



## Testimony

Before the Subcommittee on Tactical Air  
and Land Forces, Committee on Armed  
Services, House of Representatives

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# F-35 JOINT STRIKE FIGHTER

## Observations on Program Progress

Statement of Michael J. Sullivan, Director  
Acquisition and Sourcing Management

Accessible Version

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Chairman Turner, Ranking Member Sanchez, and Members of the Subcommittee:

Thank you for the opportunity to discuss our work on the F-35 Lightning II, also known as the Joint Strike Fighter (JSF). With estimated acquisition costs of nearly \$400 billion, the F-35 is the Department of Defense's (DOD) most costly acquisition program. Through this program, DOD is developing and fielding a family of strike fighter aircraft, integrating low observable (stealth) technologies with advanced sensors and computer networking capabilities for the United States Air Force, Navy, and Marine Corps, as well as eight international partners.<sup>1</sup> The F-35 family is comprised of the F-35A conventional takeoff and landing variant, the F-35B short takeoff and vertical landing variant, and the F-35C carrier-suitable variant. Over time, the program has made a number of changes affecting the planned quantities and associated costs.<sup>2</sup> According to current projections, the U.S. portion of the program will require acquisition funding of \$12.4 billion a year, on average, from now through 2038 to complete development and procurement of 2,457 aircraft. DOD also estimates that the F-35 fleet will cost around \$1 trillion to operate and support over its lifetime, which poses significant long-term affordability challenges for the department.

As we have reported in the past, the F-35 program's significant cost, schedule, and performance problems can largely be traced to (1) decisions made at key junctures without adequate product knowledge and (2) a highly concurrent acquisition strategy with significant overlap among development activities, flight testing, and production.<sup>3</sup> This testimony is based on our April 2015 report which is being released

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<sup>1</sup>The international partners are the United Kingdom, Italy, the Netherlands, Turkey, Canada, Australia, Denmark, and Norway. These nations contributed funds for system development and signed agreements to procure aircraft. In addition, Israel, Japan and South Korea have signed on as foreign military sales customers.

<sup>2</sup>An overview of changes in program cost and quantity from 2001 through 2014 can be found in app. I.

<sup>3</sup>GAO, *Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Still Lags*, [GAO-11-325](#) (Washington, D.C.: Apr. 7, 2011); *Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risk*, [GAO-12-437](#) (Washington, D.C.: June 14, 2012); *Joint Strike Fighter: Current Outlook Is Improved, but Long-Term Affordability is a Major Concern*, [GAO-13-309](#) (Washington, DC.: Mar. 11, 2013).

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today. Our work was conducted in response to a provision of the National Defense Authorization Act for Fiscal Year 2010, which requires us to review the F-35 acquisition program annually for 6 years.<sup>4</sup> For this review we assessed (1) development and testing progress, (2) manufacturing and supply chain performance, and (3) cost and affordability.

For our April 2015 report, we reviewed and analyzed program briefings, management reports, test data and results, and internal program analyses. To assess the reliability of the cost, manufacturing, and supply chain performance data we reviewed the supporting documentation and discussed the data with DOD; Lockheed Martin, the aircraft contractor; and Pratt and Whitney, the engine contractor. We determined that all of the data we used were sufficiently reliable for the purposes of our work. We also discussed ongoing manufacturing process improvements with contracting and Defense Contract Management Agency (DCMA) officials. We conducted this work in accordance with generally accepted government auditing standards.

