NASA
Office of Inspector General

NASA's Acquisition of Next-Generation Spacesuit Services

April 20, 2026

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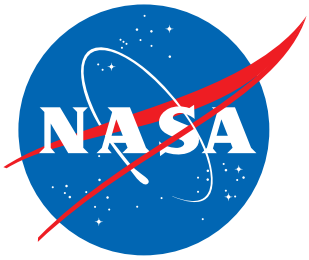

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RESULTS IN BRIEF

NASA's Acquisition of Next-Generation Spacesuit Services

April 20, 2026 IG-26-006 (A-24-14-01-HED)

WHY WE PERFORMED THIS AUDIT

Spacesuits are critical to NASA's operations in microgravity on the International Space Station (ISS) as well as its broader goals of returning humans to the Moon through the Artemis campaign and sending the first crew to Mars. Astronauts wear spacesuits as protection from the harsh environment of space when exploring outside of a spacecraft—activities known as spacewalks. However, the Extravehicular Mobility Unit spacesuits that astronauts use on the ISS were designed over 50 years ago, have not undergone a major redesign in the last 20 years, and carry significant safety risks. Further, for Artemis missions on the lunar surface, astronauts will require an entirely new spacesuit with expanded capabilities. After several in-house and contractor-supported efforts failed to complete a flight-ready spacesuit, in May 2022, NASA awarded Exploration Extravehicular Activity Services (xEVAS) contracts to two providers—Axiom Space (Axiom) and Collins Aerospace (Collins)—to allow them to compete to provide next-generation spacesuits for use in microgravity on the ISS, on the lunar surface during Artemis missions, and during future space flight missions.

Under xEVAS, NASA will purchase spacewalking services, essentially renting the spacesuits from the providers, following an initial demonstration of the lunar suit during an Artemis lunar landing mission and the microgravity suit on the ISS. These firm-fixed-price, indefinite-delivery, indefinite-quantity, milestone-based contracts have a current combined maximum value of $3.1 billion and allow the providers to compete for task orders for missions to provide the full scope of NASA's spacewalking needs. NASA selected two providers in order to promote competition and ensure redundancy. However, in June 2024, NASA and Collins mutually agreed to descope the company's xEVAS task orders citing an inability to meet the agreed-upon schedule, leaving NASA reliant on Axiom as the single provider.

In this audit we examined NASA's management of next-generation spacesuits for the ISS Program and Artemis campaign. Specifically, we examined (1) the extent to which NASA is meeting its cost, schedule, and performance goals for the xEVAS effort and (2) whether NASA's service-based acquisition strategy for xEVAS addresses the requirements of the ISS Program and Artemis campaign. To complete this audit, we performed work at NASA Headquarters and Johnson Space Center and interviewed officials from NASA and various contractors. We also issued an anonymous survey to over 70 individuals from NASA and industry involved in spacesuit development, maintenance, management, or use to gain a wider perspective of the status, challenges, and risks associated with the xEVAS effort.

WHAT WE FOUND

NASA faces challenges in ensuring next-generation spacesuits are available to meet the Agency's current schedules for the Artemis lunar landing mission in 2028 and prior to the ISS's decommissioning in 2030. NASA's original schedules to demonstrate the lunar and microgravity spacesuits in 2025 and 2026, respectively, were overly optimistic and ultimately proved unachievable, as evidenced by delays of at least a year and a half for both spacesuits. Based on our analysis, if Axiom experiences design and testing delays in line with the historical average for recent space flight programs, the Artemis and ISS demonstrations may not occur until 2031.

NASA's choice to use a firm-fixed-price, service-based acquisition strategy for xEVAS aligns with the Agency's strategic decision to shift the risk of cost overruns to the contractor, as well as help foster a commercial space economy. However, in this case, the firm-fixed-price contract approach conflicted with the developmental nature of next-generation spacesuits, which carry higher levels of technical, financial, and schedule risk. Further, NASA's attempt to replicate other space flight service-based acquisitions by "renting" spacewalking services from a provider was risky because there was no commercial market for spacesuits prior to the xEVAS effort. Moreover, overly burdensome requirements like requiring offerors to bid on both microgravity and lunar spacesuits further constrained an already limited pool of applicants that were capable of and interested in developing new suits. In our judgment, while firm-fixed-price and service-based contracts can be viable options for certain NASA procurements, applying that approach to a developmental effort like xEVAS introduced its own set of risks to achieving NASA's goals.

Following the awards to Axiom and Collins, NASA took risky contract management actions—with mixed results—to promote competition between the providers and ensure spacesuit redundancy. NASA sole-sourced a task order to Collins, approved partial milestone payments to Axiom and Collins, and awarded "cross-over" task orders to both providers. Despite NASA's efforts to retain both providers, Collins' inability to meet its contractual requirements led to the mutual decision to descope its task orders from the contract just 2 years after the contract was awarded. Collins' descope from xEVAS negated the competition and redundancy sought by the Agency, leaving NASA with only one xEVAS spacesuit provider.

To ensure Axiom's success in developing both the microgravity and lunar spacesuits, NASA is taking proactive risk mitigation measures by identifying potential supply chain issues, increasing the amount of spacesuit testing, and leveraging additional government collaboration. However, if Axiom cannot satisfy its contractual requirements in a timely or cost-effective manner, then NASA could be forced to continue using the problematic EMUs throughout the life of the ISS and significantly adjust its lunar plans. While the xEVAS contracts include a clause that allows other contractors to submit proposals at any time, NASA officials do not believe that adding another provider at this time would help the Agency achieve its immediate ISS and Artemis goals. Regardless, we identified multiple companies that are developing capabilities that could reintroduce competition for NASA's spacewalking needs in the longer-term.

Moving forward, if the Agency seeks additional providers, it must apply the appropriate lessons learned from the xEVAS procurement, as well as contend with spacesuit compatibility concerns, and adjust its strategy accordingly. A more suitable acquisition strategy can help NASA attract the investment necessary to move toward a more robust commercial space economy.

WHAT WE RECOMMENDED

To improve management of the Agency's next-generation spacesuits, we recommended the Associate Administrator for Exploration Systems Development Mission Directorate (1) seek industry input on current xEVAS contract requirements to maintain competition as needed in the future and (2) develop a plan to establish interoperability standards between Artemis lunar vehicles and spacesuits.

We provided a draft of this report to NASA management who concurred with our recommendations and described planned actions to address them. We consider management's comments responsive; therefore, the recommendations are resolved and will be closed upon completion and verification of the proposed corrective actions.

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TABLE OF CONTENTS

Acronyms

BAA	Broad Agency Announcement
EHP	Extravehicular Activity and Human Surface Mobility Program
EMU	Extravehicular Mobility Unit
EVA	extravehicular activity
FAR	Federal Acquisition Regulation
ISS	International Space Station
OIG	Office of Inspector General
SAA	Space Act Agreement
xEMU	Exploration Extravehicular Mobility Unit
xEVAS	Exploration Extravehicular Activity Services

INTRODUCTION

Spacesuits are critical to NASA's operations on the International Space Station (ISS or Station)—the world's preeminent orbiting microgravity research and development laboratory—as well as the Agency's broader goals of returning humans to the Moon through the Artemis campaign and sending the first crew to Mars. For ISS spacewalks, astronauts use the Extravehicular Mobility Unit (EMU) spacesuit that was designed over 50 years ago for the Space Shuttle Program and faces significant safety risks. For Artemis missions on the lunar surface, astronauts will require an entirely new spacesuit with expanded capabilities to safely explore the South Pole of the Moon. Despite nearly two decades of effort, NASA has not completed an upgraded flight-ready suit to accommodate its ISS or Artemis needs.

In 2021, the Agency shifted its strategy from designing and building spacesuits in-house to purchasing spacesuit services from commercial providers. To this end, in 2022, NASA awarded two Exploration Extravehicular Activity Services (xEVAS) contracts—firm-fixed-price, service-based contracts with a current combined maximum value of $3.1 billion—to teams led by Axiom Space (Axiom) and Collins Aerospace (Collins). NASA selected two providers in order to promote competition and ensure spacesuit redundancy. However, in 2024, the Agency and Collins mutually agreed to remove the company's task orders citing an inability to meet the agreed-upon schedule, leaving NASA reliant on a single provider for next-generation spacesuits. Following this and other programmatic issues, NASA has been increasingly challenged to address immediate spacesuit needs for ISS operations through the Station's planned decommission in 2030 while ensuring readiness for the Artemis lunar surface mission in 2028.

In this audit we examined NASA's management of next-generation spacesuits for the ISS Program and Artemis campaign. Specifically, we examined (1) the extent to which NASA is meeting its cost, schedule, and performance goals for the xEVAS effort and (2) whether NASA's service-based acquisition strategy for xEVAS addresses the requirements of the ISS Program and Artemis campaign. Details about the audit's scope and methodology are outlined in Appendix A.

Background

Astronauts wear spacesuits as protection from the harsh environment of space when exploring outside of a spacecraft—activities known as extravehicular activities (EVA) or "spacewalks." Similar to a spacecraft, spacesuits provide all the functions necessary to support humans in space, such as life support, waste management, liquid cooling and ventilation, hydration, communications, and astronaut health monitoring. Spacesuits must be capable of performing a full range of expected mission objectives in varied environments. Spacesuit requirements vary for EVAs on the ISS, the lunar surface, and Mars, as each destination has different temperatures, radiation levels, pressures, mobility requirements, and exposure to dust and debris. For example, while operating in microgravity outside of the ISS does not require leg mobility, gathering geological samples on a planetary surface like the Moon does, resulting in different mobility requirements to achieve mission objectives.

Microgravity Spacesuits

Currently used in microgravity on the ISS, EMUs were developed in the 1970s by Hamilton Standard (later known as Collins Aerospace) and ILC Dover.[1] These spacesuits were first used on the sixth Space Shuttle mission in 1983.[2] Astronauts from the United States, Europe, Japan, and Canada rely on these suits to regularly conduct spacewalks outside the ISS for science experiments and to perform maintenance, repairs, and upgrades to the Station.[3] As of March 2026, astronauts have conducted 203 spacewalks on the ISS using the EMU.

The EMU is composed of two major subsystems: a pressure garment system and primary life support system. The pressure garment system protects the astronaut's body, provides mobility, and includes interchangeable components for arm and leg assemblies, gloves, boots, and the Hard Upper Torso. The primary life support system provides the astronaut's life support while performing a spacewalk. This backpack-like structure performs functions such as providing breathable air and battery power for the electrical functions, removing carbon dioxide and humidity, and maintaining the astronaut's body temperature. The primary life support system also includes a display and control module that helps the system operate and a second oxygen pack that provides astronauts 30 minutes of oxygen in the event of a system failure.

