent overcontrolling in pitch.

Landings were fairly straightforward. Like any turboprop, you fly the Merlin by the numbers. About 15 miles north of Lunken, we slowed to 200 KIAS, then put out half flaps at the V_{FE} of 177 KIAS. On downwind, the gear was extended at 160 KIAS—well below the 173-KIAS V_{LO}—and 150 KIAS was maintained until turning final. By the time we're 2 miles out on final, we've slowed to the blueline of 135 KIAS, and the visual approach slope indicators are showing white over white. Now it's time for full flaps.

At this point, Davis suggested using fuel flow as a measure of the proper power setting. Pulling the power levers back to 230 pounds per hour per side at 500 feet agl resulted in 120 KIAS for short final. With vigorous nose-up trimming, touchdown can take place as low as 80 KIAS. Squeeze the power lever triggers, pull the props into beta, then reverse, and you might make the first turnoff.

Takeoffs using the water injection system were a bit more sprightly, though the extra power isn't really noticeable until the system is turned off. After an AWI takeoff, Davis turned off the water at 500 feet agl. The Merlin seemed to decelerate so much so that you feel yourself pressing forward against the shoulder harness.

A/M uses its Merlin for charter work, along with a Lear 35. If passenger loads are light and time is a factor, the Lear gets the call. But if there's six or more passengers, the Merlin's the airplane of choice. In a typical year, A/M's Merlin flies 400 hours, usually on multiple legs of 200 to 750 nm, and

Stall recovery requires great gobs of power and precise airspeed management.

usually in the 21,000- to 23,000-foot altitude range—where its 7.0-psi pressurization system keeps the cabin at a comfortable 2,000 feet. The IIIB is certified to 31,000 feet; its predecessors, the III and IIIA, have maximum operating altitudes of 28,000 and 28,900 feet, respectively. The heavier IIIC is limited to 27,000 feet.

Fuel consumption for A/M's IIIB averages 670 pph (100 gallons per hour) in the low 20s, and Davis flight plans the airplane for 280 KTAS. Except for some operations that give its Merlins heavier duty in roles such as hauling checks or freight, A/M's mission profiles are fairly typical of the fleet at large.

Owners and operators of the Merlin III series have two ways to approach the airplane's regular maintenance requirements. The customer support organization of Fairchild Aircraft, owners of the Merlin's type certificate, strongly recommends a four-stage system of "letter checks" for annual maintenance. Letter check A involves inspection and maintenance of the engines and propellers, plus a look at the upper and lower center fuselage sections. Letter check B requires an inspection of the cabin subfloor structure, plus maintenance of the brakes and landing gear and checks for oxygen and hydraulic leaks. Letter check C is another check of the engines and props, with a look at the generator control panels and bleed air lines and wing inspection. The D check takes in the nose and tail and comprises a check of the batteries, trim actuators, and weather radar.

As for time between overhauls, the Merlin III and IIIA's 840-shp -3U engines can go for 5,400 hours before facing an overhaul. The IIIB and IIIC's 900-shp, -10 engines have 3,600-hour TBOs. Operate under an FAA-approved aircraft inspection program, and a schedule of progressive maintenance phase checks applies. Whether you use the letter checks or progressives, the Merlin is a maintenance-intensive airplane. For such a systems-heavy airplane, it's what you'd expect.

Still, the Merlin IIIs are aging well. These are very strong airplanes, built to Transport-category standards and with dispatch reliability in mind. In this regard, the airplane has benefited greatly from the commuter and regional airline experience of its sister airplanes—the Metro II and III. The Merlins and Metros share the same wing, tail, and other structures and have redundant load-path, fail-safe wing attach points. The pressure vessel is built to fail-safe standards too and has a 25,000-hour life limit.

There have been few reports of corrosion and relatively few major airworthiness directives. In the early 1980s, there were ADs requiring a redesign of the engine air inlets so that ice shed from the propeller spinner would not cause flameouts. Another icing AD required the installation of an automatic-relight engine ignition system that would energize if any ice caused a decay in engine torque or rpm. Periodic inspections of the SAS, windows, and control cables are the subjects of major recurrent ADs. The most recent AD (93-07-12) mandates a beef-up of the outboard elevator hinges.

A spate of three in-flight, loss-of-directional-control accidents (two of them killing all aboard) led to AD 92-18-7. It was widely believed that the accidents were caused by the pilot inadvertently pulling a power lever back through the beta gate while in flight. This would allow a propeller to go to flat—or reverse—pitch in flight, causing an unavoidable V_{MC}-type rollover of the type that occurred in the two fatal crashes. The AD required that the aluminum gates be replaced with sturdier ones made of stainless steel.

According to figures provided by turbine aircraft accident analyst Robert E. Breiling Associates, the Merlin III series has had a total of 37 accidents, 14 of them fatal. Trends that emerge are improper IFR operations and duck-unders (four fatal accidents) and five accidents where the airplane swerved off the runway after landing.

The first Merlin III rolled off the line in late 1970, and 50 were built. The IIIA, with 43 sales, was produced from 1975 to 1978. Next came 71 IIIBs, built from 1979 to 1981, followed by the IIICs. The last IIIC left the factory in 1983, and only 26 of that type were built. The last model in the series—the Fairchild 300—was manufactured from 1984 to 1986. The 300 had winglets, redesigned ailerons, better single-engine climb performance, and shorter landing distances than its predecessors. However, with just 10 sold, it's a rare bird indeed.

The best buy in the III market today would depend on your needs. An early

III would give you more speed, range, and useful load for the buck. The IIIB has 60 more horsepower per side, lower drag due to new wing and tail fairings, the rudder bias system, four-blade props, and lower interior noise levels, but it can run twice the price of a rapidly aging III. Still, for most operators, the edge would have to go to a well-kept IIIB—with water injection—like A/M's. For the same price as a Piper Cheyenne II, Cessna Conquest I, Commander 690, or Beech C90 King Air of comparable vintage, you'll go anywhere from 20 to 60 KTAS faster and fly hundreds of miles farther, carrying a bigger load.

If this is the kind of performance you're looking for, a Merlin III series might be your cup of tea. Just make sure you take regular proficiency training at FlightSafety International, or other programs familiar with the airplane, to stay current in abnormal and emergency procedures, and don't skimp on the maintenance. The Merlin's a substantial airplane with substantial demands. Treat it lightly, and the beast can bite back. □

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