



New Sensor Aims to Give F-35 Pilots a 'Window Into the Night'

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By Grace V. Jean

F-35 fighter pilots will wear a helmet that allows them to peer into the darkness with ease — but only if a new digital sensor proves itself as capable as or better than existing night vision technology.

To fly combat missions in blackout conditions, today's fighter pilots clip onto their helmets special aviator night vision systems that amplify low-level light. They look through the imaging technology as they would a pair of binoculars. In front of their eyes, they see a 40-degree circular field of view that illuminates their dark surroundings. But aviators complain that the spotlight-like perspective offers up a limiting "soda straw" picture of the world.

F-35 pilots, on the other hand, won't have to spy through tubes. Instead they will have an enhanced nighttime picture projected onto their visors via their helmet-mounted display system.

"It really is a window into the night," says Andres "Drew" Brugal, president of Vision Systems International, the Silicon Valley, Calif.-based joint venture between Elbit Systems of America and Rockwell Collins that is developing the helmet-mounted display system.

The F-35 Lightning II is the Pentagon's first tactical fighter aircraft to forgo the cockpit-mounted

heads-up display found in fourth-generation jets including the F-16, F-15 and F/A-18. All of the pertinent targeting and avionics information, such as altitude, airspeed and heading, are provided to the pilot via the helmet-mounted display. Tracking devices inside the aircraft help computers overlay the correct symbols and imagery in front of the pilot's eyes as he turns his head to look out the canopy window.

The helmet-mounted display also incorporates night vision. But that part of the system is falling short of the program's 20/20 resolution expectations, officials said.

"We're doing everything possible and sparing no expense among our team in getting the right solution out to the fleet to the guys and girls who are going to be flying this airplane"

— Drew Brugal, Vision Systems International, LLC, President

When an F-35 pilot needs to land on the deck of an aircraft carrier or an amphibious ship at night, for example, there are certain functions he has to be able to perform in order to accomplish the lights-out touchdown safely.

"The challenge is making sure we provide that acuity, that sensitivity for him to be able to see in the

dark," said Casey Contini, director of F-35 electro-optics and helmet systems at Lockheed Martin Corp., the prime contractor for the program.

The fighter's main night vision capability originally was to be derived from the network of aircraft-mounted sensors called the distributed

aperture system, or DAS. The six mid-wave infrared sensors would capture the exterior world in a 360-degree video that would be processed then piped into the helmet. But recent analysis has determined that the clarity of the resulting footage is less than what fighter pilots are accustomed to seeing with their current night vision goggles, said Brugal.

Experts attribute the degraded quality to the limited number of DAS sensors employed to cover the large fields of view necessary for a spherical representation of the airspace.

"If you take a sensor with a fixed number of pixels and you make the field of view too big, then that's the same effect as having poor eyesight," explained Bill Maffucci, managing director of Intevac Inc., which manufactures the night imaging sensor that has been embedded in the F-35 helmet. The camera's primary function is to record missions for evaluation and to augment the head tracker. But it also serves as the F-35's back-up night vision sensor. Officials have turned to it as a solution for the night acuity problem.

Inside the camera is Intevac's electron bombarded active pixel sensor, called ISIE-10. It is a digital sensor that employs a complementary metal-oxide semiconductor, or CMOS, imager to receive and amplify the light coming into the system. Though the sensor yields an image with 1280x1024 resolution, it fails to give pilots their desired 20/20 acuity to fly at night with a 40-degree field of view.

"You have to have a certain number of pixels across that 40 degrees to have that acuity," said Maffucci.

The firm has developed an improved sensor called ISIE-11, which has an increased number of pixels resulting in a 1600x1200 resolution. Industry and government officials are evaluating the technology as a potential upgrade to the current helmet camera.

So far, the new system has demonstrated a 30 percent improvement in resolution and sensitivity, said Lockheed's Contini.

ISIE-11 "is showing very favorable comparative performance to night vision goggles," said Brugal. "It will give the pilots something very close to what they're used to right now."

Officials said they would achieve a solution by 2013, when the Marine Corps had first expected to have initial operating capability with the short-take off and vertical landing variant of the F-35. Marine officials since have slipped the aircraft operational date by two years.

"What we want to have is a helmet that ... we will be able to put in the latest digital capability and improve that system readily to essentially stay ahead of any analog capability that's out there," Contini said.

The night vision problem is no small challenge, said Brugal. "We're doing everything possible and sparing no expense among our team in getting the right solution out to the fleet to the guys and girls who are going to be flying this airplane," he said.

Because the F-35 night vision risks are still high, program officials are pursuing a dual technology path to solve the acuity challenge. Lockheed Martin this spring requested proposals for a legacy-based helmet system to meet the night vision requirements. Officials had plans to award the contract this summer to a bidder with a solution using existing goggles.

"That's a prudent approach to ensuring that the war fighter will have that capability in the next two years," said Contini. But Lockheed officials also are pushing hard on the integrated helmet solution.

"Our desired result is to fix the helmet we have," said Steve O'Bryan, vice president for F-35 customer engagement. "The helmet has flown successfully on every flight since 2007. It is not slowing us down."