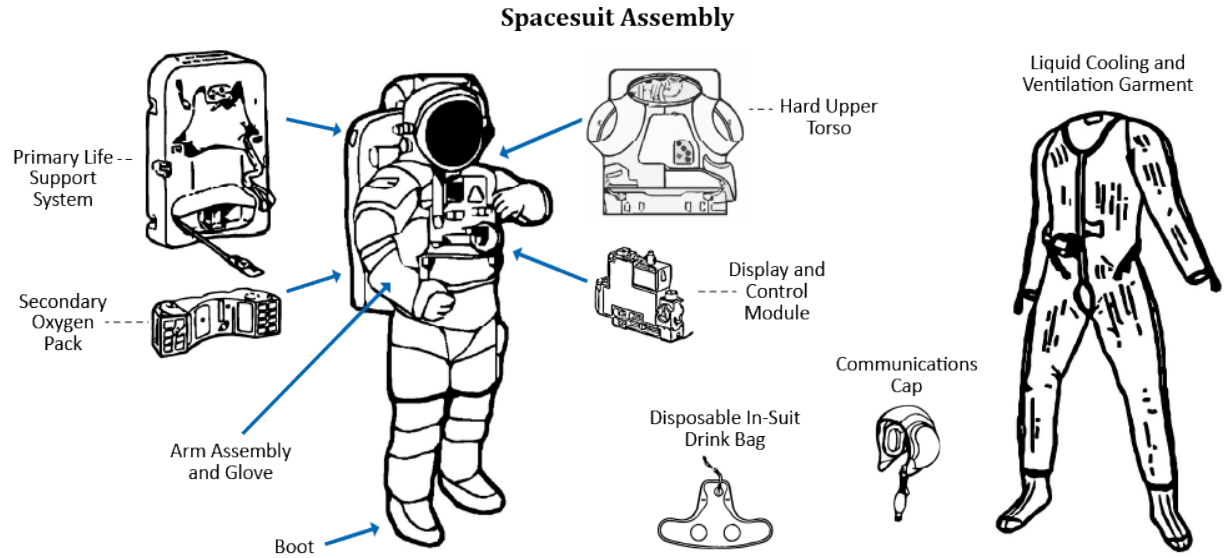
In addition, the EMU includes a liquid cooling and ventilation garment through which cool water flows to help regulate body temperature. Other primary components include the disposable in-suit drink bag and communications cap, which help the astronauts hydrate and communicate with ground control or other crewmembers. See Figure 1 for the primary components of the EMU.

[1] Microgravity refers to the condition of the environment on the ISS in which things appear to be weightless due to the Station being in a free fall state while orbiting Earth. Hamilton Standard and Sundstrand Corporation merged in 1999 to form Hamilton Sundstrand. After a 2012 merger, Hamilton Sundstrand became UTC Aerospace Systems, which later became Collins Aerospace following another merger.

[2] The Space Shuttle Program flew missions from 1981 to 2011 and consisted of reusable shuttles that carried crew and cargo to space and back to Earth.

[3] Cosmonauts use Russian-made Orlan spacesuits when conducting ISS spacewalks.

Figure 1: Primary Components of the EMU



Source: NASA.

While several improvements have been made to the EMU over the past three decades, the suit has not undergone a major redesign in the last 20 years. Design flaws with the EMU have led to water leaking into helmets, malfunctions with thermal regulation components that protect against overheating or extremely cool temperatures, and astronaut injuries. Furthermore, as we previously reported, replacing critical components on the EMU has grown increasingly difficult and costly due to the age of the suit's design and the performance of Collins, the prime contractor for EMU maintenance and operation.[4] Regardless, NASA plans to continue using the EMU until the ISS is decommissioned in 2030 or until upgraded replacements known as next-generation spacesuits are available.

[4] NASA Office of Inspector General (OIG), *NASA's Management of ISS Extravehicular Activity Spacesuits* (IG-25-012, September 30, 2025).

Lunar Spacesuits

Apollo spacesuits, first used on the Moon in 1969, were designed to operate with accessories specifically for lunar surface operations. For example, EVA gloves and lunar boots were designed to protect against the unique set of natural hazards encountered on the lunar surface—such as extreme temperatures, sharp rock formations, and abrasive dust—that can accelerate wear of soft goods. These spacesuits were not built for long-term durability and cannot be reused or refurbished for several reasons, including their custom fitted design, material degradation, and outdated technology.

NASA Astronaut Neil Armstrong's Apollo 11 Spacesuit

This preflight photograph shows Neil Armstrong's spacesuit in its lunar surface configuration, which includes the liquid cooling and ventilation garment to the left and the extravehicular gloves and lunar boots to the right. Neil Armstrong was the first human to set foot on the Moon as part of the July 1969 Apollo 11 mission.

Source: NASA.

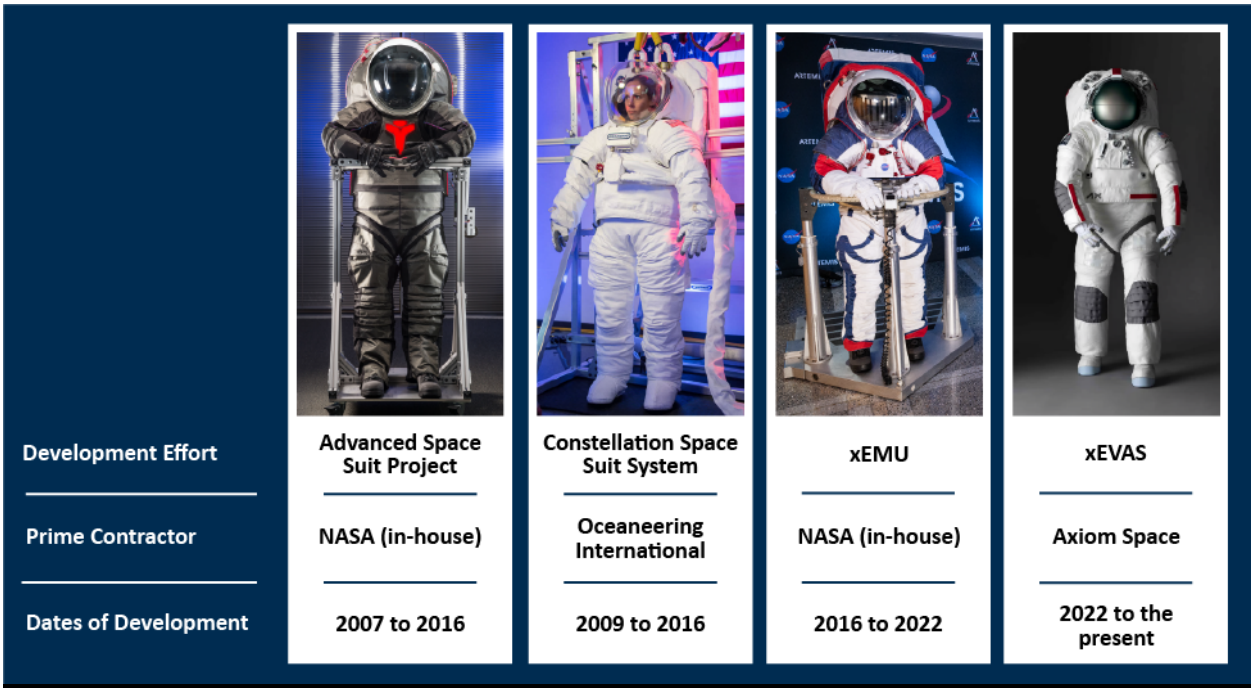
As such, NASA will require next-generation spacesuits for the Artemis campaign, which aims to return humans to the Moon and build a sustainable lunar presence prior to a crewed exploration of Mars.[5] During the Artemis lunar landing mission, currently planned for 2028, astronauts will use the new suits to explore the Moon's South Pole region, retrieve samples, and collect other data to meet scientific objectives. The new spacesuits will need to have the capability to interface with various Artemis systems to ensure communications and operational compatibility. For example, the suits will physically and operationally connect with the Human Landing System that will ferry astronauts to and from the lunar surface, and in later missions the Lunar Terrain Vehicle—an unpressurized rover that will transport crew and equipment further across the lunar surface for longer-duration EVAs.

Next-Generation Spacesuits

NASA's next-generation spacesuits will be built by commercial providers under the xEVAS contract to meet spacewalking capabilities for both the ISS and future Artemis missions. xEVAS is NASA's fourth effort since 2007 to obtain an upgraded spacesuit: (1) the Advanced Space Suit Project, (2) the Constellation Space Suit System, (3) the Exploration Extravehicular Mobility Unit (xEMU), and (4) the xEVAS effort (see Figure 2).

[5] In December 2022, NASA successfully completed Artemis I, which served as the first and only integrated uncrewed test flight of NASA's deep space exploration systems. These systems include the Space Launch System heavy-lift rocket, the Orion Multi-Purpose Crew Vehicle, and the facilities and ground systems needed to process and launch the rockets and spacecraft. In April 2026, Artemis II became the first crewed Artemis mission around the Moon.

Figure 2: NASA's Spacesuit Development Efforts from 2007 to the Present



Source: NASA Office of Inspector General (OIG) presentation of Agency images and information.

Efforts from the Advanced Space Suit Project and Constellation Space Suit System resulted in two pressure garment prototypes and a newly developed advanced portable life support system for testing; however, neither effort produced a flight-ready spacesuit. Then, in 2016, NASA decided to design, test, and produce a completely new next-generation spacesuit in-house, known as the xEMU, utilizing contractor and vendor support. Although NASA planned to build six suits and then issue a contract to produce additional suits, the Agency shifted its acquisition strategy in April 2021 to instead use a service-based contract approach, xEVAS, to support the design, initial production, and demonstration of a next-generation spacesuit. While xEVAS allows for multiple providers, as of March 2026, there is only one active provider, Axiom, which is developing its Axiom Extravehicular Activity system for both microgravity and the Moon.

The next-generation spacesuits developed under the xEVAS effort must function safely and efficiently in both microgravity and lunar environments. In addition to protecting the crew against treacherous terrain, extreme temperature fluctuations, and unique lighting conditions in an unexplored region of the Moon, the new spacesuits also need to provide enhanced mobility, improved communications capabilities, and advanced life support. The new upper torso will include enhancements to allow the astronauts to move, lift objects, and reach across their body more easily. The suit will also be designed with a mobile lower torso, which will allow the astronauts to walk and kneel more naturally on the lunar surface. With more advanced materials and joint bearings, the astronauts will be able to bend and rotate at the hips and bend at the knees. This eliminates the "bunny hopping" astronauts experienced during the Apollo missions. The new design will accommodate a broader range of sizes to improve the overall fit and comfort level.

The new suits will also be equipped with new technology, such as high-speed data communications, high-definition video, and integrated communications. This will not only allow for crew-to-crew communication but also provide astronauts with the ability to capture and transmit real-time

high-definition video to Earth. Further, this advanced suit will offer increased protection from the lunar surface. The lunar soil poses a high risk to the astronauts as the soil is composed of tiny glass-like shards that could enter the suit. To mitigate this risk, the suit will be equipped with dust-tolerant features to prevent the astronauts from inhaling the dust particles and prevent the particles from contaminating the suit's life support system.

Providers are also responsible for developing specialized tools—such as hammers, scoops, and tongs—to accomplish specific exploration and scientific needs. These tools will play an essential role in astronauts' ability to collect lunar samples while exploring the surface of the Moon.

