

## Lockheed Martin F-16 Tests Mid-Air Collision Prevention System

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Lockheed Martin has successfully demonstrated an Automatic Air Collision Avoidance System (Auto ACAS) on a U.S. Air Force F-16, marking the first time this safety-enhancing technology was employed on a production F-16.

One of the hazards of flying high-speed, agile aircraft is the danger of a mid-air collision, especially during air combat training and formation flying. Auto ACAS is designed to automatically maneuver an aircraft hosting the system at the last instant before a mid-air collision. It has long-term potential for use with unmanned as well as piloted vehicles.

Five different pilots made a total of 287 test runs using Auto ACAS during six F-16 flights originating from Fort Worth, June 5-13. Simulated targets (representing other aircraft) were generated by a ground station and data-linked to the aircraft, providing a means to safely test the system's operation.

The Auto ACAS program is a cooperative effort between the United States and Sweden, based on a developmental Ground Collision Avoidance System that was successfully flown on a modified F-16 in 1998. The program is being jointly managed and funded by the U.S. Air Force Research Laboratory (AFRL) and Forsvarets Materielverk of the Swedish defense establishment.

Extensive ground simulation and failure mode testing preceded the recent flight tests. A one-of-a-kind test bed, the Variable-Stability In-flight Simulator Test Aircraft (VISTA)/F-16, operated by the U.S. Air Force Test Pilot School at Edwards Air Force Base, Calif., was used recently to test the data link, system algorithms and single-ship testing against a ground station.

"The flight testing on an F-16 at Fort Worth is another important step in our building-block approach," said Steve Markman, Auto ACAS flight test director at AFRL in Dayton, Ohio. "Early in the program we learned that the air-collision problem is much more complex than ground collision. We are very safety conscious in this program, as we will be flying two manned aircraft toward each other at high closing speeds. We need to make sure each piece of the puzzle works as intended before we get to the final stage of having two actual aircraft in the air."

The last and most critical test series is planned for July at Edwards, when two modified aircraft -- the VISTA/F-16 and another Fighting Falcon -- will fly together using Auto ACAS.

"The flight testing with one aircraft and a virtual target provided a realistic environment of flight hardware and software, but with a greater margin of safety compared to two aircraft," said Edward M. Griffin, program manager for Combat Air Systems Integration and Demonstration at Lockheed Martin. "This combination is also more efficient because we could conduct many more runs per mission with the flying costs of only a single aircraft. We still need to have the final demonstration session with two aircraft to gain the

confidence level needed to validate the concept."

This is how the Auto ACAS system works: The system continually computes trajectories six seconds into the future and determines the optimum escape maneuvers for participating aircraft. If the pilot does not take sufficient action, the system automatically executes the predetermined escape maneuver seconds prior to the predicted collision. The system commands an aggressive maneuver that is carried out by the aircraft's electronic flight control system.

In a cooperative situation, involving two aircraft equipped with Auto ACAS, data is passed between the aircraft via a data link, and both aircraft will maneuver cooperatively. In a non-cooperative situation, the host fighter must be aware of the other aircraft via an onboard sensor, such as a radar set.

Auto ACAS is intended only to provide "last-ditch" collision avoidance and not traffic de-confliction, as does the commercial Traffic Alert and Collision Avoidance System that is operational in many transports today.

The U.S. Air Force Test Pilot School at Edwards is conducting the flight- test program, assisted by the National Aeronautics and Space Administration at Edwards. The 46th Test Wing at Eglin Air Force Base, Fla., will provide an F-16 for the final flight-test session at Edwards.

Other industry participants include Saab, Boeing, Veridian Engineering, Bihrl Applied Research, Raytheon and Smiths Aerospace.

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