National Aeronautics and Space Administration

COMMERCIAL CREW PROGRAM

American Rockets
American
Spacecraft
American Soil

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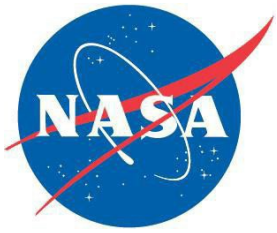


What is Commercial Crew?

NASA's Commercial Crew Program is delivering on its goal of safe, reliable, and cost-effective human transportation to and from the International Space Station from the United States through a partnership with American private industry. A new generation of spacecraft and launch systems capable of carrying astronauts to low-Earth orbit and the International Space Station provides expanded utility, additional research time, and broader opportunities for discovery on the orbiting laboratory.

The station is a critical testbed for NASA to understand and overcome the challenges of long- duration spaceflight. As commercial companies focus on providing human transportation services to and from low-Earth orbit, NASA is freed up to focus on building spacecraft and rockets for deep space missions. With the ability to purchase astronaut transportation from Boeing and SpaceX as a service on a fixed-price contract, NASA can use resources to put the first woman and the first person of color on the Moon as a part of our Artemis missions in preparation for human missions to Mars.

NASA has officially certified SpaceX's crew system and started regular missions with astronauts to the International Space Station. SpaceX's Crew Dragon spacecraft launches on the company's Falcon 9 rocket from Launch Complex 39A at NASA's Kennedy Space Center in Florida.

NASA and Boeing continue to make progress on the company's second uncrewed flight test on the CST-100 Starliner system to prove its capability to carry astronauts to low-Earth orbit and the International Space Station. The end-to-end flight test, known as Orbital Flight Test 2 (OFT-2), launched on the United Launch Alliance Atlas V rocket from Space Launch Complex 41 on Cape Canaveral Space Force Station in Florida on May 19, 2022. Following the successful launch of OFT-2, Boeing's crewed test flight on Starliner is scheduled for Spring 2023. If successful, this paves the way for NASA's certification of Boeing's astronaut transportation system for regular missions to the ISS.

How is the Commercial Crew Program Different?
The Commercial Crew Program represents a revolutionary approach to government and commercial collaborations for the advancement of space exploration.

NASA's Prior Approach for Obtaining Crew Transportation Systems
Since the Mercury program in the early 1960s, NASA has used an almost identical operating model to achieve its goals of human spaceflight. This includes the Space Shuttle Program and the American portions of the International Space Station. NASA would identify a need for a crew transportation system and then the agency's engineers and specialists would oversee every development aspect of the spacecraft, support systems, and operations plans. A commercial aerospace contractor would be chosen to build the system, ensuring that it meets the specifications spelled out by NASA. Personnel from NASA would be heavily involved and oversee the processing, testing, launching, and operation of the crew system to ensure safety and reliability. All of the hardware and infrastructure would be owned by NASA.

Commercial Crew's Approach for Obtaining Crew Transportation Systems
NASA identified a need for a crew transportation system and a broad set of requirements that would be necessary to ensure crew safety. In the case of commercial crew, the need centered around a safe, reliable, and cost-effective means of getting humans to low-Earth orbit, including the International Space Station, and return safely to Earth. Interested companies are free to design in a way they think is best and are encouraged to apply their most efficient and effective manufacturing and business operating techniques. The companies own and operate their hardware and infrastructure. NASA's engineers and aerospace specialists work closely with the commercial companies, allowing for substantial insight into the development process and offering up expertise and available resources.

The Commercial Crew Program is the first time this model has been implemented.
For more, click here: https://www.nasa.gov/content/commercial-crew-program-the-essentials/.

National Investment

NASA, Boeing and SpaceX, with the help of contractors throughout America, have accomplished something amazing. Men and women at locations across the country have dedicated countless hours to the Commercial Crew Program to achieve a common goal: restore our nation’s ability to launch humans to the International Space Station from U.S. soil.

This government-private industry partnership has significant economic benefits, with more than 1,000 suppliers employing workers in all 50 states to support commercial crew spacecraft systems. Great minds are applying their most efficient and innovative approaches to launch astronauts back into low-Earth orbit on American-made spacecraft and rockets.

Commercial Crew Program Timeline

2010
NASA invests about $50 million for Commercial Crew Development Round 1 (CCDev1) to stimulate efforts within the private sector to aid in the development and demonstration of safe, reliable and cost-effective crew transportation capabilities. Companies include:

- Blue Origin
- Boeing
- Paragon Space Development Corporation
- Sierra Nevada Corporation
- United Launch Alliance

2011
NASA continues to develop partnerships with industry through Commercial Crew Development Round 2 (CCDev2) by awarding nearly $270 million to four companies and providing expertise to an additional three companies to further development and demonstration of safe, reliable and cost-effective transportation capabilities. The agency's funded agreements are with:

- Blue Origin
- Boeing
- Sierra Nevada Corporation
- SpaceX

The agency's unfunded agreements are with:

- Alliant Techsystems Inc.
- Excalibur Almaz I
- United Launch Alliance

2012
Commercial Crew Integrated Capability (CCiCap) continues the development of three fully integrated systems in August 2012. The Space Act Agreements call for industry partners to develop crew transportation capabilities and to perform tests to verify, validate and mature integrated designs. Companies include:

- Boeing
- Sierra Nevada Corporation
- SpaceX

2013
Kickoff of the Certification Products Contracts (CPC), is the first of a two-phase certification plan. The three U.S. companies work with NASA to develop data products to implement the agency's flight safety and performance requirements. This includes implementation across all aspects of the space system, including the spacecraft, launch vehicle, and ground and mission operations. NASA awards a total of about $30 million under the CPC contracts. Companies include:

- Boeing
- Sierra Nevada Corporation
- SpaceX

2014
Commercial Crew Transportation Capability (CCtCap), the second of a two-phase certification plan for commercially built and operated integrated crew transportation systems, begins. Through its certification efforts, NASA will ensure the selected commercial transportation systems meet the agency's safety and performance requirements for transporting NASA crew to the International Space Station. NASA awards a total of $6.8 billion under CCtCap contracts.
Companies include:

- Boeing
- SpaceX

2015
NASA names four astronauts as Commercial Crew Cadre to work with Boeing and SpaceX as the companies refine their spacecraft systems. The crew provides invaluable user experience feedback to help shape their hardware and systems to ensure they are ready for flight.
Astronauts include:

- Bob Behnken
- Eric Boe
- Doug Hurley
- Suni Williams

2016
Boeing and SpaceX design and manufacture hardware for testing to ensure their spacecraft can handle the harsh environment of space.

The International Docking Adapter, or IDA, is installed on the International Space Station. Two IDAs will ultimately serve as the docking points for Boeing's CST-100 Starliner and SpaceX's Crew Dragon.

2017
Boeing and SpaceX continue development and testing to prepare for emergency situations and ensure human safety.

Boeing and SpaceX unveil brand-new spacesuits to be worn by crews while on board each company's spacecraft.

2018
Testing ramps up and nears completion for Boeing and SpaceX as they prepare their hardware, systems, flight crews and ground support teams for launch.

NASA assigns nine astronauts to crew Boeing and SpaceX's test flights and first operational missions on Starliner and Crew Dragon.

2019
Flight Tests Completed:
SpaceX Demo-1 (March 2-8)
Boeing Pad Abort Test (Nov. 4)
Boeing Orbital Flight Test (Dec. 20-22)

2020
Flight Tests Completed:
SpaceX In-Flight Abort Test (Jan. 19)
SpaceX Demo-2 (May 30-Aug. 2)

Missions Launched:
SpaceX Crew-1 (Nov. 15)

2021
Missions Launched:
SpaceX Crew-2 (April 23)
SpaceX Crew-3 (Nov. 10)

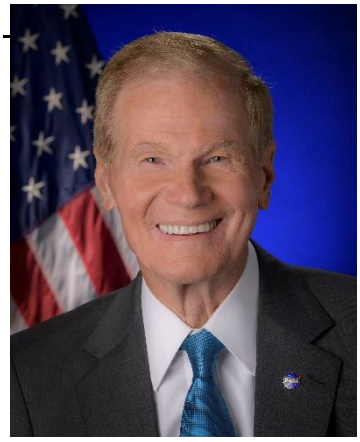
2022
SpaceX Crew-4 (April 27)
Boeing Orbital Flight Test-2 (May 19)
SpaceX Crew-5 (Early fall 2022)

Upcoming Missions:
Boeing Crew Flight Test
SpaceX Crew-6

For NASA's launch schedule, visit
https://www.nasa.gov/launchschedule/

Biographies

NASA Leadership



Bill Nelson

Sen. Bill Nelson was sworn in as the 14th NASA administrator on May 3, 2021, tasked with carrying out the Biden-Harris administration's vision for the agency.

Nelson chaired the Space Subcommittee in the U.S. House of Representatives for six years and later served as the Ranking Member on the Senate Commerce, where he was recognized as the leading space program advocate in congress.

During his time in congress, Nelson was a strong advocate for NASA's Earth science programs and authored numerous pieces to combat and mitigate the effects of climate change. Nelson was also a vocal proponent for STEM career training and education programs to create and fill the jobs of the future.

In 2010, Nelson and Sen. Kay Bailey Hutchinson (R-Texas) passed the landmark NASA legislation that mapped out a new future for NASA and set the agency on its present dual course of both government and commercial missions. In 2017, Nelson and Sen. Ted Cruz (R-Texas) authored the NASA Transition Authorization Act of 2017, which expanded NASA's commercial activities in space. After leaving the Senate, Nelson continued to be engaged in NASA activities, serving on the NASA Advisory Council under former Administrator Jim Bridenstine.

From president of 4-H to international president of the Key Club in high school, Nelson has always known the importance of investing in your neighbors and community to create a better future. Nelson continued to serve his community and country while in college at the University of Florida, Yale, and University of Virginia Law School through various service organizations, school leadership positions. He served on active duty as a Captain in the U.S. Army.

Nelson has served in public office over four decades, first in the state legislature and U.S. Congress, then as State Treasurer. He was elected three times to the United States Senate, representing Florida for 18 years. His committees included the breadth of government policy from defense, intelligence and foreign policy to finance, commerce, and health care.

In 1986 he flew on the 24th flight of the Space Shuttle. The mission on Columbia orbited the earth 98 times over six days. Nelson conducted 12 medical experiments including the first American stress test in space and a cancer research experiment sponsored by university researchers.

In 1971, Bill met Grace Cavert of Jacksonville, Florida, while speaking at a statewide young leader convention. Grace has been an active partner in Bill's public service career. From his first race for a seat in the Florida Legislature, Grace has been by his side knocking on doors and talking to folks about issues that mattered to them and their families. They have two grown children, Bill Jr. and Nan Ellen.

Kathy Lueders

Kathy Lueders was named associate administrator for NASA's Space Operations Mission Directorate on Sept. 21, 2021. She was selected by former NASA Administrator Jim Bridenstine to lead the Human Exploration and Operations (HEO) Mission Directorate June 12, 2020. Since 2014, Lueders has directed NASA's efforts to send astronauts to space on private spacecraft, which culminated in the successful launch of Demo-2 from the Kennedy Space Center in Florida on May 30.

Lueders began her NASA career in 1992 at the White Sands Test Facility in New Mexico, where she was the Shuttle Orbital Maneuvering System and Reaction Control Systems Depot manager. She later moved to the International Space Station Program and served as transportation integration manager, where she led commercial cargo resupply services to the space station.

She also was responsible for NASA oversight of international partner spacecraft visiting the space station, including the European Space Agency's Automated Transfer Vehicle, the Japan Aerospace Exploration Agency's H-II Transfer Vehicle, and the Russian space agency Roscosmos' Soyuz and Progress spacecraft. She went to Kennedy as acting Commercial Crew Program Manager in 2013 and was selected as the head of the office in 2014.

Lueders has a Bachelor of Business Administration in Finance from the University of New Mexico and a Bachelor of Science and Master of Science in Industrial Engineering from New Mexico State University.

Janet Petro

Janet E. Petro was named the 11th director of NASA's John F. Kennedy Space Center in Florida on June 30, 2021. She had been serving as acting director since May 2021 following NASA Administrator Sen. Bill Nelson's announcement that Robert D. Cabana, previous Kennedy director, would assume the role of NASA's associate administrator.

Prior to being named director, Petro served as Kennedy's deputy director since April 2007, where she shared responsibility with the center director in managing the Kennedy team of civil service and contractor employees, determining and implementing center policy and managing and executing Kennedy missions and agency program responsibilities.

During her tenure as deputy director, Petro helped Kennedy transition into a multi-user spaceport, leading cross-agency initiatives with the Federal Aviation Administration and U.S. Air Force to streamline government processes and support commercial space operations to increase government efficiency and limit redundancy. She served a 12-month appointment at NASA Headquarters in Washington, D.C. as the deputy associate administrator and acting director for the Office of Evaluation. From 2017 through January 2020, she served as the Program Executive leading the agencywide initiative for a phased implementation to restructure all mission enabling functions to ensure efficient and effective support of NASA's missions. Her assignment to the Mission Support Future Architecture Program (MAP) concluded in January 2020.