A NASA Engineer Uses Tongs to Pick Up Geology Samples During Testing at Johnson Space Center

Source: NASA.

xEVAS Contracts

In May 2022, NASA awarded xEVAS contracts to two providers—Axiom and Collins—to allow them to compete to provide next-generation spacesuits for use in microgravity on the ISS, on the lunar surface during Artemis missions, and during other future missions. The xEVAS contracts are firm-fixed-price, indefinite-delivery, indefinite-quantity, milestone-based contracts with a current combined maximum value of $3.1 billion across both providers.[6] Unlike previous efforts, NASA will purchase a service—essentially renting the spacesuits—from the companies following an initial spacesuit demonstration.

This acquisition strategy was designed so that each provider could compete for task orders for missions to provide the spacewalking capabilities required by NASA. Task orders are generally organized into three categories: (1) the ISS, (2) Artemis missions, and (3) advanced capabilities for future missions (e.g., Mars).[7] Each category has separate task orders for the initial demonstration of the spacesuit, future recurring services, and mission-unique capabilities such as additional training or research. NASA can award task orders at any point during the life of the contract. In addition, while each provider is responsible for investing its own money into the development of the suit, each contract includes a guaranteed minimum order that NASA is required to meet—a dollar amount that varies per contract based on negotiations with NASA.[8] Providers are encouraged to explore non-NASA applications for their spacesuits to encourage a market for the technologies and help foster the commercial space economy.

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[6] A firm-fixed-price contract provides a price that is not subject to any adjustment based on the contractor's cost experience in performing the contract, placing maximum risk and full responsibility on the contractor for all costs and resulting profit or loss. Indefinite-delivery, indefinite-quantity contracts require the government to order and the contractor to furnish at least a stated minimum quantity of supplies or services during a fixed period. Milestone-based contracts include payments for the accomplishment of defined events.

[7] There is also a fourth category for task orders related to special studies, such as potential changes in requirements, material provision, and feasibility studies.

[8] Federal Acquisition Regulation (FAR) 16.504, *Indefinite-quantity contracts*, states an indefinite-quantity contract "must require the Government to order and the contractor to furnish at least a stated minimum quantity of supplies or services" and the minimum quantity "should not exceed the amount that the Government is fairly certain to order."

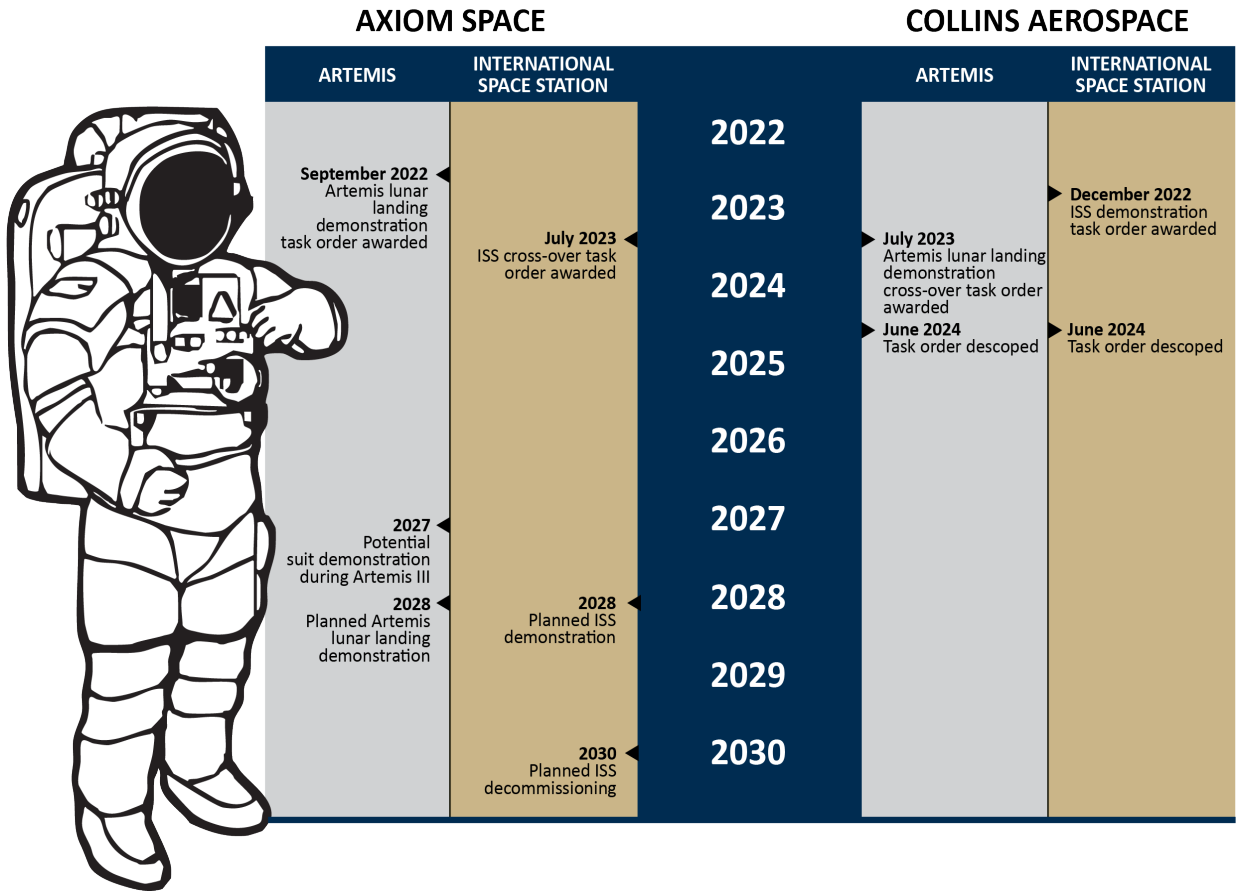
Through competition between Axiom and Collins, NASA awarded the first xEVAS task order to Axiom in September 2022, valued at $228 million, to develop and demonstrate its next-generation lunar spacesuit during the first Artemis lunar landing mission, then scheduled for November 2025.[9] Subsequently, in December 2022, NASA awarded Collins the second task order on a sole-source basis, valued at $97 million, for development through the Critical Design Review of its next-generation microgravity spacesuit to be demonstrated on the ISS by April 2026.[10] According to NASA, the second task order was awarded to Collins without competition to keep both companies active in suit development. Then, in June 2023, NASA awarded both Axiom and Collins "cross-over" task orders valued at $5 million each, which allowed each provider to pursue both microgravity and lunar spacesuits in parallel and serve as a backup in case the other company encountered significant issues on its primary task order.

However, in June 2024, NASA and Collins mutually agreed to descope—or remove—its task orders from its xEVAS contract after the provider determined its development timeline would not support the ISS demonstration schedule. As a result, Axiom is the only active provider of microgravity and lunar suits under xEVAS. Going forward, Axiom plans to demonstrate its microgravity spacesuit on the Station and its lunar spacesuit during a future Artemis mission. See Figure 3 for a summary of major events in the xEVAS acquisition process.

[9] At the time of award, NASA planned for the first Artemis lunar landing mission to be Artemis III. However, in February 2026, NASA announced a revised mission profile for Artemis III, which will now serve as a test flight to low Earth orbit. The new Artemis III mission includes an Orion rendezvous and docking with one or both of SpaceX's and Blue Origin's lunar landers in low Earth orbit, as well as the potential for testing of the next-generation lunar spacesuit. The Agency is planning for Artemis III to occur in 2027, with a lunar landing now expected during a 2028 Artemis mission.

[10] FAR Part 2.101 defines a sole-source acquisition as a contract for the purchase of supplies or services that is entered into or proposed to be entered into by an agency after soliciting and negotiating with only one source. FAR Part 6.302 details the various scenarios in which a sole-source contract or task order would apply, such as if there is only one responsible source to satisfy agency requirements, there is compelling urgency, or for national security reasons. A Critical Design Review demonstrates that a program or project design is sufficiently mature to proceed to full-scale fabrication, assembly, integration, and testing. The review is considered a key step in the development process because it often reveals shortcomings that must be addressed before the design is finalized and manufacturing begins.

Figure 3: Major xEVAS Events



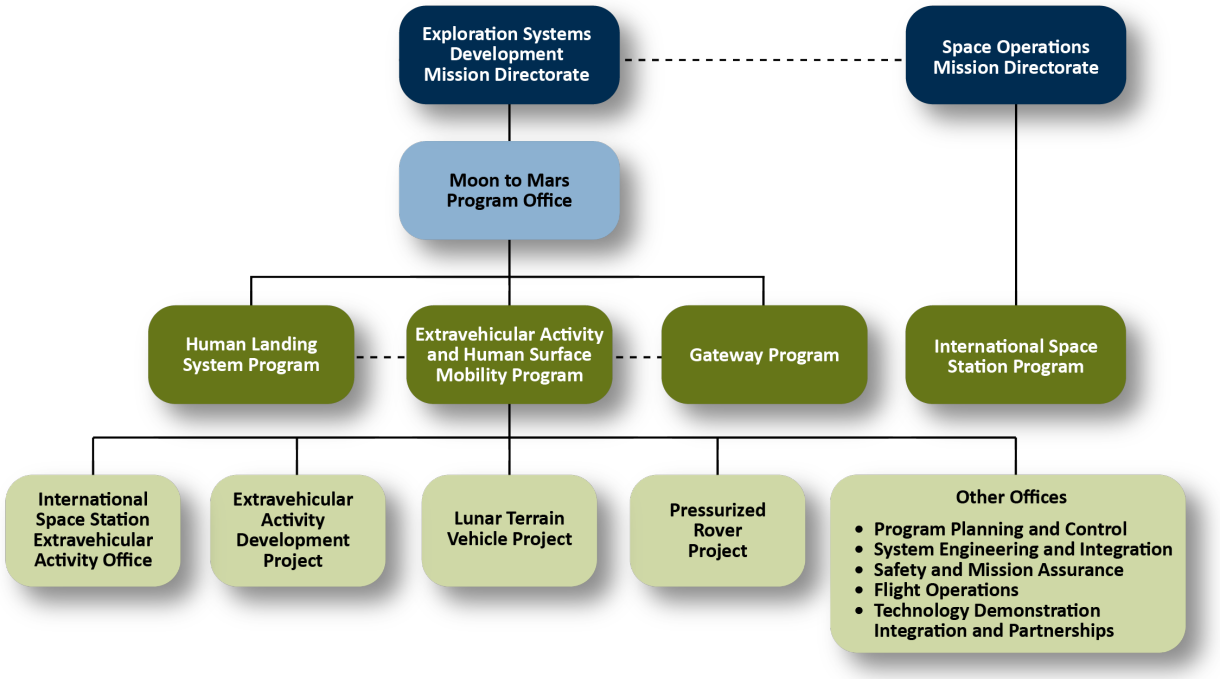
Source: NASA OIG representation of Agency information.

NASA's Spacesuit Management and Organizational Structure

NASA's Extravehicular Activity and Human Surface Mobility Program (EHP) at Johnson Space Center, established in 2022, has overall responsibility for xEVAS spacesuits, the Lunar Terrain Vehicle, and a pressurized rover for crew to live in and work on the lunar surface without the use of a spacesuit. Prior to 2022, next-generation spacesuits were managed by the Gateway Program for 3 years.[11] EHP falls under the Exploration Systems Development Mission Directorate's Moon to Mars Program Office, and its EVA Development project is responsible for managing the xEVAS effort. Since the lunar suits will be used by the Human Landing System Program and Gateway Program and the microgravity suits will be used by the ISS Program, all three programs are also major stakeholders in the xEVAS effort. See Figure 4 for the management and organization structure of the xEVAS spacesuits.

