



March 2017

# KC-46 TANKER MODERNIZATION

Delivery of First Fully  
Capable Aircraft Has  
Been Delayed over  
One Year and  
Additional Delays Are  
Possible

Accessible Version

# GAO Highlights

Highlights of [GAO-17-370](#), a report to congressional committees

## Why GAO Did This Study

The KC-46 tanker modernization program, valued at about \$44 billion, is among the Air Force's highest acquisition priorities. Aerial refueling—the transfer of fuel from airborne tankers to combat and airlift forces—is critical to the U.S. military's ability to effectively operate globally. The Air Force initiated the KC-46 program to replace about a third of its aging KC-135 aerial refueling fleet. Boeing was awarded a fixed price incentive contract to develop the first four aircraft, which are being used for testing. Among other things, Boeing is contractually required to deliver a total of 18 aircraft and 9 wing air refueling pod sets by August 2017. This is defined as required assets available. The program plans to eventually field 179 aircraft in total.

The National Defense Authorization Act for Fiscal Year 2012 included a provision for GAO to review the KC-46 program annually through 2017. This is GAO's sixth report on this issue. It addresses (1) progress made in 2016 toward achieving cost, performance, and schedule goals and (2) development risk remaining. GAO analyzed key cost, schedule, development, test, and manufacturing documents and discussed results with officials from the KC-46 program office, other defense offices, the Federal Aviation Administration, and Boeing.

## What GAO Recommends

GAO is not making recommendations.

View [GAO-17-370](#). For more information, contact Michael Sullivan at (202) 512-4841 or [sullivanm@gao.gov](mailto:sullivanm@gao.gov).

March 2017

## KC-46 TANKER MODERNIZATION

### Delivery of First Fully Capable Aircraft Has Been Delayed over One Year and Additional Delays Are Possible

## What GAO Found

The KC-46 tanker modernization program is meeting cost and performance targets, but has experienced some recent schedule delays.

- **Costs:** As shown in the table below, the program's total acquisition cost estimate has decreased about \$7.3 billion, or 14 percent, since the initial estimate. This is primarily because there have been no requirements changes and there have been fewer engineering changes than expected.

#### Total Acquisition Cost Estimate for the KC-46 Tanker Aircraft Has Decreased

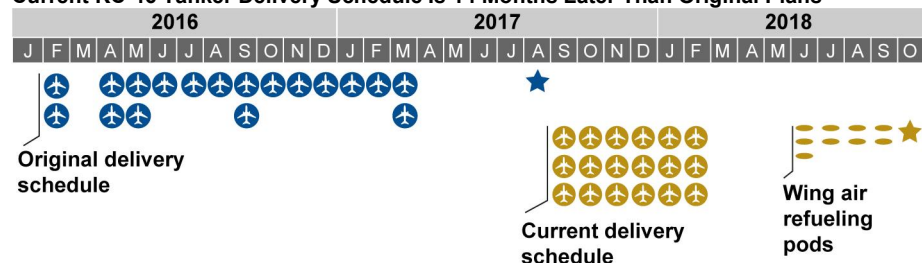
(then-year dollars in millions)

	February 2011	January 2017	Percent Change
Development	7,149.6	5,897.7	-17.5
Procurement	40,236.0	35,494.1	-11.8
Military construction	4,314.6	2,966.7	-31.2
<b>Total</b>	<b>51,700.2</b>	<b>44,358.5</b>	<b>-14.2</b>

Source: GAO presentation of Air Force Data. | GAO-17-370

- **Performance:** The program office estimates that the KC-46 will achieve its key and technical performance capabilities, such as completing a mission 92 percent of the time. As noted below, though, much testing remains.
- **Schedule:** The program fixed design problems and was approved for low-rate initial production in August 2016, a year late. Boeing (the prime contractor) will not meet the original required assets available delivery schedule due to ongoing Federal Aviation Administration certifications of the aircraft, including the wing air refueling pods, and flight test delays. As shown, the remaining schedule was modified to allow Boeing to deliver the first 18 aircraft and pods separately by October 2018, 14 months later than first planned.

#### Current KC-46 Tanker Delivery Schedule Is 14 Months Later Than Original Plans



★ Original contractual delivery date    ★ Current planned delivery date

Source: GAO analysis of KC-46 program data. | GAO-17-370

GAO's analysis shows there is risk to the current delivery schedule due to potential delays in Federal Aviation Administration certifications and key test events. Boeing must also complete over 1,700 test points on average for each month from February to September 2017, a level that is more than double what it completed in the last 11 months. Program officials agree that there is risk to Boeing's test completion rate until it obtains Federal Aviation Administration approval for the design of all parts, including the pods, but test mitigation strategies are underway.

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#### Abbreviations

DOD	Department of Defense
WARP	Wing Air Refueling Pod

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March 24, 2017

Congressional Committees

The KC-46 tanker modernization program, valued at about \$44 billion, is one of the Air Force's highest acquisition priorities and is to provide aerial refueling to Air Force, Navy, Marine Corps, and allied aircraft. The program recently completed its sixth year of a 9-year development program to convert an aircraft designed for commercial use into an aerial refueling tanker. Aerial refueling—the transfer of fuel from airborne tankers to combat and airlift forces—is critical to the U.S. military's ability to effectively operate globally. KC-46 aircraft are intended to replace roughly one-third of the Air Force's aging aerial refueling tanker fleet, comprised of about 455 aircraft that are mostly KC-135 Stratotankers, and help the Department of Defense (DOD) meet the requirement for 479 tankers. The Air Force contracted with Boeing to develop, test, and provide initial delivery of 18 KC-46 tankers by August 2017, and eventually field a total of 179 aircraft.

The National Defense Authorization Act for Fiscal Year 2012 included a provision that we annually review and report on the KC-46 program through 2017.<sup>1</sup> This is our sixth report reviewing the program. In this report, we evaluate (1) program progress made in 2016 toward achieving cost, performance, and schedule goals and (2) development risk remaining. See the Related GAO Products listed at the end of this report for our previous reports on the KC-46 program.

