



MILITARY PARACHUTES

Observations on Army and Marine Corps Acquisition Programs

Accessible Version

July 2020

GAO Highlights

Highlights of [GAO-20-524](#), a report to the Armed Services Committee, House of Representatives

Why GAO Did This Study

Combined, the Army and the Marine Corps expect to spend almost \$150 million to replace thousands of aging free fall parachute systems with higher performing ones better suited for current threats. Free fall parachute systems allow military personnel to deploy a parachute during descent and then navigate to a designated landing area. Each service has awarded contracts for its new parachute system. The Army awarded its contract for the Advanced Ram Air Parachute System—known as the RA-1—in 2011. The Marine Corps awarded its contract for the Enhanced-Multi Mission Parachute System—now called the PS-2—in 2018.

The House Armed Services Committee included a provision for GAO to review the Army and Marine Corps' procurement of free fall parachutes. This report examines: (1) the acquisition strategies used by the Army and Marine Corps for their parachute programs and (2) the extent to which the Army and Marine Corps programs are meeting their cost, schedule, and performance goals.

GAO analyzed program and contract documentation for the Army's RA-1 and the Marine Corps' PS-2 acquisition programs and interviewed or obtained information from relevant officials from the Army, Marine Corps, and prime contractor for both programs.

View [GAO-20-524](#). For more information, contact Timothy J. DiNapoli at (202) 512-4841 or DiNapoli@gao.gov.

July 2020

MILITARY PARACHUTES

Observations on Army and Marine Corps Acquisition Programs

What GAO Found

The Army and Marine Corps use free fall parachutes with their special operations forces and reconnaissance units to covertly land personnel in contested areas. Both services used low-risk acquisition strategies for their parachute replacement programs that were based on buying existing systems that could meet their needs with minor modifications and no government-funded development. But, according to GAO's review of program documents, their requirements differed in several areas, which helps explain why they chose different systems to fulfill their needs. For example, the Marine Corps' need for a small drogue parachute (see Marine Corps system on right side of figure below) differentiated it from the Army. A drogue parachute helps prevent "head over heels" tumbling, which was a contributing factor in previous Marine Corps parachuting fatalities. According to the Marine Corps, the added in-flight stability from a drogue parachute also helps because the Marine Corps has more limited training opportunities than the Army. The Army system on the left does not incorporate a drogue parachute, which results in a simpler design and lower-cost parachute system.

Army and Marine Corps Free Fall Parachute Systems



Army Advanced Ram Air Parachute System (RA-1)

Marine Corps Parachute System-2 (PS-2)

Source: (left) U.S. Army; (right) U.S. Marine Corps. | GAO-20-524

According to GAO's review of program documents, the Army and the Marine Corps are meeting the current acquisition goals for their free fall parachute programs. Specifically:

- **Cost:** The Army's program costs have been stable since 2013 when it revised its cost goals to account for an increase in planned parachute purchases. The Marine Corps' program has met its cost goals, and has largely addressed a \$1.4 million budget shortfall, which will enable it to buy nearly all of its planned parachutes.
- **Schedule:** The Army's program is nearing completion, having met its schedule goals. The Marine Corps' program met its one schedule milestone by fielding its initial parachutes almost 2 years earlier than planned. The Marine Corps plans to complete its program in fiscal year 2025.
- **Performance:** The Army's and Marine Corps' parachutes both met all of their minimum performance goals, such as the distances they can travel and the weights they can carry.

Contents

Letter		1
	Background	2
	Army and Marine Corps Had Several Differences in Their Parachute Acquisition Strategies and Used Similar Contracting Approaches	9
	Army and Marine Corps Are Meeting Current Cost, Schedule, and Performance Goals	18
	Agency Comments	25
Appendix I: GAO Contact and Staff Acknowledgments		26
Appendix II: Accessible Data		27
	Data Tables	27
Tables		
	Table 1: Army's RA-1 and Marine Corps' PS-2 Parachute Testing Strategies	12
	Table 2: Army's RA-1 and Marine Corps' PS-2 Parachute Procurement Contract Details and Similarities	17
	Table 3: Army RA-1 Parachute Program Baseline Costs and Quantities	20
	Table 4: Marine Corps PS-2 Program Baseline Costs and Quantities	22
Figures		
	Figure 1: Parachute Glide Ratios, Explained	4
	Figure 2: Overview of Army's RA-1 and Marine Corps' PS-2 Free Fall Parachute Programs	8
	Figure 3: RA-1 Parachute Program Planned Funding and Quantities through Fiscal Year 2019 and to Completion	21
	Figure 4: PS-2 Program Planned Funding and Quantities through Fiscal Year 2019 and to Completion	24

Accessible Data for Figure 3: RA-1 Parachute Program Planned Funding and Quantities through Fiscal Year 2019 and to Completion	27
Accessible Data for Figure 4: PS-2 Program Planned Funding and Quantities through Fiscal Year 2019 and to Completion	28

Abbreviations

ACAT	Acquisition Category
DOD	Department of Defense
PS-2	Parachute System-2
RA-1	Advanced Ram Air Parachute System

This is a work of the U.S. government and is not subject to copyright protection in the United States. The published product may be reproduced and distributed in its entirety without further permission from GAO. However, because this work may contain copyrighted images or other material, permission from the copyright holder may be necessary if you wish to reproduce this material separately.



July 16, 2020

The Honorable Adam Smith
Chairman
The Honorable Mac Thornberry
Ranking Member
Committee on Armed Services
House of Representatives

Combined, the Army and the Marine Corps expect to spend almost \$150 million to replace their free fall parachute systems, which are primarily used by special operations forces and reconnaissance units. The parachutes are used in circumstances such as navigating restricted terrain or conducting clandestine operations. The two military services have thousands of these parachutes in their inventories. In initiating their replacement programs, the Army and the Marine Corps noted that their prior free fall parachute systems were reaching the end of their service life—generally 12 to 15 years—and cited the need for improved performance to accomplish certain missions. As part of the replacement programs, each service conducted competitions, ultimately awarding separate contracts for different parachute systems to the same vendor. The Army awarded its contract for the Advanced Ram Air Parachute System (RA-1) in 2011, and the Marine Corps awarded its contract for the Enhanced-Multi Mission Parachute System—now called the Parachute System-2 (PS-2)—in 2018.¹

A House Armed Services Committee report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2020 included a provision for us to review the Army and Marine Corps' free fall parachute research, development, and acquisition strategies.² This report examines: (1) the acquisition strategies used by the Army and Marine Corps for their parachute programs and (2) the extent to which the Army and Marine Corps programs are meeting their cost, schedule, and performance goals.

To examine the acquisition strategies used by the Army and Marine Corps for their free fall parachute programs, we collected documents

¹Throughout the report, we refer to the Army and Marine Corps' free fall parachute acquisition programs as the RA-1 program and PS-2 program, respectively.

²H.R. Rep. No. 116-120, at 183-84 (2019).

such as acquisition strategies, performance requirements, market research reports, and test plans from the RA-1 and PS-2 program offices. We analyzed these documents to identify key characteristics of the acquisition strategies, including operational requirements, contracting and testing strategies, and industrial base considerations, and compared them to identify any similarities and differences.

To examine the extent to which the Army and the Marine Corps programs met their cost, schedule, and performance goals, we collected documents such as acquisition program baselines, program briefings, test reports, contracts, contract pricing memorandums, and delivery schedules from the RA-1 and PS-2 program offices. We compared the programs' baseline cost, schedule, and performance goals against information in these documents to determine the extent to which the parachute programs were meeting those goals as of the end of fiscal year 2019.

