

What's it like to tangle with a stealthy, far-seeing, heavy-punching fifth generation fighter? The next US enemy will be the first to know.

The F-22 Is



Above, an F-22 Raptor flashes its lethal AIM-120 AMRAAMs. At right, Lockheed Martin executive Ralph Heath tells an assembled crowd at the Raptor's initial operational capability ceremony, "We did it."

Photo by Katsuhiko Tokunaga/DACT Inc.

Battle Ready

By John A. Tirpak, Executive Editor

On Jan. 21, with little fanfare, two F-22s armed with live missiles took off from Langley AFB, Va., and streaked skyward. The Raptor sortie was undertaken as part of Operation Noble Eagle, the years-long Air Force campaign to defend US airspace. It was the first operational combat mission of America's newest and hottest fighter aircraft.

The four-hour sortie marked both the end of a tumultuous acquisition process and the start of what is expected to be a 30-year career. If things go as planned, pilots not yet born will be flying and fighting in the Raptor decades hence.

The stealthy F-22, in development since the mid-1980s, has been declared battle ready. By that, the Air Force means it is able to swiftly defeat any aerial or surface-based air threat in the

world today or projected to exist for a long time to come.

The F-22 will allow US forces to gain entry into any combat theater of operations by destroying enemy air defenses—airborne or ground-based—and holding at risk targets well behind enemy lines. The pilots who fly the fighter marvel at its capabilities. Despite its factory-fresh newness, the Raptor's day-to-day reliability nearly equals that of its "mature" F-15 and F-16 stablemates.

After years of debate about its potential and utility, the F-22 is making good on the promises made for it.

The 1st Fighter Wing's 27th Fighter Squadron and 94th FS—both located at Langley—are destined to acquire F-22s. The 27th now possesses nearly its full complement of 24 Raptors. The 1st

FW's F-22s achieved initial operational capability on Dec. 15, 2005, and full operational capability will come early this fall, when the 94th FS completes the acquisition of its Raptors.

Ready To Go

The IOC declaration meant that the 27th could "take about 12 aircraft and go deploy [them] in combat," Lt. Col. James B. Hecker, the unit's commander, said.

"When we declare FOC, then [the 27th FS] will have 24 airplanes," as well as two attrition reserve aircraft, "and at that time, we'll be able to say we'll take a 24-ship package and deploy it in a limited amount of time to some base and do combat operations," he said.

The 27th has already practiced picking up and moving to a distant base of operations. Last October, a small group of F-22s deployed to Hill AFB, Utah, demonstrating that the new fighter could fly long distances and hit targets with accuracy. During exercises at Hill, four Langley Raptors dropped a total of 22 1,000-pound Joint Direct Attack Munitions against ground targets, and each one was scored a hit. Each of the bombs, Hecker said, emitted special telemetry that allowed the Air Force to record all of the fine details of release, flight, and impact.

"It's a very exact science," he noted, "that gives us a report card that says how good we did."

Hecker said the data provided "very credible ... evidence" showing that the airplane is capable of accurate bomb delivery. The JDAM hits were among the last tasks to be performed in follow-on test and evaluation, which certifies the aircraft is capable of performing





its full combat mission, including both air-to-air and ground attack tasks.

It was the successful demonstration of this deployment capability, along with having the requisite number of aircraft, that cinched the declaration of IOC by Air Combat Command chief Gen. Ronald E. Keys last December. (See "Aerospace World: Raptor Declared Operational ...," February, p. 20.)

In January, the F-22 was certified as mission capable, meaning it has the ability to meet the full range of duties that it might be assigned. This latter designation has greater scope than IOC and was a further step in certifying the F-22 ready for war.

The Hill deployment was but one of several Raptor road trips. In a recent mission to Nellis AFB, Nev., a Raptor four-ship met up, as Hecker put it, "with B-2s, with F-117s, with tankers, AWACS, Rivet Joint, some F-16s, some F-15Es." The F-22s came right out of their four-and-a-half-hour cross-country flight and went directly to simulated combat, first engaging "red air" F-15Cs in air-to-air battle and then switching to ground attack themselves. They finally landed at Nellis after having been airborne for nearly seven hours.

