



April 2018

KC-46 TANKER MODERNIZATION

Program Cost Is Stable, but Schedule May Be Further Delayed

Accessible Version

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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 aircraft. Among other things, Boeing was contractually required to deliver 18 fully capable aircraft (KC-46 aircraft with 9 sets of wing aerial refueling pods that allow for simultaneous refueling of 2 aircraft) by August 2017. The program plans to eventually field 179 aircraft in total.

GAO was asked to monitor the KC-46 program because of problems Boeing is experiencing developing the aircraft. This is GAO's 7th report on the KC-46 program. This report assesses program progress and challenges toward achieving its cost goals and delivery schedule.

GAO analyzed cost, schedule, development, and test information contained in program documents; and discussed results with officials from the KC-46 program office, other defense offices, the Federal Aviation Administration (responsible for certifying the design of the KC-46), and Boeing.

What GAO Recommends

GAO believes the Department of Defense should implement a prior recommendation to document lessons learned given the program's challenges.

View [GAO-18-353](#). For more information, contact Michael Sullivan at (202) 512-4841 or sullivanm@gao.gov.

What GAO Found

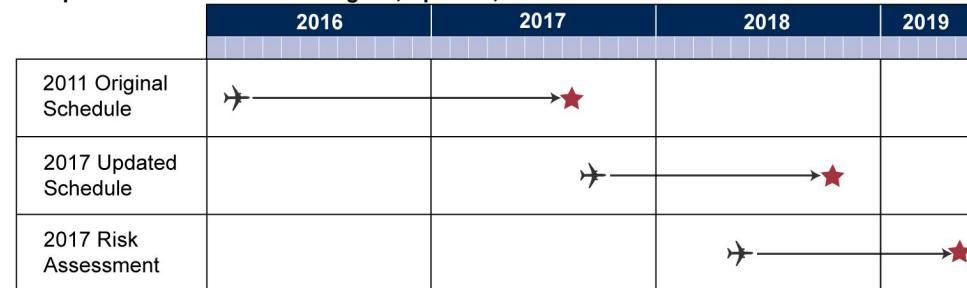
The total acquisition cost estimate for the KC-46 refueling tanker aircraft remained stable over the last year at \$44.4 billion. As shown in the table below, the estimate has decreased about \$7.3 billion, or 14 percent, since the initial estimate. This decrease is due in part to stable requirements.

Total Acquisition Cost Estimate for the KC-46 Tanker Aircraft (then-year dollars in millions)			
Category	February 2011	October 2017	Percent change
Development	7,149.6	5,835.1	-18.4
Procurement	40,236.0	35,523.8	-11.7
Military construction	4,314.6	2,999.8	-30.5
Total	51,700.2	44,358.7	-14.2

Source: GAO presentation of Air Force data. | GAO-18-353

The program updated its delivery schedule in 2017 to allow Boeing to delay delivery of the first 18 fully capable aircraft from August 2017 to October 2018—14 months. A schedule risk assessment, as well as GAO's analysis, however projects that deliveries could slip to May 2019, 21 months from the original schedule, if risks are not mitigated. See figure.

Comparison of KC-46 Tanker Original, Updated, and Risk Assessment Schedules



→ Delivery of first aircraft

★ First 18 fully capable aircraft

Source: GAO analysis of KC-46 program data. | GAO-18-353

Boeing faces the following risks and challenges and is trying to address them:

- updating test aircraft to the correct configuration to complete remaining tests;
- completing flight tests at a pace that is almost double its monthly average;
- updating test plans to reflect a more realistic schedule for certifying aircraft, such as F-16 fighters and C-17 cargo planes, to be refueled by a KC-46;
- retrofitting production aircraft to their final configuration for delivery; and
- fixing a critical deficiency to keep the boom from contacting receiver aircraft outside the refueling receptacle.

Because of the terms of the contract, Boeing, not the government, is responsible for nearly \$1 billion in additional development costs already incurred. Boeing is also providing additional training for KC-46 pilots, among other things, to compensate the Air Force for delivery delays. Meanwhile, the Air Force is continuing to use KC-135 and KC-10 tankers for refueling missions.

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April 18, 2018

The Honorable Rob Wittman
Chairman
The Honorable Joe Courtney
Ranking Member
Subcommittee on Seapower and Projection Forces
Committee on Armed Services
House of Representatives

The KC-46 aerial refueling tanker modernization program, valued at about \$44 billion, is one of the Air Force's highest acquisition priorities and will provide aerial refueling to Air Force, Navy, Marine Corps, and allied aircraft. The program recently completed its seventh 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. The Air Force contracted with Boeing to develop, test, and provide initial delivery of 18 KC-46 tankers by August 2017. The program plans to eventually field 179 KC-46 aircraft in total. These aircraft are intended to replace roughly one-third of the Air Force's aging aerial refueling tanker fleet, comprised mostly of KC-135 Stratotankers.