For both objectives, we conducted interviews or obtained information from knowledgeable officials from the (1) Army, including the Program Executive Office, Solider; RA-1 program; U.S. Army Contracting Command; U.S. Army Quartermaster School; and U.S. Army Special Operations Command; (2) Marine Corps, including the Marine Corps Systems Command and PS-2 program; and (3) the prime contractor for both programs.

We conducted this performance audit from August 2019 to July 2020 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

The Army and the Marine Corps use free fall parachutes to covertly land personnel in enemy-held or contested areas for special operations and reconnaissance missions. Free fall parachute systems allow military personnel to deploy a parachute during descent and then navigate—for distances that can be longer than 20 miles—to a designated landing area. Deploying the parachute during descent is in contrast to a static line parachute, which deploys automatically for the individual upon jumping out of the aircraft. Parachute systems that provide only a static line

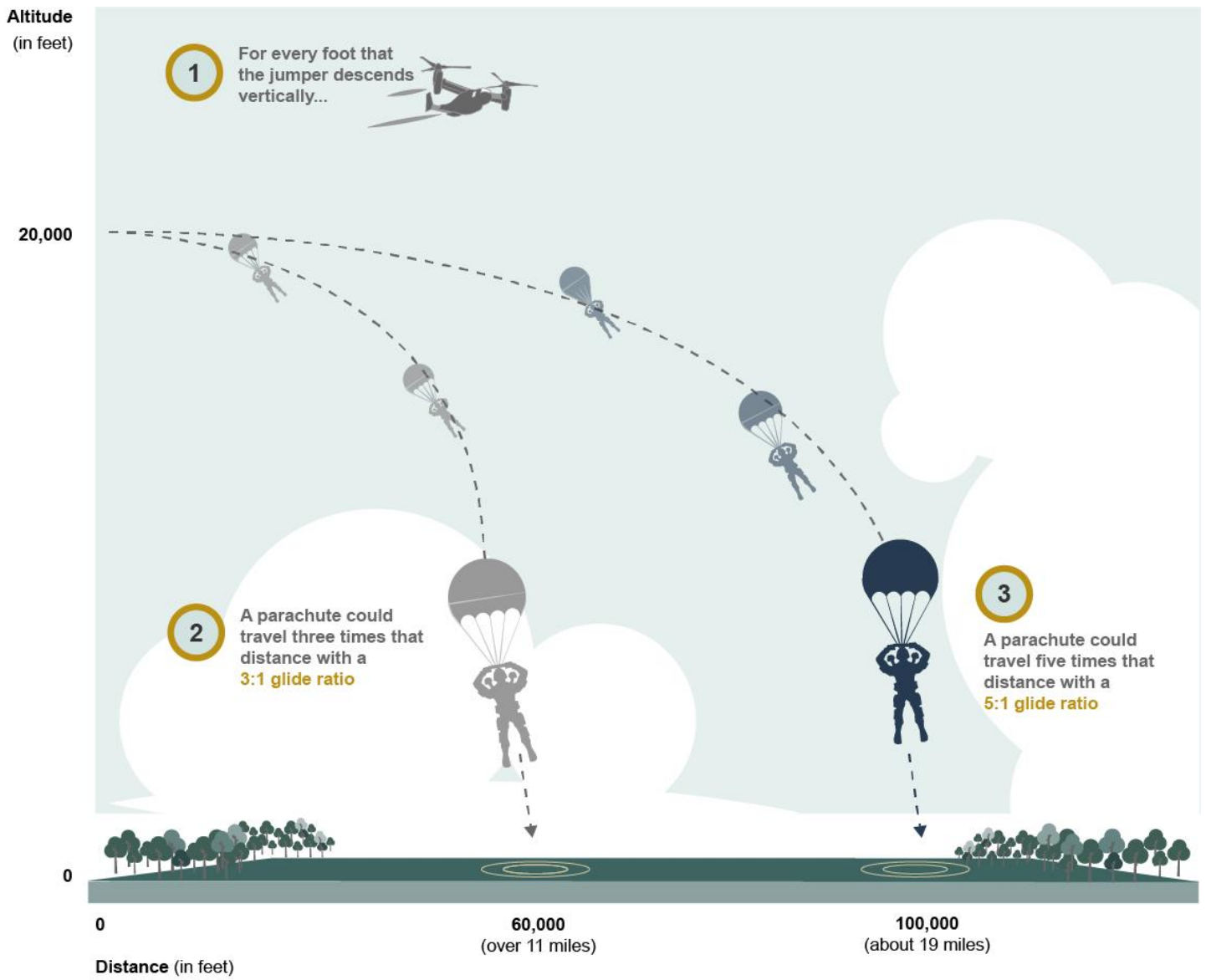
capability generally operate at lower altitudes and allow the parachutist to travel shorter distances. According to Army and Marine Corps officials, most of the parachutes in their inventories are static line and more soldiers and Marines are qualified to jump in that configuration. Qualifying to jump with free fall parachutes requires more training than qualifying to jump with static line parachutes, according to these officials.

The Department of Defense (DOD) conducts two primary types of military free fall operations:

- High-altitude low-opening—jumps made at an exit altitude of up to 35,000 feet and a parachute deployment altitude at or below 6,000 feet above the ground; or
- High-altitude high-opening— jumps made at an exit altitude of up to 35,000 feet and a parachute deployment altitude higher than 6,000 feet above the ground.

When conducting free fall operations, the distance that a parachutist can travel is determined, in part, by the exit altitude and parachute's glide ratio. A parachute's glide ratio—which is a function of the canopy's design—indicates how far parachutists can travel horizontally during their descent. For example, if a parachute canopy has a 5 to 1 glide ratio, then an individual can travel 5 feet horizontally for every foot they descend vertically after deploying the parachute (see fig. 1). Higher glide ratios can benefit military operations because they allow the aircraft that deploys the parachutists to avoid flying over the target area and maintain a greater distance from potential threats, particularly in conjunction with high-altitude high-opening operations.

Figure 1: Parachute Glide Ratios, Explained



*Figure not drawn to scale

Source: GAO analysis of Army and Marine Corps documentation. | GAO-20-524

Acquisition Program Activities and Oversight

DOD acquisition policy defines an acquisition program as a directed, funded effort that provides a new, improved, or continuing materiel, weapon, or information system, or a service capability in response to an approved need.³ The activities that acquisition program officials conduct, as well as information those officials report and oversight that the programs receive, can vary based on factors such as the estimated cost of the program and where that program enters DOD's acquisition process. DOD and military service policies generally require certain common activities, however, such as developing operational requirements, acquisition strategies, and acquisition program baselines.⁴ Specifically:

- Operational or performance requirements describe the attributes of a system that are critical or essential to the development of an effective military capability. In other words, these requirements capture what a system or piece of equipment must be able to do or what characteristics it must have to be useful.
- Acquisition strategies describe the program manager's plan to execute a program and achieve its goals from the time a need is identified through the time of a system's disposal or replacement. The strategy summarizes the approaches that will be used to acquire a capability, such as the contracting strategy, and addresses other factors, such as performance requirements, cost, schedule, risks, and funding. The acquisition strategy generally includes information on industrial base considerations, such as the sources or companies that might be able to meet the government's needs and plans for competition, among other topics.
- Acquisition program baselines describe the cost, schedule, and performance goals for an approved program. They are agreed to by the program manager

³Department of Defense Directive 5000.01, *The Defense Acquisition System* (May 12, 2003) (incorporating change 2, Aug. 31, 2018).