Such deployments have been repeated a couple of times since. In another visit, Raptors from Langley landed at Nellis first, where their pilots performed joint mission planning with those of other types of aircraft, as well as the pilots of F-22s stationed at Nellis for tactics development. After they went out and flew mock battles, the aircrews were able to take advantage of the base's advanced range record-

attack missions for a month. After that, they move to Tyndall AFB, Fla., where they will fire live air-to-air missiles at drones in Combat Archer exercises, and then return to Langley in August, he added.

In a telephone news conference to declare IOC in December, Keys said he'd like to send a detachment of F-22s on a road trip through the Pacific Theater to "showcase their capabilities" in the region. Such a road trip would come after FOC was declared. The point, Keys said, would be to familiarize US and allied units with the capabilities of the Raptor. It also would serve notice on potential adversaries in the region that the F-22 is up and running and ready to do business.

Come next January—the official



At top, F-22 pilots prepare for an operational readiness exercise at Langley AFB, Va. Above, an F-15 banks while a Raptor, borrowed from Tyndall AFB, Fla., by the 27th Fighter Squadron, flies to a training area off the Virginia coast last year. The 27th Fighter Squadron is nearing a full complement of Raptors.

ing systems to replay the action and critique tactics and procedures.

More Road Trips

More deployments will come rapidly. Langley has scheduled a substantial renovation of its main runway during June and July, so the base's entire complement of F-15s and F-22s must go elsewhere for the duration. The 1st FW will send a dozen of its F-22s to the Northern Edge air combat exercise in Alaska, then they will operate in Alaska for another month. Following that, they will operate from Savannah, Ga., until the Langley runway repairs are completed, Hecker said.

The rest of the Raptors—about 18—will deploy to Hill, practicing ground

timing has yet to be determined—Langley's F-22s will be eligible to be included in the normal rotation of the 10 Air and Space Expeditionary Forces, either AEF 5/6 or 9/10. Once in the AEF rotation, the F-22s will deploy overseas, likely to Southwest Asia, to support Operations Iraqi Freedom or Enduring Freedom. By then, the units will be well-practiced in dogfighting and bomb dropping.

By the end of January, Langley had 20 F-22s on the ramp, with more arriving at the rate of "about two-and-a-half per month," Hecker reported. New pilots also were arriving, in groups of six every two months from Tyndall AFB, Fla., the F-22 "schoolhouse." There they receive three months of

instruction; a month of academics learning the F-22's systems and flight characteristics; and then two months building proficiency in the single-seat fighter.

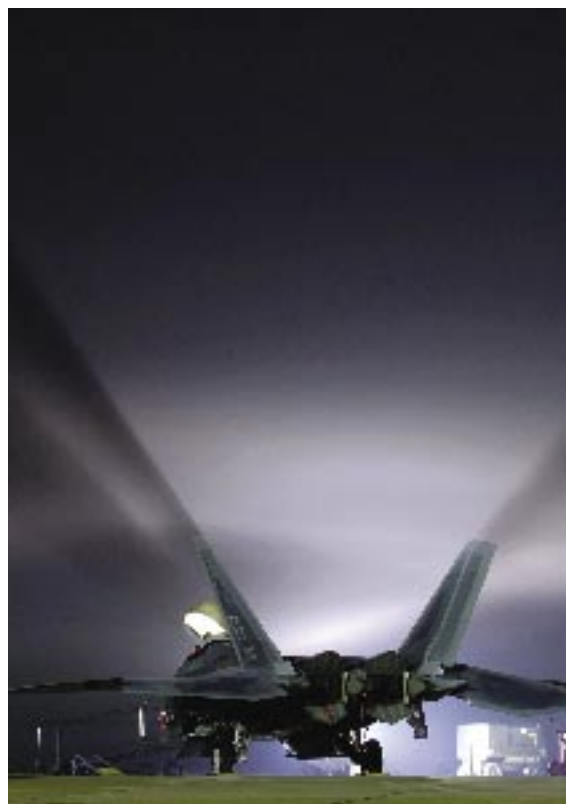
For now, the F-22 will enjoy a pilot-to-aircraft ratio of 1.25, but as its capabilities expand, more types of missions are added to its repertoire, and more aircraft become available, the ratio will likely increase to 1.5 pilots per aircraft. That's because the F-22 is designed to fly more frequently than earlier generation fighters, requiring less downtime between missions for maintenance.