You requested that we continue monitoring the KC-46 program because of problems Boeing is experiencing developing the aircraft. In this report, we evaluate program progress and challenges toward (1) achieving cost and performance goals and (2) meeting the delivery schedule. This is GAO's 7th report on the KC-46 program. See the Related GAO Products page for a list of our previous KC-46 reports.

To assess progress toward achieving cost and performance goals, we compared cost estimates established at the start of development to current estimates. This data was contained in program documents such as a defense acquisition executive summary report and acquisition program baseline document. We also compared the latest estimates of technical performance capabilities contained in program briefings to the original goals. To assess progress toward meeting the delivery schedule, we reviewed monthly schedule updates and compared them to the original and current delivery schedule plans. We also tracked Boeing's planned and actual flight test activities and examined the risks to test

completion. We reviewed the 2017 Annual Report of the Director of Operational Test and Evaluation. As part of our overall review, we examined Defense Contract Management Agency quarterly 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 two Boeing production facilities in Everett, Washington. Finally, we interviewed officials from the Air Force's KC-46 program office, other defense offices, the 412th test wing, the Federal Aviation Administration (which is responsible for certifying the design of the KC-46), and Boeing on progress made in 2017. We assessed the reliability of cost, schedule, and test data by interviewing agency officials knowledgeable about the data, and determined that the data were sufficiently reliable for the purposes of this report.

We conducted this performance audit from August 2017 to April 2018 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.

Background

In February 2011, Boeing won the competition to develop the Air Force's next generation aerial refueling tanker aircraft, the KC-46. 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.

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



Source: © 2016 Boeing Company - Photo by Paul Weatherman. | GAO-18-353

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 wing aerial refueling pods located on each wing. The pods are used for simultaneous refueling of two aircraft.

To develop a KC-46 tanker, Boeing modified a commercial 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 in a separate Boeing facility. See figure 2 for a depiction of the conversion of the 767 aircraft into the KC-46 tanker with the boom deployed and the flight certifications needed at each stage.

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

Source: GAO analysis of Boeing data (data); © Boeing (images). | GAO-18-353

The Federal Aviation Administration has previously certified the airworthiness of Boeing's 767 commercial passenger airplane (referred to as a type certificate) and in December 2017, awarded the amended type certificate for the 767-2C aircraft to Boeing. It is also responsible for certifying the design of the KC-46 with a supplemental type certificate. The Air Force is then responsible for certifying the airworthiness of the KC-46 with a military certification, as well as certifying the KC-46 and various receiver aircraft, such as F-16 fighters and C-17 cargo planes, for refueling operations. Boeing must complete developmental testing to support these certifications as well as to demonstrate that contract specifications have been met. After the first 4 KC-46 aircraft are delivered, the Air Force will complete operational testing to determine the KC-46's operational effectiveness and operational suitability for combat.