⁴These acquisitions were subject to previous iterations of DOD Instruction 5000.02, Army Regulation 70-1, and SECNAVINST 5000.2. DOD reissued and updated DOD Instruction 5000.02 on January 23, 2020, and it is now entitled *Operation of the Adaptive Acquisition Framework*. See DODI 5000.02, *Operation of the Adaptive Acquisition Framework* (Jan. 23, 2020). DOD renumbered the 2015 issuance of DODI 5000.02 to DODI 5000.02T, and DODI 5000.02T will remain in effect with content removed as it is cancelled or transitions to a new issuance. DOD Instruction 5000.02T, *Operation of the Defense Acquisition System* (Jan. 7, 2015) (incorporating change 7, Apr. 21, 2020); Army Regulation 70-1, *Research, Development, and Acquisition: Army Acquisition Policy* (Aug. 10, 2018); SECNAVINST 5000.2F, *Defense Acquisition System and Joint Capabilities Integration and Development System Implementation* (Mar. 26, 2019).

and the milestone decision authority.⁵ Acquisition program baselines contain objective and threshold values. The objective values are the desired cost, schedule, and performance goals for the program. The threshold values reflect the minimum cost, schedule, performance goals. In other words, the threshold values are the highest cost, longest time, and lowest level of performance that an acquisition program could reach before the baseline must be revisited.⁶

Testing is another program activity that is almost always conducted and certain types of testing are required by DOD and military service policy, with limited exceptions. The type of testing a program office conducts depends on where the program enters the DOD acquisition process, among other factors. Most acquisition programs that begin in the development phase conduct developmental and operational testing. Specifically:

- Developmental testing evaluates the ability of a system to meet its performance requirements. Program managers use it to manage and mitigate risks during development, to verify that products comply with contractual and performance requirements, and to inform decisions, such as initial production. Developmental testing occurs mostly during the development phase but can extend into early production.
- Operational testing evaluates the effectiveness, suitability, and survivability of a system in a realistic threat environment. Users and independent test organizations conduct and oversee the tests and assess the system. Operational testing is typically conducted during the production phase, but before an organization commits to buying a large number of systems.

Acquisition programs with low estimated program costs might not conduct operational testing. For example, Navy acquisition policy, which the Marine Corps follows, permits certain low-dollar value programs that do

⁵The milestone decision authority is the designated individual with overall responsibility for a program. This individual has the authority to approve entry of an acquisition program into the next phase of the acquisition process and is accountable for cost, schedule, and performance reporting.

⁶In this report, we use threshold values to assess the extent to which the Army and Marine Corps met their cost, schedule, and performance goals.

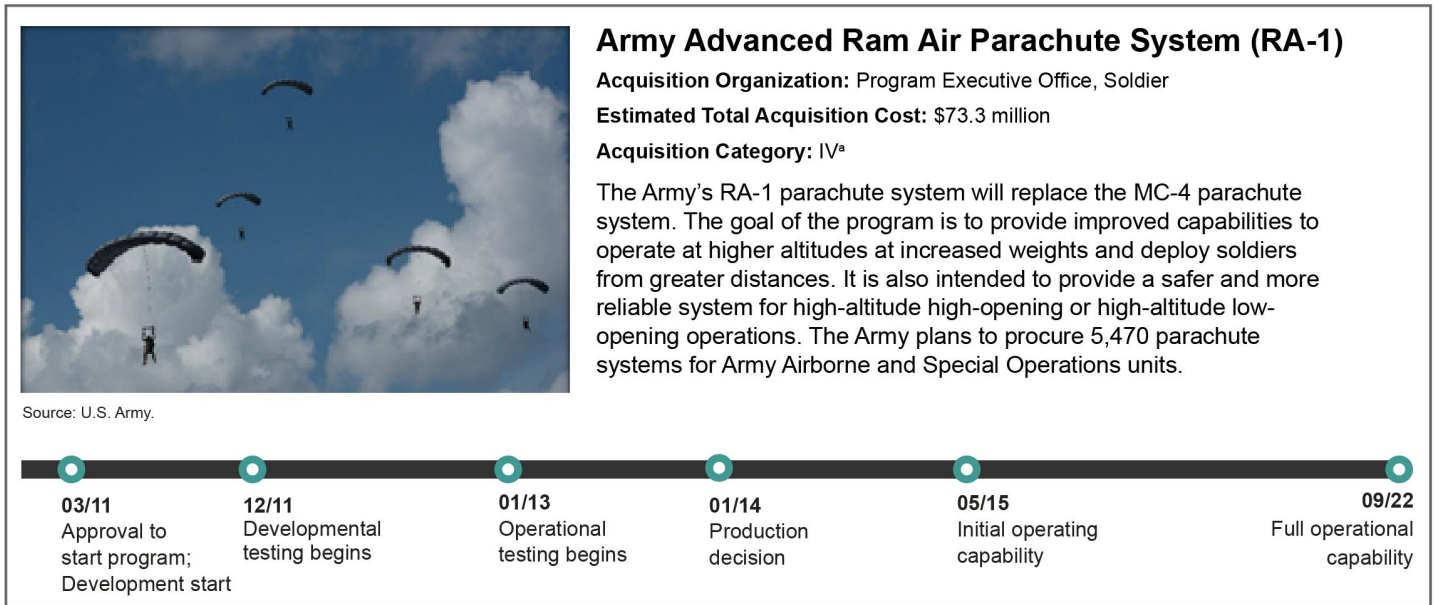
not require operational testing to be designated as abbreviated acquisition programs.⁷

Army and Marine Corps Free Fall Parachute Acquisition Programs

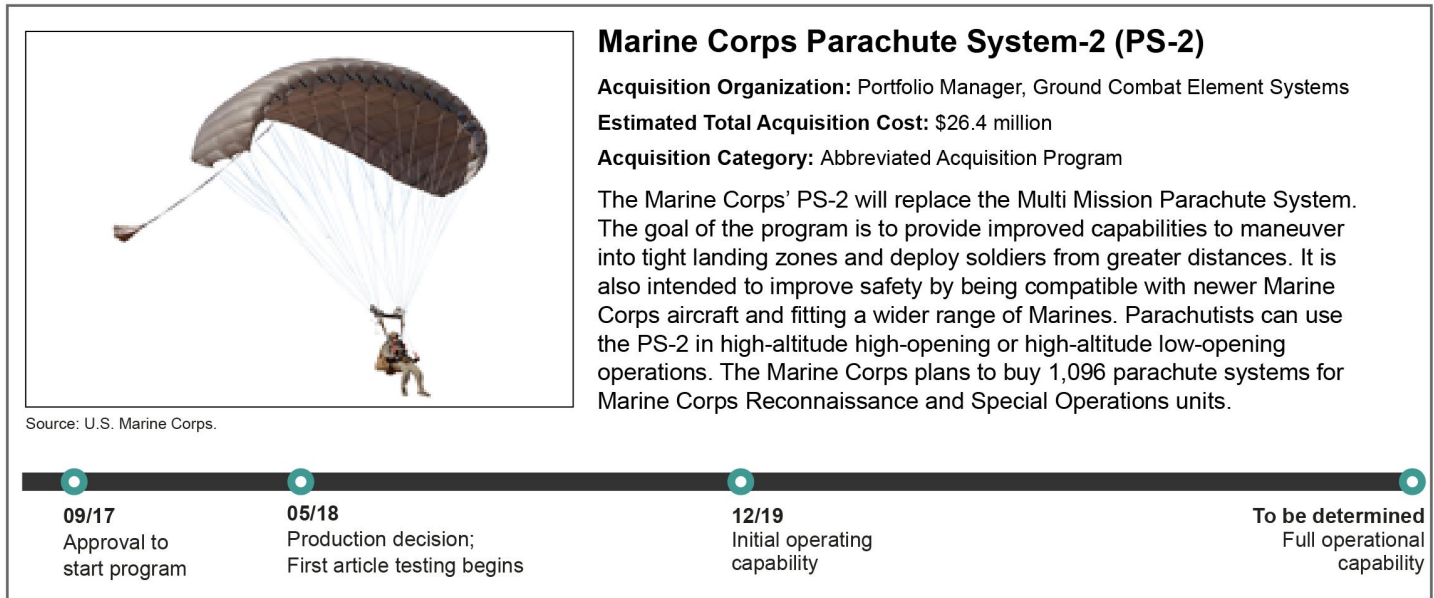
The Army and Marine Corps began acquisition programs to replace and improve upon their aging free fall parachutes in 2011 and 2017, respectively. Figure 2 provides a brief overview of the Army's RA-1 and Marine Corps' PS-2 programs.