[11] NASA's Gateway Program is an international collaboration to establish a space station in lunar orbit for long-term human exploration and scientific discovery at the Moon. In March 2026, as part of a broader realignment of the Artemis missions, NASA announced that it would pause the Gateway in its current form and shift focus to infrastructure that enables sustained surface operations.

Figure 4: xEVAS Management Organization Chart



Source: NASA OIG presentation of Agency information.

Previous NASA Office of Inspector General and External Reports on NASA Spacesuits

In September 2025, we reported on NASA's management of the EMU spacesuits used on the ISS. We found that Collins—the only provider of EMU maintenance and operations—has struggled to ensure sufficient critical life support components for the suits are delivered when needed and within budget and that meet quality expectations. Additionally, Collins' performance has declined due to the company's supply chain issues, parts obsolescence, and ineffective management practices. We ultimately questioned a portion of the award fees NASA gave to the provider despite these ongoing challenges.[12]

We also reported on NASA's development of spacesuits in two prior audit reports in April 2017 and August 2021.[13] In April 2017, we found NASA was managing multiple design and health risks associated with the EMUs used by the ISS crew. We raised concerns about the inventory of EMU life support systems and the Agency's ability to continue supporting the current fleet of EMUs through the ISS's end of life, which was 2024 at that time. Then, in August 2021, we reported on NASA's efforts to design and develop next-generation spacesuits—to replace the existing EMUs—for use on the ISS and Artemis missions. We found that NASA's schedule to produce the first two flight-ready next-generation spacesuits by November 2024 was not feasible and lacked sufficient schedule margin. NASA had spent

[12] IG-25-012.

[13] NASA OIG, *NASA's Management and Development of Spacesuits* (IG-17-018, April 26, 2017) and *NASA's Development of Next-Generation Spacesuits* (IG-21-025, August 10, 2021).

over $420 million on spacesuit design and development and was on track to spend over $1 billion by the time the two suits would be ready. While NASA intended to contract with industry to procure additional suits, during the audit the Agency changed its acquisition strategy to a service-based contract approach.

Additionally, since 2019, the Aerospace Safety Advisory Panel has expressed concerns with NASA's ability to maintain the legacy EMUs and noted the development of the next-generation spacesuits to be imperative.[14] In 2024, the panel stated it was concerned about the aggressiveness of the next-generation spacesuit schedule and identified the suits as one of the critical path items to the Artemis lunar landing mission. It emphasized that the current ISS suits were well beyond their design life and called the obsolescence of the suit a "persistent and critical risk" for the ISS.[15]

[14] The Aerospace Safety Advisory Panel provides advice and makes recommendations to the NASA Administrator on matters related to aerospace safety.

[15] Aerospace Safety Advisory Panel, *Annual Report for 2024* (January 25, 2025).

NASA Is Challenged to Meet Artemis and ISS Spacesuit Goals

NASA faces challenges in ensuring next-generation spacesuits are available for the Artemis lunar landing mission in 2028 and the ISS before its planned decommissioning in 2030. The original schedules to demonstrate the lunar and microgravity spacesuits in 2025 and 2026, respectively, proved to be unrealistic, resulting in delays of at least a year and a half for both suits. The acquisition strategy selected to meet these schedules was a firm-fixed-price, service-based contract, which in our opinion was incompatible with a spacesuit early in its development. In addition, NASA's requirement that contractors develop both lunar and microgravity spacesuits limited the potential pool of offerors in an already constrained market. Shortly after awarding contracts to two providers in May 2022, NASA took several risky contract management actions driven by its motivation to maintain competition between the spacesuit providers and ensure redundancy. Despite NASA's efforts to retain both providers, NASA and Collins mutually agreed to descope the company's xEVAS task orders in June 2024 due to its inability to meet NASA's ISS demonstration schedule. With Axiom left as the sole provider for the immediate future, NASA is taking steps to proactively mitigate schedule risks to meet its space flight goals. Moving forward, the Agency must also contend with significant compatibility concerns if it is to move toward a more robust commercial space economy.

Delays in Spacesuit Development Threaten NASA's Space Flight Goals

When the initial xEVAS task orders were awarded to Axiom in September 2022 and Collins in December 2022, Axiom agreed to demonstrate its spacesuit on the Moon in November 2025 and Collins its spacesuit on the ISS by April 2026. At the time, NASA's schedule goal for the lunar suit demonstration aligned with the launch date for the Artemis lunar landing mission, which has since slipped from 2025 to 2028. Meanwhile, the Agency's goal for the microgravity suit demonstration was intended to overlap with and ultimately replace the EMUs on the ISS prior to the Station's planned decommissioning in 2030.

However, as of January 2026, Axiom is working toward both spacesuits being ready for demonstration in late-2027—more than a year-and-a-half delay for each suit. Furthermore, there is still a significant amount of testing and qualification remaining, during which additional technical challenges are likely to arise.[16] Even with efforts to accelerate the schedule, there is little to no schedule margin for the spacesuits to be ready for the Artemis lunar landing mission and a diminishing amount of margin before the ISS's decommissioning.

[16] For example, Axiom must test its EVA system for 4 hours simulating conditions in space for the Critical Design Review milestone (planned for completion later in 2026) and complete full demonstrations in an analog environment (e.g., underwater or in a thermal vacuum chamber) for the Design Certification Review milestone. The Design Certification Review milestone formally documents the design baseline and the conditions under which the system is certified.

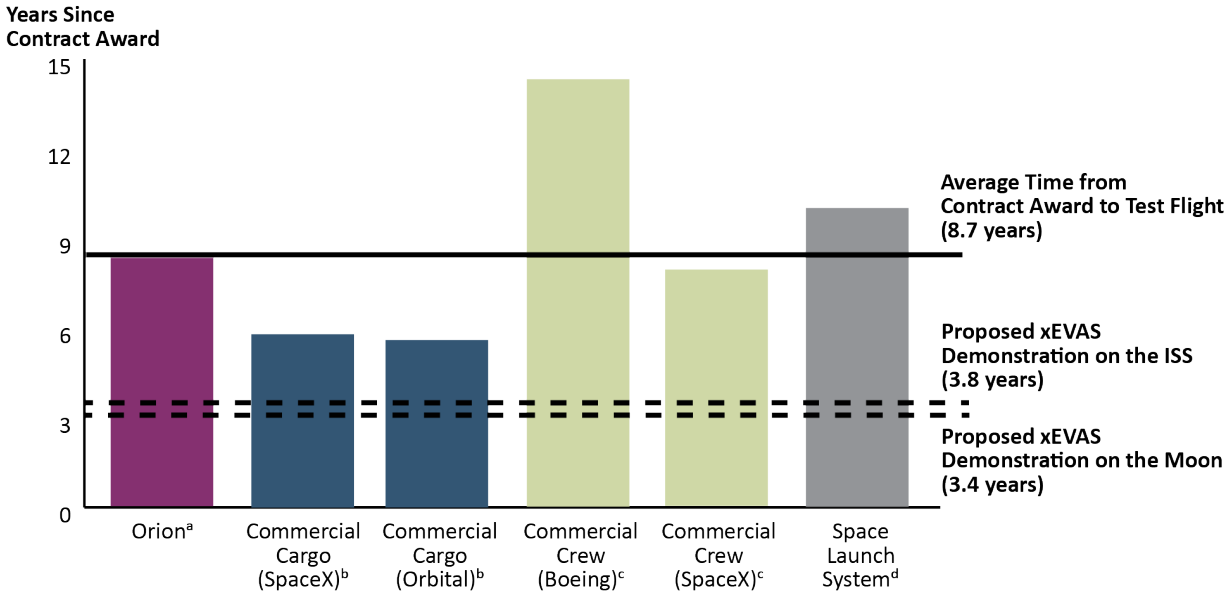
In our judgment, the original schedules for both xEVAS spacesuits were overly optimistic, a long-standing issue across the Agency that we have previously reported on.[17] Specifically, we determined the initial development schedules for both spacesuits—spanning 3.4 years for lunar suits and 3.8 years for microgravity suits—were less than half of the 8.7 year-historical average of time it takes from contract award to test flight for recent space flight programs.[18] If Axiom experiences design and testing delays in line with this historical average, the lunar and microgravity spacesuit demonstrations would not occur until 2031.[19] This would result in little to no overlap with the remaining service life of the ISS and is 3 years after the planned Artemis lunar landing date. See Figure 5 for a comparison of the proposed spacesuit schedules to recent major space flight programs at NASA.

[17] We reported on NASA's overly optimistic development schedules in our *2024 Report on NASA's Top Management and Performance Challenges* (November 2024) and *2023 Report on NASA's Top Management and Performance Challenges* (November 2023).

[18] We compared the time between each NASA space flight program's contract award and the spacecraft's test flight to the time between the xEVAS contract award and proposed spacesuit demonstration mission date agreed upon at contract award. Given that spacesuits are essentially personal spacecraft, we believe the comparison is appropriate. The proposed spacesuit schedules become increasingly unrealistic when compared to historic space flight program schedules at later milestones like first operational flight or final certification.

[19] We are not specifically projecting a 2031 readiness date for the lunar and microgravity spacesuits, as our analysis is intended only to reflect a more realistic development timeline compared to those initially agreed upon.

Figure 5: Time Between Contract Award and Test Flight by NASA Space Flight Program



Source: NASA OIG representation of historical contract award and test flight data.

Note: If Commercial Cargo Program contracts are excluded (to compare only human space flight programs), the average test time from award to test flight increases from 8.7 years to 10.2 years. Using that new historical average would yield an estimated mid-2032 readiness date for the spacesuits.

[a] The Orion crew capsule serves as the exploration vehicle that transports astronauts beyond low Earth orbit and sustains the crew during space travel. The original Orion spacecraft development contract was awarded in August 2006, with the first test flight (known as Exploration Flight Test-1 or EFT-1) occurring in December 2014.
[b] Commercial Cargo refers to the delivery of supplies, equipment, and other cargo to the ISS. Contracts for these services were awarded to SpaceX and Orbital Sciences Corporation (Orbital). Space Act Agreements were signed with SpaceX in August 2006 and Orbital in February 2008. SpaceX successfully completed its demonstration mission in May 2012, while Orbital completed its demonstration mission in September 2013.
[c] Commercial Crew refers to the provision of crew transportation to the ISS. Space Act Agreements were awarded to Boeing in February 2010 and SpaceX in April 2011, with SpaceX completing its demonstration mission in March 2019. For the purposes of this graph, Boeing's June 2024 Crew Flight Test is used.
[d] The Space Launch System heavy-lift rocket launches the Orion capsule into space. Space Launch System requirements were incorporated into an existing contract for the rocket's Core Stage in October 2012, while its first test flight was the Artemis I mission in November 2022.