To assess progress toward achieving cost, performance, and schedule goals, we compared cost estimates and program milestones established at the start of development to current estimates and milestone dates. This data was contained in defense acquisition executive summary reports, selected acquisition reports, and various program briefings provided by Boeing. We also examined current estimates of technical performance capabilities contained in program briefings. To assess development risk remaining, we compared Boeing's planned to actual flight test hours and activities, and examined the risks to test completion. We reviewed the annual report of the Director of Operational Test and Evaluation as well as the Air Force Operational Test and Evaluation Center's second operational assessment of the KC-46 program. As part of our overall

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<sup>1</sup>Pub. L. No. 112-81 § 244 (2011).

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review, we examined Defense Contract Management Agency monthly assessments of the KC-46 program and attended monthly meetings between the program office and Boeing to obtain additional insight on program progress. We visited Boeing production facilities. Finally, we interviewed officials from the Air Force's KC-46 program office, other defense offices, the 412th Test Wing, the Federal Aviation Administration, and Boeing on progress made in 2016. We assessed the reliability of cost, schedule, and test data by interviewing agency officials knowledgeable about the data, and we determined that the data were sufficiently reliable for the purposes of this report.

We conducted this performance audit from August 2016 to March 2017 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

In February 2011, Boeing won the competition to develop the Air Force's next generation aerial refueling tanker aircraft, the KC-46. To develop a tanker, Boeing modified a 767 aircraft in two phases. In the first phase, Boeing modified the design of the 767 with a cargo door and an advanced flight deck display borrowed from its 787 aircraft and is calling this modified version the 767-2C. The 767-2C is built on Boeing's existing production line. In the second phase, the 767-2C was militarized and brought to a KC-46 configuration.

The KC-46 will allow for two types of refueling to be employed in the same mission—a refueling boom that is integrated with a computer-assisted control system and a permanent hose and drogue refueling system. The boom is a rigid, telescoping tube that an operator on the tanker aircraft extends and inserts into a receptacle on the aircraft being refueled. See figure 1 for an example of boom refueling.

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**Figure 1: KC-46 Aircraft Using the Boom to Refuel a Receiver Aircraft**



Source: © 2016 Boeing Company - Photo by Paul Weatherman. | GAO-17-370

The “hose and drogue” system is comprised of a long, flexible refueling hose and a parachute-like metal basket that provides stability. Drogue refueling is available via the centerline drogue system in the middle of the aircraft, or via a wing air refueling pod (WARP) located on each wing. WARPs are used for simultaneous refueling of two aircraft. See figure 2 for a depiction of the conversion of the 767 aircraft into the KC-46 tanker with the boom deployed.

Figure 2: Conversion of a Boeing 767 into a KC-46 Aerial Refueling Tanker



Source: GAO analysis of Boeing data (data); © Boeing (images). | GAO-17-370

The Federal Aviation Administration has previously certified Boeing's 767 commercial passenger airplane (referred to as a type certificate) and is to certify the design for both the 767-2C and the KC-46 with Amended and Supplemental type certificates, respectively. The Air Force is then responsible for certifying the airworthiness of the KC-46. The Air Force is also to verify that the KC-46 systems meet contractual requirements and that the KC-46 and various receiver aircraft are certified for refueling operations.

Boeing was awarded a fixed price incentive (firm target) contract for development. The contract is designed to hold Boeing accountable for costs associated with the design, manufacture, and delivery of four test aircraft and includes options to manufacture the remaining 175 aircraft. A fixed price incentive development contract was awarded for the program because KC-46 development is considered to be a relatively low-risk effort to integrate mostly mature military technologies onto an aircraft designed for commercial use. The contract limits the government's financial liability and provides the contractor incentives to reduce costs in order to earn more profit. It also specifies that Boeing must correct any deficiencies and bring development and production aircraft to the final configuration at no additional cost to the government. The contract



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includes firm fixed price contract options for the first 2 production lots<sup>2</sup>, and options with not-to-exceed fixed prices for production lots 3 through 13. The Air Force has already exercised the first 3 production lots totaling 34 aircraft and negotiated firm fixed prices for production lot 3. The original development contract requires Boeing to deliver 18 operational aircraft, 9 WARP sets and 2 spare engines by August 2017. The contract refers to this as required assets available, while we refer to it as fully capable aircraft in this report. In addition, according to the contract, all required training must be complete, and the required support equipment and sustainment support must be in place by August 2017.

Barring any changes to KC-46 requirements by the Air Force, the development contract specifies a ceiling price of \$4.9 billion for Boeing to develop the first 4 aircraft, at which point Boeing must assume responsibility for all additional costs. Due to several development-related problems experienced over the last 2 years, Boeing currently estimates that development costs will total about \$5.9 billion, or about \$1 billion over the ceiling price. The government is not responsible for the additional cost.

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## Program Is Tracking to Cost and Performance Targets, but Aircraft Delivery Will Be Delayed

The KC-46 program is meeting total acquisition cost and performance targets, but has experienced some recent schedule delays. The government's cost estimate has declined for a fourth consecutive year and is now about \$7.3 billion less than the original estimate. In addition, the aircraft is projected to meet all performance capabilities. However, Boeing experienced some problems developing the aircraft. As a result, it now expects to deliver the first 18 fully capable aircraft in October 2018 instead of August 2017, 14 months later than expected.

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<sup>2</sup>For purposes of this report, a production lot refers to a set number of aircraft that must be built and delivered in a given time frame and procured with a specific year of funding. For example, the first production lot includes seven aircraft procured with fiscal year 2015 funding that are to be built and then delivered to the Air Force starting in 2017.

## Cost Estimates Continue to Decrease

The Air Force is continuing to work within its total program acquisition cost estimate for the KC-46, which includes development, procurement, and military construction costs. The total program acquisition cost now stands at \$44.4 billion. This is about \$7.3 billion less than the original estimate of \$51.7 billion or about 14 percent less. Average program acquisition unit costs have decreased by the same percent because quantities have remained the same. Table 1 provides a comparison of the initial and current quantity and cost estimates.