⁷SECNAVINST 5000.2F, *Defense Acquisition System and Joint Capabilities Integration and Development System Implementation* (Mar. 26, 2019). A Navy acquisition program that does not require operational testing and does not breach the ACAT IV dollar thresholds can be designated as an abbreviated acquisition program if, for all increments of the program, its estimated research, development, test, and evaluation costs are below \$26 million and its estimated procurement costs are below \$64 million (in fiscal year 2014 constant dollars). The Marine Corps' acquisition of PS-2 was subject to an earlier iteration of this instruction that also permitted certain low-dollar value programs not requiring operational testing to be designated as abbreviated acquisition programs, although the requirements differ from the current instruction. See SECNAVINST 5000.2E, *Department of the Navy: Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System* (Sept. 1, 2011).

Figure 2: Overview of Army's RA-1 and Marine Corps' PS-2 Free Fall Parachute Programs



Source: GAO analysis of Army data. | GAO-20-524



Source: GAO analysis of Marine Corps data. | GAO-20-524

^aThe Army RA-1 parachute system was originally designated as an Acquisition Category (ACAT) III program. In December 2017, the Army implemented the ACAT IV designation and directed program managers to recommend an ACAT IV designation for programs that meet certain guidelines. According to the guidelines, the program should not meet the ACAT III criteria and should have an estimated eventual total expenditure of less than \$100 million for research, development, test, and

evaluation costs or \$400 million in procurement costs (in fiscal year 2014 constant dollars). Moreover, the decision to designate should be based on an assessment of cost, overall program risk, complexity, combat impact, and visibility. Programs should be of relatively low risk and complexity to be considered for designation as an ACAT IV. Programs having critical safety or mission impacts should in most cases remain an ACAT III. The RA-1 parachute system was re-designated as an ACAT IV program in January 2018.

Army and Marine Corps Had Several Differences in Their Parachute Acquisition Strategies and Used Similar Contracting Approaches

According to our analysis of program documents, the Army and Marine Corps had several differences in their acquisition strategies to replace and improve their prior free fall parachute systems, reflecting each military services' specific (or unique) operational requirements, testing strategies, and industrial base considerations. Overall, however, both the Army and Marine Corps used low-risk acquisition strategies, including similar contracting approaches that reflected the availability of existing parachutes that could meet the Army and Marine Corps' needs with minor modifications.

The Army and Marine Corps Had Different Operational Requirements, Testing Strategies, and Industrial Base Considerations

The Army and Marine Corps acquisition strategies for their respective free fall parachute systems differed in several areas, including operational requirements, testing strategies, and industrial base considerations. Program officials noted that factors such as the conditions under which they expect to utilize the parachutes, available funding, and the desire to maintain competition during parachute production played roles in the development of their strategies.

Operational Requirements

The Army and the Marine Corps purchased distinct free fall parachute systems, in part, due to differences in operational requirements, which were based on how they each intended to deploy their parachutists during missions and how they trained for those missions. Our analysis found that these differences included:

- the Marine Corps' need for a drogue parachute,
- the Army's need for a static line capability, and
- the desired glide ratios for the respective parachutes.

Drogue Parachute

According to Marine Corps officials, the requirement for a drogue parachute was a key distinguishing factor from the Army's RA-1 parachute. In 2014, the Marine Corps validated its need for a drogue parachute as a requirement for its new free fall parachute system. A drogue parachute is a smaller parachute that is released behind the main canopy to help slow the parachutist's descent. In validating the need, the Marine Corps noted that a drogue parachute helps increase in-flight stability and prevent "head over heels" tumbling. The Marine Corps found that a lack of stability was a contributing factor in two previous parachuting fatalities. In addition, program officials stated that operating in a ship-based environment can limit training opportunities for Marines to maintain their parachuting proficiency. The added stability from a drogue parachute helps mitigate the risk that could result from those limits. Conversely, the Army did not have a requirement for a drogue parachute for its RA-1 parachute system. An Army Special Operations Command official stated that its level of training negated the need for a drogue parachute, making for a simpler design and lower-cost parachute.

The Marine Corps' use of a drogue also contributed to the need for two PS-2 sizes compared to one for the Army's RA-1 parachute. The Marine Corps had an objective requirement for one PS-2 harness to fit all jumpers within a height and weight percentile range of the 5th percentile female Marine at the low end to the 95th percentile male Marine at the high end. For example, the Marine Corps conducted a market research evaluation with a female that was 5 feet 1 inch tall and 130 pounds, and a male that was 6 feet 1 inch tall and 230 pounds to represent this range. The threshold requirement, however, allowed for two different harness sizes. According to the PS-2 prime contractor, parachutists at the low end of the required weight range might not generate the drogue parachute speed needed to reliably activate the automatic safety feature of the parachute. The contractor modified its design and qualified a smaller version of the PS-2 to address this issue, as well as other fit-related issues the Marine Corps identified during its market research. Because the Army's RA-1 parachute does not use a drogue, a single parachute

harness was sufficient for personnel at all weights to reach the speeds they needed to activate its automatic safety feature.

Static Line Capability

The ability to deploy the parachute in a static line configuration was another distinguishing feature between Army and Marine Corps parachute requirements. In addition to the RA-1's primary capability as a free fall parachute system, the Army had a requirement that the parachute have the capability of being deployed in a static line configuration. The static line configuration would provide personnel not qualified for free fall operations the ability to utilize the parachute under different mission conditions. In developing this capability, the Army noted that having the option to deploy the RA-1 in either a free fall or static line configuration would provide commanders with increased operational flexibility. Similarly, when the Marine Corps originally developed the need for its new parachute system, it included a requirement for a static line configuration that was ultimately removed. The Marine Corps determined that certain aircraft, such as the MV-22B Osprey, were not compatible with using static lines under high-altitude high-opening conditions. In making that determination, the Marine Corps noted it could still meet its needs for high-altitude high-opening operations without the static line and not requiring it would save resources.

