

On April 9, the Air Force unveiled the most sophisticated warplane ever built.

Raptor 01

By John A. Tirpak, Senior Editor





With stealth, integrated avionics, supercruise, and other features, the F-22 will be the most potent fighter in the world. Bret Luedke, at left, is the second Lockheed Martin Aeronautical Systems F-22 test pilot.

WITH theatrical smoke and lasers zapping overhead, the Air Force and Lockheed Martin Corp. officially rolled out F-22 number one, *Spirit of America*. President Clinton, in a statement released simultaneously with the rollout, called it the “catalyst for a revolution in airpower.”

The April 9 event in Marietta, Ga., featured thousands of guests, including current and former company and service officials, plant workers, most of the Georgia Congressional delegation, and media representatives. All crushed forward to get a better look at the airplane that USAF is counting on to guarantee American air supremacy through the first half of the twenty-first century.

The Raptor, as the F-22 has been officially dubbed, is not especially futuristic on the outside. With its new mottled-gray “ghost” paint job, the F-22 looks like a more angular version of the F-15C Eagle it was designed to replace.

Looks are deceiving, however. The F-22’s sophistication lies in the precise way those angles were calculated to make the airplane stealthy, in the powerful and advanced Pratt & Whitney F119 engines fitted inside, and in an avionics suite that seems to verge on consciousness. No one disputes that the F-22, with a well-trained pilot in the cockpit, will be an unbeatable fighter when it reaches operational service, and its planned improvements should make it unequaled into the foreseeable future.

“This is not a business where you want to be second-best or equal,” Gen. Ronald R. Fogleman, Air Force Chief of Staff, told reporters at the rollout. “You’ve got to dominate” in the air-to-air arena, he said, in order to ensure the safety of US fighting men and women on the surface. The F-22 contributes to overall military power by making the job of the other military services “possible . . . with fewer losses, fewer casualties, less ground given up to an enemy,” Fogleman asserted.

America’s Fighter

He added, “This is not an airplane that is being bought for the United States Air Force. This is an airplane that is being bought for the nation.” Money spent on the F-22, he said, is “an investment in the preservation of



F-22 Team photo

The ultimate advanced tactical fighter, the first production F-22, Spirit of America, was unveiled in a dramatic rollout ceremony hosted by the contractor team in April. It’s the first new USAF fighter in 20 years.

the most precious treasure that we have in this country, which [is] the young men and women who serve in all our military services.”

Lockheed Martin Aeronautics President James A. “Micky” Blackwell contended that the sleek new fighter is so superior to any competing design that “the first thing the F-22 will kill is the enemy’s appetite for war.”

The assembled fans of the F-22 had a lot to be excited about.

It had taken nearly 16 years to reach the point of rollout (Lockheed Martin and the Air Force scheduled its first flight for mid-1997). The Air Force in 1981 had identified a requirement for an F-15 follow-on, the Advanced Tactical Fighter. Four years later, it modified the requirement to demand an even stealthier design.

Lockheed discarded its first ATF concept in 1987 as “technically and competitively unacceptable,” then came back to win the competition with the F-22 in 1991. Since the end of the Cold War, Congress has tinkered with F-22 funding often enough that USAF has had to restructure the program several times.

Out of this programmatic turmoil, however, has come an indisputably awesome airplane.

The F-22 is the first fighter anywhere to boast a combination of high agility and a high degree of stealthiness. It is the first operational Air Force airplane that will employ thrust vectoring. It is

the first airplane in the world that will cruise at high supersonic speeds without afterburner, a capability known as “supercruise.”

These features, when combined with an avionics suite that can integrate sensor data and present it in an easily understandable format with minimal “housekeeping” by the pilot, have made the F-22 into the aircraft that fighter pilots have been asking for since the jet age began.

The Air Force envisions the F-22 flying into combat and remaining undetected as it ranges deep into enemy territory. Aided by satellites, Airborne Warning and Control System aircraft, unmanned reconnaissance vehicles, and a host of other sensors, the F-22 pilot will have a “god’s-eye” view of the battlespace without having to emit any electromagnetic energy of its own. Once enemy aircraft are detected, the F-22 can illuminate beyond-visual-range targets with a radar possessing “frequency agility”—able to hop rapidly from one radar frequency to another. All the enemy will see are brief flashes in the electromagnetic spectrum, too few and too brief to track the F-22 or bring weapons to bear on it.

The motto of the program, echoed by Air Force Secretary Sheila E. Widnall, is “first look, first shot, first kill.”