Considering these schedule concerns, Axiom is proactively mitigating its supply chain risks—which typically cause schedule delays—and leveraging data from NASA's prior xEMU effort. Specifically, Axiom is utilizing vertical integration and expanding partnerships with companies outside the specialized but limited spacesuit industrial base.[20] For example, Axiom has begun manufacturing critical spacesuit components like batteries and valves in-house, which allows for more expeditious design, testing, and production compared to relying on networks of suppliers. For other aspects of the spacesuit, Axiom is partnering with established companies such as Prada for soft goods fabrication, Nokia for lunar communications, GU Energy Labs for in-suit nutrition needs, and Oakley for the protective visor system. In establishing these partnerships, Axiom is leveraging more varied supply chains and its partners' expertise in their respective fields, thereby allowing Axiom to focus on other aspects of the spacesuit. Axiom is using NASA's technical designs and data from its years of in-house xEMU development to further increase efficiency.

Axiom Spacesuit's Protective Visor System

Provided by Oakley, the protective visor system will shield against harmful radiation and extreme light conditions.

Source: Axiom.

NASA is highly incentivized to ensure Axiom's success given that it is the only active xEVAS provider. Nevertheless, given the developmental nature of the spacesuits and the significant amount of testing and certification remaining, Axiom and NASA will likely face additional delays typical of human space flight programs.

NASA's Acquisition Strategy Was Incompatible with Spacesuit Development

NASA's acquisition strategy for xEVAS—using a firm-fixed-price, service-based contract approach—was not well suited to the next-generation spacesuit design and development effort. Further, NASA required the potential providers to bid on both lunar and microgravity spacesuits, which constrained an already limited pool of potential offerors. Consequently, NASA only received two offers, one from a contractor with known past spacesuit performance issues and another from one that had no spacesuit development experience.

[20] Vertical integration is a business approach in which a company controls multiple stages of a production process by bringing those processes "in-house" and reducing its reliance on outside companies further down the supply chain. While often confused with "supply chain," the "industrial base" refers to the available companies that make up a worldwide industry. For example, when NASA purchases a piece of hardware from a specific company, all suppliers that company uses to produce the hardware (from raw material to final fabrication and shipping) comprise the supply chain for that item. However, all other companies capable of producing that hardware—and their respective supply chains—comprise the industrial base.

NASA Used a Firm-Fixed-Price, Service-Based Contract Approach for Spacesuit Development Despite Significant Technical Risks

In recent years, NASA has made a strategic decision to increase the use of firm-fixed-price contracts across the Agency to shift the risk of cost overruns to the contractor.[21] In general, a firm-fixed-price contract is best used when certain operational conditions exist, such as when system requirements are well-defined, technical risk is low, and market conditions are stable. This type of contract may be unsuitable for a developmental system with higher levels of technical, financial, and schedule risk, such as the next-generation spacesuit.[22]

A fully operational spacesuit has not been designed, developed, and produced for NASA's use since the 1970s, underscoring the novel technical risks involved in doing so nearly half a century later. Furthermore, according to industry officials, NASA's requirements for xEVAS were overly burdensome for a firm-fixed-price contract. These requirements—such as those for enhanced mobility, greater environmental protections, improved life support systems, and new advanced materials—are viewed as overly prescriptive and pose significant technical, financial, and schedule risks. This was evident in September 2024, when one of NASA's top EVA development risks was Axiom's non-compliance with several requirements during its Preliminary Design Review.[23] At the time, Axiom's lunar spacesuit exceeded the allowable mass and required more resources (e.g., oxygen, water, and power) than NASA's requirements permitted. Axiom is still working to resolve this issue, and if the company is unable to meet the design requirements, NASA would be forced to issue a waiver or delay Axiom's demonstration of its spacesuit.

Along with an increase in the use of firm-fixed-price contracts, the Agency has increased its use of service-based contracts in recent years, particularly in its human space flight programs.[24] Even though NASA acknowledged a service-based acquisition was risky because there was "no market" for spacesuits, the Agency proceeded with this approach for xEVAS. In opting for a service-based acquisition—in which the Agency would essentially rent spacewalking services from a provider instead of owning the spacesuit hardware—NASA sought to replicate certain efficiencies realized in prior service-based contracts, such as those in the Commercial Crew and Human Landing System procurements.[25] In those programs,

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[21] Examples of recent firm-fixed-price contracts include those for the Human Landing System, Commercial Lunar Payload Services, and the Lunar Terrain Vehicle.

[22] This concern was shared by the independent Standing Review Board, which found in August 2023 that few of the necessary conditions for successful firm-fixed-price contracts were present in EHP's firm-fixed-price contracts—which includes xEVAS—but that it was too late to change the contract structures. A Standing Review Board is the primary tool NASA relies on to achieve its independent assessment objectives. It is composed of independent experts from within and outside of NASA who assess a program's or project's programmatic and technical approach, risk posture, and progress against the program or project cost and schedule baseline. See NASA OIG, *NASA's Standing Review Board Practices* (IG-25-009, July 31, 2025).

[23] The Preliminary Design Review is part of the design life cycle of a program or project to evaluate the planning, technical, cost, and schedule baselines developed during formulation and assess the preliminary design to determine if the program or project is sufficiently mature to begin final design and fabrication.

[24] For example, NASA is utilizing service-based contracts for Commercial Cargo and Crew, Gateway Logistics Services, the Human Landing System, and the Lunar Terrain Vehicle.

[25] The Agency also hoped a service-based acquisition strategy would encourage an emerging commercial market for different spacesuit customers. However, several NASA and industry officials told us there is currently no non-governmental, commercial marketplace for these spacesuits, particularly for lunar spacesuits. Commercial applications of spacesuits appear to be limited to upcoming Commercial Low Earth Orbit Destinations—privately-run space stations that will replace the ISS—which are not expected to be operational until the end of the decade at the earliest.

though, NASA helped foster emerging technologies through Space Act Agreements (SAA) or Broad Agency Announcements (BAA) prior to awarding the service-based contracts.[26]

While NASA considered using SAAs and BAAs for its next-generation spacesuits, it noted several weaknesses with the approach. For example, the Agency felt it did not have time to develop spacesuit technology under SAAs or BAAs before shifting to a service-based contract due to the aggressive schedule for upcoming Artemis missions. NASA was also hesitant to abandon its investment in its in-house spacesuit development—over 10 years and hundreds of millions of dollars—since industry would be responsible for the next-generation spacesuit design. Ultimately, instead of utilizing an SAA or BAA approach, the Agency relied on its in-house spacesuit technology development that had not produced a flight-ready suit by the time the acquisition strategy changed.

While NASA offered its xEMU technical designs to the xEVAS bidders, it did not require the selected providers to utilize the data. Though this allowed the providers to innovate and utilize their own designs, not leveraging NASA's prior work could increase the providers' technical and schedule risk given the substantial technology development required for a spacesuit. Ultimately, Axiom's design leveraged NASA's xEMU design, which NASA officials expect will mitigate schedule risk, while Collins' design did not.

NASA Requirement to Bid on Both Microgravity and Lunar Spacesuits Limited the Potential Offerors

NASA required potential xEVAS offerors to submit bids for spacewalking capabilities that met both ISS and Artemis requirements. NASA's analysis found that most spacewalking requirements are driven by the needs of the human body inside the spacesuit as opposed to the microgravity or lunar surface environment the spacesuit is operating in, reflecting considerable commonalities in the requirements for each suit. Dual-purpose spacesuits would also allow each provider, assuming more than one contract was awarded, to serve as a backup to the other. While NASA did not expect this requirement to inhibit commercial engagement, the strategy likely dissuaded some companies from competing that may specialize in or prefer to focus on only one environment.[27] The challenges associated with this requirement were exacerbated by a lack of commercial marketplace for spacesuits and the fact that the industrial base for spacesuit technologies was already limited after decades of NASA sole-sourcing the maintenance of its existing EMUs to Collins.

Ultimately, these factors resulted in NASA receiving only two bids for xEVAS: one from Collins, a contractor with extensive experience but poor management of its EMU spacesuit maintenance contract, and one from Axiom, a provider with no spacesuit development experience.

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[26] SAAs establish a set of legally enforceable promises between NASA and a second party, requiring a commitment of Agency resources, including personnel, funding, services, equipment, expertise, information, or facilities. The purpose of SAAs is to enhance NASA's ability to advance cutting-edge science and technology and to stimulate industry to start new endeavors. Beginning in 2010, funded SAAs were used at three different phases during the Commercial Crew Program over the course of several years to enable contractors to develop and demonstrate launch vehicles and ground and mission operations capabilities. Subsequent certification and services were acquired using fixed-price contracts. BAAs are used to obtain proposals for research and development to advance or evaluate innovative technologies that are not related to a specific system or hardware requirement. Issued in 2016, NASA is procuring the Human Landing System through a BAA with certain sections of the BAA applying to different phases of development.

[27] For example, representatives from Genesis Engineering Solutions—whose Single Person Spacecraft is an innovative alternative to a spacesuit designed to operate in microgravity but not the lunar surface—told us the company would have submitted an offer if it was able to only bid on microgravity EVA work. See the "xEVAS Contract Allows for Future New Providers" section for more information.

Collins Had Management Issues on the Current EMU Maintenance Contract

Collins has decades of experience performing maintenance of the EMUs used on the ISS, most recently through the incumbent Extravehicular Activity Space Operations Contract, which we discussed in our September 2025 report.[28] However, Collins struggled with its management of this contract in the time surrounding the xEVAS award. Specifically, in 2020, NASA noted that Collins had failed to address several "systemic management issues," such as cost management, supply chain management, and an inability to complete contract scope. These long-standing issues culminated in March 2023 when four NASA program managers signed a letter to Collins senior management outlining pervasive management and performance issues over the previous several years. The program managers concluded that the company's performance was a risk to upcoming Artemis launch schedules and maintaining NASA's EVA capability necessary to sustain the health and viability of the ISS, among other NASA programs and capabilities.

Despite these well-known concerns, NASA nevertheless rated Collins' past performance during the xEVAS source selection as Excellent. According to the Source Selection Authority in the xEVAS Source Selection Statement, Collins "demonstrates very effective performance in providing development of NASA systems and services that are essentially the same as the xEVAS effort."[29] In addition, the Source Selection Authority wrote that Collins' performance with respect to schedule included "minor problems that had little identifiable effect on overall performance" but summarized that "there is a high level of confidence the Offeror [Collins] will successfully perform the required effort under xEVAS." Ultimately, Collins would be descoped from its xEVAS task orders just 2 years later, specifically citing schedule reasons. In our view, ignoring or downplaying past performance issues increases NASA's risk exposure and threatens effective acquisitions and achievement of the Agency's goals.

Axiom Had No Spacesuit Development Experience

While Collins had extensive, but recently poor, management and performance experience with the maintenance of current ISS spacesuits, Axiom had the opposite problem—it had no appreciable spacesuit development experience. For its xEVAS bid, even though Axiom partnered with a subcontractor that also supports the Extravehicular Activity Space Operations Contract, this subcontractor did not have any past performance that was relevant to developing or manufacturing a pressure garment system—its primary xEVAS task—which NASA noted as a weakness. Ultimately, NASA decided that past performance of the team led by Axiom was relevant despite these shortcomings, underscoring the risk the Agency accepted in its pursuit of redundant spacesuits. To its credit, Axiom has hired many former NASA spacesuit experts who worked on the Agency's in-house xEMU design that the company's spacesuit leverages.