Glide Ratios

The Army and the Marine Corps also had different glide ratio requirements for their parachutes. The Army's glide ratio requirement for the RA-1 was lower than the Marine Corps' glide ratio requirement for the PS-2. In a 2018 report to Congress, the Marine Corps cited glide ratio, along with the lack of a drogue parachute, when describing why the RA-1 parachute system did not meet its needs.⁸ The Marine Corps developed its glide ratio requirement after researching advancements in parachute capabilities and design that had occurred after the Army's requirements were set. The requirement also reflected the need, known as standoff range, to be able to deploy parachutists further away from enemy air defenses. The Army's requirements document for the RA-1 stated that it has a similar need to increase standoff range in the future.

⁸Department of the Navy, United States Marine Corps, *Report to Congress on the Enhanced Multi-Mission Parachute System* (Washington, D.C.: Mar. 14, 2018).

Despite the differences in glide ratio requirements, neither the Army nor Marine Corps officials we interviewed believed those differences would negatively affect interoperability—the ability for the Army and Marine Corps to conduct joint free fall operations. For example, Marine Corps officials stated that while the Army and Marine Corps would rarely conduct joint free fall parachute operations due to the differences in their missions, their respective parachutes’ glide ratios would not hinder the potential ability to conduct these operations if they needed to do so. Any potential issues related to the different capabilities of the parachutes could also be addressed through the joint operational planning that would occur before such missions.

Testing Strategies

The Army and Marine Corps relied on different testing strategies for the RA-1 and PS-2 parachute systems. The Army’s RA-1 program’s test strategy included both developmental testing and operational testing, while the Marine Corps’ PS-2 program subsequently relied solely on first article testing.⁹ As shown in table 1, the Army’s testing for the RA-1 took place over a longer period and had higher associated costs than the Marine Corps’ subsequent testing for the PS-2.

Table 1: Army’s RA-1 and Marine Corps’ PS-2 Parachute Testing Strategies

Parachute system	Type of testing conducted	Testing dates	Number and type of parachute jumps	Estimated testing costs
Army’s RA-1	Developmental testing	December 2011 – July 2012	166 free fall 103 static line	\$1,000,000
Army’s RA-1	Operational testing	January 2013 – March 2013	280 free fall 181 static line	\$500,000
Marine Corps’ PS-2	First article testing	May 2018 – December 2018	692 free fall	\$800,000

Source: GAO analysis of RA-1 and PS-2 acquisition program documents. | GAO-20-524

The Army’s RA-1 test strategy was typical for a program entering the acquisition process in the development phase, even though the RA-1 was an existing system that required only minor modifications. According to Army test documents, the program utilized developmental testing to evaluate the RA-1’s ability to meet operational requirements, its flight performance characteristics, and its readiness for operational testing. The Army conducted the developmental testing with 30 parachute systems

⁹First article testing is a means of testing and evaluating initial deliveries to determine if a product meets contract requirements before or in the initial stages of production.

purchased from the prime contractor. In addition, the contractor provided on-site support for the testing at the government's expense.

Upon the successful completion of developmental testing in July 2012, the Army moved on to operational testing to assess the RA-1's suitability and effectiveness under realistic operational conditions. The Army purchased 30 more RA-1 parachute systems from the prime contractor for this testing. Operational testing was planned, executed, and reported on by the U.S. Army Operational Test Command—the Army's independent operational test organization. In contrast to developmental testing, operational testing is conducted entirely by operational users, such as U.S. Army Special Forces.

The Marine Corps' reliance on first article testing reflected its assessment that the developmental effort, including testing, typically associated with a new parachute system was not required for the PS-2. According to program officials, their market research showed that vendors already had parachute systems capable of meeting Marine Corps requirements. As a result, the Marine Corps determined that it would not need to conduct its own developmental testing. In addition, due to the PS-2's design similarity to the predecessor parachute system and its status as an abbreviated acquisition program, the Marine Corps Operational Test and Evaluation Activity—its independent operational test organization—agreed that operational testing for the PS-2 was not required.

The Marine Corps instead used first article testing to assess the technical and operational suitability of initial production deliveries, as well as to verify the parachute's design and manufacturing process. The Marine Corps conducted the testing with a combination of government and contractor test resources over a 7-month period and invited the independent operational test agency to attend. The Marine Corps' PS-2 contract required the prime contractor to provide 44 parachute systems for first article testing. The contractor subsequently refurbished the parachutes that were not destroyed and delivered them to the Marine Corps as part of its initial parachute order. The contractor also stated that it provided aircraft and on site assistance to facilitate the testing, which saved Marine Corps resources. In contrast to operational testing, the parachutists involved in the first article tests included contractor personnel, as well as Marine Corps operational users.

Industrial Base Considerations

The Army and the Marine Corps both assessed the parachute industrial base as part of their acquisition planning. The Army's strategy differed though because it took additional steps to promote long-term competition for its parachute orders. In conducting their market research, the Army and Marine Corps solicited information from industry and concluded that there were parachute manufacturers capable of meeting their performance requirements and production needs. They each identified the same three parachute manufacturers, with the Marine Corps identifying a fourth potential vendor as well. When the Army and Marine Corps awarded their initial production contracts for the RA-1 parachute system and the PS-2, they received bids from six and two contractors, respectively.

The Army's parachute acquisition strategy differed from the Marine Corps' because its contract included the option to purchase technical data rights. Specifically, the Army contract included the option to procure government purpose rights for technical data required to solicit and procure any future follow on production and sustainment parachute systems on the basis of full and open competition.¹⁰ Army officials stated they included this option to maintain configuration control over the design of the system and foster long-term competition. In this case, the technical data included drawings and any items, components, or processes that were developed exclusively at the contractor's expense and were necessary to competitively re-procure the RA-1. We have previously reported that a long-standing factor affecting DOD's competition rate for contracts is its reliance on an original equipment manufacturer throughout the life cycle of a program.¹¹ As we have reported, this reliance is often because of a previous determination that purchasing technical data would not be cost effective. Without the necessary technical data rights, it can be difficult for a program to make competitive awards later in the acquisition cycle. In situations such as these, where the development of the technologies is completed wholly at private expense, the government must determine if

¹⁰Government purpose rights enable the government to use, modify, reproduce, release, perform, display, or disclose technical data within the government without restriction, and to release or disclose technical data outside the government and authorize persons to whom release or disclosure has been made to use, modify, reproduce, release, perform, display, or disclose that data for government purposes. See Defense Federal Acquisition Regulation Supplement § 252.227-7013(a)(13).

¹¹GAO, *Defense Contracting: Actions Needed to Increase Competition*, [GAO-13-325](#) (Washington, D.C.: Mar. 28, 2013).

the potential benefits of future competition outweigh the cost of purchasing the data. The government cannot share one contractor's technical data with another contractor, unless the appropriate data rights have been acquired to do so. Marine Corps officials stated that the limited size and scope of the PS-2 parachute program did not warrant the investment for purchasing the parachute's technical data rights. The officials noted that they focused their limited resources on procuring the parachutes they needed under the existing program.

The Army purchased the technical data rights for the RA-1 parachute in two steps. First, in March 2013, the Army purchased certain technical data it needed to maintain configuration control over the design of the system for \$270,000 through a modification to its initial RA-1 production contract. Next, in May 2014, the Army exercised the option in that contract to acquire the data rights necessary to conduct future competitions. In accordance with the modified contract, the Army acquired the rights necessary to use the technical data for future competitions at no cost when 2,501 parachute systems were procured from that contract. In addition to supporting opportunities for competition, Army officials stated that qualifying additional suppliers is a way to mitigate risk if a supplier goes out of business or leaves the market.

