PRODUCT UPDATE

Eurocopter AS350B3—more power, new displays

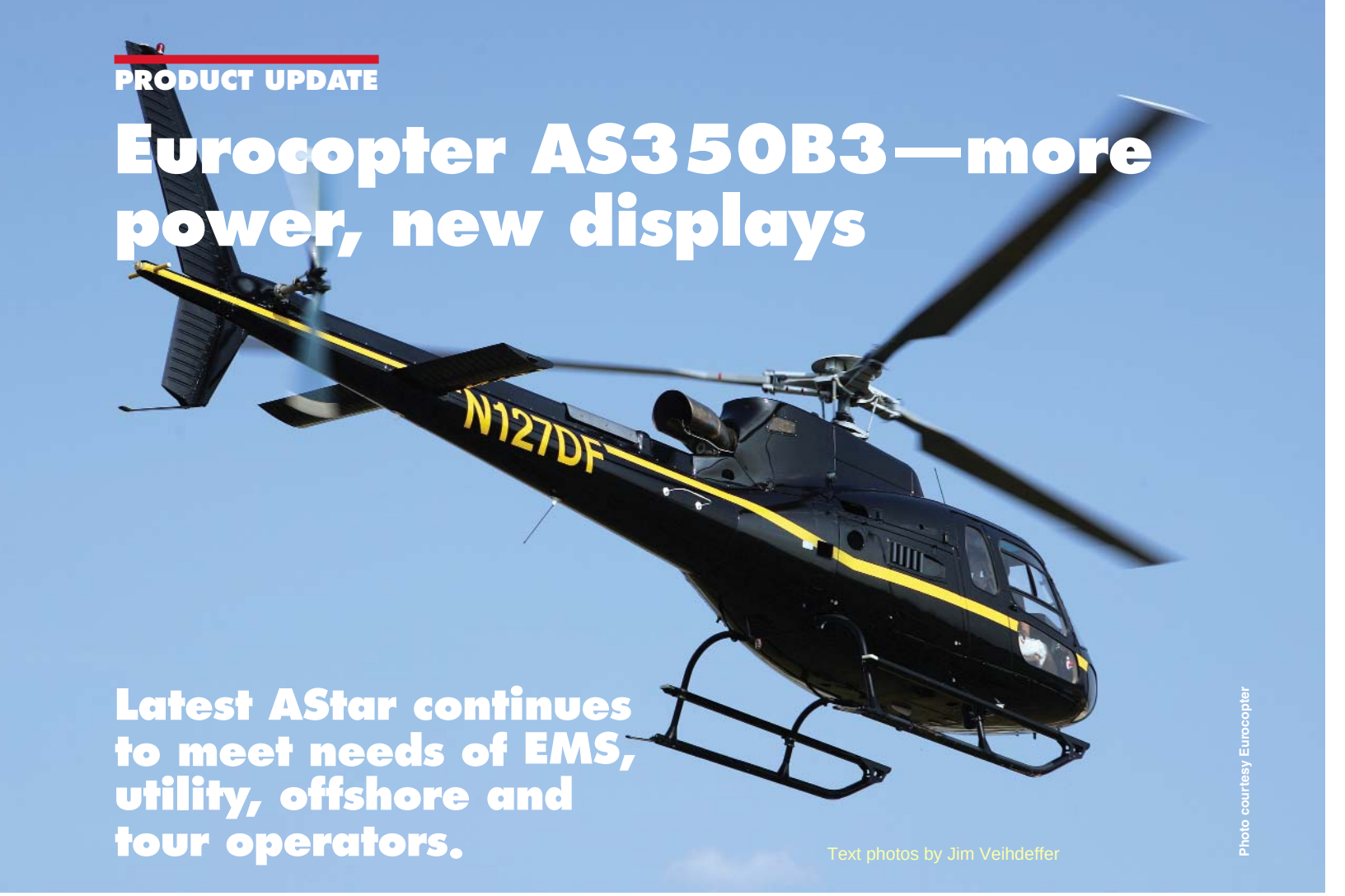


Photo courtesy Eurocopter

Latest AStar continues to meet needs of EMS, utility, offshore and tour operators.

