

The Eagle Flies



In a relatively short time, Eagle Technologies has gone from bit player to principal actor in rotary-wing component design and manufacturing

By Robert W. Moorman

Growth has always been a solid barometer for success and Eagle Technologies LLC has growth in spades.

Eighteen years ago, this veteran-owned business started with two employees, one of which was the company founder. Today, Eagle employs 70 people and has moved five times to accommodate its growth. The company will soon move from its 59,000 ft² (5500 m²) facility in Hampton, Virginia up the road to a sprawling 220,000 ft² (20,440 m²) manufacturing center in Newport News.

Sikorsky Support

Eagle is known for producing various components for fixed and rotary-wing aircraft. It manufactures radomes for Boeing's intelligence-gathering aircraft, the inlet door and engine air system for the Sikorsky S-76D, and the avionics door for the Sikorsky UH-60A/L Black Hawks. But it is Eagle's original design of composite structures and rapid prototyping capabilities that

This image, shot by Sikorsky for our Nov-Dec 2014 issue of Vertiflite, highlights the X2 and S-97 blades built by Eagle Technologies. (Sikorsky photo)

attracted the attention of fixed-wing and rotorcraft manufacturers.

"We are cutting edge when it comes to producing composite rotor blades," said Emitt Wallace, CEO of Eagle Technologies. "Our processes are new. We think out of the box continuously."

Eagle produces the advanced composite main rotor blades for the Sikorsky S-97 Raider helicopter prototype, which features a coaxial rigid main rotor and a pusher propeller. The technology is designed to produce superior hover, range, speed and endurance.

Eagle's participation with the Sikorsky's X2 Technology Demonstrator began in 2005. "We contracted Eagle initially to do the blades on the X2 technology demonstrator and they proved themselves to be a valuable and capable rapid prototyping company," said Mark Hammond, Program Manager

for the S-97 program. Through a competitive bid process, Eagle won the bid to produce the rotor blades on the S-97 Raider as well.

"We had history with Eagle and were definitely happy with that history," Hammond added. Eagle is one of several suppliers Sikorsky has brought in to bring the Raider program to fruition.

The S-97 is the follow-up to the X2 demonstrator program, which in 2010 achieved flight speeds of more than 250 kt (463 km/h). The X2 demonstrator technology earned Sikorsky the National Aeronautic Association's 2010 Robert J. Collier Trophy for its future rotorcraft technology design.

The Raider will demonstrate the mission readiness and performance value of X2 technology for potential customers.

The fact that the design and building of the composite rotor blades for the

S-97 was outsourced at all is telling. Typically, such an important part of a new rotorcraft program might be considered a core competency and kept in-house. Yet, the economic realities of today have forced OEMs [original equipment manufacturers] toward a "new normal" when it comes to developing new aircraft. A Congress trying to rein in government spending is likely to remain a permanent fixture, at least for the foreseeable future.

All research and development (R&D) costs for both the X2 Demonstrator and the S-97 were borne by Sikorsky and its industry partners (53 companies on the Raider). This is the reality OEMs and their partners face today, which is one reason why small companies like Eagle are so valuable to aircraft OEMs.

"The large corporations often have a budget and a time limit in which to get something done," explained Wallace. "These OEMs come to us because we help cut the costs and time of the program."

The fact that Eagle is AS9100 certified also is appealing to larger companies, said Wallace. [AS9100 is a widely adopted comprehensive quality standard system that aerospace manufacturers often require of companies with whom they do business.] Eagle is qualified, under AS9100, for both prototype R&D and production.



Eagle Technologies designed, prototyped, tested and now manufactures the S-76D inlet (above) and inlet plenum. (Eagle photo)

"Eagle Technologies has experienced significant growth through its ability to position itself as a valuable partner to aerospace OEMs," said Ray Jaworowski, senior aerospace analyst, Forecast International, an aerospace consultancy. "Key in this regard was its certification a few years ago to AS9100 Rev C quality management standards, often a prerequisite to securing supplier contracts on aerospace projects."



With expertise in the design and fabrication of composite and metal components, "Eagle is able to assist OEMs in the entire development process, from the design stage through prototype construction and ground and flight testing and into production," added Jaworowski.

Ringin' A Bell

Eagle's skill in advancing the science of composites has generated additional work. The company is manufacturing the prototype blades for the first Bell Helicopter V-280 Valor tiltrotor, one of two aircraft selected as part of the Joint Multi-Role Technology Demonstrator (JMR-TD) program, the forerunner to the U.S. Department of Defense's Future Vertical Lift (FVL) Program. The Army-led FVL program was created to replace the aging helicopter fleet of all four services.

The company's experience in producing composite tiltrotor and rotorcraft blade provides a "natural fit" to the V-280. "The Bell V-280 Valor tiltrotor continues to progress towards a milestone first flight in 2017, and world class suppliers like Eagle Technologies continue to play a large role in this effort," said Keith Flail, Bell Helicopter Director for JMR and FVL. "The first of its kind all-carbon prop rotor blade for the next generation V-280 will provide significant weight reductions



KARI's Smart UAV proprotor blades, rotor hub, rotor controls, pylon conversion and drive system were all designed and manufactured by Eagle. (KARI)



Eagle Technologies has an in-house autoclave capability with a 5 ft (1.5 m) diameter and a 27 ft (8.2 m) inside length. (Eagle photo)

as well as performance and product improvements over legacy blades."

