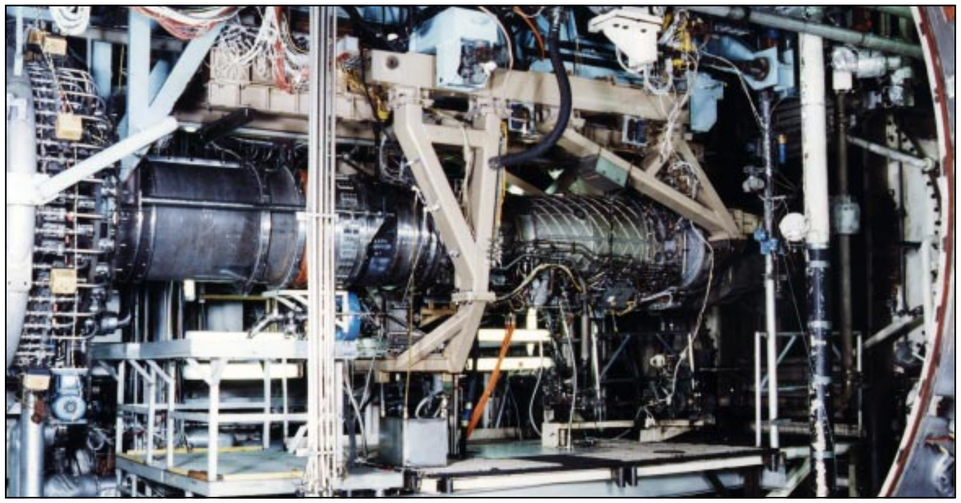
Getting it ready

AEDC continues to play an important role in testing and developing the nation's next fighter — the F-22 Raptor



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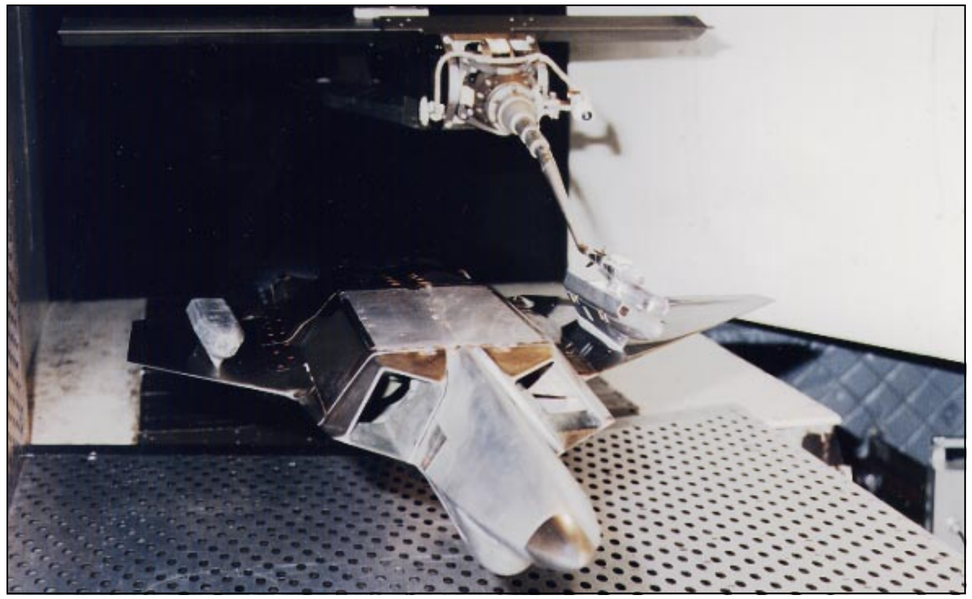

The Captive Trajectory Support stingbalance positions a GBU-32 JDAM model to a pod on a F-22 aircraft model during a test recently completed at AEDC.

Aeropropulsion testing: Readying the F-22's F119-PW-100 engine

Pratt & Whitney's F119 engine is prepared for testing in the Aeropropulsion Systems Test Facility.