[28] IG-25-012.

[29] Per NASA FAR Supplement Part 1815, the Source Selection Authority is the Agency official responsible for the source selection process and making the final decision on which proposal will be awarded the contract. The Source Selection Statement is the document that reflects the thought process behind the selection and represents the independent judgment of the Source Selection Authority.

NASA Took Risks in Its Efforts to Maintain Multiple Spacesuit Providers

Following the xEVAS contract awards to Axiom and Collins in May 2022, NASA sought to maintain competition between the two providers and ensure spacesuit redundancy throughout the acquisition. To do so, NASA took risks in its contract management decisions with mixed results, such as non-competitively awarding the ISS demonstration task order to Collins, making partial milestone payments to both providers, and awarding cross-over task orders to both providers for redundancy.

NASA Did Not Compete the Microgravity Spacesuit Task Order

In December 2022, NASA non-competitively awarded a task order to Collins—initially valued at $97 million—for development through the Critical Design Review of a next-generation spacesuit to be demonstrated in microgravity on the ISS. While the xEVAS effort was designed to allow each provider to compete for task orders, NASA issued a Justification for an Exception to Fair Opportunity to explain its decision to sole-source the award to Collins and not give Axiom an opportunity to compete.[30] In the justification, NASA wrote that the Federal Acquisition Regulation allows the Agency to circumvent the typical competitive process if it is necessary to help satisfy a contract's guaranteed minimum order.

NASA's xEVAS contracts include a guaranteed minimum order, based on a contractually specified dollar amount unique to Axiom and Collins, that commits NASA to procure services worth at least that amount from each provider. Although Axiom was awarded a task order in September 2022—valued at $228 million—to develop and demonstrate a next-generation lunar spacesuit, prior to December 2022 Collins had not been competitively selected for an award of any xEVAS task order.[31] Concerned that it would not be able to meet its guaranteed minimum order with Collins and to maintain the company's participation in xEVAS, NASA opted to non-competitively award the task order for ISS spacesuits.

NASA also wrote in the justification that the sole-source award to Collins "increases NASA's ability to compete EVA services tasks in the future." As such, while NASA's sole-source award to Collins sacrificed competition in the short-term, its intent was to ensure competition between Axiom and Collins remained in the longer-term for future task orders.

Partial Payments to Providers Undermine Intent of Milestone Approach

In December 2023, NASA approved partial milestone payments to Collins and Axiom for each provider's primary task order Preliminary Design Review—Collins for its microgravity spacesuit and Axiom for its lunar spacesuit.[32] In approving Collins' partial milestone payment, NASA noted that "significant

[30] FAR 16.505 (b)(2) notes that NASA must give every awardee of a multiple-award contract fair opportunity to be considered for a task order unless certain exceptions apply, including if it is necessary to satisfy a minimum guarantee. If an exception is exercised, NASA must write a Justification for an Exception to Fair Opportunity that details the rationale for doing so.

[31] A NASA official told us the Agency intended to award task orders for both the microgravity and lunar spacesuits at the same time but lacked the budget to do so.

[32] Though the requests for partial milestone payments from Axiom and Collins were submitted on the same day (December 18, 2023), NASA told us that this was a coincidence. In addition to the December 2023 partial milestone payments for both providers' Preliminary Design Reviews, NASA approved partial milestone payments in March 2023 and December 2023 to Axiom for the Certification Baseline Review of its lunar spacesuit.

portions" of the milestone had already been completed and that the provider agreed to complete the remaining work at a later date. NASA also cited the existence of upcoming milestone reviews to ensure completion of remaining work, additional training events of value offered by Collins, and the assumption that the partial payment would "motivate performance." Axiom's request offered a similar rationale and concessions to NASA in exchange for a partial payment of its Preliminary Design Review milestone.

On the one hand, NASA's decision to approve these partial milestone payments deviated from standard firm-fixed-price milestone requirements set forth in the xEVAS contracts, which explicitly state that "the Contractor shall not be entitled to payment of a request for performance-based payment prior to successful accomplishment of the event or performance criterion for which payment is requested." That is, completing only most of the agreed-upon milestone criteria does not warrant payment by NASA. Furthermore, acceptance of incomplete milestone work could reduce a provider's urgency to fully finish the entire performance scope of that milestone, leading to schedule delays.

On the other hand, one of the reasons cited by NASA officials for approving partial milestone payments was "vendor health and viability." As such, the partial payments may have been vital in assisting one or both providers with financial concerns that could have threatened the companies' ability to continue their xEVAS efforts and NASA's ability to maintain competition. Similarly, NASA has already adjusted Axiom's milestone payment plan to shift funding to earlier milestones, signifying cash flow issues.

Regardless, the fact that both providers felt compelled to request such deviations from the contract suggests weaknesses in the milestone funding outlay and even the overall acquisition strategy. Moreover, the decision to approve partial payments for incomplete milestones reduced NASA's financial control over its providers' performance, potentially setting a precedent for future contractors and ultimately shifting financial and schedule risk to the Agency despite a fixed-price environment that is meant to do the opposite.

Cross-Over Task Orders Awarded to Increase Spacesuit Redundancy

In July 2023, NASA awarded $5 million task orders to both Axiom and Collins that allowed each provider to begin concurrent work on spacesuit development for both the microgravity and lunar surface environments. NASA awarded these "cross-over" task orders to increase spacesuit redundancy, giving itself built-in backup plans in case one of the providers was unable to perform the work associated with its primary task order (a lunar suit for Axiom and a microgravity suit for Collins). Although risky considering the financial investment, this proved to be a prescient decision once Collins was descoped from the xEVAS effort less than a year later. By doing so, Axiom and NASA were able to take advantage of the existing cross-over task order and avoid some of the schedule impact of the descope since Axiom had already been working toward its microgravity spacesuit for nearly a year.

Central to the success of the cross-over task orders was the additional flexibility and risk mitigation built into its incremental milestone-based approach. For a milestone-based contract, NASA and the contractor typically schedule milestone dates upfront for the entire development of the system. The contractor then progresses to the next milestone after successful completion of the prior one. For the cross-over task orders, though, NASA structured each milestone such that the Agency could allow it to proceed incrementally as circumstances dictated. In this case, if one of the providers was underperforming on its primary task order, NASA could progress the other provider through the milestones for the same spacesuit and maintain overall redundancy for that capability. This scenario

occurred when NASA chose to exercise options for Axiom to proceed through multiple development milestones for its microgravity spacesuit in the months leading up to Collins' descope. Exercising these options authorized Axiom to continue developing its microgravity spacesuit while NASA and Collins determined how best to proceed.

Collins' Withdrawal from New Spacesuit Efforts Led NASA to Take More Proactive Schedule Risk Mitigation Measures

Collins' extensive performance problems on the xEVAS contract culminated in the mutual decision to remove—or descope—its xEVAS task orders in June 2024. As a result, Axiom became the sole provider dedicated to NASA's next-generation spacesuits, leading the Agency to take various risk mitigation steps to help ensure Axiom's success.

Collins' Descope Leaves NASA with Only One xEVAS Provider

NASA officials told us that Collins' performance issues on xEVAS began less than a year after the award of its first task order. Despite the provider having a different management team for xEVAS than it has under the Extravehicular Activity Space Operations Contract —which encouraged Agency officials—Collins' management problems nevertheless persisted as milestone requirements were not being met. For example, NASA officials told us that Collins often lacked sufficient detail in its overall schedule and struggled with its subcontractor management. As a result of this and other delays, Collins did not complete the Preliminary Design Review for its microgravity spacesuit until June 2024, one year after the contractual completion date.

Shortly thereafter, also in June 2024, NASA and Collins mutually agreed to descope Collins' xEVAS task orders after the provider "recognized its development timeline would not support the Space Station's schedule and NASA's mission objectives." The descope means that while Collins will no longer work on the xEVAS task orders it was awarded, it will technically maintain its xEVAS contract (at no cost to NASA) and could restart that work and compete for task orders in the future if it chooses to do so. By the time of the descope, NASA had already paid $37 million to Collins for the completion of four milestones across its two task orders, which was substantially less than the guaranteed minimum order amount. As part of the descope agreement, NASA lowered Collins' contracted guaranteed minimum to the amount already paid to the company—$37 million—meaning that NASA was no longer bound to the original guaranteed minimum amount in the contract.[33] Additionally, while NASA received no hardware for the investment, it retained data related to Collins' conceptual spacesuit designs. NASA officials told us they believe the Agency saved significantly more money by having a competitive environment during the xEVAS procurement process than what was spent on milestone payments to Collins.

Nonetheless, with Axiom the only xEVAS provider available to develop the next-generation spacesuits, NASA can no longer rely on a competitive environment to help control costs. Further, any future schedule slips now impact both the Artemis campaign and ISS Program.

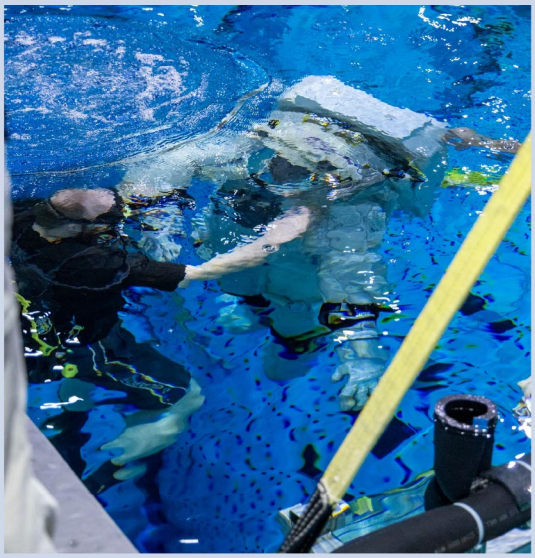
[33] Funding set aside for Collins' guaranteed minimum amount remains in the EHP budget and is tied to work that will now be performed by Axiom.

NASA Is Taking Steps to Mitigate Axiom's Schedule Risks

NASA is investing in various risk mitigation approaches to ensure Axiom's success in developing microgravity and lunar spacesuits, including supply chain risk mitigation, increased spacesuit testing, and additional government collaboration. To determine high-risk components of Axiom's spacesuit supply chain, NASA uses several evaluation factors, such as whether parts are sole-sourced or internationally-sourced, and contractual insight tools like schedule and supply chain reviews. These evaluation factors and insight tools allow the Agency to proactively identify schedule vulnerabilities and mitigate unique supply chain risks, such as with obsolete and aging components.

NASA is also investing in certain key spacesuit components to increase the number available for testing. For example, in December 2025, NASA awarded a $13.1 million contract for the development of oxygen regulators for the next-generation spacesuits, a critical and low-inventory component that is also considered a top risk for the current EMU spacesuits.[34] By leveraging existing Agency supplies and initiating new procurements, NASA has also procured long-lead-time blocks of steel and aluminum to help manufacture different components of Axiom's spacesuit, like oxygen tanks and the Hard Upper Torso.

