



F-35 Lightning II Program

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F-35: Exiting the Pattern,

At long last, the F-35 strike fighter set to complete development phase

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The F-35 Lightning II's development program is finally coming to a close, nearly 17 years after the Lockheed Martin design was selected as the Joint Strike Fighter, and almost six years after the program was restructured due to delays and cost growth. Aircraft in the baseline, or "3F" configuration, will be handed over to the Operational Test community in the next few months to verify that everything works as intended.



An F-35 in-flight over Edwards Air Force Base, Calif. The colorful markings on the bombs and the "spots" help calibrate cameras recording this flutter test. Photo by Darin Russell

Under the restructure plan, initial operational test and evaluation (IOT&E) was supposed to have begun around July 2017, which means the development program will probably wrap up between six and eight months late. That reflects estimates made by top Pentagon leaders—such as former Undersecretary of Defense Frank Kendall—in mid-2016, but is better than estimates made by the Defense operational test and evaluation community that same year. DOT&E forecast that operational testing might be delayed until late 2018 or even early 2019.

There is "nothing major," preventing the F-35 from entering the home stretch of its basic development, Joint Program Office director Vice Adm. Mathias Winter told *Air Force Magazine* in a September interview.

“We have the resources” in the Fiscal 2017 and 2018 defense budgets to complete development, Winter said, adding that he expected airworthiness flight testing of all three variants, in the 3F configuration, to conclude in December 2017. Development will have cost \$55 billion, in then-year dollars, by the time it is done.

F-35 Joint Program Office officials say if new discoveries require an extension of System Development and Demonstration (the official name of the development effort), \$100 million has been earmarked by Congress to come out of the first batch of money for future upgrades to cover the shortfall.

Flight testing of the Air Force version, the F-35A, was already complete last summer, while flight testing of the F-35B—the short takeoff, vertical landing variant used by the Marine Corps—was in September only a few “ski jump” test flights from completion, he said. Testing the F-35C carrier-compatible version was several “high-altitude, high-mach” test flights from concluding, but those flights are heavily dependent on good weather, Winter said.

Conditions at both Edwards AFB, Calif., and NAS Patuxent River, Md., deteriorate in the winter, making weather “probably our biggest inhibitor” of completing the flight sciences phase of development, he said.

While IOT&E depends on handing testers 23 jets in the 3F configuration, Winter’s predecessor, retired Lt. Gen. Christopher Bogdan, told Congress last year an arrangement was being struck with DOT&E to begin testing with fewer jets, adding more as they become available. Earlier-version F-35s, flying with the 2B or 3i software and/or processors have to be modified to the latest and “final baseline” configuration. The 23 jets comprise six each of the A,B, and C variants from the Air Force, Marine Corps and Navy, while three more will be B models from Britain and two others will be Dutch F-35A models.

So what happens after the jets are handed off? The test community will put them through their paces, matching them against the no-fail requirements set by the services in all the mission areas the F-35 must perform. These include air-to-ground attack, air-to-air combat, suppression of enemy air defenses, electronic warfare, electronic attack, close air support, and ancillary missions related to intelligence, surveillance and reconnaissance. If all goes well, and no substantive deficiencies are found, the F-35 can proceed to full-rate production in the 3F configuration.

Planning is well underway for follow-on development. Driven by changes in the threat, the new effort—at this point known broadly as Block 4—will continuously add new weapons, software, electronic warfare capabilities, sensors, and maintenance updates. The Government Accountability Office, however, recommended in April that the Pentagon hold off on Block 4, against the possibility that something serious may yet be discovered in testing. That in turn would delay ramping up to full production rates and the fielding of the Navy’s F-35C, the GAO said. The program office, responding to the GAO, rejected that suggestion, saying the evolving threat demands that Block 4 work begin without “undue delay” to ensure there are no US or partner nation “critical ... capability gaps.”

It is worth noting that the Marine Corps went operational with its initial F-35Bs in 2015 and the Air Force with F-35As in 2016, but with a less-than-all-up operating system and weapons suite. The Navy is due to declare initial operational capability in 2018, with the 3F version of software and weapons suite.

The Air Force and Marine Corps units flying the F-35 have given it rave reviews, and both services have deployed their F-35s operationally. The major gripes reported by operational squadrons so far have mainly to do with spare parts availability. The joint program office has acknowledged that issue, saying vendors are making parts for several block configurations of the F-35 at the same time.