In October 2014, the Army chose designs from Bell Helicopter and a Sikorsky-Boeing team to build technology demonstrators for the JMR program. Bell's V-280 is an advanced, faster tiltrotor modeled after the Bell-Boeing V-22 Osprey. The V-280 is designed to cover ground twice as fast as existing helicopters. The company is also a contractor to AVX Aircraft for the development of its JMR/FVL coaxial rotor system and controls.

Eagle has become a primary vendor for commercial and military aircraft manufacturers. The company has also designed several sets of performance-enhancing winglets for an as-yet unnamed customer.

Backstory

Bailey, who joined Eagle in 2004, first met Wallace in 1992 when they worked together in support of Sikorsky on the RAH-66 Comanche program, which was cancelled by the U.S. Army in 2004.

Their paths separated in 1997 but rejoined in 2004 when Wallace's own small company, Eagle Aviation Technologies Inc., won a major development program requiring a significant increase in engineering capacity. [The company changed its name to Eagle Technologies LLC in 2009.]

Wallace presented Bailey with an enticing opportunity that the engineer accepted. Beginning in June 2004, Bailey assembled a group of engineers at Eagle to support the development of

an unmanned tiltrotor aircraft dubbed the "Smart UAV," which was funded by the Korea Aerospace Research Institute (KARI). The 5 m (16.4 ft) long, 7 m (23 ft) wide Smart UAV is equipped with a fly-by-wire control system developed by South Korean interests. The proprotor blades, rotor hub, rotor controls, pylon conversion and drive system were all designed and manufactured by Eagle, for which they maintain current international property (IP) rights. This program became a launching point from which Eagle could obtain new business, such as the rotor blade design and manufacture for the X2 Technology Demonstrator, which Eagle completed in December of 2006.

On the Leading Edge

Asked where rotorcraft design is headed, Bailey said: "You are going to see the expanded use of composites on aircraft. That may seem like old news, but it is not." He explained: "Composite technology is now accepted and, in some quarters, expected," said Bailey.

Eagle continues to evaluate new composite materials. The composites of today are more robust and last longer than earlier structures installed on military and commercial aircraft. Composite fibers are evolving as well. IM7 carbon fiber structure has been the standard for years due to its reliable combination of stiffness and strength. High modulus carbon fiber variants have been evolving, but with most trading the higher stiffness benefit with strength reduction or loss in durability.

More recently, Hexcel, Toray and other

companies have been producing higher modulus carbon fiber variants showing greater promise. Hexcel Composite Inc's HexTow IM10, an advanced carbon fiber being offered in the marketplace, is now beginning to be used in flight applications. IM10 carbon fiber is roughly 13% stiffer and 25% stronger than its predecessor IM7.

The Eagle engineering team has considered IM10 fiber for several recent programs, said Bailey. And it is only a matter of time for these new fibers to gain the necessary credibility for designers to feel confident in their selection, he added. Toray now offers seven carbon fiber variants at or above a tensile modulus of 50 msi [million pounds per square inch; 3.5 million kilograms per square centimeter] including M46J and M60J, which have seen some aviation industry application, and the trend seems to be increasing.

Eagle's varied experience in the rotorcraft industry led to work in other areas. The company was responsible for blades fabrication of the Boeing Phantom Eye propeller blades. The Phantom Eye is a liquid hydrogen-fueled, high altitude long endurance (HALE) unmanned aircraft system (UAS). The Phantom Eye was elevated last year from "unproven" to "experimental" status, and continues endurance and altitude testing at a test range several miles from Edwards Air Force Base, California.

Eagle also supports the aircraft R&D community with scaled research models for wind tunnel testing, including scaled rotor blades for powered testing at nearby NASA Langley Research Center, and around the world. Examples include scaled blades delivered to Dr. Oliver Wong for testing in Langley's 14 by 22 ft [4.3 by 6.7 m] Subsonic Wind Tunnel facility and active twist blades delivered to Matt Wilbur of the Army Research Laboratory (ARL) for testing on the Aeroelastic Rotor Experimental System (ARES) in Langley's Transonic Dynamics Tunnel (TDT). Both Wong and Wilbur are active in the AHS community, having presented several papers related to the test results obtained using rotor sets produced by Eagle.

Eagle's work history includes design and development of several powered rotor test programs. The company can also provide a turnkey design from concept to facility integration at the customer's location.

Expanding for the Future

Eagle's new facilities at Newport News will include larger testing facilities, precision machine shop, quality assurance capability as well as areas for tooling, prototyping and various stages of the design and production process of metal and composite structures. The company will have a large autoclave system for composites, numerous clean room complexes and an engineering lab, in which fatigue and risk reduction testing is performed.

In recent years, Eagle has taken a more proactive role to ensure growth and profitability. While the company continues to rely on its partnerships with OEMs, Eagle scouts for new business on its own. ARL issued an R&D contract recently for concepts to enhance intelligence, surveillance and reconnaissance (ISR) capabilities. The multiple-award, indefinite-delivery indefinite-quantity contract has a five-year period of performance and a total contract of around \$49 million for all awardees. Eagle is monitoring this program closely, said Wallace.

Although its expansion is impressive, Wallace insists that Eagle maintain a conservative growth posture. That



The S-97 mock-up has been a regular attendee of the AHS Annual Forum. Eagle designed and built the mock-up for Sikorsky in 16 weeks starting in late December 2008. (AHS photo from Forum 66)

go-slow tactic, plus an expertise in advanced composite structures and rapid prototyping capability, should ensure continued profitability of this lean and nimble company.

About the Author

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transportation business. With nearly 30 years of experience, he runs a freelance writing business, RWM Associates. His writing clients include several of the leading aviation magazines targeting the civil and military markets.

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