In brief, recent F-35 technical challenges forced DOD to make unexpected changes to its development and testing plans over the past year and ultimately delay key developmental and operational test activities. The key technical challenges affecting the program were a structural failure on the F-35B durability test aircraft, an engine failure, and a higher-than-expected amount of test point growth largely to address software rework. In addition, the F-35 system reliability has been limited by poor engine reliability which will take additional time and resources to achieve reliability goals. With flight testing of more complex software and advanced capabilities still ahead, additional discoveries during testing and subsequent design changes are likely. At the same time, DOD plans to significantly increase production rates over the next 5 years. Design changes needed to address new technical problems or improve engine reliability while the program continues to buy new aircraft will likely result in additional retrofits, cost increases, and schedule delays. Lockheed Martin has made progress in manufacturing the aircraft and delivered 36 aircraft last year, as planned. Higher-than-expected part shortages and manufacturing rework continue and could pose significant challenges as the program increases production rates. However, based on our ongoing work, we believe that affordability remains the biggest

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<sup>4</sup>Pub. L. No. 111-84, § 244 (2009).

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challenge facing the program. From fiscal years 2015 to 2019, planned annual funding increases from \$8 billion to around \$12 billion, then shortly thereafter reaches \$14 billion and remains between \$14 and \$15 billion for nearly a decade. We are concerned that the program will be unable to receive and sustain such a high and unprecedented level of annual funding over this extended period, especially with other significant fiscal demands weighing on DOD and the nation.

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## Recent Technical Challenges Will Likely Result in Future Cost Growth and Schedule Delays

DOD continued to experience development and testing discoveries over the past year, largely due to a structural failure on the F-35B durability test aircraft, an engine failure, and more software test growth than expected. Together, these factors led to adjustments in the program's test schedule. The program's test resources and aircraft capabilities were reprioritized and test points were deferred or eliminated in order to mitigate some of the schedule risk. In the end, the program still had to delay the completion of some developmental test activities. Also, decisions were made to restructure a Block 2B operational test event that was planned for 2015. While these changes allowed the program to accomplish nearly the same number of test points it had planned for the year, not all of the specific test activities scheduled were completed. As a result, the completion of developmental flight testing for the three blocks of software that provide warfighting capability—Block 2B, Block 3i, and Block 3F—has been delayed 3 to 6 months.

We believe that DOD has a long way to go to achieve its engine reliability goals as engine reliability at this time is extremely poor. Reliability is a function of how well a system design performs over a specified period of time without failure, degradation, or need of repair. Poor reliability with the engine has limited the program's overall reliability progress. According to program and contractor officials, the overall reliability of the aircraft had been improving over the past year. In contrast, engine reliability remained relatively steady over the same time period and remained below expected levels. We believe that improving the F-35 engine reliability to achieve established reliability goals will likely require more time and resources than originally planned.

While DOD is addressing these unanticipated technical issues and working to improve engine reliability, it is also planning to significantly increase aircraft procurement over the next 5 years. As of December 2014, DOD plans to steeply increase procurement from 38 aircraft in 2015 to 90 aircraft in 2019. By the time developmental flight testing is finished—currently expected to occur in 2017—DOD will have procured a