Text photos by Jim Veihdeffer

By Woody McClendon
ATP/Helo. Challenger, Citation III, Bell 412, Bell 222

Eurocopter's AS350B3 AStar offers a significant increase in power over earlier versions. It also has FADEC and a larger tail rotor.

Eurocopter's predecessor, Aérospatiale, first brought its products to the US in the 1970s. The Alouette II was a gangly framework of a helicopter lacking the style of the Bell JetRanger and the speed and performance of the Hughes 500. But Aérospatiale was relentless in its commitment to the American marketplace and soon offered its Alouette III—a larger, more powerful development of the Alouette II. This helicopter quickly found a place in the US commercial market, because of its high-altitude performance, and in the newly emerging EMS community, which adopted the Alouette III because of its large cabin.

But it still bore the open airframe look of its predecessor and lacked cabin amenities. If Aérospatiale was going to launch a serious challenge to the JetRanger, a sleek, modern helicopter was the only answer.

Enter the AStar—the American name for the AS350 Ecureuil (French for squirrel). Aérospatiale's label for the new helicopter highlighted its maneuverability but was unpronounceable for Americans.

In France, the military bought the AS350 and used it as a scout ship and utility transport. The AS350 sported a large, open cabin with panoramic windows and a stylish fuselage. Aérospatiale was ready to take on Bell Helicopter at a time when Bell and Hughes dominated the US commercial operator market and Americans were prejudiced against European helicopters.

Aérospatiale's sales people were constantly on the defensive when it came to the AStar's Starflex rotor system—a breakthrough composite rotor head that eliminated hinges, bearings and grease. Ironically, the AStar's actual weak link was its American engine—the Lycoming LTS101, a high-tech powerplant with design and manufacturing innovations that promised modular maintenance and low cost. Those promises went unfulfilled as the early LTS101s flew apart in flight and frequently failed maintenance checks. So many LTS101s were out of service at any one time that no spares were left in the system. If his engine developed a problem, an AStar owner could expect to be out of service for weeks.

But Aérospatiale stayed the course. Its sales team would fly company demonstrators anywhere at any time for a prospective sale. The AStar gained respect in the marketplace as customers lauded its spacious, quiet cabin and smooth ride. Ridding itself of a major problem, Aérospatiale replaced the LTS101 with the French Turbomeca engine, greatly improving powerplant reliability as well as tapping the potential for improved variants with more horsepower.

Aérospatiale and Messerschmitt-Bölkow-Blohm (MBB) merged into a new European entity—Eurocopter. Their combined product line was a formidable player in not only the American marketplace but the rest of the world. Eurocopter committed itself to an aggressive product growth program. The AStar evolved from the original AS350D to the AS350B with introduction of the Turbomeca powerplant, and then went on to more variants with a host of improvements, larger rotor blades, more horsepower and better quality and fit. Following the AS350B, BA and B1, the AS350B2 featured a Turbomeca Arriel 1D1 engine with over 700 shp and an improved electrical system to accommodate modern avionics.

By now the AStar had carved out a major share of the US market. Tour operators exploited the roomy cabin using a 6-place seating configuration to maximize passenger loads. Since tour flights are relatively short, operators could carry full passenger loads and trade fuel for payload. Their customers enjoyed a dramatic view through the large windows and ease of entry and exit through the large sliding doors.

Entering the US market

Eurocopter began to make inroads in all the major US markets. Law enforcement agencies used the spacious instrument console to build in their ever-increasing inventory of communications and surveillance equipment. Police pilots and observers found new levels of comfort and back support in the spacious crew seats.

The improved AStar proved to be a workhorse for commercial operators on remotely-based US Forest Service contracts where its simple, rugged airframe was easy to maintain. Helitak crews liked the aircraft's large sliding doors and spacious cabin that accommodated their bulky gear packs.