Army and Marine Corps Used Similar Contracting Approaches That Reflected Their Acquisitions' Low Risk

The Army and the Marine Corps both used indefinite delivery, firm-fixed-price contracts for their acquisition programs because they considered the parachutes to be readily available non-developmental items that could meet their needs at a low risk.¹² According to the Federal Acquisition Regulation, firm-fixed-price contracts are suitable for acquiring commercial items or other supplies and services—in this case, parachutes—on the basis of reasonably defined functional or detailed specifications such that the contracting officer can establish fair and reasonable prices at the outset.¹³ This type of contract provides for a price that is not subject to any adjustment on the basis of the contractor's cost

¹²The contracts used by the Army and Marine Corps were both indefinite delivery contracts with firm-fixed-price unit pricing. According to the Federal Acquisition Regulation, indefinite delivery contracts may be used to acquire supplies and/or services when the exact times and/or exact quantities of future deliveries are not known at the time of contract award. See Federal Acquisition Regulation § 16.501-2(a).

¹³Federal Acquisition Regulation § 16.202-2.

in completing the contract, which limits the risk of cost increases for the government.

Firm-fixed-price contracts are appropriate for non-developmental items as they require only minor modifications from items found in the commercial marketplace in order to meet the needs of an organization. According to the Army and Marine Corps' acquisition strategies, pursuing parachutes with non-developmental designs provided several other benefits, including low technical risk and the ability to leverage existing contractor parachute data. These data included extensive usage history and testing analyses demonstrating the parachutes' capabilities. Table 2 provides additional information related to the contracts for the RA-1 and PS-2 parachute programs and similarities in their contracting approaches.

Table 2: Army’s RA-1 and Marine Corps’ PS-2 Parachute Procurement Contract Details and Similarities

Parachute system	Competition type and number of offerors	Contract type ^a	Duration of ordering periods	Dates of ordering periods	Total contract value, including all options
Army’s RA-1	Full and open competition Six offerors	Firm-fixed-price, requirements ^b	1 base ordering period, 1 optional ordering period (5 years total)	Base: September 2011 – June 2013 Option: June 2013 – September 2016	\$38.4 million
Army’s RA-1	Full and open competition One offeror	Firm-fixed-price, Indefinite delivery, indefinite quantity ^c	5 ordering periods (5 years total)	June 2016 – June 2021	Up to \$99 million
Marine Corps’ PS-2	Full and open competition Two offerors	Firm-fixed-price, Indefinite delivery, indefinite quantity	5 ordering periods (5 years total)	January 2018 – January 2023	Up to \$26.7 million

Source: GAO analysis of RA-1 and PS-2 contract documents and federal procurement data. | GAO-20-524

^aRequirements and indefinite quantity contracts are types of indefinite delivery contracts.

^bA requirements contract provides for filling all actual purchase requirements of designated government activities for supplies or services during a specified contract period (from one contractor), with deliveries or performance to be scheduled by placing orders with the contractor. A requirements contract may be appropriate for acquiring any supplies or services when the government anticipates recurring requirements but cannot predetermine the precise quantities of supplies or services that designated government activities will need during a definite period. See Federal Acquisition Regulation § 16.503(a) - (b).

^cAn indefinite quantity contract provides for an indefinite quantity, within stated limits, of supplies or services during a fixed period. The government places orders for individual requirements, and quantity limits may be stated as number of units or as dollar values. Contracting officers may use an indefinite-quantity contract when the government cannot predetermine, above a specified minimum, the precise quantities of supplies or services that the government will require during the contract period, and it is inadvisable for the government to commit itself for more than a minimum quantity. See Federal Acquisition Regulation § 16.504(a) - (b).

In addition to using similar contract types, the Army and Marine Corps both evaluated competitors’ parachutes to ensure they met their needs prior to their procurement contract awards. The Army and Marine Corps used these evaluations to help confirm that the parachutes being offered were in fact low-risk non-developmental items.

The Army’s acquisition strategy included several steps to evaluate competitors’ parachutes before awarding the RA-1 contract. The strategy stated the Army would solicit proposals from vendors that were to include data on parachute testing, price, and past performance, among other things. After evaluating the data, the Army purchased four types of parachutes from three vendors to conduct a process called design validation. The Army used this process to determine whether the candidate parachute systems were capable of meeting their requirements.

Similarly, as part of the Marine Corps' PS-2 contract award process, two vendors loaned parachute systems to the program so it could evaluate their ability to meet performance requirements. The Marine Corps used the parachutes to conduct free fall operations under conditions such as day and nighttime operations, personnel of different weights, and various configurations including weapons and combat equipment. The Army and the Marine Corps ultimately awarded separate contracts for their different parachute systems to the same vendor.

Army and Marine Corps Are Meeting Current Cost, Schedule, and Performance Goals

The Army and the Marine Corps are meeting the current acquisition goals for their free fall parachute programs as of the end of fiscal year 2019. The Army revised the cost goals for the RA-1 program upward in 2013 when it added to the number of parachutes it planned to buy, but costs have remained stable since then. The Marine Corps' PS-2 program is meeting its goals and has largely addressed a budget shortfall, which will enable it to buy nearly all of its planned parachutes.

Army Continues to Meet Goals as Program Nears Completion

The Army is meeting its current cost, schedule, and performance goals for the RA-1 program as it approaches completion.

Cost. The cost of the RA-1 program has been generally stable since 2013 when the Army updated the acquisition program baseline to reflect an increase in planned quantities. The Army's 2011 baseline set its procurement cost goal at \$59 million for 3,259 parachutes. In 2013, the Army revised its procurement cost goal to almost \$68 million when it increased the number of parachutes it planned to buy by over 2,000. Army officials stated that the quantity increase was due to changes in force structure, with corresponding increases in both the number of Army units and personnel utilizing the RA-1 parachute. The program's research, development, test, and evaluation costs also increased after the initial baseline but subsequently remained stable. Army program officials stated the program utilizes its research and development funds to evaluate potential areas for RA-1 modernization, evaluate safety and long-term maintenance issues, and develop potential solutions to those

issues to mitigate risk. Army officials stated that they expect the program to remain within its current cost goals through its completion. Table 3 shows the changes in the RA-1 baseline costs and quantities over time.

Table 3: Army RA-1 Parachute Program Baseline Costs and Quantities

Dollars in millions

Baseline estimate	Estimated research, development, test and evaluation costs	Estimated procurement costs	Estimated total acquisition cost	Estimated total parachute quantities
Original baseline (2011)	\$4.7	\$59.3	\$64.0	3,319
Production baseline (2013)	\$5.5	\$67.6	\$73.1	5,395
Current baseline (2018)	\$5.5	\$67.8	\$73.3	5,515