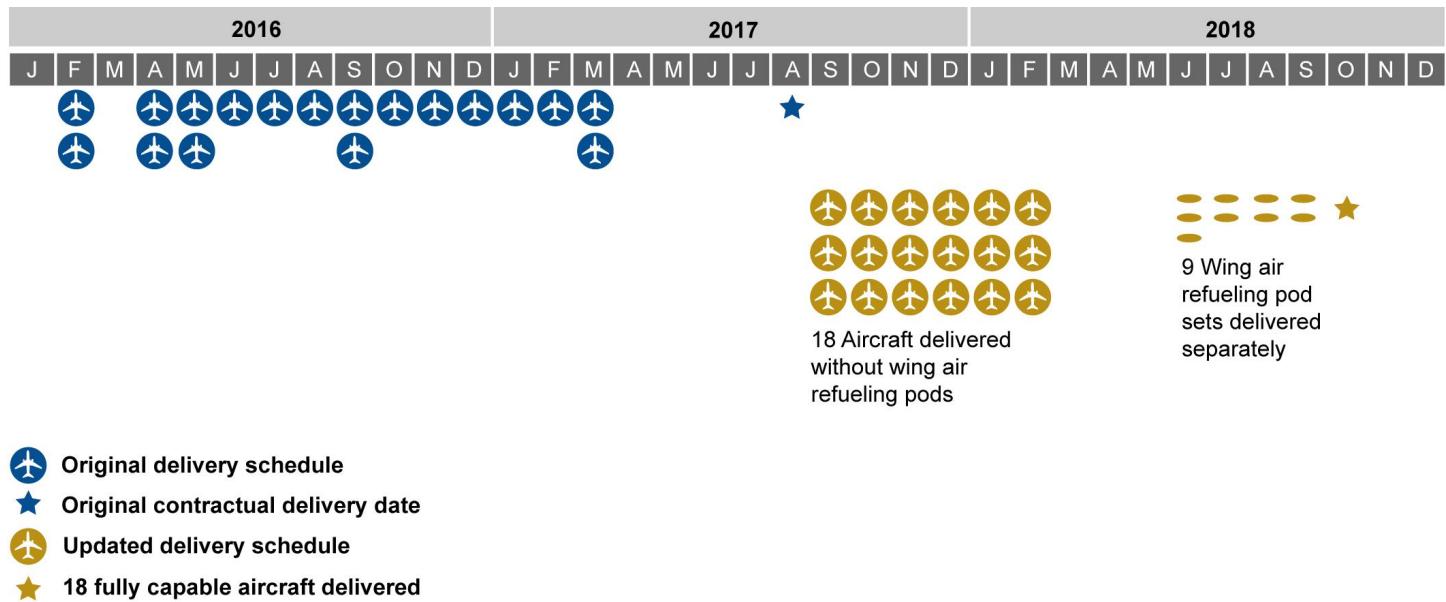
Boeing was awarded a fixed-price-incentive (firm target) contract for KC-46 development, which includes the design, manufacture, and delivery of four test aircraft. Barring any changes, the contract specifies a ceiling price of \$4.9 billion for Boeing to develop the first 4 aircraft, at which point Boeing must assume responsibility for all additional costs. The contract includes options to manufacture the remaining 175 aircraft with firm-fixed-price contract options for the first 2 production lots, and options with not-to-exceed fixed prices for production lots 3 through 13. 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 7 aircraft procured with fiscal year 2015 funding that are to be built and then delivered to the Air Force starting in 2018. The original contract also required Boeing to deliver 18 fully capable aircraft by August 2017.¹

The Under Secretary for Acquisition, Technology and Logistics approved the KC-46 program to enter low-rate initial production in August 2016. Since then, the Air Force has exercised options for the first 3 production lots for 34 aircraft totaling about \$4.9 billion. Previously we reported that in January 2017, Boeing and the program office updated the schedule to reflect a 14-month delivery delay due to problems Boeing experienced wiring the aircraft, design issues discovered with fuel system components, a fuel contamination event, and test delays (see figure 3).²

¹The original development contract requires Boeing to deliver 18 operational aircraft, 9 wing aerial refueling pod 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.

²GAO, *KC-46 Tanker Modernization: Delivery of First Fully Capable Aircraft Has Been Delayed Over One Year and Additional Delays Are Possible*, [GAO-17-370](#) (Washington, D.C.: Mar. 24, 2017); and *KC-46 Tanker Aircraft: Challenging Testing and Delivery Schedules Lie Ahead*, [GAO-16-346](#) (Washington, D.C.: Apr. 8, 2016).

Figure 3: Comparison of Original and Updated KC-46 Delivery Schedule

Source: GAO analysis of KC-46 program data. | GAO-18-353

As we reported, instead of meeting the original August 2017 date, the updated schedule shows Boeing would deliver the first 18 aircraft with booms and centerline drogue systems between September 2017 and February 2018. Then, the 9 wing aerial refueling pod sets would be delivered separately by October 2018, at which point Boeing will have delivered 18 fully capable aircraft.

Cost Estimates and Performance Capability Goals Remain Favorable, but a Critical Deficiency Has Not Yet Been Resolved

The KC-46 program's total acquisition cost estimate remained stable over the past year at \$44.4 billion, which is about \$7.3 billion less than the original estimate. In addition, the aircraft is projected to meet all performance capabilities. However, Boeing is currently trying to resolve a critical deficiency it discovered in testing, which could affect performance.