**Table 1: Initial and Current KC-46 Tanker Aircraft Program Quantities and Acquisition Cost Estimates**

	Category	February 2011	January 2017	Change (percent)	Difference
<b>Expected quantities</b>	Development quantities	4	4	—	0.0
	Procurement quantities	175	175	—	0.0
	Total quantities	179	179	—	0.0
<b>Cost estimates (then-year dollars in millions)</b>	Development	7,149.6	5,897.7	-17.5	1,251.9
	Procurement	40,236.0	35,494.1	-11.8	4,741.9
	Military Construction	4,314.6	2,966.7	-31.2	1,348
<b>Total program acquisition</b>		<b>51,700.2</b>	<b>44,358.5</b>	<b>-14.2</b>	<b>7,341.7</b>
<b>Unit cost estimates (then-year dollars in millions)</b>	Average program acquisition	288.8	247.8	-14.2	41

Source: GAO presentation of Air Force Data. | GAO-17-370

Note: Then-year dollars include the effects of inflation and escalation.

The Air Force has been able to decrease its cost estimate over the past 4 years primarily because it has not added or changed requirements and therefore there were fewer engineering changes than expected. According to program officials, the Air Force's initial cost estimate included a large amount of risk funding for possible requirements changes, based on its experience with prior major acquisition programs. Military construction costs have also come in below estimates.

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## Performance Metrics Are on Track

The program estimates that the KC-46 will achieve its performance capabilities. This includes 9 key performance parameters and 5 key system attributes that are critical to the aircraft's military capability and 7 technical performance capabilities that track progress to meeting contract specifications. For example, the aircraft is expected to be ready for operational use when required at least 89 percent of the time and, once it is deployed for an aerial refueling mission, be able to complete that mission 92 percent of the time. Appendix I provides a description of each of the key performance parameters and system attributes as well as the status of technical performance capabilities.

The program has collected actual test data that validates a few of the performance capabilities. For example, the aircraft is using less than 1,557 gallons of fuel per flight hour, its fuel usage rate target. In addition, the program also closely tracks the actual weight of the aircraft because weight has a direct effect on the amount of fuel that can be carried. As of January 2017, the program had approximately 595 pounds of margin to the operational empty weight target of 204,000 pounds. The program also tracks a reliability growth metric—the mean time between unscheduled maintenance events due to equipment failure—and set a reliability goal of 2.83 flight hours between these events by the time the aircraft reaches 50,000 flight hours. According to program officials, as of September 2016, the program had completed about 1,300 flight hours and was achieving 1.56 hours compared to its goal of 1.72 hours by that time. Program officials believe that the reliability will improve as additional flight hours are completed and as unreliable parts are identified and replaced.

Program officials also report that the program does not yet have actual flight test data to validate many of the other key and technical performance capabilities, such as those for operational availability and mission capability mentioned above. In lieu of flight test data, it assesses the measures on a monthly basis, relying on other information such as data from ground testing; models and simulations; and prior tanker programs. Test officials eventually expect to collect and analyze this data through flight testing. In some cases the program will be tracking progress towards achieving some performance capabilities while the aircraft is in operation. For example, in addition to the reliability growth metric mentioned above, Boeing is expected to demonstrate that mechanical problems on the aircraft can be fixed within 12 hours at least 71 percent of the time once the aircraft has accumulated 50,000 flight hours.

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## Key Schedule Milestones Have Slipped at Least One Year

Since our last report in April 2016, the Under Secretary for Acquisition, Technology and Logistics approved the KC-46 program to enter low-rate initial production in August 2016, one year later than originally planned. In addition, the Air Force has exercised contract options for the first 3 low-rate production lots of aircraft. We previously reported that the delay to the low-rate initial production decision was the result of problems Boeing had wiring the aircraft, design issues discovered with the fuel system components, and a fuel contamination event that corroded the fuel tanks of one of the development aircraft.<sup>3</sup> Those problems have been overcome, but time was lost working through them. Until the low-rate initial production decision, the program had met its major milestones.

Boeing and KC-46 program officials modified the program schedule in January 2017 to reflect the work remaining, including obtaining Federal Aviation Administration confirmation that the aircraft's parts all match their design drawings. While the Federal Aviation Administration has approved the design of many aircraft components, it is expected that the WARPs will be the last subsystem to receive design approval for all of its parts and to demonstrate that the parts conform to the designs. According to Boeing officials, the company and its WARP supplier had underestimated the level of design drawing details the Federal Aviation Administration needed to review to determine that the parts conformed to the approved design.<sup>4</sup> According to these officials, the WARP supplier has been negotiating with its various sub-tier suppliers over the past 3 years for the necessary design documentation. Program officials estimate that the WARP design will be approved by the Federal Aviation Administration in July 2017, which will then allow Boeing to complete remaining developmental flight tests and meet other key milestones. Program officials do not consider the WARP design to be a significant program risk because the WARPs performed well in flight testing leading up to the low-rate initial production decision. Changes to key milestones are shown in table 2.

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<sup>3</sup>GAO, *KC-46 Tanker Aircraft: Challenging Testing and Delivery Schedules Lie Ahead*, [GAO-16-346](#) (Washington, D.C.: Apr. 8, 2016).

<sup>4</sup>According to Boeing officials, the WARP supplier began producing the version of the WARP used on the KC-46 in 2000, but has not gone through the Federal Aviation Administration certification process before.