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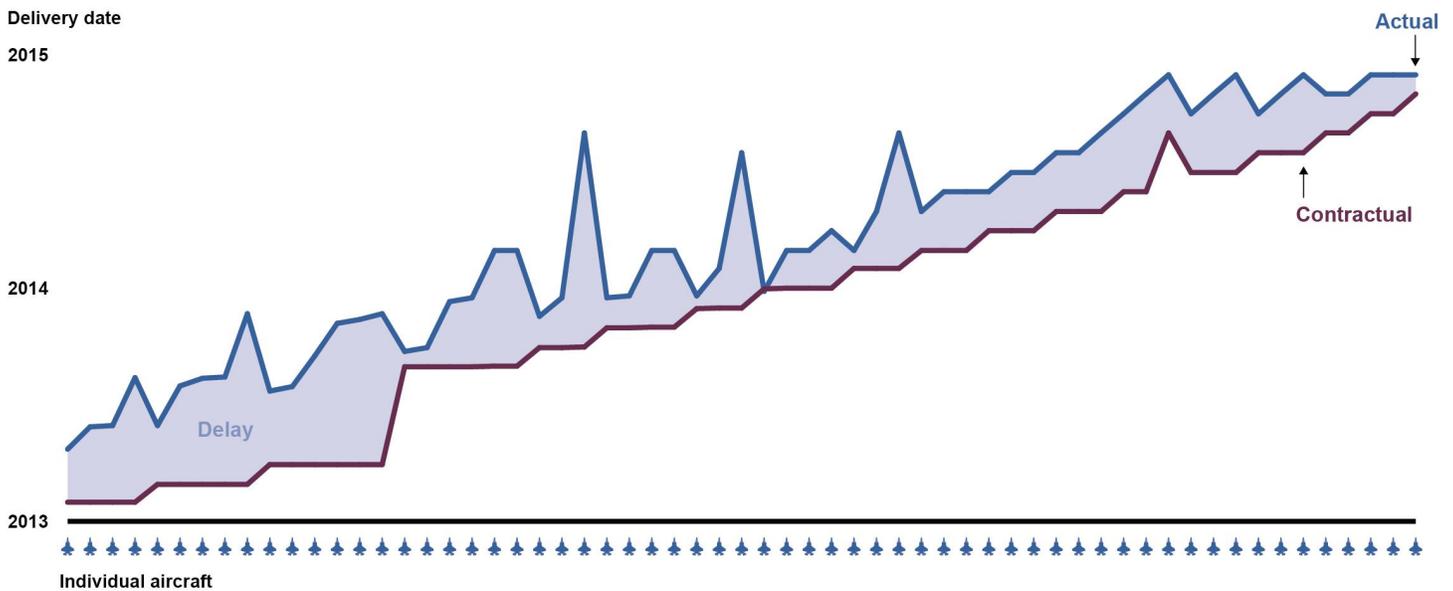
cumulative total of 340 aircraft. During this same time, the program plans to flight test the F-35's full warfighting capabilities—Block 3F—which are expected to demonstrate capabilities needed to perform in more demanding and stressing environments. While DOD has taken steps over the past few years to reduce concurrency, the program's strategy still contains a noteworthy overlap between the completion of flight testing and the increase in aircraft procurement rates. With the flight testing of the more complex software and advanced capabilities still ahead and reliability improvements needed, we believe that it is almost certain that the program will discover more technical problems. Depending on the nature and significance of the discoveries, we are concerned that the program may need additional time and money to incorporate design changes and retrofit aircraft.

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## While Manufacturing Progress Continues, Planned Production Increases Could Be Challenging in the Near Term

Lockheed Martin delivered 36 aircraft in 2014, bringing the total number of production aircraft delivered since production deliveries began in 2011 to 110 aircraft—none of which were delivered with warfighting capabilities. Although Lockheed Martin continues to deliver aircraft later than planned, delivery performance is trending in the right direction and Lockheed Martin expects to begin meeting contracted delivery dates sometime in 2015 (see figure 1). Improving delivery performance will be imperative as the United States and international aircraft deliveries are expected to exceed 90 aircraft per year within the next 5 years.

**Figure 1: Trend of F-35 Joint Strike Fighter Contractual Delivery Dates Compared to Actual Delivery Dates**



Source: GAO analysis based on Department of Defense and contractor data. | GAO-15-429T

Note: This figure includes deliveries to the United States and all foreign partners.

Manufacturing efficiency is improving as the number of hours needed to build aircraft is trending down over time. The number of major engineering design changes has also continued to decline over time, and is currently tracking closer to the program’s plan. The reduction in engineering design changes over time has been one of the keys to improving Lockheed Martin’s manufacturing performance. Lockheed Martin has made this progress despite increases in the percentage of time it has spent correcting manufacturing defects. For example, the percentage of time spent on scrap, rework, and repair increased from 13.8 percent to 14.9 percent between the two most recently completed production lots. Lockheed Martin attributes most of the rework time to fixing misplaced brackets and uneven seams.