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Since 1988, the F119-PW-100 has had a seemingly permanent home at AEDC.

Center engineers and technicians have supported the development and testing of the F119, the powerplant for the Air Force's next-generation fighter, the F-22 Raptor. This support included the Demonstration and Validation phase of the F-22 program and now focuses on the Engineering and Manufacturing Development phase.

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Currently, an F119 is being tested in Propulsion Development Test Cell C-1, and, in addition, a derivative of the F119, which will be used in the Joint strike Fighter, is undergoing testing in Propulsion Development Test Cell C-2. Preparations are under way for F119 testing in Sea Level Test Cell SL-2 in support of the F-22 in January and in Propulsion Development Test Cell J-2 in support of JSF in March.

During the past two years, the Pratt & Whitney's F119 E&MD engine underwent testing to evaluate the engine's aeromechanical performance, combustor and augmentor operability, vectored and non-vectored nozzle performance, fan performance, compressor stall margin and air start capability.

The F119 reached a milestone in 1997 with the completion of both an Accelerated Mission Test and Preliminary Flight Qualification altitude performance and operability clearance test.

"This is a major milestone in the F119 program, putting us on the threshold of F-22 flight testing," said Walter N. Bylciw, Senior Vice President of F-22 flight testing at Pratt & Whitney's Government Engines and Space Propulsion, which conducts the military engine programs. "Successful completion of these tests are the final engine requirements for flight clearance."

During the AMT, the F119 engine completed 1,050 TAC cycles simulating more than 300 Air Force combat missions and included more than 13 hours in augmentation and more than 40 hours of hot time. Each cycle involves multiple settings of the engine's thrust vectoring exhaust nozzles, which totaled more than 12,000 vectored transients. The altitude testing, which verifies engine performance and operability, took the engine to all extremes of the fighter envelope. These extensive test programs included performance and operability testing at 15 different flight conditions, certifying the engine was cleared for flight testing in the F-22.

F-22 flight testing began in September 1997 at the Air Force Flight Test Center at Edwards AFB, Calif. "This has been an outstanding effort by the F-22/F119 team," said Maj. Gen. Robert F. Raggio, former F-22 system program director. "We all can be proud of our contributions to the challenging and rewarding development work that is being done in the program."

The engine features a pitch and vectoring exhaust nozzle for improved in-flight maneuverability and enhanced takeoffs. The F119 is capable of operating at supersonic speeds for extended periods without use of afterburner augmentation.

The F-22 Raptor is an air dominance fighter with much improved capability over the current Air Force aircraft. From the inception of the battle, the F-22 will clear the skies of adversary aircraft. Its stealth, integrated avionics, supercruise and other features will make it the most potent fighter in the world, Air Force officials say.

While at the center, there have been several success stories surrounding the F-22 program — engine installations reduced from six weeks to three days, common missile control hardware and processes to correlate tests from the 16-foot transonic and supersonic wind tunnels, and unique designs to test flow fields in the 4-foot transonic wind tunnel, a one-of-a-kind national capability. Maj. Gen. Michael Mushala, the System Program Director for the F-22 Raptor, said AEDC's capabilities and efficiencies have improved because of what the F-22 needed and demanded of a critical supplier.

"The F-22 has raised this nation's capabilities in aerospace to a new level," he said. "We are revolutionizing the entire aerospace industry together. You do whatever it takes to meet F-22 program needs. I call that commitment and pride."

According to Mushala, the fate of the F-22's program rests on the ability to meet key program milestones in design and test. "Time and time again that ability rests in the execution by the AEDC team," he said. "I don't fly if engines don't run here; I don't test if we can't model safe store separation; and we can't finish a test program if you don't help me with test deficiency corrections. As we continue to test and field the F-22, we must leverage the exceptional work and capabilities of the people and the place that is AEDC. That is the definition of a key supplier."