Cost Estimates Remain Stable

Similar to last year, the Air Force estimates that the total program acquisition cost for the KC-46, which includes development, procurement, and military construction costs will be \$44.4 billion. This is about \$7.3 billion, or about 14 percent, less than the original estimate of \$51.7 billion. 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 1a: Initial and Current KC-46 Tanker Aircraft Program Quantities and Acquisition Cost Estimates

Quantity category	February 2011	October 2017	Change (percent)	Difference
Expected quantities	n/a	n/a	n/a	n/a
Development quantities	4	4	n/a	0.0
Procurement quantities	175	175	n/a	0.0
Total quantities	179	179	n/a	0.0

Source: GAO presentation of Air Force data. | GAO-18-353

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

n/a	Acquisition cost estimates (then-year dollars in millions)	Acquisition cost estimates (then-year dollars in millions)	n/a	Acquisition cost estimates (then-year dollars in millions)
Acquisition category	February 2011	October 2017	Change (percent)	Difference
Development	7,149.6	5,835.1	-18.4	1,314.5
Procurement	40,236.0	35,523.8	-11.7	4,712.2
Military Construction	4,314.6	2,999.8	-30.5	1,314.8
Total program acquisition	51,700.2	44,358.7	-14.2	7,341.5

Source: GAO presentation of Air Force data. | GAO-18-353

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

n/a	Unit cost estimates (then-year dollars in millions)	Unit cost estimates (then-year dollars in millions)	n/a	Unit cost estimates (then-year dollars in millions)
Category	February 2011	October 2017	Change (percent)	Difference
Average program acquisition	288.8	247.8	-14.2	41

Source: GAO presentation of Air Force data. | GAO-18-353

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

The Air Force decreased its cost estimate primarily because it has not added or changed requirements and therefore there were fewer engineering changes than expected. Program officials said the initial cost estimate included a large amount of funding for possible requirements changes, based on the Air Force's experience with prior major acquisition programs. Military construction cost estimates also decreased as the Air Force has decided, for example, to reuse existing facilities at its operating bases rather than build new ones.

Boeing Has Achieved Some Performance Goals and Others Are Projected to Be Met, though Additional Testing Is Needed

The program expects to meet all of its 21 performance goals. 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. In addition, the aircraft is now using less than 1,557 gallons of fuel per flight hour, its fuel usage rate target. 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 2018, program officials told us that there are approximately 176 pounds of margin to the operational empty weight target of 204,000 pounds. When we met with them in December 2017, Boeing officials told us they do not expect the aircraft to exceed the target weight. Appendix I provides a description of each of the performance capabilities.

In some cases, the program will be tracking progress towards achieving performance capabilities while the aircraft is in operation. For example, the program set a reliability growth goal of 2.83 flight hours between unscheduled maintenance events due to equipment failure by the time the aircraft reaches 50,000 flight hours. As of November 2017, the program had completed about 2,159 flight hours, achieving 1.8 hours at that time. Program officials believe that the reliability will improve as additional flight hours are completed and as unreliable parts are identified and replaced.

The 2017 Annual Report by the Office of the Director of Operational Test and Evaluation included a recommendation that the Air Force re-test the KC-46 in an operationally representative condition to demonstrate that

aerial refueling systems could perform their required missions following an electromagnetic pulse event. This type of testing is related to the aircraft's survivability performance goal, meaning the aircraft should be capable of operating in a hostile environment, including after a nuclear incident that delivers an electromagnetic pulse. The report stated that the program powered down or removed critical mission systems during this testing and that therefore, the KC-46's capability to deliver fuel during or immediately following an electromagnetic pulse was not fully tested. Program officials stated that this testing was adequate to meet the initial contract specifications. They also stated that the program is assessing whether additional tests are needed to meet the new, more stringent standards that were issued by the Department of Defense after the fixed-price contract was signed.

A Critical Deficiency Has Not Been Resolved

Boeing is currently working to resolve a high-priority deficiency related to the performance of the aerial refueling boom that it discovered during testing. According to the 2017 Annual Report by the Director of Operational Test and Evaluation, analysis of boom aerial refueling testing to date showed a significant number of instances where the boom nozzle contacted the receiver aircraft outside the refueling receptacle. In many of those instances, the aerial refueling operators were unaware that those contacts had occurred. Boom nozzle contact outside the receptacle can damage antennae or other nearby structures. It is especially problematic for low-observable receiver aircraft, such as the F-22 fighter, because it can damage radar-absorbing coatings. Program officials said that Boeing is currently developing a software fix for the remote vision system that would provide aerial refueling operators better visibility for refueling operations to help avoid unintended boom contacts with receiver aircraft. The officials also said that Boeing is responsible for the costs to develop and retrofit the fix onto existing aircraft.

