

Falcon Force

Extra test vehicle adds weight to USAF's mounting confidence in reaching hypersonic goals

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The U.S. Air Force is looking to ramp up the Falcon hypersonic technology program to include an extra "boost-glide" test vehicle, amid signs of a growing belief within the service that routine air-breathing operations in the Mach 5-plus speed regime could soon be attainable.

The Falcon program, a joint effort by the Air Force and the Defense Advanced Research Projects Agency (Darpa), is developing and demonstrating hypersonic technologies aimed at fielding a global-reach hypersonic cruise vehicle. Falcon involves a series of hypersonic test vehicle (HTV) demonstrators intended to incrementally prove new technologies, culminating with the competitively bid Blackswift flight-test program in late 2012.

Unlike Blackswift, which will have a hydrocarbon-fueled, turbine-based combined cycle propulsion system, the preceding HTV-2 will be a rocket-boosted glider aimed at evaluating high Mach flying characteristics, as well as structures and systems technology. The first airborne test of HTV-2 is due to begin with "Mission A" in May 2009, with a second HTV-2 due to fly "Mission B" the following October. Both will be boosted by a Minotaur IV Lite launch vehicle from Vandenberg AFB, Calif., with a planned termination in the Pacific near the Kwajalein Atoll test range.

Until now only two HTV-2 vehicles have been planned, but USAF chief scientist Mark Lewis tells *Aviation Week & Space Technology* that "we are really getting enthusiastic about that, and we are looking to have an extra flight of HTV-2." Negotiations over funding and timetables for the third HTV-2 are thought to be ongoing, although the current HTV and Blackswift schedules suggest a 2010-11 target window. Speaking at the American Institute of Aeronautics and Astronautics International Space Planes and Hypersonics conference here recently, Steven Walker, deputy director of Darpa's Tactical Technology Office, confirms USAF's interest in funding a third HTV-2, and adds that the initiative is being made independently of the research agency.

Assembly of the first HTV-2 is un-



Plans for the HTV-3X, a powered Mach 6-plus demonstrator designed by Falcon prime contractor Lockheed Martin using technology from the HTV-2, have given way to competitive procurement of the Blackswift demonstrator.

LOCKHEED MARTIN/DARPA

derway; the critical design review was completed in October 2007. "We are in the Phase 3 build cycle now and the carbon-carbon aeroshell is 50-70% complete," says Walker, who adds that "we have also begun to put the inside of the vehicle together." Structural proof testing of the aeroshell is "one month away, and we've seen no delaminations so far." Production problems with the aeroshell for the first HTV, particularly delamination, forced Darpa into a total redesign of the protective surface. It also contributed to delays which resulted in the complete restructuring of the Falcon plan, and the decision to develop HTV-1 for ground testing only.

Design changes have also been made to the leading edges of HTV-2, which have been slimmed down to improve lift/drag ratio "by an order of three. I got a lot of encouragement from my Air Force partners to do wind tunnel work and I'm glad I took them up on it," Walker says. Tests at NASA Langley Research Center in the wind tunnel at Mach 6 and 10 helped identify "heat-streaks" on the vehicle "... early on and we were able to tweak the design and get rid of them." Arc-jet tests to confirm the durability of the new leading edge have been conducted by NASA Ames Research Center and at the Tullahoma, Tenn.-based Arnold Engineering Development Center.

AEDC's White Oak Tunnel 9 facility and Purdue University's Quiet Tunnel

site in Lafayette, Ind., were also used to help verify the predicted high Mach performance. This latter tunnel, which is designed to minimize aerodynamic perturbations created by the tunnel structure itself, "gave us confidence we won't get a [boundary layer] transition problem, but of course we have to go and actually fly the vehicle now," Walker notes. Working closely with AFRL, Darpa is also developing "plasma probes" to protrude through the sheath of plasma the vehicle is expected to generate at high Mach numbers. The probe is necessary to maintain telemetry links that the plasma field might otherwise black out.

Meanwhile, bids for the design, assembly and flight testing of the Blackswift flight demonstrator (formerly HTV-3X) are due in to Darpa by May 19, says Walker. "We'd like to get a team on contract by the end of September." First flight is projected for September 2012, with a "maximum Mach" flight attempt to Mach 6-plus by early 2013. Multiple Blackswift vehicles are not ruled out, and depend on the contract bids.

Explaining what some observers believe is a curious requirement to conduct an "aileron roll" in flight tests, Walker says: "We want it to be an airplane. We want to say once and for all we've built a hypersonic aircraft and that we've demonstrated the technology for this country to be able to decide if it's worth the money to build an operational version." 