Petro began her professional career as a commissioned officer in the U.S. Army after graduating in 1981 from the U.S. Military Academy at West Point, New York, with a Bachelor of Science degree in engineering. She was in the second class of West Point graduates to include women. Petro also holds a Master of Science degree in business administration from Boston University's Metropolitan College.

Prior to joining NASA, Petro served in various management positions for Science Applications International Corp. (SAIC) and McDonnell Douglas Aerospace Corporation. At SAIC, Petro held a number of management positions within the corporation's operations. She interfaced with NASA, the U.S. Air Force, the U.S. Navy, and commercial entities on numerous aerospace and military programs. At McDonnell Douglas Aerospace, Petro advanced from mechanical engineer and payload manager to multiple management positions including program manager for executing a classified, multimillion-dollar U.S. Department of Defense program, to senior manager for Communications and Data Systems Division.

Petro is the recipient of numerous service and performance awards. She helped lead the senior management team that was awarded the 2019 Samuel J. Heyman Service to America Sammies Management Excellence Medal, she is the recipient of a President's Distinguished executive award and has received the astronaut-selected Silver Snoopy award for outstanding performance for contributing to flight safety and mission success. In 2018, Petro was selected by Florida Governor Rick Scott for induction in the Florida Women's Hall of Fame.

Vanessa E. Wyche

Vanessa E. Wyche is the director of NASA's Johnson Space Center, home to America's astronaut corps, Mission Control Center, International Space Station, Orion and Gateway Programs and its more than 10,000 civil service and contractor employees. She is responsible for overseeing a broad range of human spaceflight activities, including development and operation of human spacecraft, commercialization of low-Earth orbit and Johnson's role in landing the first woman and first person of color on the surface of the Moon.

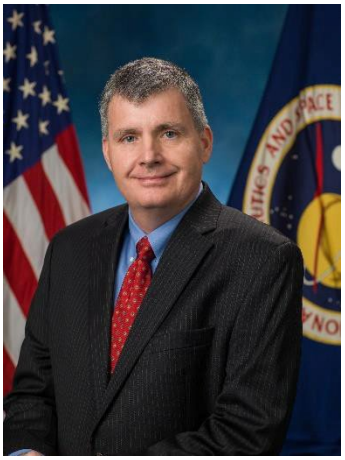
Wyche was most recently deputy director at Johnson, a position she held since 2018. Other key leadership positions Wyche has held at NASA include: assistant and deputy director of Johnson; director of the Exploration Integration and Science Directorate, flight manager of several missions of the retired Space Shuttle Program, executive officer in the Office of the NASA Administrator, and led additional center- level technical and program organizations. Before joining NASA in 1989, Wyche worked for the Food and Drug Administration in Washington D.C.

Wyche has received many prestigious awards including two NASA Outstanding Leadership Medals, two NASA Achievement Medals, and is a "Women at NASA" awardee. She has been recognized as a national "Women Worth Watching" honoree by Profiles in Diversity Journal, an "Inspiring Woman from South Carolina" by Coastal Carolina University. She is a current fellow of the International Women's Forum.

Wyche is a native of South Carolina and earned a Bachelor of Science in engineering and a Master of Science in bioengineering from Clemson University. In recognition of her contributions to the engineering profession, she was inducted into the Thomas Green Clemson Academy of Engineers and Scientists at Clemson University in 2019.

A strong supporter of innovation and inclusion (I&I), she serves as a member of JSC's I&I Council and advocates for mentorship at all levels. She is also a passionate promoter of science, technology, engineering, and math (STEM) serving on the Houston Exponential and SpaceCom boards, as a member of the University of Houston's C.T. Bauer College of Business Advisory Panel and is a past chair of the space Center Houston board of directors. Wyche is active in multiple organizations in her community sharing her passion for STEM and future leader development.

Wyche is married to George Wyche Jr. Esq, and has one son, George Wyche III.



Steve Stich

Steve Stich serves as the program manager for NASA's Commercial Crew Program. In this role, he aids in the execution of the agency's goals to help private companies develop a new U.S. capability to carry astronauts into low-Earth orbit and eventually take crews to the International Space Station, or ISS. He oversees program facilitation of commercial spacecraft development and certification to enable the safe transportation of NASA astronauts.

Stich previously served as the deputy manager of NASA's Commercial Crew Program, assisting in the overall business, technical management and integration of the program. Based at NASA's Johnson Space Center in Houston, he also is a member of the program leadershipteam guiding NASA's direction in developing U.S. crew transportation services to the International Space Station.

Prior to his role in the Commercial Crew Program, Stich served as director of the Exploration Integration and Science Directorate, with a focus on the strategic direction of exploration and science activities at Johnson.

Stich earned a Bachelor of Science in aerospace engineering from Texas A&M University in 1987 and joined NASA that same year.

His NASA career has spanned numerous organizations, including Johnson's Engineering, White Sands Test Facility, Space Shuttle Program and Johnson's Advanced Exploration Systems. Stich has been instrumental in many exploration concepts and strategies in support of the Human Exploration and Operations Mission Directorate including leading a multi-center team developing the near-term proving-ground missions for Orion and the Space Launch System rocket, or SLS.

Stich also served as deputy director of Engineering at Johnson, manager of the Orbiter Project Office, deputy manager of the White Sands Test Facility, and as an ascent/entry flight director for space shuttle missions.

The commercial crew providers are developing the ground and mission operations, launch vehicles and spacecraft to safely transport crews to the International Space Station and return them safely to a landing site along with a small amount of critical cargo. The Commercial Crew Program is assisting the providers with their transportation system development to ensure the provider's vehicles meet the NASA safety and performance requirements through their certification of flight readiness process.

Dana Hutcherson

Dana M. Hutcherson is the deputy program manager of NASA's Commercial Crew Program (CCP) at Kennedy Space Center in Florida. CCP is working with the American aerospace industry to develop safe, reliable and cost-effective crew transportation systems for low-Earth orbit destinations, including the International Space Station. Along with the program manager, Hutcherson is responsible for the budgeting, contracting, safety and technical areas of the program at Kennedy.

Hutcherson previously served as deputy manager of the CCP Systems Engineering and Integration Office, which included managing and maintaining program requirements as well as prioritizing, planning, tracking and integrating the certification of the Boeing and SpaceX crew transportation system designs for the Commercial Crew Transportation Capability contracts. She initially joined CCP as deputy manager of the program's Launch Vehicle Systems Office, inwhich she supported in the oversight of partner launch vehicle design, development, testing, operational readiness, compliance verification, risk management and system certification.

Prior to joining CCP, Hutcherson was a NASA flow director within the Launch Vehicle Processing Directorate at Kennedy. She acquired management responsibility for integrating, scheduling and conducting space shuttle Endeavour's processing operations in February 2009.Her last task for the shuttle program was leading the ground processing team during the final flow of space shuttle Endeavour for its final mission to the International Space Station, STS- 134.

Hutcherson joined the nation's space program as a Kennedy team member in 2000. She began her career with United Space Alliance as an airframe engineer, obtaining dual-system certifications in both the Thermal Protection Subsystem and Orbiter Structures System. In 2004, Hutcherson transitioned into an engineering leadership position with United Space Alliance's Orbiter Element Division where she served as a subsystem engineer in the thermal protection and reinforced carbon systems.

In 2006, Hutcherson joined NASA as a member of the Shuttle Operations and Integration Division and vehicle processing engineer for shuttle Atlantis. She was promoted to NASA vehicle manager for Atlantis in 2007, taking on more of a leadership role within the NASA Operations Team for the overall processing of Atlantis from landing through launch. She provided leadership, direction and oversight to planning and scheduling operations and overall management of the processing team. Hutcherson held this position until her appointment as flow director of Endeavour.

She has received numerous honors, including On the Spot Awards, Group Achievement Awards, a Certificate of Commendation, NASA's Space Flight Awareness Award, Space Flight Awareness Leadership Award and Outstanding Leadership Medal. She also was recognized as CCP's Program Employee of the Year for 2013.

Hutcherson graduated from Evans High School in Evans, Georgia. She received a Bachelor of Science in mechanical engineering from the Georgia Institute of Technology in Atlanta. Shealso earned a Master of Science in industrial engineering of engineering management from the University of Central Florida in Orlando.

Ven Feng

Ven Feng is the deputy program manager of NASA's Commercial Crew Program at the Johnson Space Center in Houston. In this role, he is responsible for assisting in the overall business, technical management, and integration of U.S. commercia crew transportation systems from SpaceX and Boeing.

Prior to this assignment, he served as the manager for the International Space Station (ISS) Transportation Office, where he managed integration and/or development of 66 missions to the ISS including commercial cargo resupply missions (NorthropGrumman, Sierra Nevada, SpaceX), ISS integration with commercial crew spacecraft (Boeing, SpaceX) and International Partners (Soyuz, Progress, HTV, HTV-X). He was responsible for managing the overall strategic, tactical, and executional readiness of the space station fleet to meet programmatic and customer needs.

He has held leadership positions across ISS visiting vehicle integration, external integration, safety and mission assurance, avionics and software, operations integration and payloads. He has provided leadership and direction for implementing agency policy for human spaceflight programs in the U.S. and abroad. He has supported the ISS, space shuttle and Spacelab as a contractor and civil servant.

He is a recipient of the Outstanding Leadership Medal, Exceptional Service Medal, Rotary NASA Stellar Award, Silver Snoopy, Space Flight Awareness, Center Director's Commendation and other awards.

Feng graduated from the University of Texas with a Bachelor of Science in mechanical engineering in 1989. In 2008, he completed Harvard University's Senior Executive Fellowship, and in 2011, he underwent NASA program/project management development.

Reid Wiseman

Reid Wiseman served as Flight Engineer aboard the International Space Station for Expedition 41 from May through November of 2014. During the 165-day mission, Reid and his crewmates completed over 300 scientific experiments in areas such as human physiology, medicine, physical science, Earth science and astrophysics.

They set a milestone for station science by completing a record 82hours of research in a single week. This was Reid's first spaceflight, which also included almost 13 hours as lead spacewalker during two trips outside the orbital complex. Reid also fostered a strong social media presence throughout his mission by sharing the raw emotions of spaceflight as seen through the eyes of a rookie flier.

The Baltimore native earned a Bachelor of Science degree from Rensselaer Polytechnic Institute in Troy, New York, and a Master of Science in systems engineering from the Johns Hopkins University in Baltimore. Currently, Wiseman is the Chief of the Astronaut Office.

Joel Montalbano

Joel Montalbano is presently serving as the International Space Station (ISS) Program Manager. He is responsible for the overall management, development, integration and operation of the ISS. This nearly $3B per year, 15-nation program encompasses the design, manufacture, testing and delivery of complex space flight hardware and software and its integration with modules from international partners into a fully functional and operating space station with a permanent human presence. In addition, the program manager is responsible for policy development, international partner negotiations, development of low-Earth orbit commercialization, onboard research and utilization, and the overall safety and health of the crew and on-orbit vehicle.

Previously, Montalbano served as the deputy program manager for the ISS Program Office, sharing responsibility with the program manager for day-to-day management of the program. Montalbano worked across ISS organizations, NASA centers, other government agencies, and partners to ensure seamless and efficient ISS integration, to ensure recognition as a National Laboratory with defined projects that support national, agency, and ISS Program goals for scientific, technological, diplomatic, and educational purposes and which support future objectives in human space exploration, and to foster commercial activities in low-Earth orbit.

Prior to his role as the deputy program manager, Montalbano served as the director of NASA's Human Space Flight Program in Russia from 2008 to 2012. He was also a NASA Flight Director from 2000 – 2008. Each NASA flight director chooses a symbol/color to represent his team. Montalbano chose Flash for his flight control team. In Mission Control Center, the Foundation of Mission Operations states "To always be aware that suddenly and unexpectedly we may find ourselves in a role where our performance has ultimate consequences." At all times, the Flight Control Team must be able to react quickly and decisively (in a flash). Montalbano started his career at Rockwell in June 1988 and became a NASA civil servant in August 1998. He was inducted into the Senior Executive Service in 2008. He began his current role in 2020.

In 2018, Montalbano has been recognized with the NASA Distinguished Service Medal as well as the Advancement of International Cooperation Award by the American Astronomical Society. In 2017, he received the JSC Directors Commendation. He was awarded Rank of Meritorious Executive, conferred by the President of the United States in 2012. In 2007, he received the NASA Exceptional Service Medal and the Superior Accomplishment Award. He was awarded the NASA Outstanding Leadership Medal in 2004 and both the Rotary Space Award Nominee and the NASA Exceptional Service Medal in 2003. He was presented the Flight Director Plaque Hanging Honor at NASA's Mission Control Center in both 1997 and 1995. He was awarded the Astronaut's Silver Snoopy and was a Manned Space Flight Awareness Honoree in 1994. Montalbano was also an Eagle Scout.

Montalbano holds a bachelor's degree in aerospace, aeronautical, and astronautical engineering from Iowa State University.

Astronaut Training

Commercial Crew astronauts work side-by-side with Boeing and SpaceX to understand the spacecraft and launch systems, the spacesuits, and refine how to operate in space.

The astronauts also train to live and work aboard the space station, where they stay for up to six months on each crewed mission. The astronauts go through significant preparation forspace station missions, including learning how to conduct spacewalks, maintain the space station, and perform a myriad of research investigations covering all scientific disciplines.