Suppliers continued to deliver parts late, resulting in part shortages. We are concerned that if these trends continue, Lockheed Martin could have difficulty improving its manufacturing efficiency at its expected rates. Over the past year, the number of part shortages increased, including severe shortages that caused workarounds or work stoppages. A similar condition exists at Pratt & Whitney, the engine manufacturer. Pratt & Whitney is experiencing challenges with part shortages and supplier quality with nearly 45 percent of its key suppliers delivering parts late over

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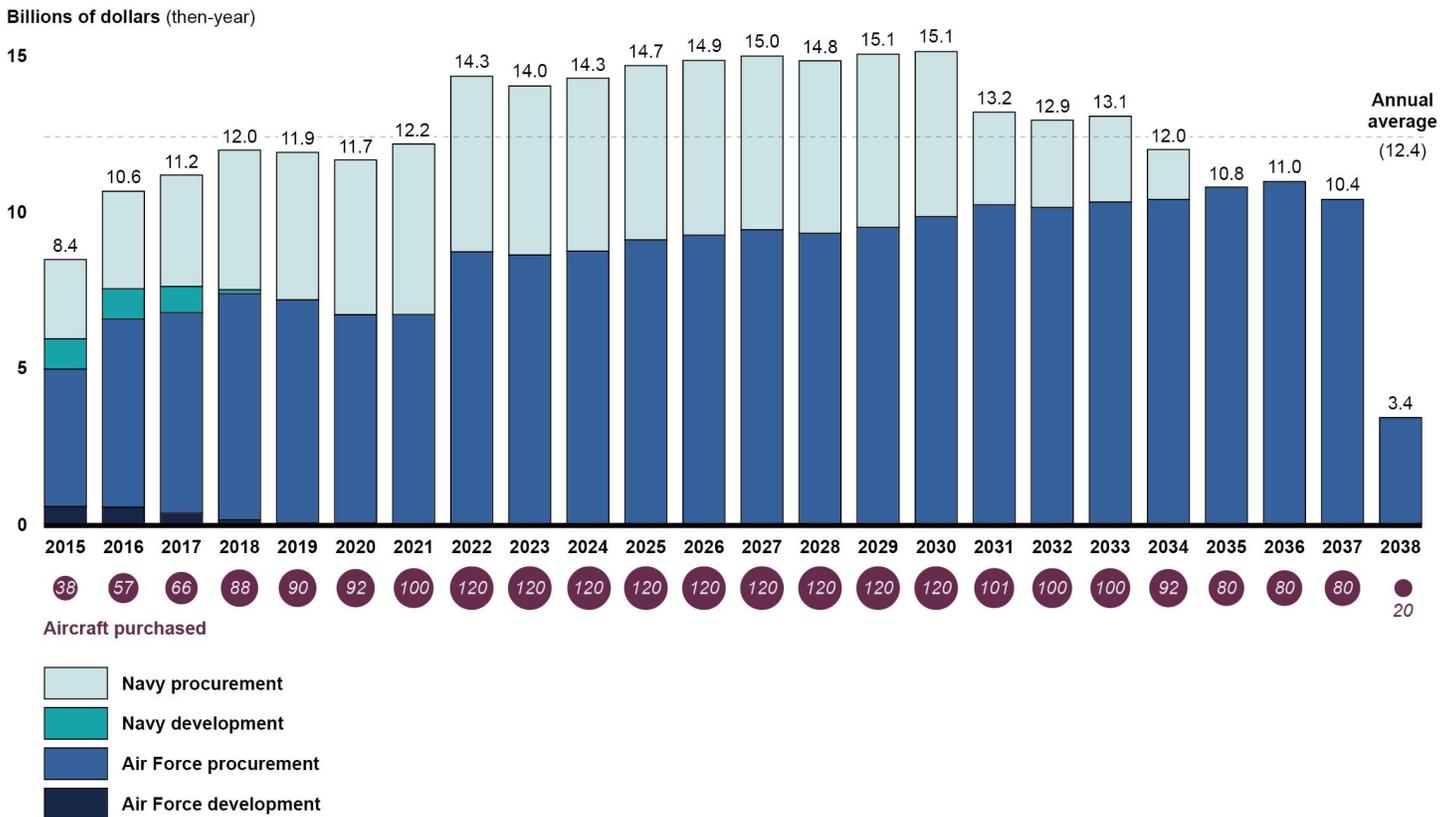
the past year. Both Lockheed Martin and Pratt & Whitney officials stated that they are addressing these supplier performance problems. We believe that if these problems are not resolved they will likely be amplified as production rates increase over the next 5 years.