ANG Steps In

The 1st FW also will have a special relationship with the Air National Guard. Pilots and maintainers from the 192nd Fighter Wing, based at Richmond, Va., will drill with the 1st FW at Langley. In February, the first ANG pilot who will fly the F-22 was in training at Tyndall. It marks the first time that the Air Force has included the Guard in operating a brand-new fighter.

Langley also has a full slate of maintenance technicians who are trained for the aircraft. Some have long experience on the Raptor, having serviced it at Nellis, Tyndall, and Edwards AFB, Calif., where it is in continuing flight test. Others have been transferred from working on F-15Cs at Langley. There are sufficient instructors available to conduct some basic training and many levels of intermediate and refresher courses on the airframe and its F119 engine.

An F-22 sits on the flight line at Langley AFB, Va., during Phase 1 of the operational readiness evaluation. In January, the Raptor was certified mission capable, meaning it has the ability to carry out the full range of duties that it might be assigned.



USAF photo by SrA Austin Knox

While there are Lockheed Martin tech reps at the squadron, the vast majority of the maintenance is done by USAF technicians.

The F-22 was designed to be more easily serviced than the F-15C, which it replaces. The goal was to reduce the number of people, parts, and support gear that would be needed for a deployment, while at the same time reducing the amount of touch labor needed to keep the Raptor flying and

increase the sortie generation rate versus the Eagle.

So far, the Raptor needs fewer maintainers than the Eagle "on paper," Hecker said, but he admits taking as many support personnel on deployments as the Eagle requires. It's because the aircraft is still so new, and there are still bugs to be worked out, he explained.

However, compared to the F-15 or the F-16 at a comparable point in their



SSgt. Jason McDonald (left), weapons load crew chief from the 27th FS, checks his technical orders after loading two Joint Direct Attack Munitions onto an F-22 at Hill AFB, Utah. During the exercises at Hill last fall, Raptors dropped a total of 22 JDAMs.

USAF photo by SSgt. Samuel Rogers

fielding, “we’re doing better than they were,” he said.

“We still have some room to improve, to get the sortie generation rates that we’re trying to get. But I think we’re ahead of where those airplanes were, and when you look at where those airplanes are right now, I think we’re going to be even better.”

The 27th has several times achieved an aircraft utilization rate equal to that of most F-15 and F-16 squadrons. However, the parts pipeline is still not delivering at the level of a mature system, and some of the parts “are failing a little more than we thought they would,” Hecker noted. That’s a headache because of the low observable (LO) coatings and treatments on the aircraft.

“Where parts are hard to get at, and they’re LO-intrusive, ... you have to tear it apart, put the part in, and then put it back together, which is very time-consuming.”

During its development, the Raptor was delayed several times because of software problems that caused its computer operating system to blank out in flight, requiring the pilot to reboot the system. (See “The F/A-22 Force Forms Up,” April 2004, p. 34.) It still happens, though far less frequently than during the peak flight-test period, Hecker said.

“All of our airplanes now have an upgraded software package,” he said, which “has reduced a significant number of those lockups.” They happen about “one out of every 100 sorties,” Hecker noted, compared to one in



USAF photo by TSgt. Kevin J. Gruenwald

An F-22 breaks away from an F-16 after completing a training mission at Nellis AFB, Nev. In a recent mission, a Raptor four-ship flew cross-country and went directly into simulated combat. The F-22 was airborne for nearly seven hours.

three several years ago. The reboot takes three minutes or so and if “you’re just about to go into an engagement, that can seem like an eternity.” Still newer versions of the software will further reduce the lockup problem, and USAF officials expect it will disappear completely with a software version expected in about 18 months.