The astronauts have participated in many nominal and off-nominal mission simulations, studying every aspect of their spacecraft, as well as launch, in-orbit and landing procedures.This intense work ensures they are prepared for any situation that may arise during their mission.

Current Missions

LAUNCH AMERICA

NASA's SpaceX Crew-5

Crew-5 will be the fifth crew rotation mission of SpaceX's human space transportation system and its sixth flight with astronauts, including the Demo-2 test flight, to the space station through NASA's Commercial Crew Program. Crew-5 is expected to launch no earlier than fall 2022.

The following astronauts have been assigned to the mission:

- Nicole Mann, Spacecraft Commander
- Josh Cassada, Pilot
- Koichi Wakata, Mission Specialist
- Anna Kikina, Mission Specialist

NASA's SpaceX Crew-4

Crew-4 is the fourth crew rotation mission of SpaceX's human space transportation system to the space station through NASA's Commercial Crew Program.

NASA astronauts Kjell Lindgren, spacecraft commander, Bob Hines, pilot, Jessica Watkins, mission specialist, and ESA astronaut Samantha Cristoforetti, International Space Station commander, lifted off on a SpaceX Falcon 9 rocket and Crew Dragon from Launch Complex 39A at Kennedy Space Center in Florida on April 27, 2022.

Crew-4 will spend several months conducting science and maintenance aboard the orbiting laboratory before the four astronauts return to Earth in fall 2022, after a brief handover to Crew-5.

Upcoming Missions

CFT

Boeing's Crew Flight Test (CFT) will help write a new chapter in human spaceflight by launching the first flight of the CST-100 Starliner spacecraft with astronauts to the International Space Station. CFT will demonstrate the ability of the Atlas V rocket and Starliner to safely carry astronauts to and from the space station as part of the agency's Commercial Crew Program. The CFT mission will occur once all flight objectives from OFT-2 are met. Both are targeted for launch in 2022.

The following two astronauts are currently training for the mission:

- Barry "Butch" E. Wilmore, Spacecraft Commander
- Mike Fincke, Joint Operations Commander

Crew-6

Crew-6 will be the sixth crew rotation mission of SpaceX's human space transportation system and its seventh flight with astronauts, including the Demo-2 test flight, to the space station through NASA's Commercial Crew Program. Crew-6 is expected to launch no earlier than spring 2023.

The following astronauts have been assigned to the mission:

- Stephen Bowen, Spacecraft Commander
- Woody Hoburg, Pilot
- Andrei Fedyaev, Mission Specialist
- Sultan AlNeyadi, Mission Specialist

Starliner-1

Starliner-1 will be Boeing's first operational flight with crew to the International Space Station aspart of the agency's Commercial Crew Program. Launch is TBD.

The following astronauts are currently training for the mission, and additional flight assignments will be made in the future:

- Jeanette Epps
- Sunita (Suni) Williams

Crew-7

Crew-7 will be the seventh crew rotation mission of SpaceX's human space transportation system and its eighth flight with astronauts, including the Demo-2 test flight, to the space station through NASA's Commercial Crew Program. Crew-7 is expected to launch no earlier than 2023.

The following astronauts are currently training for the mission, and additional flight assignments will be made in the future:

- Jasmin Moghbeli, Spacecraft Commander
- Andreas Mogensen, Pilot

SpaceX Operations

Crew Dragon

Designed with crew and reuse in mind, Crew Dragon is an innovative achievement worthy of the challenge to advance human spaceflight.

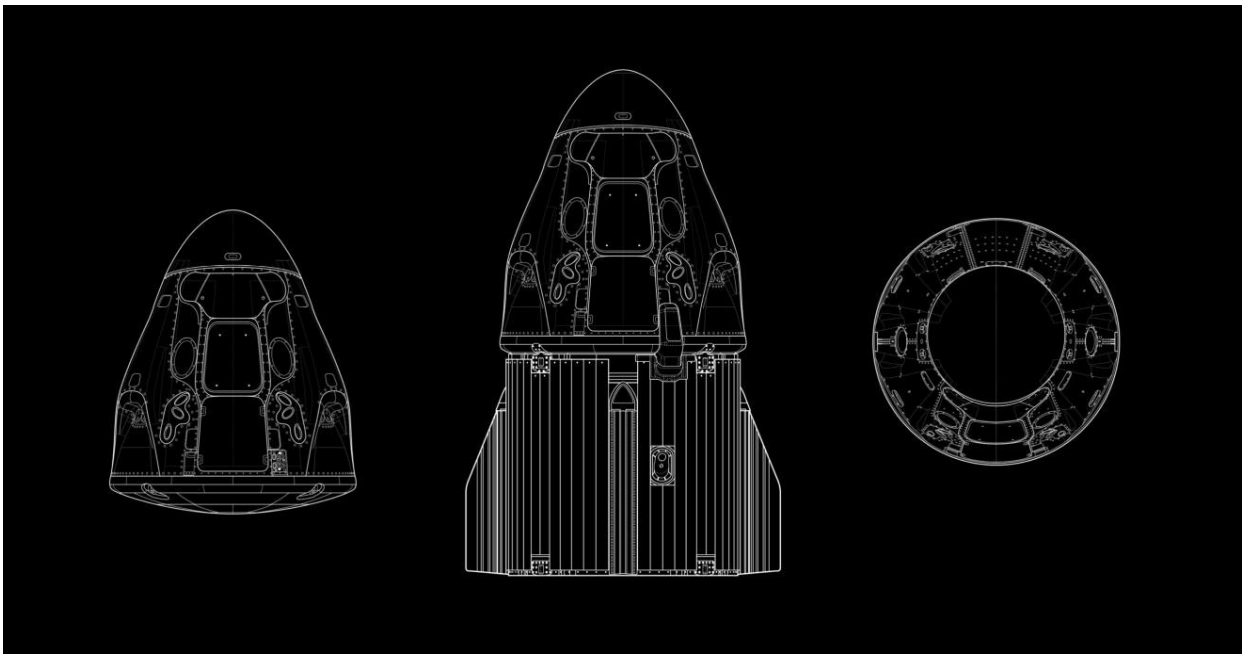
SpaceX's Crew Dragon spacecraft has re-established an American human launch capability, flying astronauts regularly to the International Space Station from U.S. soil and increasing use of the orbiting laboratory’s unique research environment.

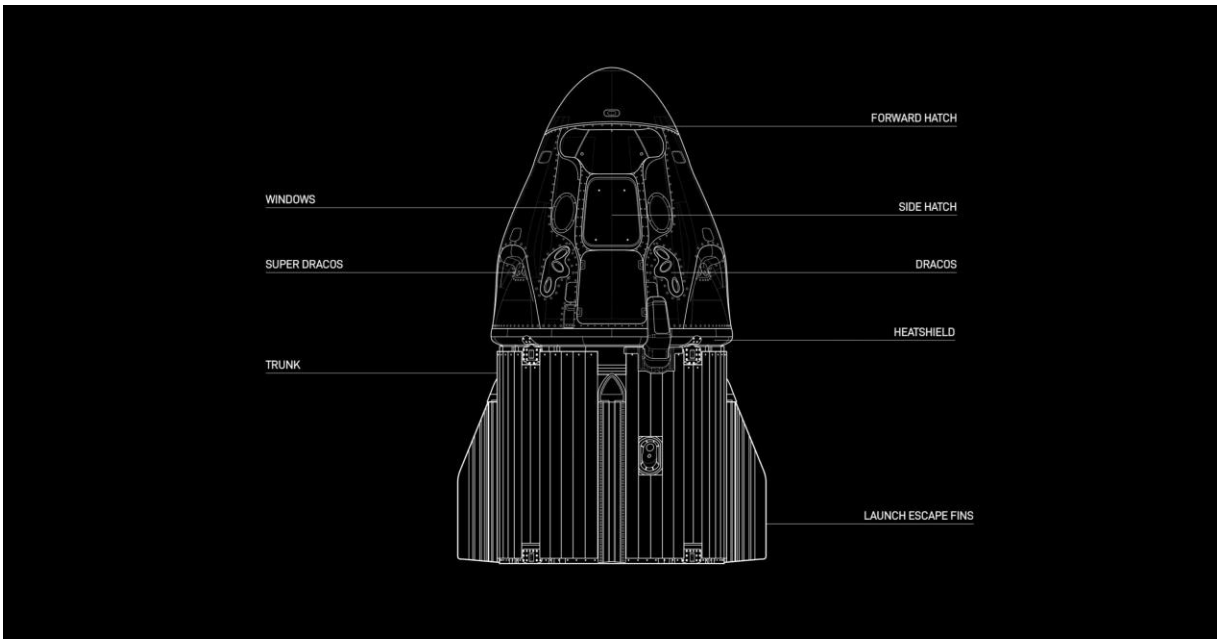
Crew Dragon is an autonomous spacecraft designed to deliver crew and critical cargo to orbiting destinations.

Crew Dragon launches atop a Falcon 9 rocket from Launch Complex 39A at NASA's Kennedy Space Center in Florida.

As part of NASA's commercial resupply services contract with SpaceX, the company developed its cargo Dragon spacecraft to carry science and supplies to space, but they designed it with people in mind. For its second commercial resupply services contract, SpaceX delivered an upgraded cargo Dragon similar to the Crew Dragon that also lifts off from Launch Complex 39A at NASA’s Kennedy Space Center.


SPACEX





Crew Dragon Design and Development

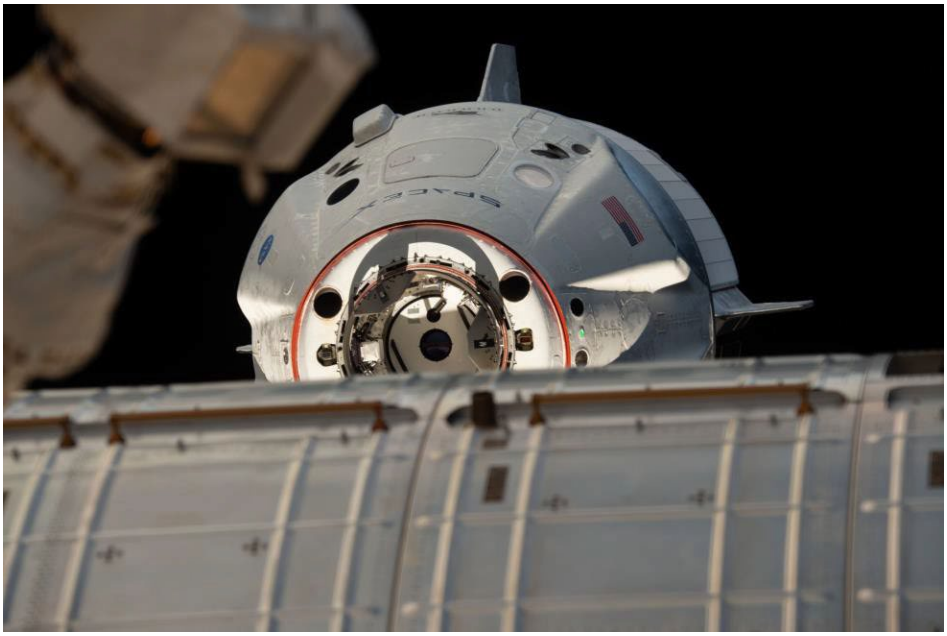
Crew Dragon was developed in collaboration with NASA's Commercial Crew Program.

In 2014, NASA awarded Commercial Crew Transportation Capability (CCtCap) contracts to Boeing and SpaceX to each safely and cost-effectively transport astronauts to the International Space Station from the United States.

Crew Dragon is capable of carrying up to seven passengers but carries up to four astronauts for NASA missions, and is designed for water landings.

Crew Dragon's displays provide real-time information on the state of the spacecraft's capabilities—anything from the spacecraft's position in space, to possible destinations, to the environment on board.

Crew Dragon is a fully autonomous spacecraft that can be monitored and controlled by onboard astronauts and SpaceX mission control in Hawthorne, California.



Dragon is composed of two main elements: the capsule, which is designed to carry crew and critical, pressurized cargo, and the trunk, which is an unpressurized service module. The capsule is subdivided into the pressurized section, the service section and the nose cone, which is opened once on orbit and stowed prior to re-entry.

Near the base of the capsule, but outside the pressurized structure, are the Draco thrusters, which allow for orbital maneuvering. Additional Draco thrusters are housed under the nose cone, along with Dragon's Guidance Navigation and Control (GNC) sensors.

Dragon's trunk provides the mating interface for the capsule to Falcon 9 on its ascent to space. On orbit, half of the trunk contains a solar array, which powers Dragon, and the other half contains a radiator, which rejects heat. Both the radiator and solar array are mounted to the exterior of the trunk, which remains attached to Dragon until shortly before re-entry when the trunk is jettisoned.

Crew Dragon was designed with three windows so passengers can take in views of Earth, the Moon and the wider solar system right from their seats.

Crew Dragon has an Environmental Control and Life Support System (ECLSS) that provides a comfortable and safe environment for crew members. During their trip, astronauts onboard can set the spacecraft's interior temperature to between 65 and 80 degrees Fahrenheit.

Crew Dragon features an advanced abort system with eight SuperDraco engines and a series of parachutes that can be activated instantaneously from the moment they are armed onthe launch pad all the way through orbital insertion.