**Table 2: Original and Current KC-46 Key Program Milestones**

Key Milestones	February 2011 (Original)	January 2017 (Current)	Change
Program contract award (Milestone B)	February 2011	February 2011	—
Preliminary design review	April 2012	April 2012	—
Critical design review	July 2013	July 2013	—
Low-rate initial production (Milestone C)	August 2015	August 2016	12 months
Initial operational test and evaluation start	May 2016	November 2017	18 months
Full rate production decision	June 2017	August 2019	26 months
Required assets available <sup>a</sup> (delivery of 18 fully capable aircraft)	August 2017	October 2018	14 months

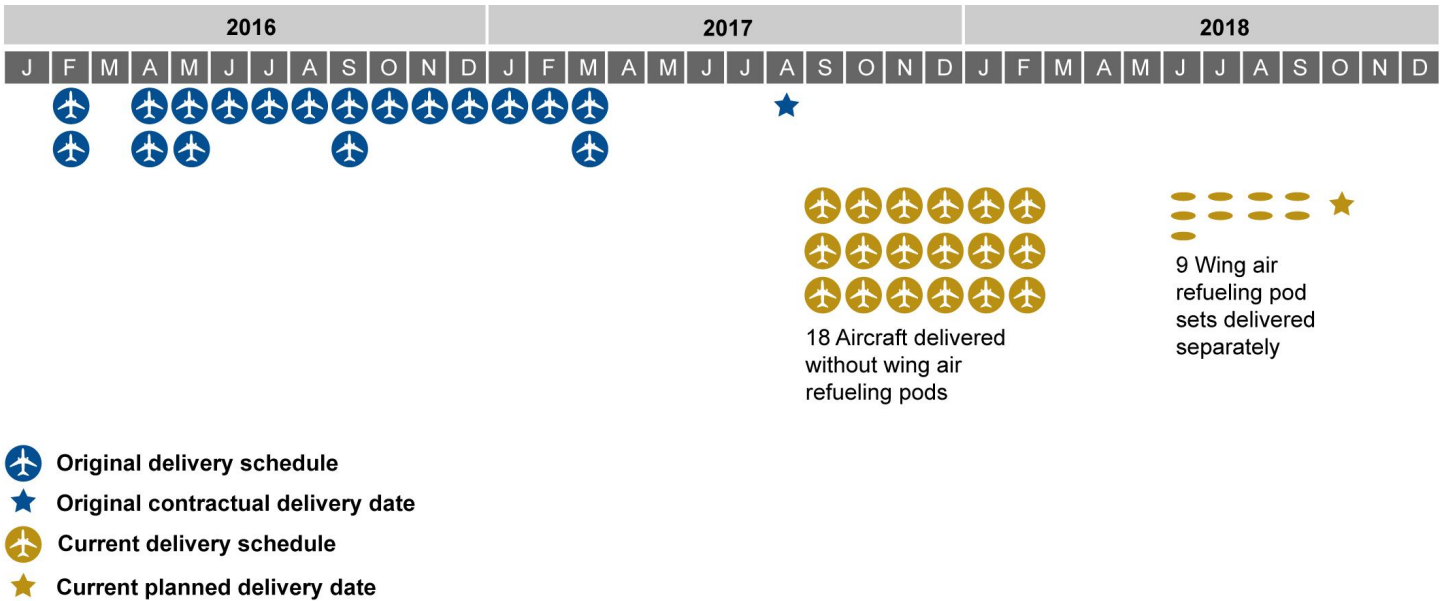
Source: GAO analysis KC-46 program data. | GAO-17-370

<sup>a</sup>According to the development contract, required assets available includes 18 fully capable aircraft, 9 wing air refueling pod sets, and 2 spare engines.

Overall, the current schedule reflects a 14-month delay in Boeing delivering the first 18 aircraft with 9 WARP sets under the terms of the development contract, referred to as 18 fully capable aircraft in table 2.<sup>5</sup> Instead of meeting an August 2017 date, the program office now estimates that Boeing will deliver the first 18 aircraft by February 2018 and the 9 WARP sets separately by October 2018. Air Force officials are negotiating for considerations from Boeing to account for lost military tanker capability associated with the delivery delays. According to program officials, the lost capability includes lost benefits—such as the Air Force not being able to grow the overall U.S. tanker fleet to 479 aircraft until later—and additional costs—such as the government having to maintain and sustain legacy aircraft and its test infrastructure longer than originally planned. The planned delivery of the first 18 aircraft, though 6 months late, will provide boom and drogue refueling capability to the warfighter. When delivered, the WARPs will enable the refueling of two receiver aircraft simultaneously, a capability that is not used as frequently, according to Air Force officials. Air Force officials said the current schedule and considerations will be part of a contract modification that is expected to be finalized in summer 2017. Figure 3 provides a closer look at the original and current delivery schedules.

<sup>5</sup> A WARP set includes 2 refueling pods, one for each aircraft wing.

Figure 3: Current KC-46 Tanker Delivery Schedule Is 14 Months Later than Original Plans