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## Affordability Concerns Will Continue to Challenge Procurement Plans

To execute its current procurement plan, the F-35 program will need to request and obtain, on average, \$12.4 billion annually in acquisition funds for more than two decades. Regardless of any future increases in program costs, continued investment of this magnitude in one program—estimated at roughly \$300 billion over the next 24 years—must be viewed within the context of DOD’s other investment priorities as well as other fiscal needs facing the nation. The F-35 program will have to compete for funding with many other large, high-priority defense programs, including a new bomber, tanker, submarine, and aircraft carrier, as well as other government priorities external to DOD’s budget. In a time of austere budgets, we believe fully funding all of the department’s priorities at the same time will undoubtedly force DOD to continue to make difficult trade-off decisions. The F-35 program’s latest planned funding profile for development and procurement—as of December 2014—is shown in figure 2. In our April 2015 report we recommended that DOD conduct an affordability analysis of the program’s current procurement plan that reflects various assumptions about future technical progress and funding availability, and DOD agreed with our recommendation.

**Figure 2: F-35 Joint Strike Fighter Budgeted Development and Procurement Costs by Service, 2015-2038**



Source: GAO analysis of Department of Defense data. | GAO-15-429T

Note: Annual projected cost estimates expressed in then-year dollars reflect inflation assumptions made by a program.

From fiscal years 2015 to 2019, DOD plans to increase development and procurement funding for the F-35 from around \$8 billion to around \$12 billion, an investment of more than \$54 billion over that 5-year period. This funding reflects the U.S. military services' plans to significantly increase annual aircraft procurements from 38 in 2015 to 90 in 2019. Annual U.S. procurements peak at 120 aircraft in 2022, and will require between \$14 and \$15 billion annually for nearly a decade. During that same time, DOD will be operating and sustaining an increasing number of fielded F-35 aircraft. Officials from the Office of the Secretary of Defense have stated that the current F-35 sustainment strategy, with cost

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estimates around \$1 trillion over the life cycle of the program, is not affordable; and in a September 2014 report, we found that DOD's estimates may not reflect the most likely sustainment costs.<sup>5</sup> When acquisition and sustainment funds are combined, annual funding requirements could easily approach \$30 billion in some years.

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In conclusion, as the Congress considers DOD's proposed increases in F-35 annual procurements over the next 5 years, we believe that several key areas of risk remain. First, with more demanding and complex testing still to be done, the program faces the risk that new technical problems—including those related to software—will be discovered and additional design changes will be needed. Second, while Lockheed Martin's manufacturing capabilities and efficiency have continued to improve, the extent to which the improvement is enough to meet the demands of the increased production rates remains uncertain. Finally, it is unclear whether DOD's current procurement plan is affordable in the context of the fiscal pressures, both internal and external, facing DOD.

Chairman Turner, Ranking Member Sanchez, and members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions you may have. We look forward to continuing to work with the Congress as we to continue to monitor and report on the progress of the F-35 program.

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## GAO Contact and Staff Acknowledgments

If you or your staff have any questions about this testimony, please contact Michael Sullivan, Director, Acquisition and Sourcing Management at (202) 512-4841 or [sullivanm@gao.gov](mailto:sullivanm@gao.gov). Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions to this testimony are Travis J. Masters, Assistant Director; Peter W. Anderson; Marvin Bonner; Matthew Lea; Megan Porter; and Abby Volk.