Triple Threat

What makes the F-22 so advanced is its combination of stealth, speed, and sensor fusion, Hecker said. Rather than having to “assimilate” the visual and audio inputs from a half-dozen radars, radar warning receivers, radio calls,

and other sensors, the F-22 pilot sees the entire air battle on a single display, with vastly improved identification of the enemy and where he is.

“The airplane itself is incredible,” according to Hecker, a career-long F-15C pilot.

“It outperforms any of the aircraft we have, to include the F-15C by ... a lot,” he said, declining to go into classified comparisons of the aircraft.

The F-22 typically operates at about 60,000 feet, he noted. At that altitude, the stealthy Raptor can slice through the thin air at Mach 1.5, undetected by the enemy. And even if detected, the Raptor would be out of reach or long gone by the time an opponent could bring his weapons to bear.

The high-altitude flight profile also means that Langley is a good place to operate the Raptor. Pilots can train off the East Coast, in set-aside airspace where they can go supersonic without doing any ground damage due to their supersonic booms. For ground attack practice, pilots merely need to make sure the F-22 is lined up properly for bomb release at the right time; coordinates for an attack are usually loaded into the aircraft’s computer before takeoff. For time-sensitive targets, the Raptor pilot also can reprogram the bomb’s target coordinates from the cockpit.

The F-22s routinely tangle with F-15Cs at Langley, according to Capt. Bill Creeden, a Raptor pilot with the 27th.

In a typical training mission, he



SSgt. Jason Larkins of the 71st Fighter Squadron loads ammunition onto an F-15 at Langley. The F-22 can be serviced more easily than the F-15C it replaces.

USAF photo by SrA. Austin Knox

said, a given number of Raptors will be matched against twice as many adversaries.

A certain type of mission is simulated—defending a base, escorting an attack package, defending a high-value asset such as an AWACS—and the F-15s routinely are destroyed without ever seeing the F-22s.

However, Creeden said, “they’re not fighting as F-15s. ... They’re simulating an adversary aircraft, so they have ‘handcuffs’ on.” The F-15C, he said, remains a highly capable aircraft, but its pilots will simulate Su-27s and other likely threat aircraft with their associated tactics, rather than F-15s. The US is not likely to fight full-up F-15s, he said.

Asked why the F-22s don’t fight F-15s with the handcuffs off, Creeden said the objective isn’t to tax the F-22 pilots but figuring out how to “maximize tactics” against a realistic threat.

Capt. John Echols, another Raptor pilot with the 27th, said sometimes the F-22s go against each other, but pilots prefer “dissimilar” air combat training.

With the Threat in Mind

“There are some inherent issues with practicing air-to-air against a stealthy airplane,” he said. “Our airplane is built with the threat in mind. And the threat is not F-22s—it’s conventional, aluminum-type airplanes.” Still, “we do have ways that we can train against each other, techniques that we can use, ... but that’s our Plan B.”

He added that the F-15s at Langley “do a real good job” as adversaries, “even though they have a mission to fulfill, and they need to train their pilots just as much as we need to train our pilots.”

Echols, who is also an instructor pilot, said sometimes the F-15s “win” against an F-22, but it is a rare event. When it does, it provides ample fodder for tactics evaluation.

Should the F-22 ever get into a close-in, turning dogfight, it still will have a considerable edge. Despite its large size, the F-22 can turn as tightly as an early model F-16 and can, in fact, sustain a turn at 9.5Gs—a half-G better than any previous fighter. Hecker said the F-22 pilots can stay conscious in such a situation because they also have a new kind of G-suit that covers more of the lower body.