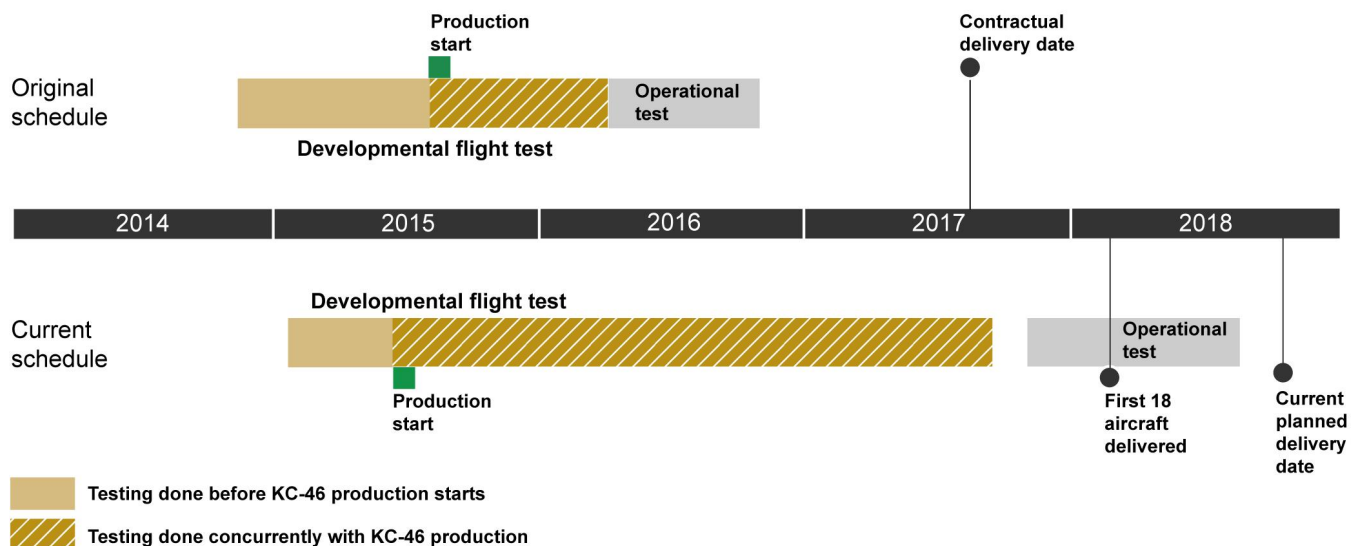


Source: GAO analysis of KC-46 program data. | GAO-17-370

As shown, under the current schedule Boeing plans to deliver aircraft over a compressed 6-month period of time compared to its original plan to deliver aircraft over a 14-month period of time. This delivery period assumes Boeing will deliver 3 aircraft per month, a greater pace than planned during full rate production. According to program officials, Boeing is already in the process of manufacturing 18 aircraft from the first 3 low-rate production lots; 12 of these aircraft are over 70 percent complete.

The current schedule also takes into account the decision by the Under Secretary for Acquisition, Technology and Logistics to designate productions lots 3 and 4 (of 15 aircraft each) as low-rate instead of full-rate lots. This was done to help Boeing avoid a break in production while it completes developmental and operational testing. The program expects to begin delivering these aircraft in 2018 and 2019, respectively. As a result, as shown in figure 4, concurrency between developmental flight testing and production has increased. The Air Force will have contracted for 49 aircraft before developmental flight testing is completed, representing 27 percent of the total aircraft, compared to the original plan of 19 aircraft, or about 11 percent. Further, the first 18 aircraft without WARPs will be delivered before most of operational testing has been completed.

**Figure 4: Increase in Concurrent KC-46 Testing and Production**



Source: GAO analysis of KC-46 program data. | GAO-17-370

Note: Though KC-46 production was scheduled to start with the low-rate initial production decision in August 2015, Boeing began production independently in June 2015.

There is risk that Boeing may identify problems during flight testing that will lead to design changes. However, according to the terms of the development contract, the cost to fix these discoveries will be borne by Boeing, as it is required to bring all aircraft to the final configuration after completion of testing.

## Boeing Faces Challenges Meeting the Current Delivery Schedule

Boeing faces two primary challenges in meeting the current delivery schedule, both of which relate to its developmental test schedule. Our analysis indicates that testing may take longer than the program is estimating. If test points are not completed at the planned rate, then aircraft deliveries will be delayed, indicating that the new delivery schedule is optimistic.

- **Electromagnetic Effects Testing Schedule:** First, there is risk that Boeing will not be able to complete required electromagnetic effects testing on the KC-46 in May 2017, as currently planned. Boeing officials stated this is because the WARP supplier has not yet

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provided all detailed design drawings to the Federal Aviation Administration for approval. While Boeing had planned on delivery of an approved WARP by March 2017, it now expects that to occur in late July 2017. The original plan, according to agency officials, was to have all aircraft parts, including the WARPs, conform to design drawings and gain Federal Aviation Administration approval prior to this testing. During the testing, the KC-46's electrical systems will be examined to verify that they do not create any electromagnetic interference, a process that requires a unique government facility that is also in high demand by other programs. Consequently, Boeing officials report that if the KC-46 is not ready for its scheduled time, these critical tests could potentially be delayed until the facility is available. The program is working on ways to mitigate the potential for delays in the delivery of the first 18 aircraft. For example, program officials stated that they are considering separate electromagnetic testing on the aircraft and the WARPs.

- **Flight Test Completion Rate:** Second, Boeing is projecting that it can complete test points over the remaining developmental flight test schedule at a rate higher than it has been able to demonstrate consistently.<sup>6</sup> If test points are not completed at the planned rate, then aircraft deliveries will be delayed. The developmental flight test program contains about 29,000 total test points to be completed over a 32-month period. Government test officials report that these test points are a combination of Boeing-specific tests that it is conducting to reduce the risk of test failure and government-specific tests to verify the KC-46's performance. Boeing has completed 53 percent of planned testing since the KC-46 developmental flight test program began in January 2015. The company would need to complete an average of 1,713 test points per month to complete remaining testing on time so that it can begin delivering aircraft in September 2017. As shown in figure 5, Boeing has only completed this number of test points once, in October 2016, when it completed 2,240 test points, which program officials reported was part of a planned test surge.