NASA and SpaceX are capable of supporting seven splashdown sites located off Florida's east coast and in the Gulf of Mexico. These sites are off the coasts of Pensacola, Tampa, Tallahassee, Panama City, Cape Canaveral, Daytona, and Jacksonville.

In August 2018, NASA announced the first astronauts who would fly aboard Demo-2 and SpaceX's first operational mission, or Crew-1. In Demo-2, launched May 30, 2020, NASA astronauts Bob Behnken and Doug Hurley became the first to fly aboard Crew Dragon and returned to Earth 64 days later with a splashdown in the Gulf of Mexico on Aug. 2, 2020.

Following the successful Demo-2 flight test and completion of the NASA certification process, SpaceX began regular crew rotation missions to the space station, beginning with Crew-1. The Crew-1 crew of NASA astronauts Victor Glover, Mike Hopkins, Shannon Walker and JAXA astronaut Soichi Noguchi launched Nov. 15, 2020 and splashed down in the Gulf of Mexico on May 2, 2021.

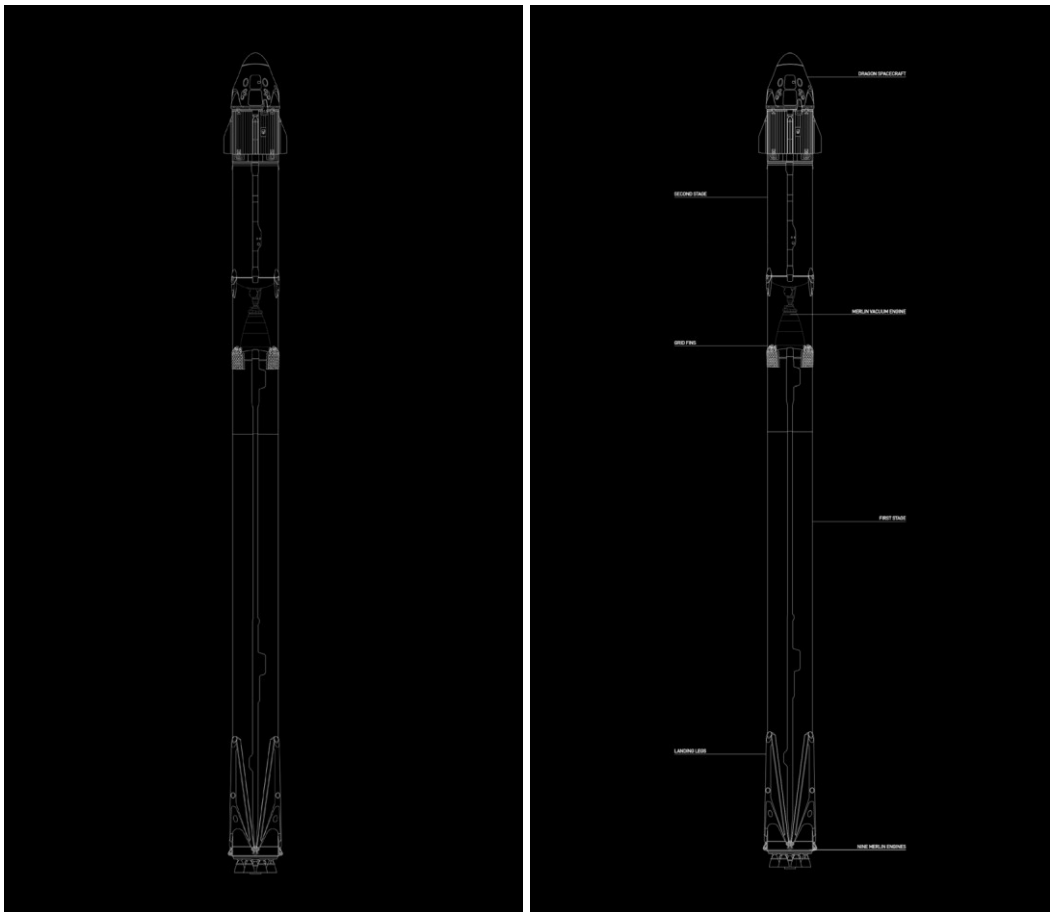
NASA has ordered six crew rotation missions to the International Space Station from SpaceX. Crew-1 was the first of these rotation missions, Crew-2 was the second, and Crew-3 was the third.

Falcon 9

Falcon 9 is a two-stage rocket designed and manufactured by SpaceX for the reliable and safe transport of satellites and the Dragon spacecraft into orbit. Falcon 9 is the first orbital class rocket capable of re-flight.

Falcon 9 made history in May 2020 when it launched two American astronauts on an American spacecraft from American soil to the International Space Station as part of NASA's Commercial Crew Program (CCP) – the first time since the retirement of the Space Shuttle Program in 2011. Falcon 9 has since successfully launched eight more astronauts to the space station for CCP.

Falcon 9 began delivering cargo to the International Space Station for NASA in 2012, making SpaceX the first commercial company to visit the station. Falcon 9 went on to make numerous tripsto space, delivering satellites to orbit as well as delivering and returning cargo from the space station for NASA, before becoming certified to launch astronauts.



Falcon 9’s first stage incorporates nine Merlin engines and aluminum-lithium alloy tanks containing liquid oxygen and rocket-grade kerosene (RP-1) propellant. After ignition, a hold-before-release system ensures that all engines are verified for full-thrust performance before the rocket is released for flight. Then, with thrust greater than five 747s at full power, the Merlin engines launch the rocket to space. Unlike airplanes, a rocket's thrust actually increases with altitude; Falcon 9 generates more than 1.7 million pounds of thrust at sea level but produces over 1.8 million pounds of thrust in the vacuum of space. The first-stage engines are gradually throttled near the end of first-stage flight to limit launch vehicle acceleration as the rocket’s mass decreases with the burning of fuel.

The interstage is a composite structure that connects the first and second stages and holds the release and separation system. Falcon 9 uses an all-pneumatic stage separation system for low-shock, highly reliable separation that can be tested on the ground, unlike pyrotechnic systems used on most launch vehicles.

Falcon 9 is equipped with an Autonomous Flight Termination System to be used in the unlikely event that the rocket drifts off course or becomes unresponsive.

Carbon fiber landing legs and hypersonic grid fins, all stowed during ascent, are two of the critical elements essential to ensure safe and successful landing of the Falcon 9 first stage.

Technical Overview

- Height: 70 meters or 229.6 feet
- Mass: 549,054 kilograms or 1,207,920 pounds
- Payload to Low Earth Orbit: 22,800 kilograms or 50,265 pounds
- Diameter: 3.7 meters or 12 feet

SpaceX Spacesuit

SpaceX designed its spacesuit for astronauts to wear inside the Crew Dragon spacecraft as they fly to and from the International Space Station and to ensure their safety as they operate in low-Earth orbit.

The suit is custom-made for each passenger aboard Crew Dragon and is designed to be functional, lightweight, and to offer protection from potential depressurization.

A single connection point on the suit's thigh attaches life support systems, including air and power connections.

The helmet is custom manufactured using 3D printing technology and includes integrated valves, mechanisms for visor retraction and locking, and microphones within the helmet's structure.

NASA astronauts perform spacesuit fit checks and other testing to prepare for their missions, including pressurized spacesuit tests.

Launch Complex 39A

Launch Complex 39A (LC-39A) was originally built for the Apollo/Saturn V rockets that launched American astronauts on their historic journeys to the Moon and back.

Since the late 1960s, Pads A and B at Kennedy Space Center's Launch Complex 39 have served as backdrops for America's most significant human spaceflight endeavors—Apollo, Skylab, Apollo-Soyuz and space shuttle.

In 2014, Space Exploration Services, or SpaceX, signed a property agreement with NASA for use and operation of LC-39A for 20 years, part of Kennedy Space Center’s transition to a multi- user spaceport.

SpaceX modified LC-39A to adapt it to the needs of the company's Falcon 9 and Falcon Heavy rockets.

SpaceX constructed a Horizontal Integration Facility near the perimeter of the pad where rockets are processed for launch prior to rollout to the pad for liftoff.

The Transporter Erector (TE) is used to move the Crew Dragon spacecraft to the top of the Falcon 9 rocket on the launch pad.

Standing 212 feet high—more than 20 stories—the TE moves launch-ready rockets and spacecraft from the processing hangar at the base of the pad up to the pad surface and into a vertical position over the flame trench.

The TE is a much larger and stronger version of the erector the company uses at Space Launch Complex 40 and is used for processing and launching Falcon Heavy rockets.

The first SpaceX launch from LC-39A was SpaceX's 10th Commercial Resupply Services mission to the International Space Station, known as CRS-10. The launch on Falcon 9 took place on Feb. 19, 2017, and carried supplies and research to the space station.

SpaceX uses LC-39A for its Crew Dragon missions to the International Space Station.

Ascent

Mission Timeline for Crew-2 Launch

(all times are approximate and subject to change)

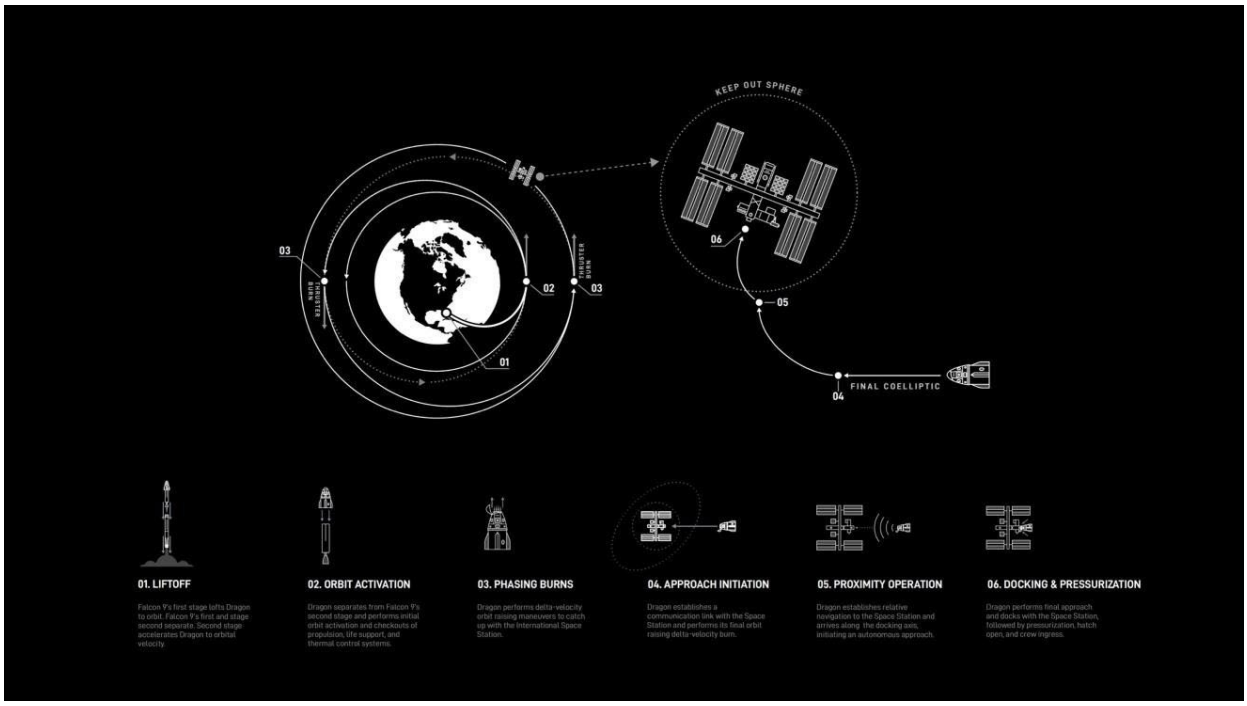
MET	Time	Event
-06:40:00	11:09:00 PM	Crew Wake
-05:30:00	12:19:02 AM	CE Launch Readiness Briefing
-05:00:00	12:49:02 AM	Launch Shift On Console
-04:59:59	12:49:03 AM	Dragon IMU align and Configure for launch
-04:30:00	1:19:02 AM	Dragon prop pressurization
-04:20:00	1:29:02 AM	Crew weather brief
-04:10:00	1:39:02 AM	Crew handoff
-04:00:00	1:49:02 AM	Suit donning and checkouts
-03:20:00	2:29:02 AM	Crew walk out from Neil Armstrong Operations & Checkout Building
-03:15:00	2:34:02 AM	Crew Transportation to Launch Complex 39A
-02:55:00	2:54:02 AM	Crew arrives at pad
-02:35:00	3:14:02 AM	Crew ingress
-02:20:00	3:29:02 AM	Communication check
-02:15:00	3:34:02 AM	Verify ready for seat rotation

-02:14:00	3:35:02 AM	Suit leak checks
-01:55:00	3:54:02 AM	Hatch close
-00:45:00	5:04:02 AM	SpaceX Launch Director verifies go for propellant load
-00:42:00	5:07:02 AM	Crew access arm retracts
-00:37:00	5:11:02 AM	Dragon launch escape system is armed
-00:35:00	5:14:02 AM	RP-1 (rocket grade kerosene) loading begins1st stage LOX (liquid oxygen) loading begins
-00:16:00	5:33:02 AM	2nd stage LOX loading begins
-00:07:00	5:42:02 AM	Falcon 9 begins engine chill prior to launch
-00:05:00	5:44:02 AM	Dragon transitions to internal power
-00:01:00	5:48:02 AM	Command flight computer begins final prelaunch checks Propellant tank pressurization to flight pressure begins
-00:00:45	5:48:17 AM	SpaceX Launch Director verifies go for launch
-00:00:03	5:48:59 AM	Engine controller commands engine ignition sequence to start
+00:00:00	5:49:02 AM	**Liftoff**
+00:01:02	5:50:04 AM	Max Q (moment of peak mechanical stress on the rocket)
+00:02:36	5:51:38 AM	1st stage main engine cutoff (MECO)
+00:02:39	5:51:41 AM	1st and 2nd stages separate
+00:02:47	5:51:49 AM	2nd stage engine starts
+00:07:27	5:56:29 AM	1st stage entry burn
+00:08:47	5:57:49 AM	2nd stage engine cutoff (SECO-1)
+00:09:03	5:58:05 AM	1st stage entry burn
+00:11:58	6:01:00 AM	Crew Dragon separates from 2nd stage
+00:13:02	6:02:04 AM	Dragon nosecone open sequence begin

International Space Station Docking

The Crew-2 astronauts arrived at the International Space Station the next day. Crew Dragon performed a series of phasing maneuvers to gradually approach and autonomously dock with the station.