Ground-Attack Built In

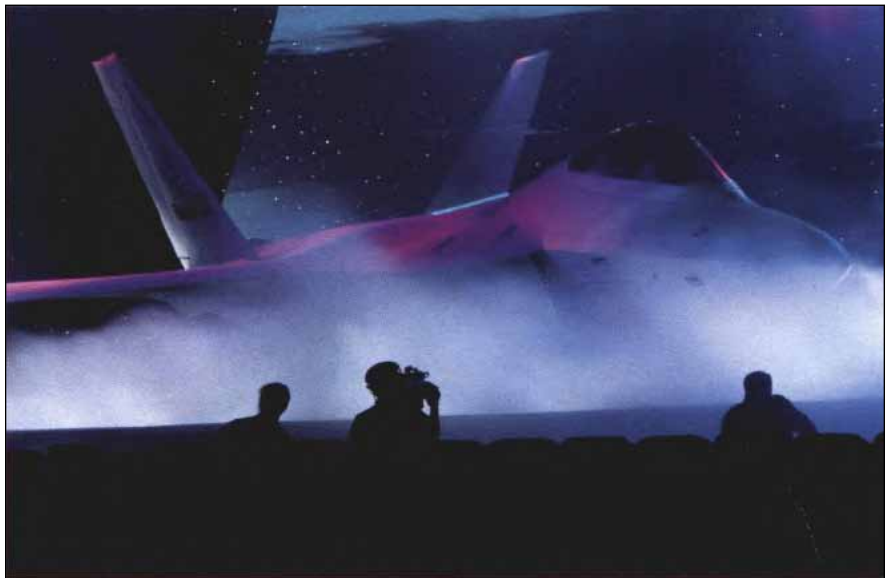
While stealthiness is extremely

valuable in a dogfight, it is absolutely critical in the ground-attack role, and “the very first F-22 produced will have an inherent air-to-ground capability,” Fogleman said. The F-22 needs to be stealthy in order to survive against increasingly sophisticated surface-to-air missiles that protect important ground targets around the world, regardless of whether competing fighters ever materialize.

Both in the air-to-air and air-to-ground mode, supercruise ability sharply narrows the window within which an enemy can see, target, and shoot at the F-22. The combination of stealth and speed means that by the time the F-22 is detected, it will usually be too late to attempt to engage it.

While the F-15C also had ground-attack capability from the beginning, Fogleman observed that it was gradually removed in order to make more room for the computer capacity needed to keep the F-15 effective as an air-to-air weapon. “That’s not a problem with the F-22,” he said, noting that the F-22 has so much on-board computing power that it can swing between strike and dogfight missions virtually with the flip of a switch.

Fogleman noted that the F-22’s inherent speed and stealth attributes would make it a natural in the role of defense suppression and other missions, but he declined to speculate on whether the Air Force might, in the future, argue for a larger buy to



F-22 Team photo

The F-22’s angles were precisely calculated to make it stealthy. Whether or not competing fighters are developed, the Raptor needs stealthiness to survive against increasingly sophisticated surface-to-air missiles.

fill such roles. He noted, though, that the F-117 and F-15E will need to be replaced “around 2025 to 2030.”

In fact, said Lockheed Martin’s Marty Broadwell, “there’s room for 200 percent growth” in the F-22’s avionics bays, so there’s little chance the airplane won’t be able to keep up with new missions. Broadwell briefed reporters on the airplane’s avionics system.

The Raptor has a self-diagnostic system that can identify and trace 98 percent of all faults in the airplane to a specific line-replaceable module,

Broadwell asserted, making the task of finding and fixing problems far easier and less time-consuming than is the case with the F-15. The F-22 program set forth a goal of achieving a 100 percent improvement in aircraft reliability and maintainability relative to the F-15, and it appears that Lockheed Martin will meet that goal easily.

So reliant is the F-22 on its computers that fully one-quarter of its flyaway cost of \$70.9 million (in 1997 dollars) is devoted to avionics. Triple-redundant flight controls mean that, even with heavy combat damage, the F-22 can still fly home.

USAF is looking at adding an infrared search-and-track system to the F-22 in the future, which will help it detect enemy stealth aircraft, should the need arise. This is not part of the baseline program and would incur an additional cost.

Additionally, the Air Force has been contemplating improvements in satellite uplinks and Global Positioning System receivers, as well as an added “side array” electronically steered radar antenna on each side of the airplane, just above the air intakes. Such an improvement would dramatically expand the range of the F-22’s “vision.”

USAF is considering the installation of a helmet-mounted sight/missile steering system, along with the integration of more types of air-to-surface weapons. The first version of the F-22



Before its “ghost” paint job, the different colors on the aircraft reveal the various materials—such as titanium, aluminum, and composites—that make up the F-22. Its bulkheads are the largest forged aluminum pieces made.

F-22 Team photo

From Rollout to Final Delivery

F-22 program milestone dates have been changed many times over the years. Here was the plan at the time of the rollout:

April 9, 1997: First F-22 unveiled in ceremonies at Lockheed Martin Aeronautical Systems in Marietta, Ga.