As the EMS business retrenched from its first generation of fleet expansion to a more cost-driven structure, single-engine helicopters that were once ignored in favor of twin-engine models returned to the forefront. The AStar's spacious cabin was once again an asset and AS350s were soon flying patients from accident scenes to trauma rooms.

Eurocopter committed to making the AStar even better. The AS350B2 had amassed a record of reliability and performance, yet there was a clear need for more hot-day/high-altitude performance.

In 1997, Eurocopter introduced the AS350B3. It incorporated a host of improvements, most notably a larger tail rotor and a new Turbomeca engine—the Arriel 2B1—with an additional 115 shp.

Pro Pilot magazine and this writer performed a flight report on the B3 in 1997 with one of the first helicopters of the type in the US. While we were doing that flight, another AStar joined us for air-to-air camera work. As we hovered over a rugged peak in the foothills of the Rocky Mountains, the camera ship moved in for a close-up and flew over our ship, no more than 50 ft above us. I braced for the severe downwash and possibly being forced onto the rocks beneath us. As the B3 shuddered in the downwash blast of the camera ship, I added a minor amount of collective pitch and easily managed the yawing with the pedals. We continued the hover well within all power and control limits. We couldn't have designed a more dramatic demonstration maneuver.

McClendon flies a speed data point demonstrating the 130-KIAS-plus cruise of the AS350B3. Note airspeed indicator.

Photos by Jim Veihdeffer

Eurocopter has continued to improve the B3 since its introduction. We had the opportunity to fly a newly-delivered B3 and review the enhancements added since the first deliveries in 1997.

AS350B3 s/n 4204, N4204 was delivered to Omniflight Helicopters last year. One of the major EMS operations in the US, Omniflight Helicopters is based in Addison TX and operates more than 75 aircraft from 60 bases throughout the US. With a history that spans the entire breadth of the commercial helicopter business, even including scheduled airline operations, Omni now focuses solely on EMS work.

N4204 entered service in Sep 2007 after installation of an EMS interior by a third-party vendor. Omniflight operates a large fleet of AS350B2s and B3s, so we had the opportunity to compare B2 and B3 configurations.

B3 enhancements

Major enhancements Eurocopter engineered into the B3 are as follows.

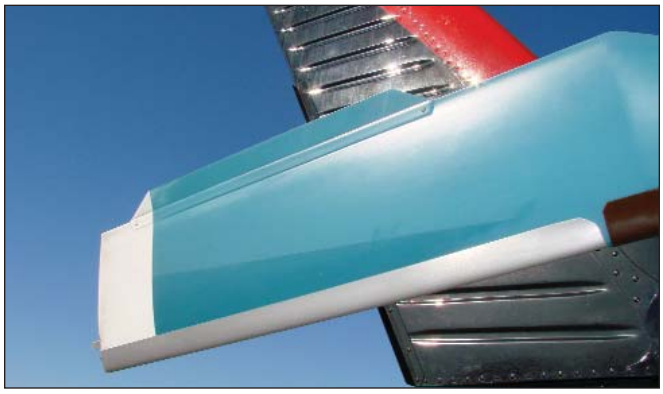
- Increase in takeoff horsepower from 732 shp to 847 shp.
- Introduction of full authority digital engine control (FADEC).
- Introduction of the vehicle and engine management display (VEMD) to replace individual engine instruments.
- Removal of one fuel boost pump.
- Addition of larger-chord tail rotor (from the AS355 TwinStar)
- Enhanced oil tank level sight gauge display.

These changes are significant improvements but, since they are all "under the hood," it's hard to tell a B3 from earlier AStar variants. The B3 does have one unique identifying feature, however. Since the Arriel 2B1 engine exhaust is hotter than the B2's Arriel 1D1, it can potentially cause heat damage to the tail rotor driveshaft cover. So Eurocopter installed a shiny steel heat shield along the top of the tail boom. If you see that steel heat shield, this is the clue that you're looking at a B3.

From the pilot's seat the differences are numerous. Gone are the floor-mounted starting lever, rotor brake and fuel shutoff, replaced by a FADEC switch for start and shutdown and overhead-mounted rotor brake and fuel levers.