After docking, the crew joined the Expedition 65 crew of Shannon Walker, Michael Hopkins, Victor Glover, and Mark Vande Hei of NASA, as well as Soichi Noguchi of JAXA and Roscosmos cosmonauts Oleg Novitskiy and Pyotr Dubrov. For a short time, the number of crew on the space station increased to 11 people until Crew-1 astronauts Walker, Hopkins, Glover, and Noguchi returned to Earth a few days later.



Retrieving Crew Dragon

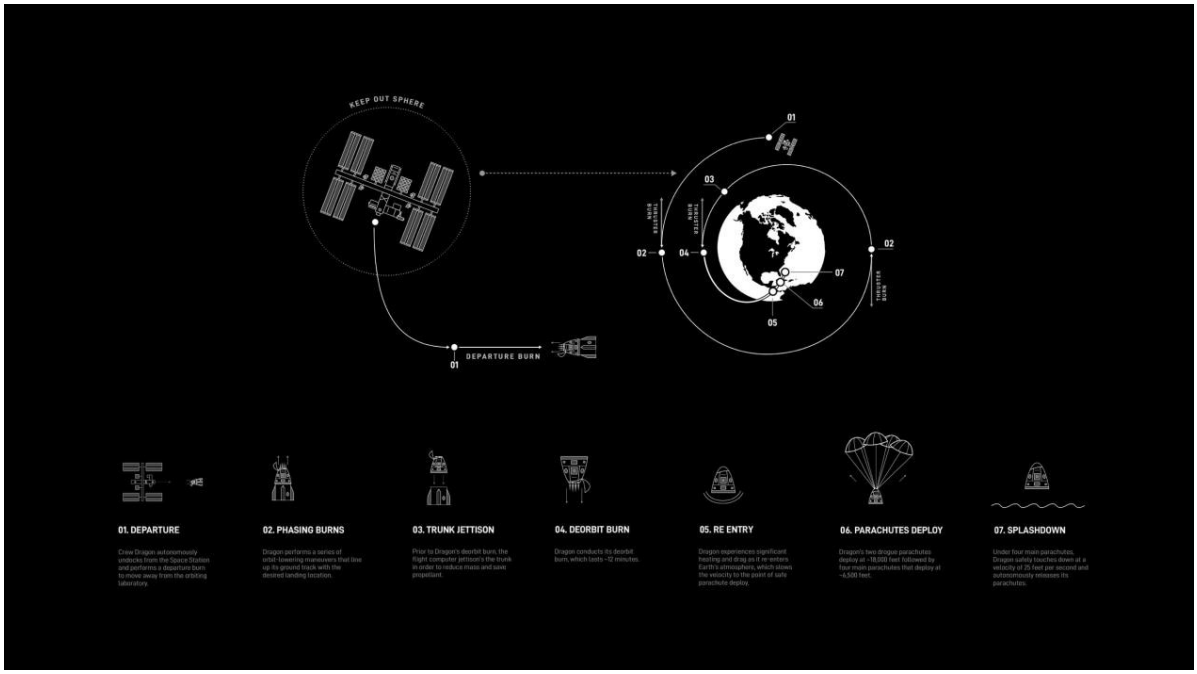
After missions to the International Space Station, Crew Dragon re-enters Earth's atmosphere and deploys drogue parachutes, prior to unfurling the spacecraft’s four main parachutes.

NASA and SpaceX are capable of supporting seven splashdown sites located off Florida's east coast and in the Gulf of Mexico. These sites are off the coasts of Pensacola, Tampa, Tallahassee, Panama City, Cape Canaveral, Daytona, and Jacksonville.

SpaceX’s recovery ship is equipped with a crane to lift the capsule out of the water and onto the main deck of the ship. The ship also is outfitted with a medical treatment facility and a helipad in the center of the vessel, allowing for immediate treatment and swift transport to a hospital in the unlikely event of an astronaut medical emergency after splashdown.

Return Flight
The crew is scheduled for a long duration stay aboard the orbiting laboratory, conducting science and maintenance. The four astronauts are set to return in early-to-mid November 2021.

At the conclusion of the mission, the Crew-2 astronauts will board Crew Dragon, which will then autonomously undock, depart the space station, and re-enter Earth’s atmosphere. NASA and SpaceX are capable of supporting seven splashdown sites located off Florida's east coast and in the Gulf of Mexico. Upon splashdown, the crew will be picked up by the SpaceX recovery ship and returned to shore.



01. DEPARTURE

Crew Dragon autonomously undocks from the Space Station and performs a departure burn to move away from the orbiting laboratory.

02. PHASING BURNS

Dragon performs a series of orbit-lowering maneuvers that line up its ground track with the desired landing location.

03. TRUNK JETTISON

Prior to Dragon's deorbit burn, the flight computer jettisons the trunk in order to reduce mass and save propellant.

04. DEORBIT BURN

Dragon conducts its deorbit burn, which lasts ~12 minutes.

05. RE ENTRY

Dragon experiences significant heating and drag as it re-enters Earth's atmosphere, which slows the vessel to the point of safe parachute deploy.

06. PARACHUTES DEPLOY

Dragon's two drogue parachutes deploy at ~18,000 feet, followed by four main parachutes that deploy at ~6,500 feet.

07. SPLASHDOWN

Under four main parachutes, Dragon safely touches down at a velocity of 25 feet per second and autonomously releases its parachutes.

SpaceX Leadership

Elon Musk

Elon Musk leads Space Exploration Technologies (SpaceX), where he oversees the development and manufacturing of advanced rockets and spacecraft for missions to and beyond Earth orbit.

Founded in 2002, SpaceX's mission is to enable humans to become a spacefaring civilization and a multi-planet species by building a self-sustaining city on Mars. In 2008, SpaceX's Falcon 1 became the first privately developed liquid-fuel launch vehicle to orbit the Earth. Following that milestone, NASA awarded SpaceX with contracts to carry cargo and crew to the International Space Station (ISS). A global leader in commercial launch services, SpaceX is the first commercial provider to launch and recover a spacecraft from orbit, attach a commercial spacecraft to the International Space Station and successfully land an orbital-class rocket booster. By pioneering the development of fully and rapidly reusable rockets and spacecraft, SpaceX is dramatically reducing the cost of access to space, the first step in making life on Mars a reality in our lifetime.

Elon also leads Tesla, which makes electric cars, giant batteries and solar products. Previously, Elon co-founded and sold PayPal, the world's leading Internet payment system, and Zip2, one of the first internet maps and directions services, which helped bring major publishers, including the New York Times and Hearst, online.

Gwynne Shotwell

As President and COO of SpaceX, Gwynne Shotwell is responsible for day-to-day operations and managing all customerand strategic relations to support company growth. She joined SpaceX in 2002 as vice president of Business Development andbuilt the Falcon vehicle family manifest to more than 100 launches, representing more than $10 billion in business. Shotwell is a member of the SpaceX Board of Directors.

Prior to joining SpaceX, Shotwell spent more than 10 years at the Aerospace Corporation, holding positions in space systems engineering, technology and project management. She was promoted to the role of chief engineer of an MLV-class satellite program, managed a landmark study for the Federal Aviation Administration on commercial space transportation, and completed an extensive analysis of space policy for NASA's future investment in space transportation.

In addition to being named the 2018 Satellite Executive of the Year, Shotwell was awarded the AIAA Goddard Astronautics Awards as well as the American Society of Mechanical Engineers Ralph Coats Roe Medal. Fortune Magazine placed Shotwell at No. 42 on its list of the World's 50 Greatest Leaders in 2018 and Forbes named her No. 70 on its list of Power Women in 2017.In 2014, Shotwell was appointed to the United States Export Import Bank's Advisory Committee and the Federal Aviation Administration's Management Advisory Council. Shotwell was elected to the honorable grade of Fellow with the American Institute of Aeronautics and Astronautics.

Through leadership in both corporate and external science, technology, engineering and math (STEM) programs, Shotwell has helped raise over $1.4 million for STEM programs reaching thousands of students nationwide.

Shotwell received, with honors, her bachelor's and master's degrees from Northwestern University in mechanical engineering and applied mathematics, and she serves on their board. She has authored dozens of papers on a variety of space-related subjects.

Benji Reed

Benjamin "Benji" Reed is the director of Crew Mission Management at SpaceX. In this role he is helping spearhead the company's development and certification efforts for the Crew Transportation System, including the Dragon spacecraft, Falcon 9 rocket, ground systems and operations. Prior to this position, Benji was a mission manager for Dragon cargo missions to the International Space Station, including the CRS-3 mission, which carried the first science payloads in the Dragon trunk. Over the past 20 years, he has been a leader in various commercial aerospace and NASA programs, including hardware development serving the Hubble Space Telescope, space station and planetary science missions. He spent many years as the co-owner of a software and Internet development firm and also has been a teacher.

A native of Boulder, Colorado, Benji graduated from the University of Colorado with a degree in mathematics, working at the Center for Astrophysics and Space Astronomy on programs, including the Far Ultraviolet Spectrographic Explorer and the Cosmic Origins Spectrograph. He lives in Los Angeles, California, with his wife and three children.

Boeing Operations

CST-100 Starliner

Building on more than a century of aerospace excellence, Boeing is demonstrating why they are ready for the next challenge in human spaceflight.

The CST-100 Starliner is Boeing's commercial crew transportation spacecraft. CST stands for Crew Space Transportation and 100 represents the Kármán line, the unofficial line separating Earth and space at an altitude of 100 kilometers.

When Boeing's Starliner spacecraft is certified by NASA to fly astronauts, the United States will have two, unique human transportation systems that provide redundancy for International Space Station access and end sole reliance on the Russian Soyuz.

Starliner is a next-generation, autonomous spacecraft that will safely take people and cargo to and from low-Earth orbit.

For NASA missions to the International Space Station, Starliner will carry up to four NASA-sponsored crew members and about 220 pounds of time-critical scientific research.

Boeing's Crew Flight Test, part of its Commercial Crew Transportation Capability (CCtCap) contract with NASA, will carry three NASA astronauts aboard Starliner to verify the fully integrated rocket and spacecraft system can launch, maneuver in orbit, and dock to the space station, as well as validate that its systems perform as expected.

Launch Abort Engines: Starliner has four launch abort engines that each provide 40,000 pounds of thrust and are dedicated for low altitude abort-use. They are capable of burning about 700 pounds (105 gallons) of propellant every second to rapidly fly crew members away from a dangerous situation.

Orbital Maneuvering and Attitude Control Engines: A total of 20 engines can each produce 1,400 pounds of thrust and, together, provide Starliner with the propulsion it needs to reach orbit after separating from United Launch Alliance's Atlas V rocket. These engines also would be used in the event of an abort.

Reaction Control System Engines: A combined 28 engines, each providing 85 pounds of thrust, will provide the velocity needed for Starliner to make small directional changes, including when it docks to the International Space Station.

Starliner Design and Development

Boeing's CST-100 Starliner was developed in collaboration with NASA's Commercial Crew Program starting with the first development Space Act Agreement in 2010.

In 2014, NASA awarded CCtCap contracts to Boeing and SpaceX to each safely and cost-effectively transport astronauts to the International Space Station from the United States.

Boeing assembles and processes Starliner for launch at the revitalized Commercial Crew and Cargo Processing Facility, or C3PF, at NASA's Kennedy Space Center in Florida. The facility was previously used to process space shuttle orbiters prior to flight.

Starliner is a reusable spacecraft that combines a proven capsule architecture, materials and subsystem technologies with 21st century innovations.

Starliner is designed for up to seven passengers or a mix of crew and cargo, but for NASA missions will carry up to four astronauts to the orbiting laboratory.

Starliner has a weldless structure, which eliminates the structural risk of traditional welds, and it also reduces mass and production time. Boeing designed the spacecraft to be reusable up to 10 times with a six-month processing turnaround time. Starliner also has wireless internet and tablet technology for crew interfaces.