As the majority of jets are upgraded to the 3F baseline, fewer versions of parts will be needed, more of the baseline types can be made, and the issue should be mitigated, the JPO has said.

Weapons accuracy—often a sticking point in test schedules—was completed in October. Thanks to greater availability of tankers for flight test support, the basic weapons suite was down to only one box to check off: the Joint Standoff Weapon, a stealthy glide bomb. Nothing had been removed from the weapon testing program except a cluster bomb that was subject to an international treaty.

What will be handed over to the Pentagon’s initial operational test and evaluation community will be a “warfighting capability,” Winter said. The aircraft will be in the 3F configuration, flying with 3F software version 6.3. Developmental test units have already been flying with version 6.2, Winter said, “so they have awareness, understanding” of what’s in it. Also required are fully stocked mission data files (MDF) which populate the F-35’s computers with up-to-date information on threats around the world, and the facility that develops those files will also be scrutinized by OT&E.

Simulators are also part of the IOT&E evaluation, to ensure that they accurately replicate the aircraft’s performance as it has been verified in flight test.

Finally, the operational testers will scrutinize the latest version of the Autonomic Logistics Information System, or ALIS, that tracks aircraft by tail number, schedules the changeout of consumable parts, and actually communicates with the aircraft's computers—such that the jet can tell the maintenance system of problems developing or faults that occurred on a mission. That way, maintainers know what to fix the moment the fighter comes to a full stop on the ramp. ALIS version 3.0 was to be available for operational test in December, Winter said.

To save time and keep on schedule, “we want to use the simulator to reduce the amount of test points we have to fly” and get IOT&E underway as soon as possible, Winter said, adding that the idea is that if the airplane's performance matches certain data points in the flight envelope, it's not necessary to fly all the data points in between.

Reminded that this approach was one of the ways the F-35 program got into trouble in the mid-2000s, Winter said he couldn't comment on program decisions “back before my time,” but said IOT&E “is still making a decision and looking at the validity” of the shortcut.

Winters said his conversations with the Pentagon's Director of Operational Test and Evaluation, David H. Duma, tell him that the organization “has taken a more reasonable approach” to clearing the 3F than that of predecessors. Although “they're ... sticklers and they're pushing,” the DOT&E looks “at the value of where we are, and the maturity of where we are, and so we have a very good working relationship with IOT&E now.”

The IOT&E program should last “roughly a year,” Winter said, and the exact test plan was to have been nailed down in November.

Under Bogdan, the Block 4 program was notionally slated to deliver capability upgrades in increments of two years each: hardware and weapons alternating with software. Winter said, “That's unexecutable.”

“There's too much scope in each of these. Can't do it,” Winter said. He explained that the F-35 must progress along a number of fronts at once, and because they all work together—operational flight program, mission data files, ALIS, new weapons, new processors, etc.—increments can't really be looked at in pieces.

He said he would bring an updated Block 4 schedule to his boss—Air Force acting acquisition chief Darlene Costello—at “the end of October.”

Will the updates come at intervals longer than two years?

“We will meet the warfighter requirements for the capability ... based on the threat,” Winter asserted. The JPO is studying the “technical flowdown to determine the most effective and efficient cadence of delivery” of each element of Block 4. Assuming Costello approval, he expected to take this updated plan to the Defense Acquisition Board for its blessing in November.

Winter noted that although the Air Force has backed off its plan to build 80 F-35s per year for at least the next five years, that doesn't reflect anything going on in development.

Changes to quantities—the Air Force stopping at 60 per year, while the Marine Corps is accelerating from 46 to 60 across the future years defense plan—is “budget driven, not capacity or warfighter requirement driven.” The services certified to Congress last summer that they are sticking to their planned purchase numbers: 1,763 F-35As for the Air Force, 353 F-35Bs for the Marine Corps, and “340 [C models] split between the Navy and Marine Corps,” Winter noted. “We're committed to the program of record,” he insisted, adding that the program is on the verge of a large surge in production.

“We'll go from 60 airplanes to 160 airplanes [per year] over these next five years,” he said, adding “expanding and stretching the supplier base, we will go from 240 airplanes in the field today to almost 1,000 aircraft in the field in five years ... while bringing the rapid capability enhancements of Block 4.”