“It covers a lot more surface area, so

An F-22 receives gas from a KC-10 tanker during a training sortie at Langley. The base has scheduled a substantial renovation of its main runway for this summer, so all of Langley’s F-22s must go elsewhere for the duration.



USAF photo by TSgt. Ben Bloker

what pilots are seeing is that it gives you an extra G or two,” Hecker reported. On the upper body, F-22 pilots wear the Combat Edge suit, classified by the Air Force as “a partial pressure suit,” Hecker said.

“That does help us get up a bit higher” in altitude.

The F-22 has a special feature that will allow it to be seen on radar when flying Noble Eagle and area training missions, Hecker said, but that feature is removed if the aircraft is going to war or practicing full-up. He declined to describe it, due to classification, but acknowledged that it is not unlike a special radar enhancer used on the F-117.

Creeden said about 60 percent of pilot training in the F-22 is done in the air, with the rest done in a high-fidelity simulator. Emergency procedures are the biggest items to practice in the simulator, since they can’t be safely simulated in the aircraft itself. And what do pilots practice for most?

“The electrical system,” Creeden said. “It all comes down to a cooling problem. Everything on the jet is electrical,” and all those black boxes generate a lot of heat.

“If you lose your cooling, then you’re going to start losing electrical

systems and have cascade failures.” Recognizing and fixing electrical problems before they become “serious issues” is something the pilots focus on, he said.

The F-22 carries six AIM-120C AMRAAM radar missiles and two AIM-9 heat-seeking missiles. Because the Raptor will usually destroy targets at a distance, long before the enemy knows the F-22s are there, the AMRAAM is the weapon of choice. And while the combination of the AMRAAM and the F-22’s advanced radar is formidable, and the likelihood of a one-shot kill is high, sometimes Raptor pilots will shoot more than just one missile per adversary.

Snake Eyes for Him

If the opponent “starts to maneuver, we may up the ante,” Creeden said. “Another reason might be, this guy’s getting really close to what we’re trying to protect. So we may decide to shoot two right now just to make sure, if, for whatever reason, the first one doesn’t get him, the second one will.”

Echols said there is no shortage of applicants to become F-22 pilots, but the requirements are not ultra-stringent. Early in the B-2 program, every potential pilot had to have a personal interview with the then-head

of Air Combat Command, Gen. John Michael Loh.

The plan is to recruit pilots at all experience levels to build a solid, demographically valid cadre of Raptor pilots.

"The biggest [consideration] is timing of where guys are in their careers," Echols said, "not just [taking] the best guy out there." The reason is that USAF wants to avoid creating bulges in the F-22 cadre at any given rank, which could short-circuit careers or leave voids at certain ranks. The process will increasingly mirror that used for the F-15 and F-16. "Eventually, they'll take guys right out of pilot training," Echols said.

Perhaps the biggest question long posed about the F-22 has been its ability to operate like any other fighter, even though stealth technology has historically demanded meticulous care of aircraft surfaces, well beyond what could be managed at an austere expeditionary airstrip. In real-world F-22 operations, though, it has proved not to be an issue.

"We've made huge advancements as far as the coating application, the durability, and maintainability as a whole" of the F-22's stealth systems, according to MSgt. Renee Daig, non-commissioned officer in charge of Langley's Low Observable Composite Repair Facility.

She said the F-117 is considered first generation stealth, the B-2 was second generation, and the F-22 is third generation. The F-35 Joint Strike Fighter "will be considered the fourth generation," she noted.

On the F-117, radar-absorbent material had to be fitted to the aircraft with virtually artistic skill, and any intrusion into a panel to repair a part caused huge downtimes as the material had to be painstakingly reapplied. On the B-2, things improved with the addition of more access hatches and panels, but the coatings and tape that sealed seams still posed a headache of reapplication after every mission.

By contrast, the F-22's stealth systems can be fixed outside, on a ramp, not requiring substantial touch-ups for long periods of time, Daig said.