One of the NASA requirements under the CCtCap contract was to have autonomous capability. This reduces training time for crews and provides greater flexibility with other potential customers. Starliner adapted a best practice from the commercial industry, with backup manual controls for the pilot. Starliner crews receive extensive training to ensure the astronauts can handle any situation that could arise in the harsh environment of space, even with a spacecraft that is designed to be autonomous.

The service module contains Starliner's four launch abort engines to be used during an unlikely abort scenario. They would fire between 3 and 5.5 seconds, with enough thrust to get the spacecraft and its crew away from the rocket, before splashing down in the ocean under parachutes.

The pusher abort system provides safe crew escape throughout the launch and ascent phase of the mission.

Starliner uses a proven parachute and airbag system for shock absorption in order to land on ground.

NASA astronauts Barry "Butch" Wilmore, Mike Fincke and Nicole Mann will be the first astronauts to fly aboard Starliner in Boeing's Crew Flight Test (CFT), after the successful completion of Boeing's second Orbital Flight Test (OFT-2). The flight test is part of the path to certification for Starliner.

Following the successful Crew Flight Test and completion of the NASA certification process, Boeing will begin regular crew rotation missions to the space station, beginning with Starliner-1.

The NASA astronauts assigned to Starliner-1 are Josh Cassada and veteran Suni Williams. It will be Cassada's first spaceflight and Williams' third.

In addition to an uncrewed and a crewed flight test, NASA has ordered six crew rotation missions to the International Space Station from Boeing. Starliner-1 will be the first of these rotation missions.

Starliner's development has required more than 425 suppliers in 37 states.

Atlas V

Atlas rockets have evolved over four decades to become the Atlas V rocket that is used today. John Glenn became the first U.S. astronaut to orbit the Earth after being launched on a heritage Atlas LV-3B rocket from Cape Canaveral, Florida, in 1962.

For Starliner missions to station, Boeing will use the Starliner Configuration of the Atlas V, as seen above.

Configuration Breakdown:
RD-180: The first stage booster will deliver more than 860,000 pounds of thrust at liftoff and a range of continuous throttling capability. The liquid oxygen/liquid kerosene, two-thrust-chamber RD-180 engine is a complete propulsion unit equipped with hydraulics for control valve actuation and thrust vector gimbaling, pneumatics for valve actuation and system purging, and a thrust frame to distribute loads.

Atlas V Booster: The Atlas V Common Booster Core is the first stage of the Atlas V family of rockets produced and operated by United Launch Alliance. It stands 106 feet tall with a 12.5-foot diameter, and houses the combination liquid oxygen/liquid kerosene fuel to power the RD- 180 engine at its base.

Solid Rocket Boosters: A pair or solid rocket boosters, or SRBs, will be used along with the core stage and RD-180 engine to provide enough thrust to achieve liftoff on the way to orbit. Each SRB is capable of approximately 380,000 pounds of thrust, for a total of over 1.6 million pounds of thrust at liftoff. The Atlas V SRBs are manufactured be Aerojet and use the world's largest monolithic filament-wound carbon composite case.

400 Series Interstage Adapter: The interstage adapter connects the first and second stage while leaving a safe amount of room between the second stage engine and the top of the propellant tanks on the first stage. The adapter is built to be strong enough to manage the forces of launch without buckling, but it also has to be as light as possible. It is jettisoned along with the first stage on the Atlas V.

Dual Engine Centaur: For Starliner missions, the Centaur upper stage will fly with two RL10A-4- 2 engines, offering more thrust to accommodate Starliner. The engines also help shape the ascent trajectory to station.

Emergency Detection System: This system monitors various launch vehicle parameters to determine the health of the rocket, and provides a capability to take action by signaling an abort command so the Starliner can escape, if necessary.

Launch Vehicle Adapter and Aeroskirt: The launch vehicle adapter (LVA) provides the structural attachment of the Starliner capsule to the Atlas V rocket. The LVA uses a truss structure and metallic ring to attach the spacecraft to the Centaur upper stage of the Atlas V. ULA also designed a 70-inch-long aeroskirt to extend Starliner's aerodynamic surface, which enhances the aerodynamic characteristics, stability, and loads of the Atlas V for the unique crew configuration.

Stats

- Height: 62.5 meters (205 feet)
- Diameter: 3.81 meters (12.5 feet)
- Mass: 21,173 kilograms (46,678 pounds)
- Stages: Two
- Maiden Flight: Aug. 12, 2002

Boeing Spacesuit

Astronauts heading into orbit aboard Boeing's CST-100 Starliner spacecraft will wear spacesuits that are 40 percent lighter than astronauts wore in years past. Boeing designed the suit with comfort, utility, and production in mind.

The suit capitalizes on historic designs, meets NASA requirements for safety and functionality, and introduces cutting-edge innovations. A few of the advances in the design include:

- Lightweight and flexible materials and new joint patterns
- Helmet and visor incorporated into the suit instead of detachable
- Touchscreen-sensitive gloves
- Vents that allow astronauts to be cooler, but can still pressurize the suit immediately

The full suit, which includes an integrated shoe, weighs about 20 pounds with all of its accessories – about 10 pounds lighter than the launch-and-entry suits worn by space shuttle astronauts.

The new Starliner suit’s material lets water vapor pass out of the suit, away from the astronaut, but keeps air inside, making crew cooler without sacrificing safety. Flexible material in the elbows and knees allows astronauts greater movement, while strategically located zippers allow them to adapt the suit’s shape when standing or seated.

On launch day, the crew will don their suits in the historic Astronaut Crew Quarters inside John F. Kennedy Space Center’s Neil Armstrong Operations and Checkout building in Florida before being transported to Space Launch Complex 41. At the launch pad, the crew will ascend the Crew Access Tower and stride through the Crew Access Arm to board Starliner, which will be secured atop a United Launch Alliance Atlas V rocket.

Space Launch Complex 41

United Launch Alliance (ULA) has modified the pad at Space Launch Complex 41 (SLC-41) at Cape Canaveral Space Force Station for launches of Boeing's CST-100 Starliner spacecraft aboard ULA's Atlas V rocket to carry astronauts to the International Space Station.

The Vertical Integration Facility at SLC-41 is where Atlas V is stacked and tested, and where Boeing's Starliner spacecraft is installed atop the rocket.

For Boeing, launching from SLC-41 meant needing a Crew Access Tower, the first crew-focused structure at Cape Canaveral since Apollo 7.

The tower was built in segments close to the launch pad and stacked together to form the nearly 200-foot-tall structure.

The Crew Access Arm and White Room provide the walkway for astronauts to enter the Starliner spacecraft on top of the Atlas V rocket. The arm is connected to level 12 of the Crew Access Tower, about 172 feet above the pad deck.

Weighing about 90,000 pounds and reaching almost 50 feet, the arm is outfitted with several systems including electronics, data, lighting, and fluids.

The White Room is an enclosed area big enough for astronauts to make final adjustments to their suits before climbing aboard the spacecraft. It is a clean area designed to keep contaminants out of the spacecraft and off the astronauts' suits.

Boeing and United Launch Alliance designed and built the arm and White Room based on their unique design and lessons learned from NASA's more than 50 years of spaceflight.

The escape, or egress, system is located on level 12 of the Crew Access Tower – the same level as the Crew Access Arm.

The slide wire emergency escape system features five seats on four separate slide wires, so up to 20 astronauts and ground support personnel can quickly escape from the tower in the unlikely event of a dangerous situation on the launch pad. The egress system allows astronauts and ground personnel to evacuate the Crew Access Tower to a landing zone more than 1,340 feet from the base of the Atlas V, outside of the launch pad perimeter.

The system was designed with the astronauts' spacesuits in mind; the escape seats are easy to get into and are attached to easily accessible handles to control speed on the slide down from the launch tower.

Ascent

COUNTDOWN

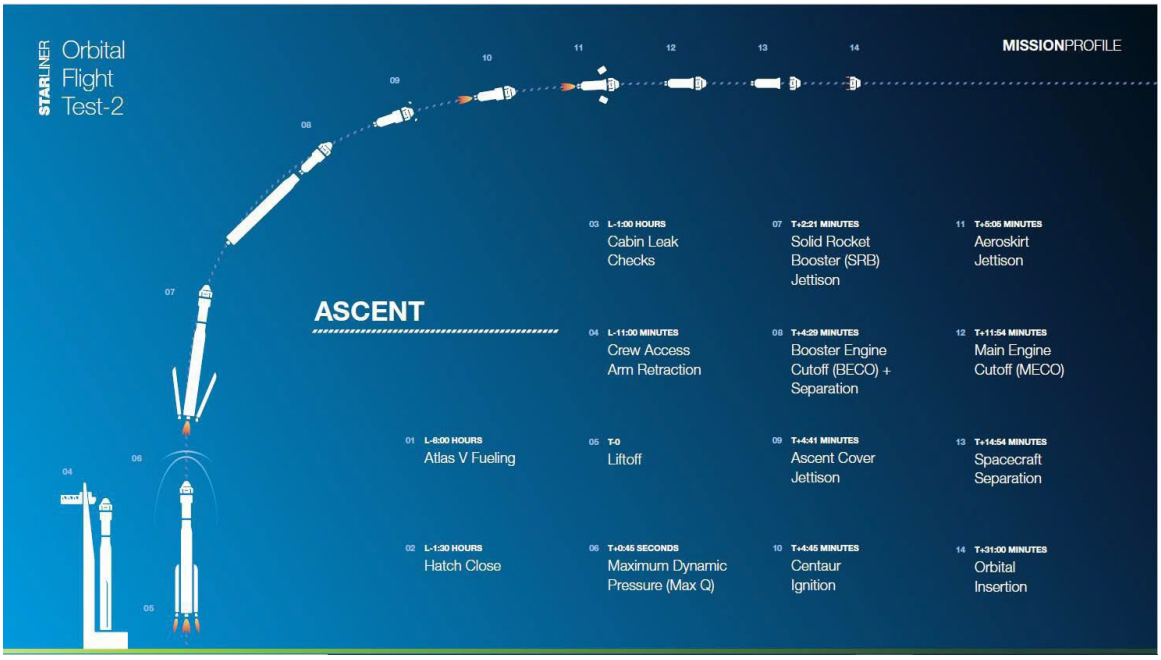
(all times are approximate and adjustments may occur prior to launch)

Hour/Min/Sec	Events
-06:00:00	Atlas V fueling commences
-04:05:00	Atlas V fueling is complete
-04:04:00	T-4 built-in hold begins
-01:25:00	Hatch closure complete
-01:15:00	Prelaunch cabin leak checks
-01:05:00	Cabin pressurization complete
-00:20:00	Launch Conductor conducts terminal count briefing
-00:18:00	CST-100 poll for terminal count
-00:15:00	CST-100 to internal power
-00:10:00	Crew Access Arm retracted
-00:08:00	Launch vehicle poll for terminal count
-00:04:45	Starliner configured for terminal count
-00:04:00	T-4 minute built-in hold releases
-00:01:00	CST-100 is configured for launch
-00:00:03	RD-180 engine ignition

LAUNCH, LANDING AND CST-100 DEPLOYMENT

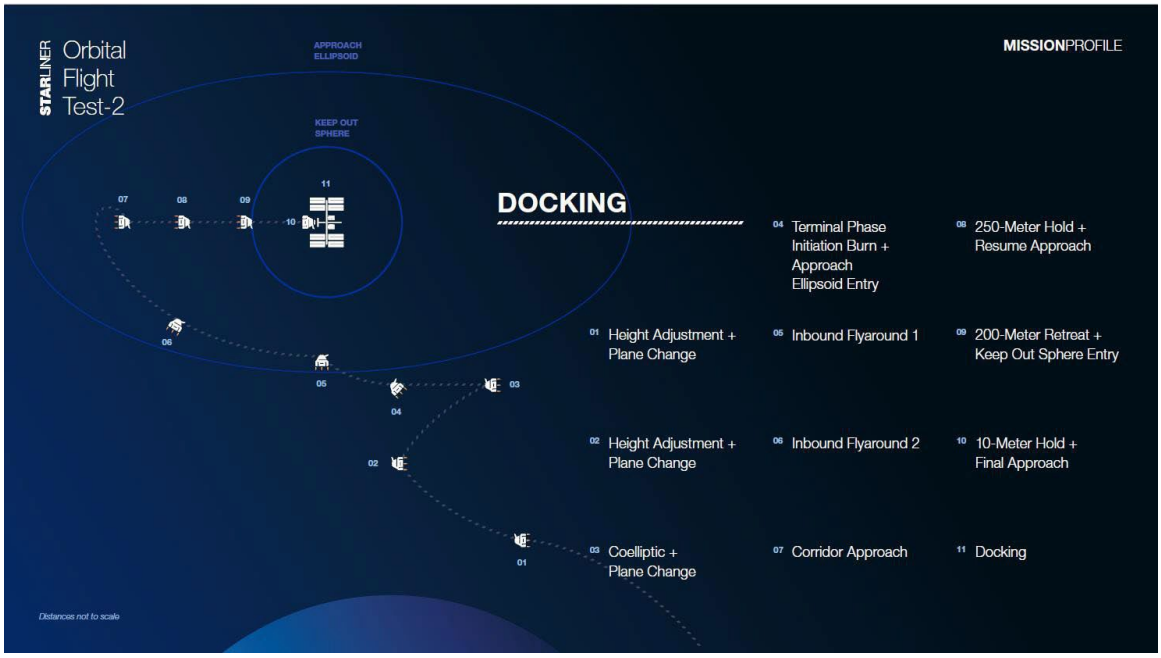
(all times are approximate and adjustments may occur prior to launch)