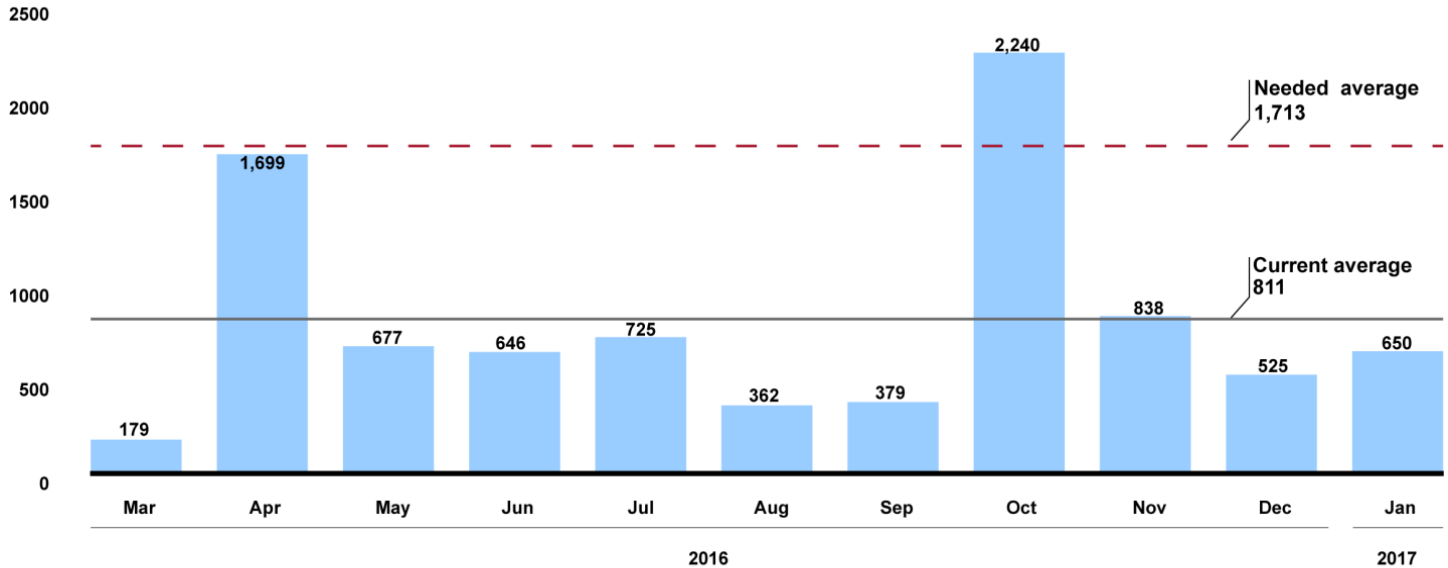
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<sup>6</sup>In GAO's 2016 report on the KC-46, we reported Boeing test data in terms of test information sets (test activities) completed. In October 2016, Boeing changed its monthly test reporting metric to numbers of conditions (test points) met during test flights.



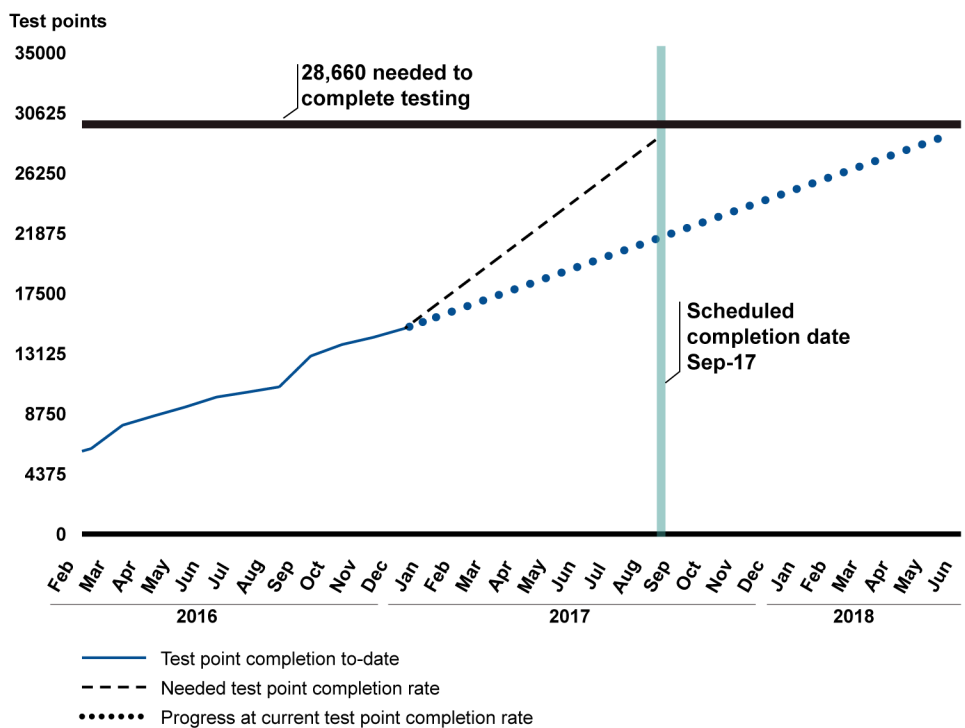
**Figure 5: KC-46 Developmental Flight Test Points Completed between March 2016 and January 2017**

Test points completed



Source: GAO presentation of KC-46 program data. | GAO-17-370

Boeing test data shows that from March 2016 to January 2017, it completed an average rate of 811 test points per month. As shown in figure 6, at that rate, we project that Boeing would finish the remaining 13,706 test points in early June 2018, 9 months later than the planned completion date.

**Figure 6: Developmental Flight Test Completion Rate Compared to Schedule**

Source: GAO presentation of KC-46 program data. | GAO-17-370

Note: Test point completion is a combination of actual test points completed and test points that were cancelled. Government test officials report that test points can be cancelled if Boeing determines that it has gained sufficient data in prior tests.

The Director for Operational Test and Evaluation has previously assessed and continues to assess the KC-46 schedule as aggressive and unlikely to be executed as planned, stating that execution of the current schedule assumes historically unrealistic test aircraft flight rates. Boeing's test schedule is based on flying 65 flight test hours on 767-2C aircraft per month and 50 hours on KC-46 aircraft per month. The program has actually averaged—across all aircraft in the development test program—about 25 hours per aircraft per month. A government test official stated that similar programs in the past have sustained a pace of about 30 hours a month per aircraft. Government test officials noted that a large portion of testing completed so far was for Boeing-specific test points that could include tests that were cancelled if Boeing believed it had sufficient data already, and more time will likely be needed to plan and coordinate upcoming government-required testing.