The instrument console is dominated by the dual flat panel display for the VEMD just to the left of the

Because of its higher exhaust gas temperature, the AS350B3 sports a stainless steel shield on the tail boom to protect the aluminum structure. The shield is the easy way to tell the B3 from its predecessors.



The B3 tail rotor has a wider chord than previous AStar tail rotors to provide more antitorque control, balancing the additional power from the Turbomeca Arriel 2B1 engine.

(Above) On the AS350B3, power gauges have been replaced by a vehicle and engine management display—a sophisticated flat panel unit that displays a single-needle gauge called a first limit indicator that combines the 3 limiting engine parameters into the single needle, simplifying power management for the pilot. (Below) The center console offers a new style, cooler operating push switch for system controls and lights.

primary flight instruments. Several line buttons, sited vertically along the right side of the unit, control power-on, brightness and other management functions. The VEMD powers up with the Batt switch turned on. The top display shows the 3 primary power parameters—gas generator rpm (NG), turbine temperature (T4) and torque.

After the engine is started, the display changes to first limit indicator (FLI), which is a simple arc dial marked from 0–11. It integrates the 3 power parameters. A combined limit of 10 is marked with a yellow arc from 9.6–10 and a red line at 10. Values of the 3 power parameters are shown vertically along the right side of the display. If one of these increases to its designated caution level, that parameter is underlined in yellow. Bleed valve position is shown in the upper part of the display with a green-and-white indicator. The icon disappears when the valve closes.

Fuel quantity is displayed with a color vertical scale and a digital display along the left side of the window. OAT is shown in the lower right-hand corner.

The lower VEMD display shows oil pressure and temperature as well as DC bus voltage and generator output in amps. This is called the vehicle page. A small switch on the collective allows the pilot to toggle through 2 other pages—engine power check (EPC) and performance (a page that computes IGE and OGE hover ceilings based on a weight programmed by the pilot). OAT and altitude data are input by the VEMD system. The EPC page records engine power check data. If a mission is going to be performance critical, the pilot can use the performance page to anticipate when the helicopter is approaching either the IGE or OGE limit for the day's conditions.

When the helicopter is shut down at the end of a flight, the lower display defaults to the flight report page. This page shows a flight number (which is incremented automatically), flight time, and engine gas generator (Ng) and free turbine (Nf) cycles.

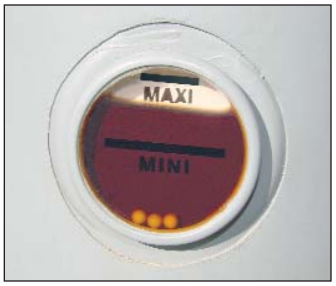
If any limits are exceeded on the flight, a yellow "Over Limit Detected" warning will be shown. And if the VEMD detects any of more than 900 system failures, a yellow "System Failure Detected" message will show. Further detail is available to maintenance technicians, who can use a combination of the line keys to bring up maintenance reports. All the flight and maintenance data, including the power checks, can be downloaded to a laptop via an optional port.

In newer B3s, the electrical console is a compact set of jet-airplane-like pushbuttons replacing the older plastic plungers that got uncomfortably hot to the touch. The new pushbuttons are backlit with a small green light indicating that the function is powered on. And the buttons that control system items that should be on intermittently, like the fuel pump (only on for starting in the B3) and landing lights, have small blue lights as reminders.

The FADEC switch configuration varies from the earliest B3s to the current version. The early B3s have 2 switches on the instrument panel—one labeled Auto–Man, the other Off–Idle–Flt. The Auto–Man switch stays in Auto unless a FADEC degradation occurs, in which case the pilot switches to Man and

Rotor brake and fuel shutoff levers have been moved from the floor to the overhead position in the AS350B3 for easier pilot access.

After several variants of FADEC switch configuration, Eurocopter has settled on a single guarded switch mounted overhead in the latest B3s.