Underwater Testing of Axiom Spacesuit's Pressure Garment System at NASA's Neutral Buoyancy Laboratory



Source: Axiom.

Further, NASA is aiming to drastically increase the amount of pressurized suited test time at the Agency's specialized facilities, most of which are located at Johnson Space Center near Axiom's facilities. In doing so, NASA and Axiom can gather additional data and reduce risk as the spacesuit continues its development. In June 2025, NASA reported an over 100 percent increase in pressurized test support in an 8-month period, a trend it expects to continue over the next year as more hardware is made available.[35] While there is concern the demand for test facilities and hardware will exceed capacity, risking deferment of critical testing, NASA plans to provide additional funding to mitigate this risk.

NASA also plans to invest in additional insight and collaboration personnel from Johnson Space Center to supplement the Axiom workforce.[36] The xEVAS contracts allow providers access to specialized NASA facilities (e.g., spacesuit manufacturing facilities, vacuum chamber testing, and life support system testing) and support from up to 25 NASA employees per fiscal year with specialized spacesuit experience

[34] The oxygen regulator is included in NASA's Critical At-Risk Industrial Technology List, which identifies NASA space industrial base at-risk items used for NASA's launch vehicles and spacecraft systems. It includes items such as raw materials, parts, components, and subsystems that are vital to Agency projects but may have only one source, a limited market, or require specialized workers or equipment.

[35] In July 2025, Axiom told us the company had completed the first 3 crewed tests in NASA's Neutral Buoyancy Laboratory and 23 tests in NASA's Active Response Gravity Offload System facility, both of which help simulate partial gravity.

[36] Insight is a monitoring activity where NASA gains an understanding of the contractor's activities and data. Since NASA will neither build the spacesuits nor own them, the appropriate level of monitoring, control, and acceptance is critical to ensure the products and services meet NASA's needs and objectives.

at no cost to the provider.[37] As of December 2025, Axiom had completed or was actively working on 37 collaboration agreements with NASA—in areas such as dust mitigation, acoustics, and manufacturing—with several more being coordinated. While Axiom officials told us the collaborations have proven successful, it remains to be seen how Agency-wide staffing reduction efforts will impact the availability of these knowledgeable civil servants moving forward.[38] As of December 2025, EHP had spent over $79 million on spacesuit testing and $63 million on insight and collaborations with its xEVAS providers.

xEVAS Contracts Allow for Future New Spacesuit Providers

The xEVAS contracts include an "on-ramp" clause that allows other contractors to submit proposals. This clause was included to allow the Agency to add new providers more easily to further competition and take advantage of advancements in the spacesuit marketplace since the initial contract awards in May 2022. In practice, this means that the xEVAS contract solicitation will remain open throughout the entire ordering period, which ends in May 2032. As such, NASA maintains the discretion to request proposals, award contracts to new providers, and award task orders for additional capabilities to existing providers.

In the short term, EHP officials told us that on-ramping another provider at this time would not help the Agency meet its immediate ISS and Artemis goals within the established time frames. Nonetheless, the clause gives NASA the ability to introduce competition for recurring spacesuit services in the future.[39] Companies such as Genesis Engineering Solutions, ILC Dover, and SpaceX are developing capabilities that may help foster future competition for spacewalking services to NASA and prevent the Agency from being reliant upon a single provider. Efforts from these three companies are described below and pictured in Figure 6.

Genesis Engineering Solutions. A longtime provider of technology and hardware solutions for NASA efforts like the Hubble and Roman Space Telescopes, Genesis Engineering Solutions is developing its own Single Person Spacecraft microgravity vehicle. Designed as a less complex, more efficient, and safer alternative to traditional spacesuits, this spacecraft would not require an airlock, could be piloted by crew in the vehicle or teleoperated from the ISS, and would utilize the same pressure as the Station—avoiding the need for lengthy prebreathe processes astronauts must perform prior to using EMUs.[40] Though the system is still in development, Genesis representatives told us they envision their spacecraft being used for various purposes in microgravity environments, such as servicing satellites, making repairs to the ISS or Hubble Space Telescope, maintaining deeper space applications like the Gateway space station or Mars transportation vehicles, and fostering space tourism.

[37] NASA considers collaboration "the highest form of insight" since it can receive increased assurance that a contractor is meeting the xEVAS requirements. The Agency has the sole authority to determine whether it will provide any collaboration resources requested by a contractor and retains the right to modify the level of the support provided by NASA employees.

[38] According to EHP officials, while the xEVAS effort lost some personnel, it was significantly less than the Agency average and the xEVAS effort received high-priority reassignment support from organizations across Johnson Space Center.

[39] Any new xEVAS provider would need to first successfully complete an EVA demonstration prior to being eligible to compete for recurring EVA services.

[40] To prevent medical issues that may occur when astronauts move from the ISS's atmosphere, with its higher partial pressure of nitrogen, to the lower pressure in the EMU, astronauts prebreathe 100 percent oxygen and exercise prior to a spacewalk. Doing so displaces nitrogen in the bloodstream or tissues, a process that takes several hours.

ILC Dover. A major subcontractor to Collins in its xEVAS effort and the Extravehicular Activity Space Operations Contract, ILC Dover has been developing the Astro™ spacesuit pressure garment system since before the xEVAS effort. In an interview, ILC Dover representatives explained that Astro™ builds off decades of spacesuit development and is cheaper, more flexible, lighter weight, and can operate at a higher pressure than the EMUs currently on the ISS. To complement its Astro™ pressure garment system, ILC Dover is also developing the necessary life support systems to complete a spacesuit that can be used in either microgravity or planetary environments.

SpaceX. A provider of crew and cargo transportation to the ISS and the Starship Human Landing System under development for Artemis missions, SpaceX has designed EVA spacesuits using an upgraded version of its current intravehicular suits used on the Crew Dragon vehicle. SpaceX demonstrated its spacesuit capabilities during the Polaris Dawn mission in September 2024.[41] To conduct the EVA, astronauts attached the spacesuit to a Crew Dragon vehicle via an umbilical cord, which provided life support features necessary for a spacewalk. The suit is part of a scalable design that is intended to allow for greater accessibility to space, including future planetary surface operations on the Moon and Mars.

Figure 6: Alternative Spacesuit Development Efforts

Left photo: Genesis Engineering Solutions' Single Person Spacecraft. Center photo: ILC Dover's Astro™ spacesuit. Right photo: SpaceX's spacesuit during the Polaris Dawn mission.

Source: Genesis Engineering Solutions, ILC Dover, and SpaceX.

NASA Lacks a Standard for Spacesuit Interoperability with Multiple Lunar Spacecraft and Assets

NASA does not contractually require a single, universally adopted standard for the spacesuits among the providers. However, spacesuit hardware must interface with almost every Artemis spacecraft and asset, including the commercial Human Landing System vehicles, the Lunar Terrain Vehicle, pressurized crewed rovers, and habitation modules. Furthermore, multiple providers for the vehicles and modules increases the number of combinations and interactions between the spacesuits and these assets. As a result,

[41] During the Polaris Dawn private astronaut mission, crewmembers completed the first commercial spacewalk using SpaceX-designed EVA spacesuits.

differences in systems—from airlocks, hatch sizes, and suit interfaces, both government and commercial—may limit full interoperability.

Compatibility standards define how hardware and systems interface with the spacesuit or facilitate EVA activities. Compatibility ensures the suits can interface with other spacecraft and assets not originally planned for, which becomes of even greater importance in the event of an emergency requiring the rescue of a stranded crewmember with an alternate vehicle. With the growth of the commercial space industry, ensuring spacesuits are compatible with vehicles they were not originally designed for is crucial for the protection of astronauts and efficiency of spacesuit interface design. In 2024, NASA released an EVA compatibility document and an interface requirements document to mitigate the compatibility risk for future vehicles; however, according to NASA officials, these documents are not sufficient to prevent interface compatibility challenges.

NASA is already encountering compatibility challenges with spacesuit and vehicle designs for future Artemis missions. Blue Origin requires specific suit information to finalize its Blue Moon Human Landing System design. To this end, Blue Origin utilized the Agency's government reference spacesuit interface design document to develop a don/doff area—where suits are put on and removed. Axiom, the presumed spacesuit provider, subsequently decided to use a different don/doff connection. For the Axiom spacesuit to be compatible with the Blue Moon lander, Blue Origin must either make significant changes to the crew module airlock layout or develop its own don/doff hardware to support Axiom's design, potentially increasing the cost to NASA. A uniform spacesuit standard could have mitigated this issue.

CONCLUSION

Spacesuits are critical to NASA's operations in low Earth orbit and the Agency's more ambitious goal of returning humans to the Moon. However, NASA will be challenged to have the next-generation spacesuits operational in time to meet the Agency's current schedules for the Artemis lunar landing mission in 2028 and prior to the ISS's decommissioning in 2030. Specifically, NASA's original schedules to demonstrate the lunar and microgravity spacesuits were overly optimistic and, combined with the use of a firm-fixed-price acquisition strategy on an inherently developmental system, ultimately hindered its spacesuit providers' success. Further, NASA's requirement for contractors to bid on both lunar and microgravity spacesuits, along with the lack of a commercial marketplace for the suits, limited the number of potential offerors that were capable of and interested in participating in xEVAS. In our judgment, while firm-fixed-price and service-based contracts can be viable options for certain NASA procurements, applying that approach to a developmental effort like xEVAS introduced its own set of risks to achieving NASA's goals.

While NASA is taking steps to mitigate schedule risk, it must also contend with the unique risks inherent to a single-provider environment until future competition is introduced. Collins' descope from xEVAS negated the competition and redundancy sought by the Agency, leaving NASA with only one xEVAS spacesuit provider. If Axiom cannot satisfy its contractual requirements in a timely or cost-effective manner, then NASA could be forced to continue using the problematic EMUs throughout the life of the ISS and significantly adjust its lunar plans. While xEVAS is flexible enough to allow for additional providers, doing so may not help the Agency meet its more immediate Artemis goals. Critically, NASA must address existing design and safety risks resulting from the lack of standard requirements for spacesuits to be compatible with various lunar spacecraft and assets. As the Agency continues its exploration of the Moon and progresses to Mars, it must carefully consider the applicability of various acquisition strategies and contract structures and ensure it learns the appropriate lessons from past procurements.

RECOMMENDATIONS, MANAGEMENT'S RESPONSE, AND OUR EVALUATION

To improve management of the Agency's next-generation spacesuits, we recommended the Associate Administrator for Exploration Systems Development Mission Directorate:

1. Seek industry input on current xEVAS contract requirements to maintain competition as needed in the future.
2. Develop a plan to establish interoperability standards between Artemis lunar vehicles and spacesuits.

We provided a draft of this report to NASA management who concurred with our recommendations and described planned actions to address them. We consider management's comments responsive; therefore, the recommendations are resolved and will be closed upon completion and verification of the proposed corrective actions.

Management's comments are reproduced in Appendix B. Technical comments provided by management and revisions to address them have been incorporated as appropriate.

Major contributors to this report include Deanna Lee, Human Exploration Audits Assistant Director; Susan Bachle, Assistant Director; Tyler Martin; Dimitra Tsamis; Rachel Pierre; Amy Bannister; Lauren Suls; and Shani Dennis.