Boeing Is Likely to Experience Additional Delays in Delivering the First 18 Aircraft

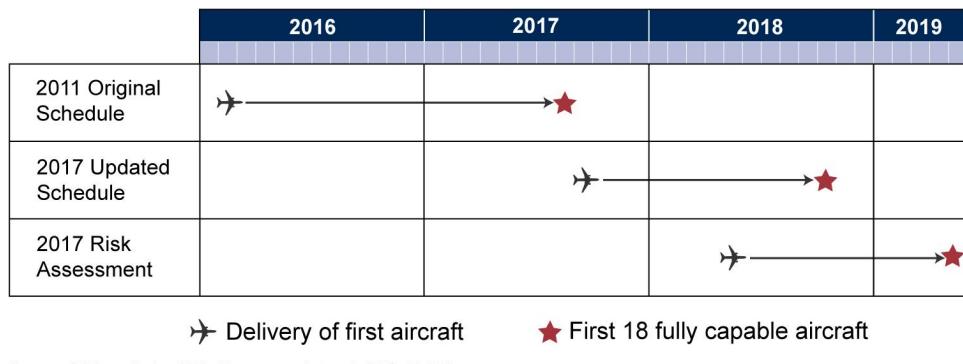
Although Boeing schedule documents indicate that the company remains committed to delivering 18 fully capable aircraft by October 2018, a program office risk assessment, as well as our own analysis, project that Boeing will not deliver the aircraft until around May 2019, if risks are not mitigated. The company is taking steps to address several risks

associated with developmental testing, but challenges remain. Boeing, not the government, is responsible for the cost of development delays based on the terms of the fixed-price contract.

Schedule Risk Assessment Projects Additional Delays

A program office schedule risk assessment from June 2017 projects that Boeing will not deliver the first 18 fully capable aircraft until May 2019, 7 months after the updated schedule and about 21 months later than the original plan, if Boeing does not mitigate existing program risks. Boeing has already missed delivery milestones in the updated schedule shown earlier in figure 3, because it had not yet completed developmental testing. Boeing still plans to deliver 18 fully capable aircraft by October 2018, but in a compressed time period. A comparison of the original, updated, and schedule risk assessment delivery schedules are shown in figure 4.

Figure 4: Comparison of KC-46 Tanker Original, Updated, and 2017 Schedule Risk Assessment Delivery Schedules



Source: GAO analysis of KC-46 program data. | GAO-18-353

Boeing Is Taking Steps to Mitigate Schedule Risks

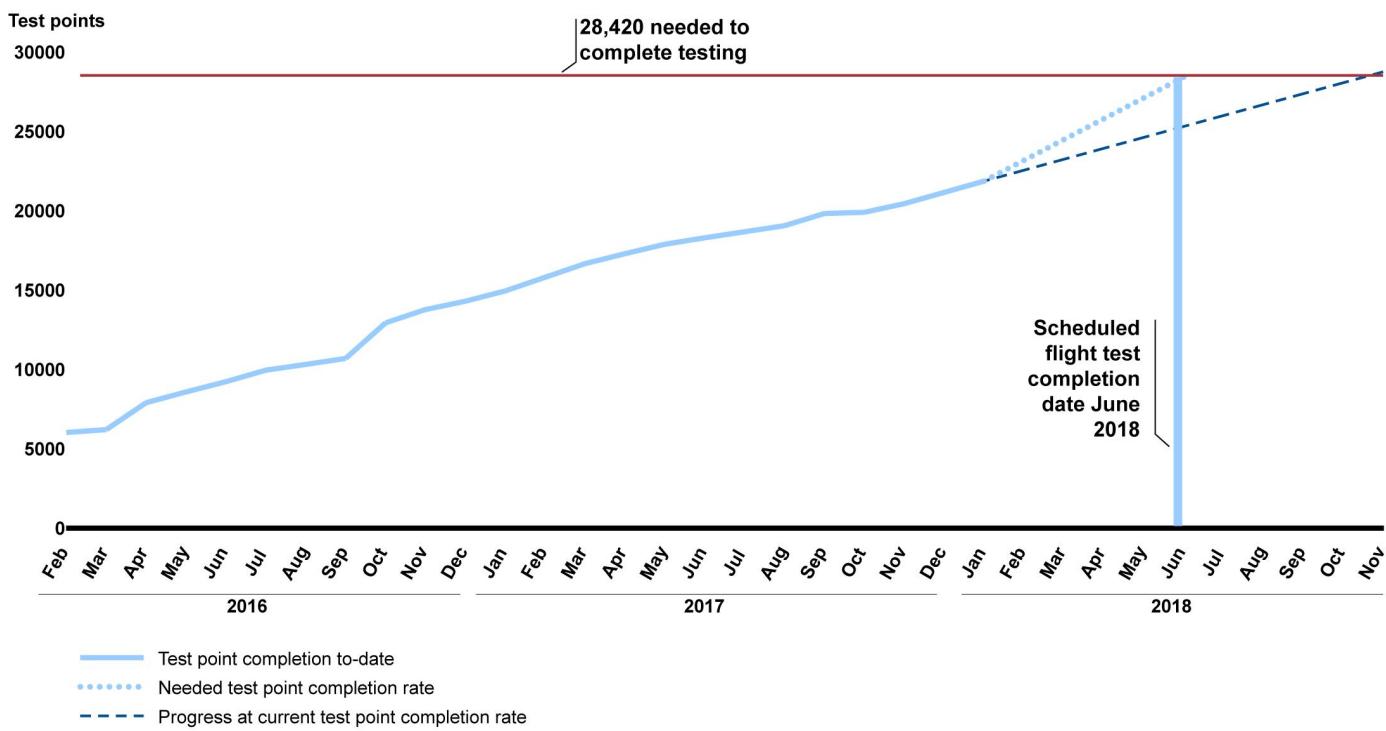
Boeing has efforts underway to mitigate several risks that threaten its ability to deliver the first 18 fully capable aircraft by October 2018. These key risks and efforts to address them are discussed below.