Mid-1997: Lockheed Martin flies the first F-22.

October 1997: The first F-22 goes to the Air Force Flight Test Center at Edwards AFB, Calif., for full testing.

Mid-1999: Award of Lot 1 contract (low-rate initial production) for two aircraft to be delivered in 2001–02.

Mid-1999: First flight of an F-22 with a full avionics suite.

Early 2000: Award of Lot 2 contract for six F-22s to be delivered in 2002.

Early 2001: Award of Lot 3 contract for 12 F-22s to be delivered in 2003.

Early 2002: Award of Lot 4 contract for 20 F-22s to be delivered in 2003–04.

Early 2003: Award of Lot 5 contract for 30 F-22s to be delivered in 2004–05.

Early 2004: Start of high-rate production with award of Lot 6 contract for 48 F-22s to be delivered in 2005–06.

Late 2004: Initial operational capability.

2013: Delivery of the 438th (last planned) production F-22.

The Quadrennial Defense Review recommended a reduction of 12 F-22s in the low-rate initial production phase. If approved by Congress, LRIP lot amounts would change. The QDR also suggested a peak production rate of 36 aircraft per year.

will have the capability for only the 1,000-pound version of the Joint Direct Attack Munition.

Don't Look for These

However, the F-22 will lack three “gee whiz” features once thought likely to show up on the aircraft. One is voice-activated and “fingers on glass” controls, which were technically feasible but “the pilots just didn’t want them,” according to Lt. Col. Scott Anderson of Air Combat Command. Another is a plug-in, flight-planning interface, which allows hands-off flying most of the way to a ground target. These are present in the F-117 stealth fighter and B-2 stealth bomber. The F-22 also will not have a so-called “panic button,” which a disoriented flyer could hit to have an autopilot restore the airplane to wings-level flight.

However, the combination of mechanical and electronic advances will enable the F-22 to go from a cold start to taxi in less than 30 seconds, with only three steps necessary to ready the airplane for flight.

More than 25 percent of the F-22’s weight—principally wings, control surfaces, and leading edges—is made of advanced composite materials, while 25 to 30 percent of the airplane’s weight is titanium—mostly in the aft section—needed to withstand the extreme stress and temperatures the F-22 will experience. The rest of the airplane is chiefly aluminum, including bulkheads that are the largest forged aluminum pieces ever made.

Designers of the F-22 wanted pilots to be free to maneuver almost without limitations, and the combination of the avionics system, structural strength of the airplane, and thrust-vectoring nozzles makes this possible. The F-22 has no angle-of-attack limitations, meaning the pilot can maneuver even beyond a stall, and computerized load limiters will allow the pilot to push the airplane to its limits without fear of overspeeding any of the control surfaces.

The airplane that rolled out in April is one of three “basic” F-22s, consisting of airplane and engines without combat avionics. These aircraft will

be used to explore flight characteristics, flutter, loads, propulsion, and envelope expansion. Another six aircraft in the flight test program will be avionics test-beds. The course of the F-22 program will differ from that of the B-2 program, in which each test airplane was dedicated to a single area of development. The six F-22 avionics test-beds will be “interchangeable” to prevent schedule problems should one or two airplanes develop faults. The test program is expected to take five years and require about 2,700 flights, lasting a cumulative 7,800 hours.

The first squadron of F-22s is slated to be operational in 2005, with 32 airplanes. For several years, the approved Air Force plan called for production to continue until 2013, with the last of a total of 438 Raptors to roll off the assembly line in that year. In the Quadrennial Defense Review earlier this year, however, the Pentagon recommended a cutback to 339 of the fighters. Congress will have to grapple with the issue for months to come.

Cost Controversy

The unveiling took place at a time when controversy about cost swirled around the aircraft program. Fogleman argued that “high-end” cost estimates for how expensive the F-22 *might* get ignore the cost savings accruing from new technologies being applied to its manufacture. He noted, for example, that original estimates at how many man-hours it would take to apply the F-22’s special stealth coatings ran as high as 35,000 hours, but “as a result of the robotics we have put in place . . . we can coat the airplane with less than 1,000 man-hours,” resulting in “huge savings” in touch-labor costs. As the F-22 makers advance on the learning curve, he said, the cost could be further reduced.

Acknowledging that \$71 million “is a lot of money,” the Chief of Staff pointed out that the cost measures up well when weighed against the cost of American lives. The fact that US ground troops have not been attacked by enemy aircraft in more than 45 years “did not happen just by luck,” said Fogleman. “Somebody has got to pay attention to it. Somebody has got to go develop the airplane. Somebody has got to make the investment.” ■