"Ninety-five percent of the restorations that we do on the aircraft we can do with a standard brush or roller," she said. "Now, does that mean you can do it out on the open flight line? ... You sure can."

Just as "you wouldn't consider painting your house" in bad weather, the

F-22's LO maintainer also must use common sense, and "in a deployed environment, ... we would prefer to have some type of shelter or overhang" to work under. But it isn't always necessary. Stealth materials were touched up on the Nellis ramp during a deployment last year because it was a sunny day, 70 degrees, and there was no wind, she noted.

Good Enough To Beat You

Rather than clean up every single defect after every mission—"whether it be missing material, a crack, disbond, delamination, what have you"—the F-22's handlers aim to keep the aircraft stealthy within certain parameters. After every inspection, the surface defects are cataloged and fed into a computer program called the Signature Assessment System. From a "pristine" aircraft fresh from the factory with no stealth defects—zero percent stealth impact—the percentage of dings on each Raptor accumulates over time in the computer model.

"When it broaches the 80 percent mark, we start to think about ... doing some repairs to get us back where we need to be," Daig explained.

The model system is a far cry from the F-117 and B-2, which both originally required elaborate measuring devices—sometimes instrumented flying ranges—to measure their stealth. The B-2 has since moved to a system similar to SAS.

The "effects of defects" model "works very well for us, because you can find yourself with 200 to 300 nicks, dings, and scratches on the aircraft and still be an LO platform and still meet your LO missions," Daig asserted. After the SAS registers 100 percent, "we can no longer guarantee to that pilot that he's where he needs to be" in terms of stealth, she said.

Daig also said that some support equipment that can measure the F-22's stealthiness is being tested, because "a lot of the pilots and senior leadership don't necessarily feel comfortable with that model mentality." However, she's convinced, because numerous range tests have validated the SAS predictions.

"It's a very solid database. We're very confident in the numbers that it gives us back."

Daig also pointed to the fact that F-22 surface treatments have held up well under years of the worst case environment—baking in the sun at Edwards and Nellis for long periods of time.

In fact, Daig said most of the demands on her shop are not prompted by the durability of the stealth treatments themselves.

"Right now, our biggest headaches" stem from other parts—compressors, fuel pumps, etc.—that "are not performing to the predicted numbers." These failures force her team to "break into the LO 'bubble'" of the aircraft to get at the part, and then restore the stealth treatments after the part is replaced.

"That is about 90 percent of my workload today," she said. "What we do every single day is restoring panels that were removed because something else was broken." Daig reported that she has about 1.67 stealth specialists—"we are sheet metal workers by trade"—for each F-22.

Both Tyndall and Langley are on the ocean, and the salty air doesn't seem to be affecting the stealth treatments either. "About all we're seeing right now is some structural component issues with corrosion, but the coatings are holding up very well," Daig asserted.

Time will tell, though, she said. The B-2 "has struggled with this—where the coatings were good when they were put on, but over 10 or 15 years, they start to degrade. The jury's still out" as to whether the F-22's stealth surfaces will prove durable for the life of the airframe. Also yet to be seen is how well the stealth coatings will hold up in an extremely cold environment over long periods of time. That lesson will be learned when Elmendorf AFB, Alaska, becomes the second base to beddown the F-22.

Hecker said his pilots will practice long-duration missions to get the F-22 anywhere it needs to go in the world, but the aircraft itself is a limiting factor. Unlike the B-2, which has flown 38-hour missions or more, the F-22 is a single-seat aircraft, limiting missions to about 15 hours.

He also said the F-22 units will continue to focus on their No. 1 mission: to "kick down the door of a highly defended air-to-air threat as well as an integrated air defense system, with state-of-the-art surface-to-air missiles ... [known as] double-digit SAMs."

Noting that US ground forces were last attacked from the air in 1952, Hecker said, "This airplane will ensure that we have air dominance so that that doesn't happen again." The Raptor, he said, "could gain us another 30 years and make sure that we protect not only Air Force assets, but particularly our guys on the ground." ■