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<sup>5</sup> [GAO- F-35 Sustainment: Need for Affordable Strategy, Greater Attention to Risks, and Improved Cost Estimates, GAO-14-778](#) (Washington, D.C.: September 23, 2014).

# Appendix I: Changes in Reported F-35 Joint Strike Fighter Cost, Quantity, and Deliveries, 2001-2014

	October 2001 Initial Baseline	March 2012 Latest Baseline	December 2014 Estimates	Change from 2001 to 2012	Change from 2012 to 2014
<b>Expected quantities (number of aircraft)</b>					
Developmental quantities	14	14	14	0%	0%
Procurement quantities	2,852	2,443	2,443	-14	0
<b>Total quantities</b>	<b>2,866</b>	<b>2,457</b>	<b>2,457</b>	<b>-14</b>	<b>0</b>
<b>Cost estimates (then-year dollars in billions)<sup>a</sup></b>					
Development	\$34.4	\$55.2	\$54.9	60%	-0.5%
Procurement	196.6	335.7	331.6	71	-1.2
Military construction	2.0	4.8	4.6	140	-4.2
<b>Total program acquisition</b>	<b>233.0</b>	<b>395.7</b>	<b>391.1</b>	<b>70</b>	<b>-1.2</b>
<b>Unit cost estimates (then-year dollars in millions)<sup>a</sup></b>					
Program acquisition	\$81	\$161	\$159	99%	-1.2%
Average procurement	69	137	136	99	-0.7
<b>Estimated delivery and production dates</b>					
Initial operational capability	2010-2012	Undetermined	2015-2018	Undetermined	5-6 years
Full-rate production	2012	2019	2019	7 years	0 years

Source: GAO analysis of DOD data. | GAO-15-429T

<sup>a</sup>Annual projected cost estimates expressed in then-year dollars reflect inflation assumptions made by a program.

# Appendix II: Accessible Data

**Data Table for Figure 1: Trend of F-35 Joint Strike Fighter Contractual Delivery Dates Compared to Actual Delivery Dates**

<b>Aircraft</b>	<b>Contractual Date</b>	<b>Actual delivery date</b>
AF-06	1/31/2010	5/10/2011
AF-07	2/1/2010	5/5/2011
AF-08	4/30/2010	7/17/2011
AF-09	5/31/2010	7/8/2011
AF-10	6/30/2010	8/15/2011
AF-11	7/30/2010	8/2/2011
AF-12	8/1/2010	9/2/2011
AF-13	9/1/2010	10/21/2011
BF-06	9/30/2010	12/30/2011
BF-07	10/1/2010	1/16/2012
BF-08	11/1/2010	1/8/2012
BF-09	12/1/2010	5/4/2012
BF-10	1/1/2011	5/4/2012
BF-11	2/1/2011	5/5/2012
BF-12	3/1/2011	6/29/2012
AF-14	4/1/2011	7/2/2012
BF-13	5/1/2011	7/20/2012
AF-15	6/1/2011	6/29/2012
BF-14	6/1/2011	7/20/2012
AF-16	7/1/2011	6/29/2012
BK-01	7/1/2011	7/12/2012
BK-02	8/1/2011	8/30/2012
AF-17	8/1/2011	12/13/2012
BF-15	9/1/2011	8/25/2012
AF-18	9/1/2011	12/13/2012
AF-19	9/1/2011	12/13/2012
AF-20	10/1/2011	12/13/2012
BF-16	11/1/2011	8/31/2012
BF-17	12/1/2011	8/21/2012
BF-18	12/1/2011	9/15/2012
AN-01	7/31/2012	7/25/2013
BF-19	8/31/2012	11/15/2012
BF-20	8/31/2012	11/16/2012
AF-21	8/31/2012	12/21/2012
CF-05	9/1/2012	12/1/2012