Hour/Min/Sec	Events
+00:00:01	Liftoff
+00:00:06	Begin pitch/yaw maneuver
+00:00:41	Maximum dynamic pressure
+00:01:05	Mach 1
+00:02:22	SRB jettison
+00:04:29	Atlas booster engine cutoff (BECO)
+00:04:35	Atlas Centaur separation
+00:04:41	Ascent cover jettison
+00:04:45	Centaur first main engine start (MES-1)
+00:05:05	Aeroskirt jettison
+00:11:54	Centaur first main engine cutoff (MECO-1)
+00:14:54	Starliner separation
+00:31:00	Starliner orbital insertion

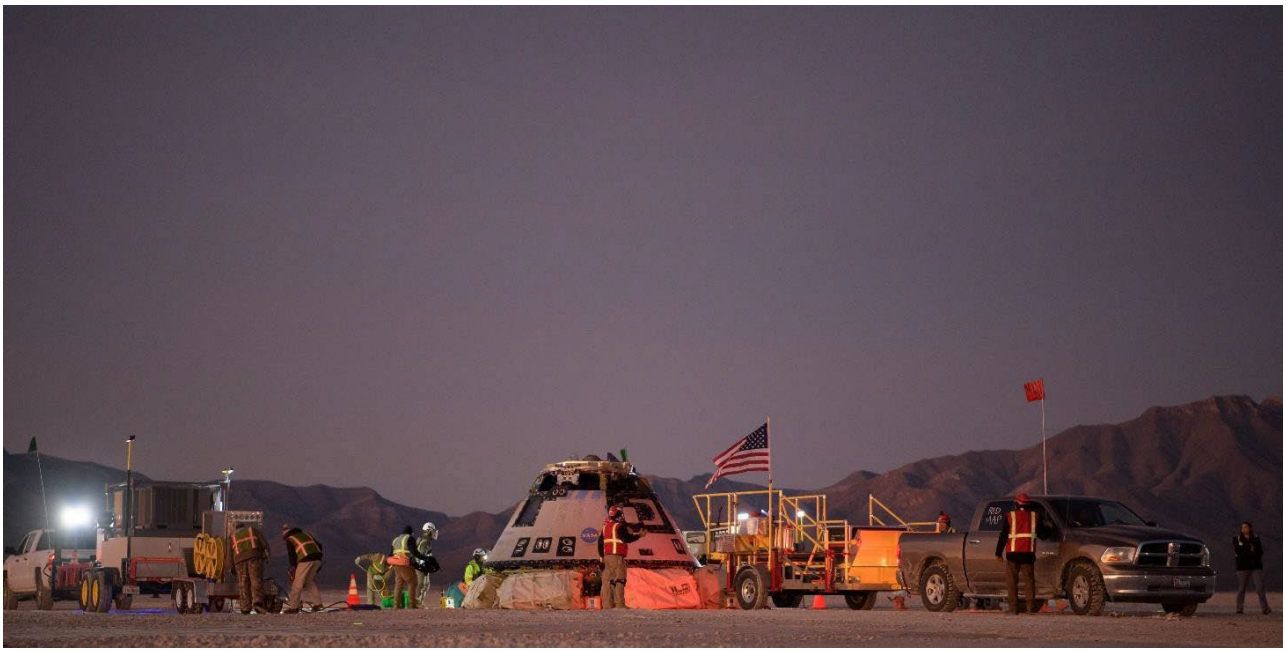


International Space Station Docking
Once in a stable orbit on course for the International Space Station, Starliner begins its rendezvous procedures. Unique to the Orbital Flight Test mission, Starliner will conduct a series of demonstration burns a few hours after launch to prove the spacecraft can maneuver itself safely in space. As Starliner closes on the station, the vehicle's star tracker cameras will first see the orbiting lab as a distant, but bright, point of light moving in front of a background of fixed stars.

Over the next few hours, Starliner will slowly move itself closer to the station and then pause before entering the 200-meter "keep out sphere" until station flight controllers clear it to enter. Starliner then begins the docking process, pausing once more 10 meters away form a Boeing- built International Docking Adapter and then continuing to final approach and docking.



Retrieving Starliner



The CST-100 Starliner is designed to land at one of five landing sites in the continental U.S. After re-entering the atmosphere the Starliner will deploy pilot and drogue parachutes, prior to unfurling the spacecraft's three main parachutes. Once the capsule is stable under its parachutes the spacecraft's base heat shield will drop away, allowing the air bag system to inflate prior to a soft landing.

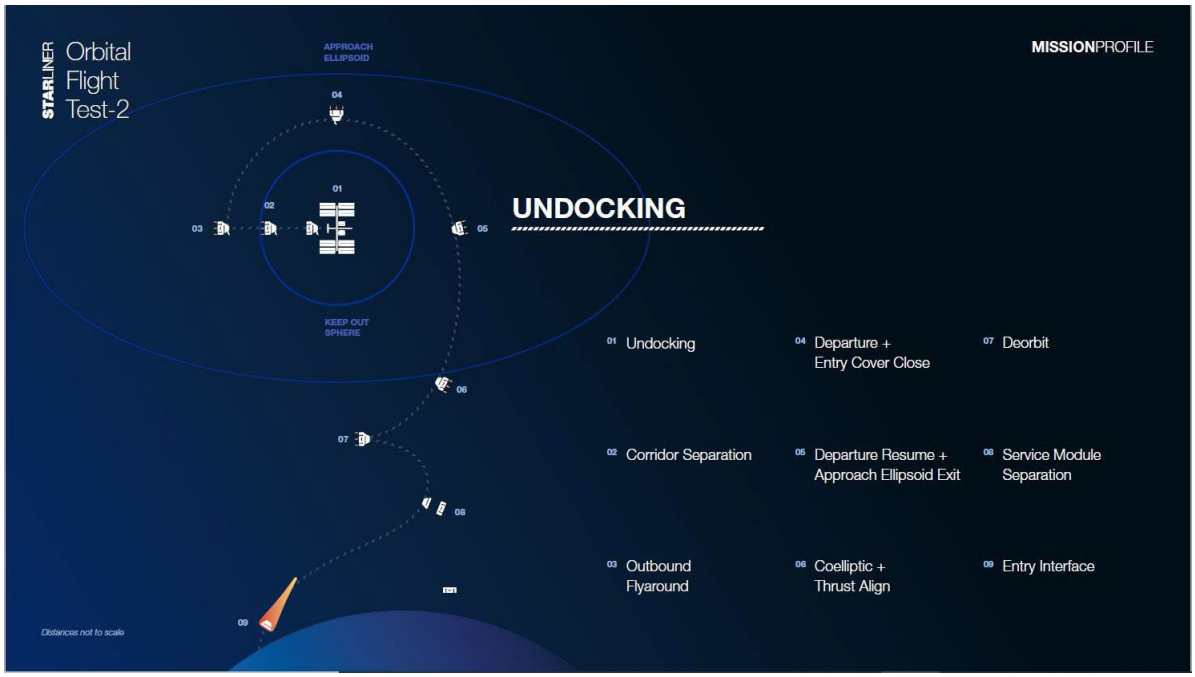
Boeing's Starliner has several designated landing sites across the western United States:

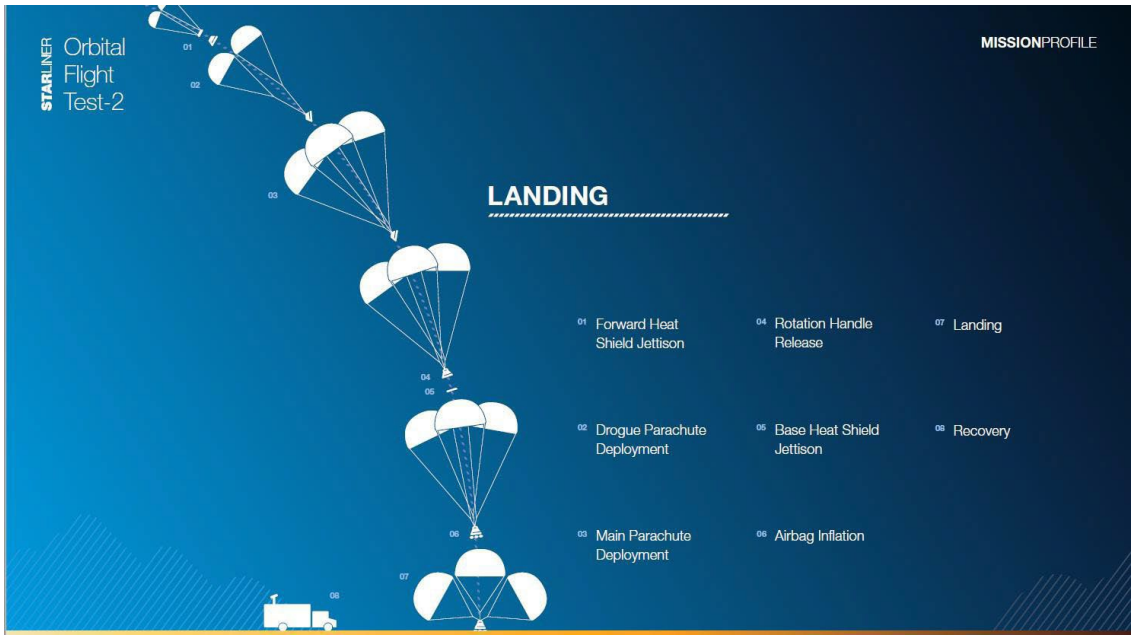
- White Sands Missile Range in New Mexico (dual sites, preferred)
- Edwards Air Force Base in California
- Willcox Playa in Arizona
- Dugway Proving Ground in Utah

Return Flight

Once Starliner is ready and cleared to leave the International Space Station, the undocking process begins and the spacecraft slowly backs away from the station. After a flyaround maneuver, Starliner positions itself for the deorbit burn. A short time later, when Starliner is in the right position over the Pacific Ocean, the service module conducts the deorbit burn, slowing down Starliner from orbital speeds, and then the service module detaches.

The crew module begins its descent through the atmosphere, facing reentry heat of 3,000 degrees Fahrenheit (1,650 degrees Celsius). The parachute sequence begins around 30,000 feet (9 km) above the ground, when Starliner jettisons the forward heat shield that protects the parachutes during reentry. Two drogue parachutes begin slowing Starliner down, then detach. The three main parachutes are then deployed and inflated, and about 3,000 feet (0.9 km) off the ground, the airbags inflate. On touchdown, those airbags absorb the initial forces of landing, cushioning the crew for a soft, safe return to Earth.


STARLINER
Orbital Flight Test-2
MISSIONPROFILE
APPROACH ELLIPSOID
KEEP OUT SPHERE
UNDOCKING
01 Undocking
02 Corridor Separation
03 Outbound Flyaround
04 Departure + Entry Cover Close
05 Departure Resume + Approach Ellipsoid Exit
06 Coelliptic + Thrust Align
07 Deorbit
08 Service Module Separation
09 Entry Interface
Distances not to scale


STARLINER
Orbital Flight Test-2
MISSIONPROFILE
LANDING
01 Forward Heat Shield Jettison
02 Drogue Parachute Deployment
03 Main Parachute Deployment
04 Rotation Handle Release
05 Base Heat Shield Jettison
06 Airbag Inflation
07 Landing
08 Recovery

Boeing Leadership

David Calhoun

David Calhoun is president and chief executive officer of The Boeing Company, a leading global aerospace company and provider of commercial airplanes; defense, space, and security systems; and global services. The company employs more than 140,000 people worldwide, leverages the talents of a global supplier base, and is a top U.S. exporter for commercial and government customers in more than 150 countries.

Calhoun became Boeing president and chief executive in January 2020. He has served as a member of Boeing's Board of Directors since 2009 and served as board chairman from October to December 2019.

Calhoun has extensive expertise in a wide array of strategic, business, safety, and regulatory matters across several industries as a result of his executive, management, and operational experience.

Calhoun previously served as senior managing director and head of portfolio operations at The Blackstone Group beginning in January 2014. During his time with the investment firm, he focused on creating and driving added-value initiatives with Blackstone's portfolio company CEOs.

Previously, he also served as executive chairman of the board for Nielsen Holdings from January 2014 to January 2016. He joined Nielsen in 2006 as chief executive officer shortly after it was acquired through a consortium of private equity investors, including Blackstone. Throughout his seven-year Nielsen tenure, Calhoun led the company's transformation into a leading global information and measurement firm listed on the New York Stock Exchange and Standard & Poor's 500 Index.

Calhoun began his career at General Electric Company (GE), where he rose to vice chairman of the company and president and chief executive officer of GE Infrastructure, its largest business unit. During his 26 years at GE, he held a number of operating, finance, and marketing roles and led multiple business units, including GE Transportation and GE Aircraft Engines.

Calhoun is a member of the board of directors of Caterpillar Inc. and a member of the Business Roundtable, an association of chief executive officers of leading U.S. companies. He also is a member of Virginia Tech's Pamplin Advisory Council and is co-author of the book, "How Companies Win."