Aerodynamics testing: Readying the F-22's airframe and stores

The Air Force is closing in on a big day, and AEDC is playing a key role in the countdown. In the year 2005, the first squadron of F-22 Raptors will become operational. And just as they have for the past 10 years, AEDC's people are working with a variety of test customers to get the new fighter ready.

Last spring, AEDC personnel and a number of different test customers conducted five weapons separation tests on the F-22 - ensuring theses weapons would separate cleanly from the fighter in actual use.

The customers—the F-22 Program Office, the Joint Direct Attack Munitions Program, The Air Force Research Laboratory, Lockheed Martin and the Air Force Seek Eagle Office— each generated their own test matrix and, in some instances, shared data.

According to Test Project Engineer Doyle Veazey, the test team conducted all five tests in the center's 4-foot transonic aerodynamic wind tunnel. One-fifteenth scale models were used to obtain separation characteristics of the AIM-120C AMRAAM missile, AIM-9M Sidewinder missile and GBU-32 JDAM from the F-22.

Weapons Separation Tests

The F-22 Program Office sponsored weapons separation test investigated separation characteristics of the AIM-9M and the AIM-120C missiles from the F-22 Raptor.

During the test, the team acquired free-stream, aerodynamic grid, captive trajectory and captive loads data. Captive trajectory support data were acquired for the missiles from the aircraft main and side weapons bays and from the inboard and outboard rails of the outboard wing pylon station. Captive loads data were obtained for the AIM-120C on the inboard and outboard rails of the outboard wing pylon station at four different positions down the rail.

Test conditions included Mach numbers from 0.4 to 1.95 and aircraft angles of attack from 0 to 26 degrees for an aircraft sideslip of zero.

JDAM, Pod Tests

Two weapon separation tests involving the F-22 aircraft, the GBU-32 Joint Direct Attack Munition and an F-22 pod were also executed. One test examined the separation characteristics of the GBU-32 from the main bay of the F-22, while the other examined the separation characteristics from the inboard wing-station-mounted F-22 Pod. Tests conditions included Mach numbers from 0.3 to 1.5 and aircraft angles of attack from 1 to 15 degrees for an aircraft sideslip of zero.

The JDAM Program, a cooperative effort between the Air Force, the Navy and part of the Aeronautical Systems Center located at Eglin AFB, Fla., sponsored the main bay GBU-32 test to evaluate the munition's most current configuration. JDAM is a guidance kit that converts existing unguided free-fall bombs into precision guided "smart" munitions. This reduces risk to the pilot because the munitions can be dropped from the aircraft up to 15 miles from the target.

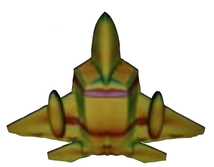
The Air Force Research Laboratory sponsored the F-22 JDAM Pod test. Lockheed Martin and the AFRL are working to develop the pod, which will make the F-22 more difficult to detect by radar though carrying stores on wing stations.

Flow-field Examination

In addition to the store separation testing, the test team also performed flow-field characteristics tests of the F-22 with open weapons bays. Lockheed Martin and the Air Force Seek Eagle Office each funded one test and supplied their own test matrix, but shared their data. This permitted both to acquire a complete database without having to pay for an entire test."With reduced budgets being the rule, it is likely that more tests will follow this pattern," Veazey said.

A three-probe rake, designed specifically for the F-22's needs in flow-field testing, was used to measure the aerodynamic pressure from oncoming wind. This allowed the acquisition of total and static pressures, Mach number and flow angularity. The rake has three 40-degree conical pressure probes and acquires three times the amount of data of a single probe for a given test position. Test conditions included Mach numbers from 0.7 to 1.5 and aircraft angles of attack of 2 and 6 degrees for an aircraft sideslip of zero.

Stability and control tests are run on the F-22 in the 16-foot transonic wind tunnel.



AEDC personnel have used Computational Fluid Dynamics to assess the Raptor's aerodynamic characteristics.