- Test aircraft configuration: Boeing needs to update test aircraft to the correct configuration before it can complete different types of testing that remain. For example, according to program officials, Boeing needs to ensure that test aircraft have up-to-date and approved wiring, software versions, and aircraft parts prior to Federal Aviation

Administration testing for the supplemental type certificate and Air Force testing for the required military certificate. At a more basic level, Boeing also needs to finalize the design of the wing aerial refueling pods to start developmental testing on that subsystem. According to Boeing officials, the company and its wing aerial refueling pod supplier had underestimated the level of design drawing details the Federal Aviation Administration needed to review to certify that the parts conformed to the approved design. Over the past 4 years, this supplier has been negotiating with several key sub-tier suppliers for the necessary documentation and has obtained most of it. Boeing has co-located some of its employees with the supplier to provide technical support to complete the remaining documentation for certification. Boeing and the program office disagree on how long it will take to reach that certification milestone. Boeing projects it will have conformed wing aerial refueling pods to test in March 2018 and program officials said there is risk to that time frame.

- Flight test pace: Boeing plans to complete about 6,550 remaining developmental flight test points by the end of June 2018 at a pace that is nearly double its current average. For example, some test points involve a KC-46 and receiver aircraft maintaining a specific airspeed and altitude during refueling. On average, from February 2016 through January 2018, Boeing has completed about 689 test points per month. It would need to almost double this pace to about 1,310 test points and sustain that pace for a 5-month period to complete testing by June. Based on the average number of tests points that Boeing has completed per month, as shown in figure 5, we project Boeing would finish the remaining test points about 5 months later than expected in early November 2018. We also project that delivery of 18 fully capable aircraft would occur around May 2019, assuming the same 5.5 month delivery time frame included in the updated schedule.

Figure 5: Test Completion at Current Pace versus Needed Pace to Complete as Planned



Source: GAO presentation of KC-46 program data. | GAO-18-353

Boeing recognizes that achieving its planned flight test pace is one of the most significant program risks and has taken several actions to address this risk. For example, last year, Boeing moved from a “test once” approach—where testing would begin once a series of tests was approved by the Federal Aviation Administration and Department of Defense—towards a more incremental testing approach where a smaller set of tests could be conducted as soon as they are approved by a single entity. Program officials pointed out that, where possible, Boeing is still using a single test point to satisfy more than one requirement from both regulators. As of January 2018, Boeing also identified about 440 test points that could be eliminated because, according to program officials, data collected in other tests may provide sufficient knowledge to cover the eliminated test points. Boeing has also consolidated a large percentage of qualification testing resources at a single location to improve efficiency.

- Test planning: According to program officials, Boeing's test plans do not fully account for the time needed to complete receiver aircraft certification testing. Program officials, government test officials, and Boeing officials said that tests for certifying F-16 fighters, C-17 cargo

planes, and other aircraft to receive fuel from a KC-46 will take between 3 and 5 weeks to complete for each aircraft. This is longer than the 1 week for each aircraft that is currently included in Boeing's test plan, according to company officials. Boeing officials said the company intends to update the test schedule in Spring 2018 to reflect more time to complete receiver aircraft certifications. Boeing has not yet quantified how much time will be added to the test schedule for these certifications or determined whether it will affect the overall delivery schedule. According to program officials, Boeing is required to have 8 receiver aircraft certified by the first KC-46 delivery. These officials stated that to avoid the risk of further delivery delays, the Air Force is discussing the possibility of reducing the number of receiver aircraft certifications needed if some, but not all, receiver aircraft are certified prior to first KC-46 delivery. This would allow the warfighter to start using KC-46 aircraft sooner rather than wait for all 8 receiver aircraft to be certified. Air Force officials still maintain, however, that 8 receiver certifications are required prior to operational testing, which is slated to begin in October 2018 and last for about 7 months.

