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The unmanned-aircraft team behind the Atlantic-crossing Aerosonde and tuna-finding SeaScan is putting finishing touches to the production configuration for its latest and most challenging design. The Aerovel Flexrotor is a 45-lb. UAV designed to fly more than 40 hr. but able to take off and land vertically on the helideck of a small ship.

White Salmon, Washington-based Aerovel recently completed sea trials with two preproduction Flexrotors. The

UAVs operated from the expedition yacht Umbra in Costa Rica's Cocos Island National Park, supporting efforts by the Dalio Foundation to curb illegal fishing.

Aerovel was founded in 2006 by Tad McGeer and others from Insitu, where they had designed the Aerosonde, SeaScan and its military development the ScanEagle. Insitu, acquired by Boeing in 2008, was getting into the military business and McGeer wanted to pursue the civil market.

The result was the Flexrotor, a tailsitting vertical-takeoff-and-landing (VTOL) unmanned aircraft with a 9.8-ft.-span fixed wing and 6.1-ft.-dia. two-blade rotor. The aircraft takes off like a helicopter then transitions to wingborne flight, the rotor becoming a propeller, then converts back for vertical landing.



Flexrotor in rotorborne vertical flight (left) and wingborne horizontal flight (right). Credit: Aerovel

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Small folding-propeller thrusters provide roll control in rotorborne flight. In a recent design change, the faired tail now opens up to form four landing legs. Propulsion is provided by a two-stroke piston engine burning automotive gasoline. Range at the 46-kt. endurance speed is more than 1,800 nm.

The Cocos trials were operated by Flexrotor launch customer Precision Integrated Programs, which flies aircraft for the Dalio Foundation. Formed by philanthropist Ray Dalio, billionaire founder of hedge fund Bridgewater Associates, the foundation owns the expedition vessels Alucia and Umbra and also supports the Woods Hole Oceanographic Institution.

The weeklong trials in May involved day and night flights of preproduction Flexrotors Arethusa and Calypso from Umbra's helideck. The 51-meter (167-ft.) superyacht was at anchor for all but one of the flights. Tests included spotting a bulk carrier detected by Umbra's automatic identification system.

"Over the summer we will finish the production design for the Mk 1. This has a larger fuel capacity and different electrical system," says McGeer. "Next year, we will move to the Mk 2, which will have an avionics update and a little bit more fuel. As we shrink the avionics we have more room for fuel."



Flexrotor sits on the helideck of the Umbra at anchor off Cocos Island. Credit: Ian Kellett, Alucia Productions

This second-generation aircraft will enable Aerovel to meet its original design goal for the Flexrotor of two days' endurance carrying a 3.3-lb. daylight- imaging payload, he says.

The Flexrotor carries an Alticam Vision daylight video camera in a stabilized nose turret. McGeer says Aerovel has received requests to carry Hood Tech Vision's midwave infrared sensor. "That's more than Flexrotor is designed for, so we would need to increase gross weight and have a larger diameter rotor."

The design can be scaled up. "We will see what develops in payloads. There is lots of ability to make a bigger aircraft," he says. Aerovel proposed a 2-ton aircraft with a 15-meter span for Darpa's Tern ship-based UAV program. "We called it the 2-ton Tern, but it was still a Flexrotor."

Initially, the company is aiming the Flexrotor at sea-based applications including tuna hunting, marine expeditions, environmental monitoring and even spotting icebergs for cruise ships venturing to high latitudes. Other possible uses could be for wildlife preservation, geological surveying, disaster relief and homeland security.

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Sea trails included night flights. Takeoff and landing is automatic. Credit: Ian Kellett, Alucia Productions

Insitu's SeaScan, which like the ScanEagle was launched by catapult and recovered by capturing it from a suspended wire, was designed for operation from fishing vessels. "There is a long-standing need to replace helicopters on tuna boats because of their expense and safety record," says McGeer.

"People in the tuna business are lining up, but there are other customers interested and it's not clear who will go first," he says, adding "We will be running hard to satisfy everybody over the next year." Flexrotor development has largely been funded internally, with support from Darpa and the Office of Naval Research, but Aerovel is looking at raising capital "so we can do more, faster," he says.

Most of the interest in the Flexrotor, which has a price tag of \$200,000, is coming from outside the U.S. "It's the reality of economics," McGeer says. "Where there is plenty of general aviation [such as in the U.S.], the economics of an unmanned aircraft [versus manned] are not so compelling. We hope to make them compelling."

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