Boeing test officials believe the company can complete developmental testing by September 2017 because they plan to increase the number of

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test points it can complete per month by adding flight hours on nights and weekends. Boeing officials also believe the test pace will gain greater efficiency as the aircraft's design and test plans stabilize. The program was working on a "test once" approach with Boeing, the Federal Aviation Administration, and DOD whereby common test activities required by multiple entities would only be performed once. According to program officials, Boeing is moving away from the test once approach and towards sequential testing as a mitigation strategy. They report that Boeing expects this will help it perform key tests more quickly because it will not need to wait for several systems to be approved for testing. Program officials, however, believe that the transition to a new testing approach will require weeks of test plan rewriting, and that obtaining approval for the design of all parts, including the WARPs, from the Federal Aviation Administration will continue to pose risk to test completion as currently planned.

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## Agency Comments

We are not making recommendations in this report. We provided a draft of this report to DOD for comment. DOD did not provide any written comments, but the KC-46 program office provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees; the Secretary of Defense; the Secretary of the Air Force; and the Director of the Office of Management and Budget. The report is also available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions concerning this report, please contact me at (202) 512-4841 or [sullivanm@gao.gov](mailto:sullivanm@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found

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on the last page of this report. GAO staff who made major contributions to this report are listed in appendix II.

A handwritten signature in black ink, appearing to read 'Michael J. Sullivan', with a large, stylized initial 'M' and a long, sweeping horizontal stroke at the end.

Michael J. Sullivan  
Director  
Acquisition and Sourcing Management

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*List of Committees*

The Honorable John McCain  
Chairman  
The Honorable Jack Reed  
Ranking Member  
Committee on Armed Services  
United States Senate

The Honorable Thad Cochran  
Chairman  
The Honorable Richard J. Durbin  
Ranking Member  
Subcommittee on Defense  
Committee on Appropriations  
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The Honorable Adam Smith  
Ranking Member  
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House of Representatives

The Honorable Kay Granger  
Chairwoman  
The Honorable Pete Visclosky  
Ranking Member  
Subcommittee on Defense  
Committee on Appropriations  
House of Representatives

## Appendix I: KC-46 Key Performance Parameters and System Attributes and Status of Technical Performance Capabilities

The program office has 14 key performance parameters and system attributes that are critical to the KC-46 aircraft's military capability and 7 technical performance capabilities that track progress to meeting contract specifications. Table 3 provides a description of each key performance parameter and system attribute. Table 4 provides the status of each technical performance capability.

**Table 3: KC-46 Key Performance Parameters and Key System Attributes**

Key performance parameter	Description
Tanker Air Refueling Capability	Aircraft shall be able to effectively conduct (non-simultaneously) both boom and drogue air refueling on the same mission.
Fuel Offload versus Radius	Aircraft shall be capable of carrying certain amounts of fuel (to use in air refueling) certain distances.
Operate in Civil and Military Airspace	Aircraft shall be capable of worldwide flight operations in all civil and military airspace.
Airlift Capability	Aircraft shall be capable of transporting certain amounts of both equipment and personnel.
Receiver Air Refueling Capability	Aircraft shall be capable of receiving air refueling from any compatible tanker aircraft.
Force Protection	Aircraft shall be able to operate in chemical and biological environments.
Net-Ready	Aircraft must be able to have effective information exchanges with many other Department of Defense systems to fully support execution of all necessary missions and activities.
Survivability	Aircraft shall be capable of operating in hostile threat environments.
Simultaneous Multi-Point Refueling	Aircraft shall be capable of simultaneous multi-point drogue refueling.
Key system attribute	
Formation Capability	Aircraft shall be capable of day and night formation flight in weather and all phases of flight.
Aeromedical Evacuation	Aircraft shall be capable to provide air transport for up to 50 patients and medical staff.
Reliability and Maintainability	Aircraft shall be deployable, operable, sustainable, and recoverable at sufficient levels of readiness and performance.
Operational Availability	Aircraft shall be operationally available at least 80 percent of the time.
Treaty Compliance Support	Aircraft shall have the necessary hardware installed to demonstrate compliance with applicable treaties.

Source: GAO presentation of Air Force information. | GAO-17-370

**Appendix I: KC-46 Key Performance  
Parameters and System Attributes and Status  
of Technical Performance Capabilities**

**Table 4: Status of Technical Performance Capabilities**

Technical performance capability	Description	Contract specification/Target	Projected to meet measure?
Operational empty weight	Maximum weight of the aircraft without usable fuel.	204,000 pounds	Yes
Fuel usage rate assessment	Gallons of fuel per hour used by the aircraft during a mission.	1,557 gallons per hour	Yes
Mission capable rate	Percentage of time aircraft performed at least one assigned mission.	92 percent	Yes
Fix rate	Percentage of time mechanical problems were fixed within 12 hours (after 50,000 fleet hours).	71 percent	Yes
Break rate	Percentage of breaks per sorties (after 50,000 fleet hours).	1.3 percent	Yes
Mission completion success probability	Probability of completing the aerial refueling mission and landing safely.	99 percent	Yes
Operational availability	Probability an aircraft will be ready for operational use when required.	89 percent	Yes

Source: GAO presentation of Air Force information. | GAO-17-370

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## Appendix II: GAO Contact and Staff Acknowledgments

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### GAO Contact

Michael J. Sullivan, (202) 512-4841 or [sullivanm@gao.gov](mailto:sullivanm@gao.gov)

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### Staff Acknowledgments

In addition to the contact named above, Cheryl Andrew, Assistant Director; Kurt Gurka; Stephanie Gustafson; Kathryn Hubbell; Nate Vaught; and Robin Wilson made key contributions to this report.