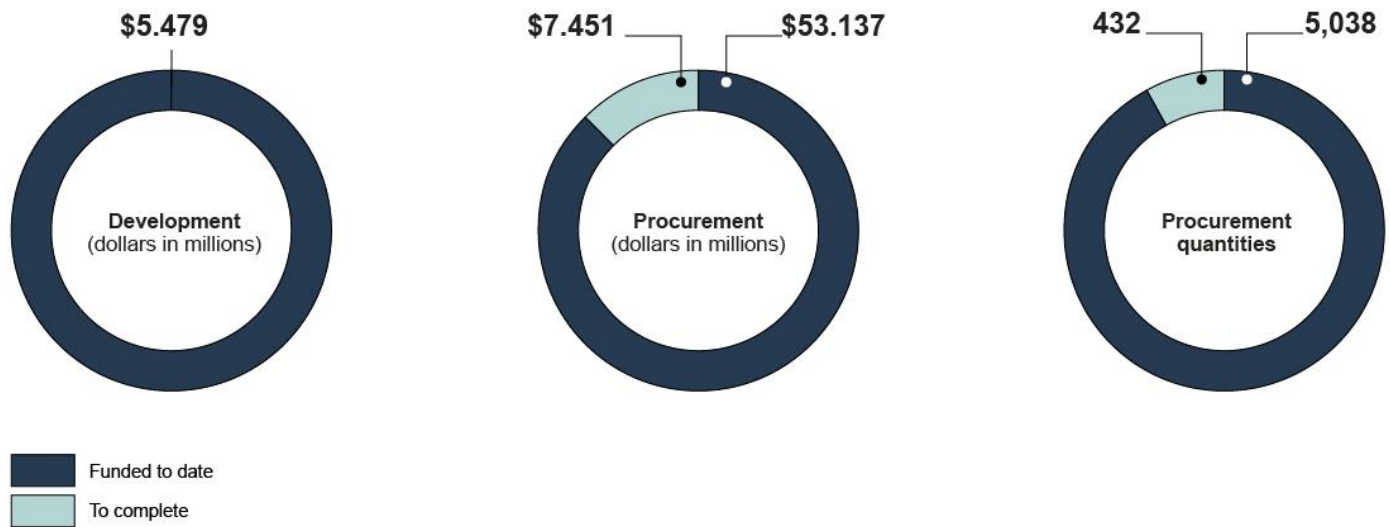
Source: Army RA-1 acquisition program baselines. | GAO-20-524

Note: Procurement costs include those for parachutes systems, support items, and initial spares. The total acquisition costs are the sum of the procurement costs and the research, development, test, and evaluation costs. The total parachute quantities reflect those associated with the total acquisition cost.

Army officials stated that program costs should remain within the current baseline, even though the amount the Army pays for the parachutes has gone up. In going from the first RA-1 production contract in 2011 to the second one in 2016, the price of the parachute system increased by 38 to 61 percent, depending on the number of parachutes ordered. Army officials attributed the increase to the contractor’s pricing strategy.

Schedule. The Army’s RA-1 program has met its baseline schedule goals and is approaching the completion of fielding parachutes to operational units. According to program documentation, the Army met key milestone dates for the start of production, completion of operational testing, and equipping its first unit with parachutes as stated in the program’s baseline. The program reported equipping its first unit with RA-1 parachutes in 2014, 6 months earlier than planned. According to the RA-1 program office, the Army is scheduled to complete parachute fielding by the end of fiscal year 2022. The program has received almost 89 percent of its total funding and purchased 92 percent of the planned parachutes. Figure 3 shows the remaining funding the RA-1 program needs and parachute quantities that it plans to buy before its completion.

Figure 3: RA-1 Parachute Program Planned Funding and Quantities through Fiscal Year 2019 and to Completion



Source: GAO analysis of Army data. | GAO-20-524

According to RA-1 program officials, the Army will continue to buy additional RA-1 parachutes as systems reach the end of their service life, which is 12 years. The Army plans to award future procurement contracts to qualified suppliers through full and open competition.

Performance. The RA-1 parachute has met all of the key performance requirements contained in the program’s baseline and requirements documents. The Army’s testing results showed that the RA-1 was reliable and capable for both high-altitude high-opening and high-altitude low-opening free fall operations and operations in its static line configuration. Testing also showed the capability of the RA-1 to support the weight of a soldier with gear up to 450 pounds—an improvement over the prior system’s capability of 360 pounds.

The Army encountered a limitation, however, during operational testing regarding the altitude requirement. Weather conditions and aircraft limitations allowed the testing of the RA-1 only up to 12,500 feet rather than the threshold altitude of 25,000 feet. Because program officials were able to test the RA-1 at the higher altitude during prior developmental testing with no incidents, the Army’s operational test command considered this limitation to be low risk and considered the RA-1 capable of performing at the higher altitude.

According to Army data and officials, the RA-1 parachute system has been safe to operate. The RA-1 did not present any potential safety or

health hazards to jumpers during the live jumps conducted in operational testing. Since putting the RA-1 parachute into service in 2015, Army officials stated that there have been two fatalities, one each in 2019 and 2020, and 14 injuries in over 100,000 jumps. The officials also stated that they did not attribute the fatalities or injuries to any issues with the functionality of the RA-1 parachute system itself.

While the RA-1 parachute system meets the Army’s performance goals, Army officials stated they have continued to explore ways to improve the design and performance of the system. Following operational testing, the prime contractor made minor changes to the RA-1’s harness, such as making adjustments to the positioning of the chest straps and leg pads to increase comfort and function. Army officials stated that these changes did not significantly affect the RA-1’s cost, design, or production schedule. In January 2020, the Army issued a request for information on potential improvements to the RA-1 so that it can be utilized above 25,000 feet.

Marine Corps Is Currently Meeting Its Goals

The Marine Corps is currently meeting its cost, schedule, and performance goals for the PS-2 program and has largely resolved a budget shortfall, which will enable it to buy nearly all of its planned parachutes.

Cost. The cost of the PS-2 program has been stable since the Marine Corps approved its original program baseline in 2018 (see table 4).

Table 4: Marine Corps PS-2 Program Baseline Costs and Quantities

Dollars in millions

Baseline estimate	Estimated research, development, test and evaluation costs	Estimated procurement costs	Estimated total acquisition cost	Estimated parachute quantities
Original and current baseline (2018)	\$1.3	\$25.1	\$26.4	1,096

Source: Marine Corps PS-2 acquisition program baseline. | GAO-20-524

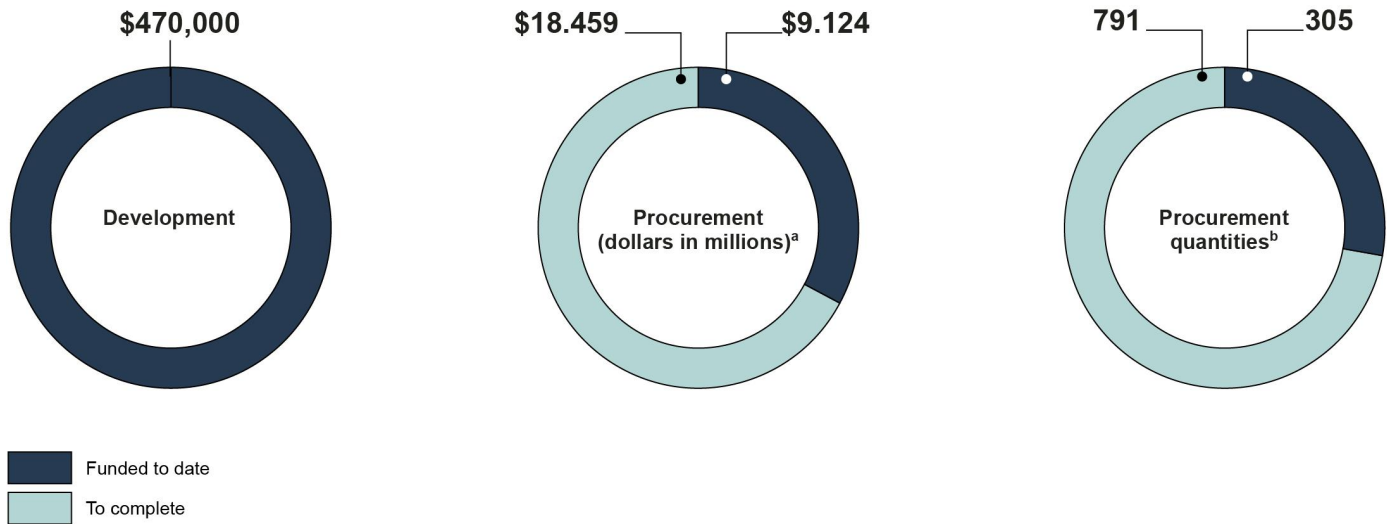
Note: Procurement costs include those for parachute systems, support items, and initial spares. The total acquisition costs are the sum of the procurement costs and the research, development, test, and evaluation costs.