- Retrofitting already produced aircraft: Based on the updated schedule, Boeing will be producing 49 aircraft, or about 27 percent of the total aircraft the Air Force plans to buy, before developmental testing is complete. Originally, the Air Force planned to buy 19 aircraft or about 11 percent of the total number concurrent with developmental testing. In general, DOD tries to limit the amount of concurrency because testing can reveal design or performance problems that need to be fixed, which could lead to costly retrofits or schedule delays. For example, Boeing already needs to retrofit 18 aircraft it has produced with an updated wiring design and 6 aircraft with new flooring and tires. The Under Secretary for Acquisition, Technology and Logistics allowed 27 percent concurrency on this program to avoid a break in production. Cost risk to the government is low because the KC-46 development contract specifies that Boeing must correct any deficiencies and bring development and production aircraft to the final configuration at no additional cost to the government. However, there could be schedule delays if continued testing reveals problems that need to be corrected on aircraft already built. As of January 2018, Boeing estimates KC-46 development will cost about \$5.9 billion or about \$1 billion over the contract ceiling price.

KC-46 Development Problems Have Resulted in Less Refueling Capacity Than Currently Anticipated

KC-46 development problems have resulted in delivery delays and kept the Air Force from achieving a higher level of refueling capacity it expected to achieve by this time. These problems have not resulted in additional costs to the government. However, if delivery delays continue past October 2018, the Air Force will need to maintain legacy aircraft such as the KC-135 longer than planned.

The Air Force expected to have 470 tankers in January 2018—a combination of KC-46, KC-135, and KC-10 aircraft—for refueling missions, but only had 455 of these aircraft at that time. Since no KC-46 aircraft have been delivered, the Air Force has had to use KC-135 and KC-10 aircraft at a higher rate than expected. Air Force officials negotiated non-monetary considerations from Boeing to offset the lost military tanker capacity associated with the delay, such as obtaining additional training at no cost to the government for KC-46 pilots and maintenance personnel and support for the aircrew training system. According to program officials, Boeing has already provided almost all of these considerations even though the contract modification that includes them has not yet been signed by Boeing.

According to Air Mobility Command officials, if there are delivery delays past October 2018, the Air Force would need to keep some KC-135 aircraft operational longer than planned. The cost of maintaining those KC-135 aircraft is estimated to be about \$10.3 million per year per aircraft. Additionally, about \$12 million per aircraft may also be needed, according to Command officials, for depot maintenance activities that are scheduled every 5 years. Command officials stated that the number of depot events that are needed will depend on how quickly Boeing can deliver expected KC-46 aircraft.

We are not making any recommendations in this report, but believe the Under Secretary of Defense for Acquisition, Technology and Logistics should implement a prior recommendation to closely monitor the cost, schedule, and performance outcomes of the KC-46 program to identify

positive or negative lessons learned.³ As one of only a few major acquisition programs to award a fixed-price incentive (firm target) development contract in recent years, evaluating performance and identifying lessons learned will be illustrative, important for informing decision makers, and help guide and improve future defense acquisition programs.

Agency Comments

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; and the Secretary of the Air Force. 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. Contact points for our Offices of Congressional Relations and Public Affairs may be found

³GAO, *KC-46 Tanker Aircraft: Acquisition Plans Have Good Features but Contain Schedule Risk*, GAO-12-366 (Washington, D.C.: Mar. 26, 2012); The Office of the Undersecretary of Defense for Acquisition, Technology and Logistics was reorganized effective February 1, 2018. There is now an Undersecretary of Defense for Research and Engineering, an Undersecretary of Defense for Acquisition and Sustainment, and a Chief Management Officer. According to an August 2017 Department of Defense report to Congress on the restructuring effort, the Undersecretary of Defense for Acquisition and Sustainment is responsible for providing the military services with best practices on acquisition programs to achieve affordable and capable warfare systems, among other things.

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".