An improved oil level sight gauge on the B3 has engraved, labeled level markers for max and min.

reverts to a manual, twist-grip throttle to maintain rotor rpm within limits. To start the engine, the pilot places the Off–Idle–Flt switch in Idle and the FADEC completes the start sequence. Once the pilot is ready to fly, he places the switch in Flt. The FADEC increases the rpm to the operational range and the helicopter is ready for flight.

As Eurocopter improved the FADEC system, the switch setup went through a number of variations. The latest version, as in N4204, is pure simplicity—a single switch mounted in the overhead panel and labeled Off–On. This configuration reflects an improvement in the FADEC system. Previous versions operated on a normal mode with a manual mode as backup. The current FADEC is full-time dual-channel, with an electrical reversion mode as a third-level backup.

Flying the B3

Our evaluation flight focused on getting photographs of the VEMD panels and the new electrical console in flight, and documenting a few performance data points. Our takeoff gross weight with 60% fuel (560 lbs) and 2 people was 4314 lbs. That fuel load would allow us 2 hours of flight to dry tanks. Given the 4960-lb maximum takeoff gross weight, we would take off at 87% of gross.

EMS helicopters are heavily loaded with medical gear, and N4204 is no exception. The typical utility B3 weighs about 2900 lbs empty. N4204's empty weight was 3315 lbs. Temperature was ISA +10 and the heliport was at 1980 ft msl. For these conditions, our OGE hover weight limit was 5913 lbs, which we could achieve theoretically in external load configuration. (Maximum external load gross weight is 6172 lbs.) Our OGE hover ceiling at our departure weight and ISA temperature state was 13,000 ft.

With doors secured and the photographer briefed and belted in, I completed the pre-start checklist and selected On with the FADEC switch. Ng accelerated through 25% and the main rotor began to turn. At about 50% Ng the starter cut out as scheduled. I set the little red guard on the start switch, turned off the boost pump, turned on the generator and completed the post-start items. These include a hydraulic system check to ensure that the servos have the correct amount of accumulator pressure as a backup in case of system failure.

Once we were ready for liftoff, I snapped the collective guard off and lifted the AStar to a hover. The AStar has the very light touch of a JetRanger and is fairly stable in a hover.

Most AStars hover in a near-level attitude with slight nose-high and nose-low variations depending on their individual CG. The Starflex composite rotor head generates a lot of control power—almost like a rigid rotor system. The pilot has all this control power available to him/her to correct for asymmetrical payloads and gusty winds. This is especially useful in the EMS world, because exact patient weights are sometimes hard to determine in the press of an emergency. With the patient on the left side of the lateral centerline, the pilot is prepared to make right cyclic corrections on the initial entry to a hover. With the Starflex rotor system that magnitude of correction is well within authority limits.

We entered a vertical climb to exit the heliport obstacle envelope using about 70% FLI and generating an 800-fpm climb. Once we were clear, I eased the nose over and added more power to accelerate to maximum cruise. Interpolating the technical chart for fast cruise showed that we would see 135 KTAS, which computed to 128 KCAS. With the AStar stabilized at 2500 ft msl, the airspeed indicator showed 130 KIAS—slightly better than the calculated data point. Fuel flow was 47 gph.

Vibration was minimal—in fact, a cup of coffee I had brought, hoping to grab a sip, showed only a few small rings in the liquid. On this flight I was wearing a helmet but other flights I've done in this AStar with a David Clark headset demonstrate a very low sound level. With executive interior soundproofing, it seems entirely possible that passengers would experience noise levels no louder than a turboprop airplane. Imagine how nice it would be to fly in a helicopter without headsets!

Eurocopter's AS350 has become the premier single-engine civilian helicopter. Increasing numbers of law enforcement agencies, EMS programs and commercial operators are taking advantage of the AStar's many mission attributes. Operators and passengers appreciate its mechanical simplicity and reliability, its excellent performance and spacious cabin surrounded by glass—not to mention its stylish looks. And Eurocopter continues to improve the AStar, further increasing its utility and comfort.

Woody McClendon is a sales executive with a major aircraft company. He flies jets and helicopters.