If you have questions or wish to comment on the quality or usefulness of this report, contact Laurence Hawkins, Financial Oversight and Audit Quality Director, at 202-358-1543 or laurence.b.hawkins@nasa.gov.

Robert H. Steinau
NASA OIG Senior Official

APPENDIX A: SCOPE AND METHODOLOGY

While we performed this audit from September 2024 through March 2026, it was temporarily suspended during the government shutdown that occurred from October 1 to November 12, 2025. The audit was performed in accordance with generally accepted government auditing standards, which 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. This is the second of two reports stemming from this audit.

Our overall objective was to examine NASA's management of next-generation spacesuits for the ISS Program and Artemis campaign. To accomplish our objective, we performed work at NASA Headquarters and Johnson Space Center. While at Johnson Space Center, we interviewed program management and safety experts from the EHP and ISS Programs, xEVAS contract specialists, and representatives from Axiom and Collins. Follow-up interviews were conducted as needed. We also conducted virtual interviews with representatives from Genesis Engineering Solutions, ILC Dover, and SpaceX to discuss their respective spacewalking capabilities and, if applicable, involvement in the xEVAS effort. Our selection of interview participants and topics was partially informed by an anonymous survey we sent in October 2024 to over 70 individuals from NASA and industry involved in spacesuit development, maintenance, management, or use. In preparation for the audit, we also conducted routine coordination with the Office of Inspector General's Associate Counsel to the Inspector General and the Office of Investigations.

To assess NASA's management of the xEVAS contracts, we reviewed xEVAS contract documentation from each provider, including base contracts, task order awards, and contract and task order modifications. We also reviewed provider invoices, development schedules, milestone completion verification forms, and performance evaluation reports. Finally, we reviewed federal and NASA requirements on a variety of subjects, including safety, as well as various sections of the Federal Acquisition Regulation.

Assessment of Data Reliability

We used limited computer-processed data for this audit. We reviewed and analyzed NASA cost, obligation, and funding data for xEVAS in NASA's financial accounting system. We concluded that the data was sufficiently reliable for the purposes of this audit. The findings and conclusions of this report do not rely on computer-generated data.

Review of Internal Controls

We evaluated the internal controls associated with NASA's management of the next-generation spacesuits to be used on the ISS and Artemis missions. We reviewed appropriate policies, procedures, and regulations and conducted interviews with responsible personnel. Our recommendations, if implemented, will improve the identified control weaknesses. However, because our review was limited to these internal control components and underlying principles, it may not have disclosed all internal control deficiencies that may have existed at the time of this audit.

Prior Coverage

The NASA Office of Inspector General and Government Accountability Office have issued seven reports of significant relevance to this report. These reports can be accessed at https://oig.nasa.gov/ and https://www.gao.gov/, respectively.

NASA Office of Inspector General

NASA's Management of ISS Extravehicular Activity Spacesuits (IG-25-012, September 30, 2025)

NASA's Development of Next-Generation Spacesuits (IG-21-025, August 10, 2021)

NASA's Management and Development of Spacesuits (IG-17-018, April 26, 2017)

Government Accountability Office

NASA: Assessments of Major Projects (GAO-25-107591, July 1, 2025)

NASA: Assessments of Major Projects (GAO-24-106767, June 20, 2024)

NASA Artemis Programs: Crewed Moon Landing Faces Multiple Challenges (GAO-24-106256, November 30, 2023)

NASA: Assessments of Major Projects (GAO-23-106021, May 31, 2023)

APPENDIX B: MANAGEMENT'S COMMENTS

National Aeronautics and Space Administration

Mary W. Jackson NASA Headquarters
Washington, DC 20546-0001

Reply to Attn of: Exploration Systems Development Mission Directorate

TO: Deputy Assistant Inspector General for Audits

FROM: Acting Associate Administrator for Exploration Systems Development Mission Directorate

SUBJECT: Agency Response to OIG Draft Report, "NASA's Management of the Exploration Extravehicular Activity Spacesuits" (A-24-14-01-HED)

The National Aeronautics and Space Administration (NASA) appreciates the opportunity to review and comment on the Office of Inspector General (OIG) draft report entitled, "NASA's Management of the Exploration Extravehicular Activity Spacesuits" (A-24-14-01-HED), dated March 4, 2026.

NASA's Exploration Extravehicular Activity Services (xEVAS) contract, managed by the Extravehicular Activity and Human Surface Mobility Program, develops next-generation lunar spacesuits that will enable astronauts to survive and work outside the confines of a spacecraft to explore the Moon. On February 27, 2026, as part of a Golden Age of exploration and discovery, NASA announced the Agency is increasing its cadence of missions under the Artemis program to achieve the national objective of returning American astronauts to the Moon and establishing an enduring presence. This includes standardizing vehicle configuration, adding an additional mission in 2027, and undertaking at least one crewed surface landing every year thereafter. NASA will accelerate the development and checkout of the Exploration Extravehicular Activity (xEVA) lunar surface spacesuits and reduce technical risk by integrating on-orbit testing in 2027, either through the Earth orbit Artemis test mission or by leveraging International Space Station-based opportunities.

The xEVAS contract was awarded as a firm-fixed-price, service-based contract structured to remain adaptable to the evolving needs of the Agency and space industry. Fixed-price contracting approaches have generally been associated with better cost stability in development programs compared to cost-reimbursement approaches. Drawing on more than five decades of in-house spacesuit expertise, NASA has defined the technical and safety standards and requirements informing the design and development of these next-generation lunar spacesuits. In alignment with this foundation, NASA's recently announced workforce directive will rebuild core competencies in the civil servant workforce, including more in-house and side-by-side development work with our Artemis partners, enabling a safer, more reliable, and faster launch cadence. Strengthening these internal capabilities enhances

NASA's ability to manage and oversee firm-fixed-price contracts and assure mission needs are met by ensuring the Agency can better evaluate contractor performance, engage and validate technical solutions, as well as maintain consistent insight into system requirements.

NASA selected Axiom Space and Collins Aerospace as the commercial partners to advance spacewalking capabilities at the Moon through services that will provide astronauts with next-generation spacesuit systems for lunar surface exploration on Artemis missions. With the firm-fixed-price, service-based contract, the commercial partners are responsible for the design, development, qualification, certification, and production of these modern lunar spacesuits. As NASA ultimately is responsible for the Artemis mission and crew safety aspects, it is critical that the Agency maintain a close partnership with the associated service-based providers. As noted in the OIG's draft report, NASA and Collins mutually agreed to descope the existing task orders upon determining that the projected development timeline would not support NASA's mission objectives.

NASA's spacesuit interoperability is a foundational requirement for astronaut safety during space missions, and NASA's ongoing efforts to mature next-generation lunar spacesuits and ensure compatibility across spacecraft interfaces are vital to the success of future missions. Safety remains NASA's top priority for the Agency and its partners as they develop critical hardware elements.

Axiom Space recently achieved a significant milestone in the development of the next-generation lunar spacesuit with the completion of a contractor-led technical review that advances toward a formal NASA assessment of the design's readiness for Artemis III. This assessment is a NASA-led critical design sync review that will provide an opportunity to confirm that the design's hardware and systems are on track for final testing and delivery. Axiom Space's achievement reflects the shared commitment to deliver a safe, capable lunar spacesuit that will enable astronauts to explore the Moon's surface. NASA is actively testing next-generation Exploration Extravehicular Mobility Unit spacesuits for Artemis lunar missions, focusing on mobility, thermal control, and dust tolerance. Testing includes underwater simulations in the Neutral Buoyancy Laboratory, vacuum chamber tests at NASA's Lyndon B. Johnson Space Center, and crewed "human-in-the-loop" evaluations. This progress underscores continued confidence that the spacesuit development effort is advancing as planned and remains aligned with the schedule required to support the lunar surface mission by 2028.

The OIG makes two recommendations to the Associate Administrator for Exploration Systems Development Mission Directorate to improve management of the Agency's next-generation spacesuits. Specifically, the OIG recommends the following:

Recommendation 1: Seek industry input on current xEVAS contract requirements to maintain competition as needed in the future.

> **Management's Response:** NASA concurs with this recommendation. The Agency previously sought industry input during the initial Request for Information for commercial spacesuits and spacewalk services supporting both International Space Station and Artemis missions. This engagement informed the development of a robust

set of requirements that were included in the final Request for Proposal for the next-generation spacesuit. If NASA decides to add support to the xEVA contract or establish a successor contract before September 2027, the Agency will seek industry feedback on contractor requirements to ensure sustained competition and provide evidence of such engagement.

Estimated Completion Date: December 31, 2027.

Recommendation 2: Develop a plan to establish interoperability standards between Artemis lunar vehicles and spacesuits.

Management's Response: NASA concurs with this recommendation. Work is already underway to coordinate across relevant programs, and the Agency will develop a plan to establish interoperability standards between Artemis lunar vehicles and spacesuits. Upon completing the individual Artemis vehicle-to-xEVA System Interface Control Documents (ICDs), NASA will develop a single, consolidated Artemis vehicle-to-xEVA System ICD.

Estimated Completion Date: December 31, 2027.

We have reviewed the draft report for information that should not be publicly released. As a result of this review, we have not identified any information that should not be publicly released.

Once again, thank you for the opportunity to review and comment on the subject draft report. If you have any questions or require additional information regarding this response, please contact Christine Solga at (202) 358-1238.

Lori Glaze Digitally signed by Lori Glaze
Date: 2026.04.06 11:04:13 -04'00'

Dr. Lori S. Glaze

cc:
Associate Administrator for Space Operations Mission Directorate/Joel Montalbano (Acting)
Assistant Administrator for Procurement/Mr. Horne (Acting)
Program Manager, Extravehicular Activity & Human Surface Mobility/Ms. Kearney

APPENDIX C: REPORT DISTRIBUTION

National Aeronautics and Space Administration

Administrator
Associate Administrator
Chief of Staff
Acting Chief Program Management Officer
Acting Associate Administrator for Exploration Systems Development Mission Directorate
Acting Associate Administrator for Space Operations Mission Directorate
Acting Assistant Administrator for Procurement
Director, Johnson Space Center
Program Manager, Extravehicular Activity and Human Surface Mobility Program
Program Manager, International Space Station Program

Non-NASA Organizations and Individuals

Office of Management and Budget
    Deputy Associate Director, Energy, Science, and Water Division

Government Accountability Office
    Director, Contracting and National Security Acquisitions

Congressional Committees and Subcommittees, Chair and Ranking Member

Senate Committee on Appropriations
    Subcommittee on Commerce, Justice, Science, and Related Agencies

Senate Committee on Commerce, Science, and Transportation
    Subcommittee on Aviation, Space, and Innovation
    Subcommittee on Science, Manufacturing, and Competitiveness

Senate Committee on Homeland Security and Governmental Affairs

House Committee on Appropriations
    Subcommittee on Commerce, Justice, Science, and Related Agencies

House Committee on Oversight and Government Reform
    Subcommittee on Government Operations

House Committee on Science, Space, and Technology
    Subcommittee on Investigations and Oversight
    Subcommittee on Research and Technology
    Subcommittee on Space and Aeronautics

(Assignment No. A-24-14-01-HED)