## Appendix III: Accessible Data

### Data Tables

**Data Table for Highlights figure, Current KC-46 Tanker Delivery Schedule Is 14 Months Later Than Original Plans**

Table shows number of aircraft delivered per month

Month	Original Delivery Schedule	Current Delivery Schedule	Wing Aerial Refueling Pods (Under Proposed Delivery Schedule)
Jan-16	0	0	0
Feb-16	2	0	0
Mar-16	0	0	0
Apr-16	2	0	0
May-16	2	0	0
Jun-16	1	0	0
Jul-16	1	0	0
Aug-16	1	0	0
Sep-16	2	0	0
Oct-16	1	0	0
Nov-16	1	0	0
Dec-16	1	0	0
Jan-17	1	0	0
Feb-17	1	0	0
Mar-17	2	0	0
Apr-17	0	0	0
May-17	0	0	0
Jun-17	0	0	0
Jul-17	0	0	0
Aug-17	0	0	0
Sep-17	0	3	0
Oct-17	0	3	0
Nov-17	0	3	0
Dec-17	0	3	0
Jan-18	0	3	0
Feb-18	0	3	0

Month	Original Delivery Schedule	Current Delivery Schedule	Wing Aerial Refueling Pods (Under Proposed Delivery Schedule)
Mar-18	0	0	0
Apr-18	0	0	0
May-18	0	0	0
Jun-18	0	0	3
Jul-18	0	0	2
Aug-18	0	0	2
Sep-18	0	0	2
Oct-18	0	0	0
Nov-18	0	0	0
Dec-18	0	0	0

**Data Table for Figure 3: Current KC-46 Tanker Delivery Schedule Is 14 Months Later than Original Plans**

Table shows number of aircraft delivered per month

Month	Original Delivery Schedule	Current Delivery Schedule	Wing Aerial Refueling Pods (Under Proposed Delivery Schedule)
Jan-16	0	0	0
Feb-16	2	0	0
Mar-16	0	0	0
Apr-16	2	0	0
May-16	2	0	0
Jun-16	1	0	0
Jul-16	1	0	0
Aug-16	1	0	0
Sep-16	2	0	0
Oct-16	1	0	0
Nov-16	1	0	0
Dec-16	1	0	0
Jan-17	1	0	0
Feb-17	1	0	0
Mar-17	2	0	0
Apr-17	0	0	0
May-17	0	0	0

Month	Original Delivery Schedule	Current Delivery Schedule	Wing Aerial Refueling Pods (Under Proposed Delivery Schedule)
Jun-17	0	0	0
Jul-17	0	0	0
Aug-17	0	0	0
Sep-17	0	3	0
Oct-17	0	3	0
Nov-17	0	3	0
Dec-17	0	3	0
Jan-18	0	3	0
Feb-18	0	3	0
Mar-18	0	0	0
Apr-18	0	0	0
May-18	0	0	0
Jun-18	0	0	3
Jul-18	0	0	2
Aug-18	0	0	2
Sep-18	0	0	2
Oct-18	0	0	0
Nov-18	0	0	0
Dec-18	0	0	0

**Figure 4: Increase in Concurrent KC-46 Testing and Production**

Event	Original Schedule	Current Schedule
Production Start	8/7/2015	6/15/2015
Contractual Delivery Date	8/24/2017	10/26/2018
Begin Developmental Flight Test	11/19/2014	1/15/2015
End Developmental Flight Test	3/7/2016	9/15/2017
Begin Operational Test	4/24/2016	1/3/2018
End Operational Test	10/9/2016	7/19/2018
First 18 Aircraft Delivered	N/A	2/23/2018

**Data Table for Figure 5: KC-46 Developmental Flight Test Points Completed between March 2016 and January 2017**

Month	Test Points Completed
Mar-16	179
Apr-16	1,699
May-16	677
Jun-16	646
Jul-16	725
Aug-16	362
Sep-16	379
Oct-16	2,240
Nov-16	838
Dec-16	525
Jan-17	650
Current Average	811
Needed Average	1,713

**Data Table for Figure 6: Developmental Flight Test Completion Rate Compared to Schedule**

	Test Point Completion To-Date	Needed Test Point Completion Rate	Progress at Current Test Point Completion Rate
Feb-16	6,034	NA	NA
Mar-16	6,213	NA	NA
Apr-16	7,912	NA	NA
May-16	8,589	NA	NA
Jun-16	9,235	NA	NA
Jul-16	9,960	NA	NA
Aug-16	10,322	NA	NA
Sep-16	10,701	NA	NA
Oct-16	12,941	NA	NA
Nov-16	13,779	NA	NA
Dec-16	14,304	NA	NA
Jan-17	14,954	14,954	14,954
Feb-17	NA	16,667	15,765
Mar-17	NA	18,381	16,576
Apr-17	NA	20,094	17,387

	Test Point Completion To-Date	Needed Test Point Completion Rate	Progress at Current Test Point Completion Rate
May-17	NA	21,807	18,198
Jun-17	NA	23,520	19,009
Jul-17	NA	25,234	19,819
Aug-17	NA	26,947	20,630
Sep-17	NA	28,660	21,441
Oct-17	NA	NA	22,252
Nov-17	NA	NA	23,063
Dec-17	NA	NA	23,874
Jan-18	NA	NA	24,685
Feb-18	NA	NA	25,496
Mar-18	NA	NA	26,307
Apr-18	NA	NA	27,118
May-18	NA	NA	27,929
Jun-18	NA	NA	28,739

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## Related GAO Products

*KC-46 Tanker Aircraft: Challenging Testing and Delivery Schedules Lie Ahead.* [GAO-16-346](#). Washington, D.C.: April 8, 2016.

*KC-46 Tanker Aircraft: Key Aerial Refueling Capabilities Should Be Demonstrated Prior to the Production Decision.* [GAO-15-308](#). Washington, D.C.: April 9, 2015.

*KC-46 Tanker Aircraft: Program Generally on Track, but Upcoming Schedule Remains Challenging.* [GAO-14-190](#). Washington, D.C.: April 10, 2014.

*KC-46 Tanker Aircraft: Program Generally Stable but Improvements in Managing Schedule Are Needed.* [GAO-13-258](#). Washington, D.C.: February 27, 2013.

*KC-46 Tanker Aircraft: Acquisition Plans Have Good Features but Contain Schedule Risk.* [GAO-12-366](#). Washington, D.C.: March 26, 2012.

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