Appendix II: Accessible Data

<b>Aircraft</b>	<b>Contractual Date</b>	<b>Actual delivery date</b>
BF-21	9/30/2012	11/15/2012
AF-22	9/30/2012	12/21/2012
CF-06	9/30/2012	4/24/2013
AF-23	10/31/2012	12/21/2012
AF-24	10/31/2012	12/21/2012
BF-22	10/31/2012	12/21/2012
CF-07	10/31/2012	4/23/2013
AF-25	11/30/2012	4/19/2013
BF-23	11/30/2012	4/19/2013
BK-03	11/30/2012	6/4/2013
CF-08	11/30/2012	8/2/2013
BF-24	12/31/2012	4/22/2013
BF-26	12/31/2012	4/30/2013
BF-25	12/31/2012	6/25/2013
AF-26	1/31/2013	4/24/2013
AF-27	1/31/2013	5/29/2013
BF-27	1/31/2013	5/31/2013
BF-28	1/31/2013	8/14/2013
AF-29	2/28/2013	5/31/2013
AN-02	2/28/2013	8/1/2013
AF-28	2/28/2013	8/13/2013
BF-29	2/28/2013	8/15/2013
BF-30	28-Feb-13	22-Nov-13
BF-32	3/31/2013	7/24/2013
BF-31	3/31/2013	7/31/2013
AF-30	31-Mar-13	17-Sep-13
CF-09	31-Mar-13	7-Nov-13
BF-33	31-Mar-13	13-Nov-13
BF-34	31-Mar-13	22-Nov-13
AF-32	31-Aug-13	24-Sep-13
AF-31	31-Aug-13	30-Sep-13
CF-10	31-Aug-13	11-Dec-13
BF-35	31-Aug-13	17-Dec-13
AF-33	30-Sep-13	18-Nov-13
AF-34	30-Sep-13	17-Dec-13
AF-36	31-Oct-13	17-Dec-13
AF-35	31-Oct-13	20-Dec-13

Appendix II: Accessible Data

Aircraft	Contractual Date	Actual delivery date
AF-37	30-Nov-13	20-Dec-13
AF-39	31-Dec-13	27-Dec-13

Source: GAO analysis of Department of Defense data. GAO-15-429T.

Note: This figure includes deliveries to the United States and all foreign partners.

**Data Table for Figure 2: F-35 Joint Strike Fighter Budgeted Development and Procurement Costs by Service, 2015-2038**

In billions of dollars (then year)

Year	Air Force development	Air Force procurement	Navy development	Navy procurement	Total	Aircraft purchased
2015	0.5354	4.269	0.9723	2.4042	8.2	34
2016	0.5226	6.0696	1.0622	2.8139	10.5	55
2017	0.3271	6.3196	0.7961	3.9695	11.4	68
2018	0.1154	7.1007	0.103	4.939	12.3	90
2019	0.0053	6.9883	0.012	5.6769	12.7	96
2020	0	6.8445	0	5.924	12.8	100
2021	0	8.649	0	6.0838	14.7	120
2022	0	8.7616	0	5.8915	14.7	120
2023	0	9.0884	0	5.8332	14.9	120
2024	0	9.1446	0	5.96707	15.1	120
2025	0	9.2863	0	5.9498	15.2	120
2026	0	9.594	0	5.8833	15.5	120
2027	0	9.7849	0	5.6885	15.5	120
2028	0	9.7253	0	5.7242	15.4	120
2029	0	10.0955	0	5.7272	15.8	120
2030	0	10.3011	0	5.4872	15.8	120
2031	0	10.6454	0	3.0661	13.7	101
2032	0	10.4503	0	2.8233	13.3	100
2033	0	10.7221	0	2.3683	13.1	98
2034	0	10.7884	0	0	10.8	80
2035	0	11.0388	0	0	11.0	80
2036	0	11.2286	0	0	11.2	80
2037	0	10.2696	0	0	10.3	80
2038	0	0.7114	0	0	0.7	2

Source: GAO analysis of Department of Defense data. GAO-15-429T.

Note: Annual projected cost estimates expressed in then-year dollars reflect inflation assumptions made by a program.

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