According to the 2018 acquisition program baseline, the Marine Corps' funding plan at the time left the program with a \$1.4 million shortfall in its budget and included only enough funding for the program to buy 94 percent, or 1,029 of its planned 1,096 parachutes. According to the PS-2 program office, its current funding plan includes enough funding in the budget to buy 1,078 parachutes. Program officials noted that they are still seeking funding to procure the remaining 18 parachutes. These remaining parachutes, if purchased under the current contract between 2020 and 2023, would cost the Marine Corps between \$389,322 and \$421,110.

In addition to the planned funding needed for the remaining parachutes, timing is also important. The program's current funding plan includes parachute purchases through fiscal year 2025. If program officials do not purchase the parachutes prior to the conclusion of the current contract in 2023, they noted that they would have to negotiate and award a second contract to buy the remaining parachutes. When the Army needed to award a second contract to the same vendor for the RA-1 parachute, the price of the parachute went up by 38 to 61 percent, depending on the number of parachutes ordered. PS-2 program officials stated they are continuing to work within the Marine Corps to identify funds to buy the remaining systems under the existing contract.

Schedule. The Marine Corps' PS-2 program met the schedule goals in its baseline and began fielding the parachute system earlier than planned. The Marine Corps established the baseline for the PS-2 program after its production decision in 2018, and it included one future milestone, initial operating capability, with a goal of October 2021. The Marine Corps defined initial operating capability as fielding 25 parachutes to one reconnaissance battalion. Program officials stated they achieved this milestone in December 2019, almost 2 years earlier than the threshold in its baseline. Program officials anticipated reaching full operational capability, which generally occurs when all units scheduled to receive a system have received it and have the ability to employ and maintain it, in fiscal year 2025. The program is still in its early stages, having received only 34 percent of its total funding and purchased 28 percent of the planned number of parachutes. Figure 4 shows the planned funding for the PS-2 program in future years and parachute quantities it plans to buy before its completion.

Figure 4: PS-2 Program Planned Funding and Quantities through Fiscal Year 2019 and to Completion



Source: GAO analysis of Marine Corps data. | GAO-20-524

^aProcurement funding is not exclusively for the PS-2 program. It covers multiple, related low-dollar acquisition programs to include low-level parachutes, tandem parachutes, parachutist's oxygen equipment, altimeters, and other personnel parachute related equipment.

^bProcurement quantities reflect the total number of parachutes the Marine Corps plans to purchase. The PS-2 program currently lacks the funding to buy 18 of the remaining 791 systems.

Performance. The PS-2 parachute has met all of the performance requirements contained in the program's baseline and requirements documents. The Marine Corps' testing results showed that the PS-2 parachute was reliable and capable of performing high-altitude high-open and high-altitude low-open parachute operations. The PS-2 parachute also demonstrated its glide ratio and an ability to carry the parachutist farther distances than required. Similar to the Army, the Marine Corps had some limitations related to testing at higher altitudes, but it was able to demonstrate that the parachute performed at its threshold altitude of 24,999 feet. Finally, according to Marine Corps data, the parachute has been shown to be safe to operate. The Marine Corps reported that the PS-2 was rigorously tested for safety during first article testing and met requirements. Since putting the PS-2 parachute into service in 2019, Marine Corps officials stated that there have been no injuries or fatalities in 157 jumps nor do they have any safety concerns at this time.

While the PS-2 met the Marine Corps' performance goals, the contractor has made minor changes to improve the design of the system. During testing with the reserve parachute, both the reserve and main canopies mistakenly deployed due to the movement of the drogue release cable

within the parachute container. As a result, the contractor incorporated additional stitching into the design to restrict the movement of the drogue release cable. The program reported that this change did not significantly affect the PS-2 parachute's cost, design, or production schedule. According to Marine Corps officials, they are not currently planning any performance improvement efforts for the PS-2.

Agency Comments

We provided a draft of this report to DOD for review and comment. DOD stated that they had no comments on the draft report.

We are sending copies of this report to the appropriate congressional committees, the Secretary of the Department of Defense, the Secretary of the Department of the Army, the Commandant of the Marine Corps, and other interested parties. In addition, the report is available at no charge on the GAO website at <https://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or DiNapoliT@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix I.



Timothy J. DiNapoli
Director, Contracting and National Security Acquisitions

Appendix I: GAO Contact and Staff Acknowledgments

GAO Contact

Timothy J. DiNapoli, (202) 512-4841 or DiNapoliT@gao.gov

Staff Acknowledgments

In addition to the contact above, the following staff members made key contributions to this report: Ron Schwenn, Assistant Director; Stephen V. Marchesani, Analyst-in-Charge; Bridget Jackson; Peter Nguyen; Stephanie Gustafson; Robin Wilson; Vinayak Balasubramanian; Alyssa Weir; Kurt Gurka; Gina Hoover; and Laura Holliday.

Appendix II: Accessible Data

Data Tables

Accessible Data for Figure 3: RA-1 Parachute Program Planned Funding and Quantities through Fiscal Year 2019 and to Completion

Category (dollars in millions)	Funded to date	To complete
Development	5.479	0.00
Procurement	53.137	7.451
Procurement quantities	5038	432

Appendix II: Accessible Data

Accessible Data for Figure 4: PS-2 Program Planned Funding and Quantities through Fiscal Year 2019 and to Completion

Category (dollars in millions)	Funded to date	To complete
Development(dollars in millions)	470,000.00	0.00
^a Procurement(dollars)	9,124,104.00	18,459,262.00
^b Procurement quantities	305	791

GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through our website. Each weekday afternoon, GAO posts on its [website](#) newly released reports, testimony, and correspondence. You can also [subscribe](#) to GAO's email updates to receive notification of newly posted products.

Order by Phone

The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's website, <https://www.gao.gov/ordering.htm>.

Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537.

Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.

Connect with GAO

Connect with GAO on [Facebook](#), [Flickr](#), [Twitter](#), and [YouTube](#).

Subscribe to our [RSS Feeds](#) or [Email Updates](#). Listen to our [Podcasts](#).

Visit GAO on the web at <https://www.gao.gov>.

To Report Fraud, Waste, and Abuse in Federal Programs

Contact FraudNet:

Website: <https://www.gao.gov/fraudnet/fraudnet.htm>

Automated answering system: (800) 424-5454 or (202) 512-7700

Congressional Relations

Orice Williams Brown, Managing Director, WilliamsO@gao.gov, (202) 512-4400,
U.S. Government Accountability Office, 441 G Street NW, Room 7125,
Washington, DC 20548

Public Affairs

Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800
U.S. Government Accountability Office, 441 G Street NW, Room 7149
Washington, DC 20548

Strategic Planning and External Liaison

James-Christian Blockwood, Managing Director, spel@gao.gov, (202) 512-4707
U.S. Government Accountability Office, 441 G Street NW, Room 7814,
Washington, DC 20548