Michael J. Sullivan
Director, Contracting and National Security Acquisitions

Appendix I: KC-46 Performance Capabilities

The program office has 21 performance goals that are critical to the KC-46 aircraft's military capability and track progress in meeting contract specifications. These performance goals include nine key performance parameters, five key system attributes, and seven technical performance measures. Table 2 provides a description of each key performance parameter and key system attribute and table 3 provides a description and status of each technical performance measure.

Table 2: KC-46 Key Performance Parameters and Key System Attributes

Category	Subcategory	Description
Key performance parameter	Tanker Air Refueling Capability	Aircraft shall be able to effectively conduct (non-simultaneously) both boom and drogue air refueling on the same mission.
Key performance parameter	Fuel Offload versus Radius	Aircraft shall be capable of carrying certain amounts of fuel (to use in air refueling) certain distances.
Key performance parameter	Operate in Civil and Military Airspace	Aircraft shall be capable of worldwide flight operations in all civil and military airspace.
Key performance parameter	Airlift Capability	Aircraft shall be capable of transporting certain amounts of both equipment and personnel.
Key performance parameter	Receiver Air Refueling Capability	Aircraft shall be capable of receiving air refueling from any compatible tanker aircraft.
Key performance parameter	Force Protection	Aircraft shall be able to operate in chemical and biological environments.
Key performance parameter	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.
Key performance parameter	Survivability	Aircraft shall be capable of operating in hostile threat environments.
Key performance parameter	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.
Key system attribute	Aeromedical Evacuation	Aircraft shall be capable to provide air transport for up to 50 patients and medical staff.
Key system attribute	Reliability and Maintainability	Able to deploy, operate, sustain, and recover aircraft at sufficient levels of readiness and performance.
Key system attribute	Operational Availability	Aircraft shall be operationally available at least 80 percent of the time.
Key system attribute	Treaty Compliance Support	Aircraft shall have the necessary hardware installed to demonstrate compliance with applicable treaties.

Source: GAO presentation of Air Force Data. | GAO-18-353

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

Table 3: KC-46 Technical Performance Capabilities and Statuses

Technical performance capability	Description	Contract specification or 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-18-353

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

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

Appendix III: Accessible Data

Data Table

Accessible Data for Figure 5: Test Completion at Current Pace versus Needed Pace to Complete as Planned

Date	Test Point Completion To-Date	Needed Test Point Completion Rate	Progress at Current Test Point Completion Rate	Test Points Needed to Complete Testing
Feb 2016	6034	n/a	n/a	28420
Mar 2016	6213	n/a	n/a	28420
Apr 2016	7912	n/a	n/a	28420
May 2016	8589	n/a	n/a	28420
Jun 2016	9235	n/a	n/a	28420
Jul 2016	9960	n/a	n/a	28420
Aug 2016	10322	n/a	n/a	28420
Sep 2016	10701	n/a	n/a	28420
Oct 2016	12941	n/a	n/a	28420
Nov 2016	13779	n/a	n/a	28420
Dec 2016	14304	n/a	n/a	28420
Jan 2017	14954	n/a	n/a	28420
Feb 2017	15813.5	n/a	n/a	28420
Mar 2017	16673	n/a	n/a	28420
Apr 2017	17300	n/a	n/a	28420
May 2017	17895	n/a	n/a	28420
Jun 2017	18301	n/a	n/a	28420
Jul 2017	18682.5	n/a	n/a	28420
Aug 2017	19064	n/a	n/a	28420
Sep 2017	19832	n/a	n/a	28420
Oct 2017	19908	n/a	n/a	28420
Nov 2017	20452	n/a	n/a	28420
Dec 2017	21162	n/a	n/a	28420
Jan 2018	21872	21872	21872	28420
Feb 2018	n/a	23181.6	22560.6	28420
Mar 2018	n/a	24491.2	23249.2	28420

Appendix III: Accessible Data

Date	Test Point Completion To-Date	Needed Test Point Completion Rate	Progress at Current Test Point Completion Rate	Test Points Needed to Complete Testing
Apr 2018	n/a	25800.8	23937.8	28420
May 2018	n/a	27110.4	24626.4	28420
Jun 2018	n/a	28420	25315	28420
Jul 2018	n/a	n/a	26003.7	28420
Aug 2018	n/a	n/a	26692.3	28420
Sep 2018	n/a	n/a	27380.9	28420
Oct 2018	n/a	n/a	28069.5	28420
Nov 2018	n/a	n/a	28758.1	28420

Related GAO Products

KC-46 Tanker Modernization: Delivery of First Fully Capable Aircraft Has Been Delayed Over One Year and Additional Delays are Possible. [GAO-17-370](#). Washington, D.C.: March 24, 2017.

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.

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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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