Calhoun has a bachelor's degree in accounting from Virginia Tech.

Mark Nappi

As vice president and program manager of Boeing's Commercial Crew Program, Mark Nappi leads the development, flight test, certification, and missions of the Crew Space Transportation (CST)-100 Starliner system.

Prior to Starliner, Nappi served as program director of Artemis I for the Space Launch System (SLS) program – leading all aspects from design to test to final operations at NASA's Kennedy Space Center in Florida. In that role, he was responsible for assembling the workforce, establishing operations processes, commencing production of Core Stage 1, performing a full-flight duration hot fire test, and ensuring readiness for the wet dress rehearsal and launch of SLS on the Artemis I mission. Before leading the Artemis team, Nappi was the director of Program Integration as well as director of the Core Stage Integrated Product Team (IPT) that was responsible for the design, production, and test of America's exploration rocket.

Prior to joining Boeing in 2015, Nappi was the senior vice president and program manager at Vencore, managing the engineering services contract for NASA's Kennedy Space Center. In this role, he led engineering support for design and development of the SLS and Multi-Purpose Crew Vehicle ground support launch infrastructure, as well as operating the Kennedy Space Center development shops and laboratories.

From 1996 through April 2012, Nappi served in management roles with increasingly greater levels of responsibility with United Space Alliance, LLC, (USA). Nappi's last role with USA was vice president and site executive for Florida operations, executing the Space Shuttle Program, Ares I-X processing, International Space Station support, and several other Florida-based USA contracts. He was responsible for all of the Space Shuttle vehicle operations leading up to and including the orbiter's final launch, as well as all ground systems and facilities maintenance.

Nappi began his career at Kennedy Space Center in 1985 with Lockheed Martin, where he served for more than 10 years as director of Engineering, director of Launch Operations, and in other engineering and management roles.

Nappi holds a bachelor's degree in ocean engineering and a master's degree in management science, both from the Florida Institute of Technology. He is also a graduate of the Lockheed Leadership Institute and the Boeing Strategic Leadership Seminar.

Chris Ferguson

Since the beginning of Boeing's Commercial Crew Program in 2011, Ferguson has worked with NASA's Human Exploration and Operations Directorate; Johnson Space Center's Engineering, Flight Crew and Mission Operations organizations; and NASA's Commercial Crew Program at Kennedy Space Center to ensure Boeing's design supports NASA's human rating requirements. He also played a key leadership role in the development and testing of system concepts and key technologies for the spacecraft's launch and ground systems.

The development of a safe, reliable and cost-effective solution for crew transportation to and from the International Space Station will allow the on-orbit research facility to continue to fulfill its promise as a world-class laboratory. With NASA as the anchor customer, Boeing's Starliner is setting the foundation for commercial passenger flights to and from low-Earth orbit destinations, to include international astronauts, scientists, and even tourists.

A retired U.S. Navy captain and former NASA astronaut, Ferguson piloted STS-115 (Atlantis) and commanded STS-126 (Endeavour) and the final shuttle mission, STS-135 (Atlantis). He has logged more than 40 days in space and 5,700 hours in high-performance aircraft. He also served as deputy chief of the NASA Astronaut Office and was spacecraft communicator (CAPCOM) for the STS-118, STS-120, STS-128, and STS-129 missions. His experience in crew communications, both on orbit and in the CAPCOM role, is a strong asset to Boeingand the Starliner team.

Ferguson holds a Bachelor of Science degree in mechanical engineering from Drexel University and a Master of Science degree in aeronautical engineering from the Naval Postgraduate School. He has been recognized with numerous service awards, including the Legion of Merit, Distinguished Flying Cross, Defense Meritorious Service Medal, Navy Strike/Flight Air Medal, NASA Spaceflight Medal (three), Navy Commendation Medal (three), and the Navy Achievement Medal.

Safety and Innovation

Crew safety remains NASA's primary responsibility and priority for all human spaceflight programs. Since the beginning of NASA's Commercial Crew Program, safety has been built into the agency's requirements as a direct result of NASA's extensive experience in human spaceflight systems development and operations.

NASA and its commercial partners, Boeing and SpaceX, have developed and rigorously tested systems that prioritize crew safety and survival, including launch pad emergency escape and egress systems. Through successful completion of launch abort tests, both companies have demonstrated their ability to safely fly astronauts away from an emergency situation.

These commercial systems are required to meet NASA's safety and performance requirements for certification to transport NASA and international partner astronauts to the space station.

Foundation of Innovation

NASA's Commercial Crew Program tailored requirements for a new generation of human-rated spacecraft, allowing the industry to create innovative design solutions, manufacturing processes, operational methods and engineering techniques. The result has been a series of components, systems and now spacecraft and rockets flying astronauts to and from the International Space Station in a manner that is both cost-effective and reliable.

At the heart of the innovation is an approach that is new to NASA's human spaceflight programs, which calls on the private industry to design, build and operate spacecraft and rockets along with all their related ground systems, control centers and support infrastructure.

To learn more on innovation and the Commercial Crew Program, click https://www.nasa.gov/feature/business-innovation-key-to-commercial-crew-program-s-success

Certification

The certification process is based upon NASA's decades of experience, as well as the combined talents and experience of the Boeing and SpaceX engineers, technicians and managers.

NASA has officially certified SpaceX's crew system and started regular missions with astronauts to the International Space Station.

When Boeing's Starliner is also certified by NASA, the United States will have two, unique human transportation systems that provide redundancy for International Space Station access and end sole reliance on the Russian Soyuz.

To complete SpaceX certification, NASA teams used flight data from the company's uncrewed Demo-1 flight test, spacecraft abort tests, and its crewed Demo-2 flight test to verify that SpaceX systems met NASA's safety and performance requirements. The crew aboard the Demo-2 test flight validated that the spacecraft systems operated as planned in both autonomous and manual settings. NASA will examine a similar set of data following Boeing's uncrewed Orbital Flight Test 2 (OFT-2) and eventual Crew Flight Test with astronauts aboard in order to certify the Boeing transportation system to begin regular astronaut flights to the space station.

NASA will verify that, throughout upcoming flight tests and regular missions, the companies demonstrate compliance with Commercial Crew Program hardware and software requirements, NASA standards for design and construction, engineering and management processes, and validation of the entire crew transportation system in a flight environment. The companies will continue to work with NASA to resolve issues as necessary to ensure the systems meet NASA's safety and performance requirements outlined in the Commercial Crew Transportation Capability (CCtCap) contracts.

Boeing and SpaceX each have six regular crewed science missions contracted with NASA following certification. SpaceX has completed two of its six and is currently on its third (Crew-3). Boeing will fly its first regular mission with astronauts (Starliner-1) following completion of OFT-2, the Crew Flight Test, and NASA certification.

A Space-Borne Lifeboat

New, American-made spacecraft flying to the International Space Station play a big role in bringing resident astronauts home to Earth, but their missions also include the ability to provide the orbiting laboratory with a temporary shelter in case of an emergency in space or even a safe ride back to Earth with short notice.

The scenarios that would call for the spacecraft to operate as space-borne lifeboats have not occurred on the space station before, but mission planners have long made sure they are prepared. An electrical issue or ammonia leak on the space station could call for astronauts to shelter inside a Commercial Crew Program spacecraft long enough to correct the problem.

To learn more about the life saving potential of commercial spacecraft docked to the space station, click
https://www.nasa.gov/feature/commercial-crew-spacecraft-will-offer-a-quick-escape-from-station

International Docking Adapter

Getting to orbit is a milestone and not a destination. It is no small feat to dock with our orbiting outpost. But before that feat can be achieved, the International Space Station needed an upgrade.

The International Docking Adapters were built to the International Docking System Standard, which features built-in systems for automated docking and uniform measurements. That means any destination or any spacecraft can use the adapters in the future—from the new commercial spacecraft to other international spacecraft yet to be designed. The adapters also include fittings so power and data can be transferred from the station to the visiting spacecraft.

SpaceX's Crew Dragon spacecraft has docked at the adapters, and soon Boeing's CST-100 Starliner will also dock at the adapters as part of NASA's Commercial Crew Program.

For more information on the International Docking Adapters, click
https://www.nasa.gov/feature/meet-the-international-docking-adapter

Space Station Research

The addition of the Boeing Starliner and SpaceX Crew Dragon to the manifest of spacecraft heading to the International Space Station raises more than the opportunity for astronauts to fly to and from space aboard American spacecraft. It also increases the amount of science and broadens the research that can be performed aboard the orbiting laboratory.

That's because the new generation of human-rated spacecraft are designed to carry time-critical science to and from the space station along with astronauts. Researchers are able to work with astronauts aboard the station to undertake a wide array of different science investigations and benefit from the increased opportunity to see their research returned back to Earth for continued examination.

To learn more about the benefits of commercial crew to space station research, click https://www.nasa.gov/feature/commercial-crew-missions-offer-research-bonanza-for-space-station

Helicopter Rescue Training

When astronauts splash down into the ocean after their journey to the International Space Station on SpaceX's Crew Dragon spacecraft, recovery teams must be able to transport them to land quickly. In the unlikely event of an astronaut medical emergency, SpaceX has outfitted each of its recovery ships with a medical treatment facility and a helipad in the center of the vessel.

To read more about SpaceX's helicopter rescue training, click https://blogs.nasa.gov/commercialcrew/2018/11/05/spacex-rehearses-helicopter-landing-at-sea/

Water Rescue Training

Rescue and recovery involves meticulous planning and close coordination among NASA, the Department of Defense (DOD) and company recovery teams for Crew Dragon. In the event of a variety of contingency landings, an elite team is prepared to rescue the crew anywhere in the world.

In preparation for both launch and landing, U.S. Air Force "Guardian Angel" pararescue forces will be pre-positioned in key locations, alert and ready to deploy at a moment's notice. Should a spacecraft splash down within 200 nautical miles of the launch site, an HC-130 aircraft, along with two HH-60 Pave Hawk helicopters, will deploy from Patrick Air Force Base in Florida. These aircraft will carry a team of up to nine Guardian Angels—also known as pararescue specialists—along with rescue equipment and medical supplies.

To read more about water rescue training, click https://www.nasa.gov/feature/rescue-operations-take-shape-for-commercial-crew-program-astronauts

Triage and Medical Evacuation Training

It is vital that teams prepare for launch day operations, including possible but unlikely emergency scenarios, and simulations are key to getting teams as ready as possible.

Teams from NASA, HSFS and SpaceX have conducted joint medical triage and medical evacuation (medevac) training exercises at NASA's Kennedy Space Center in Florida.

To read more about joint medevac training, click https://blogs.nasa.gov/commercialcrew/2018/10/25/commercial-crew-teams-practice-triage-and-medical-evacuation/

Crew Dragon Abort System

SpaceX completed a successful launch escape test of its Crew Dragon spacecraft abort system in January 2020. It was an important step in NASA's endeavor to rebuild America's ability to launch astronauts to the International Space Station from U.S. soil and set the stage for the historic Demo-2 test flight with astronauts in May 2020. To read more about the successful launch escape test, click https://www.nasa.gov/feature/nasa-coverage-of-spacex-crew-dragon-launch-escape-test.

To read more about the successful pad abort test of Crew Dragon, click https://www.nasa.gov/press-release/spacex-demonstrates-astronaut-escape-system-for-crew-dragon-spacecraft

To see the pad abort test footage, click https://www.youtube.com/watch?v=FRqLNdwsPBM

SLC-41 Emergency Egress

An emergency egress system has been installed at Space Launch Complex 41 at Cape Canaveral Space Force Station to prepare for Boeing's CST-100 Starliner crew launches for NASA's Commercial Crew Program. The Starliner spacecraft and United Launch Alliance Atlas V rocket that will boost astronauts to the International Space Station will have many safety elements built into the systems.

The Starliner emergency egress system operates a lot like a zip line, with four egress cables connecting at level 12 of the Crew Access Tower to a landing zone about 1,300 feet away from the launch vehicle. Five individual seats on four separate lines can transport up to 20 people off of the tower in the unlikely event there is an emergency on the launch pad. NASA has partnered with private industry to take astronauts to the space station.

To see highlights of some of the SLC-41 emergency egress testing, click https://images.nasa.gov/details-KSC-20170314-MH-KLS01-0002-ULA_EES_Demo_Coverage_H265-3149885.html

Starliner Abort System

In the unlikely event of an emergency, Boeing's CST-100 Starliner is equipped with an abort system capable of lifting the spacecraft and crew to safety. The high-tech, high-power system will be activated once the crew is securely on board and can be used while the spacecraft is still on the pad or during any portion of launch until the crew reach orbit. Boeing completed a successful demonstration of this capability in November 2019.

To see Boeing's pad abort test, click https://www.youtube.com/watch?v=1NLQ4bO-f58

To read more about the Starliner's abort system, click https://blogs.nasa.gov/commercialcrew/2016/10/18/starliner-propulsion-hardware-arrives-testing-begins/

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Multimedia

Commercial Crew Program Facebook
https://www.facebook.com/NASACommercialCrew

Commercial Crew Program Twitter
https://twitter.com/commercial_crew?lang=en

Commercial Crew Program YouTube Playlist
https://www.youtube.com/playlist?list=PLBE9B5BD2A8B10113

Commercial Crew Program Blog
https://blogs.nasa.gov/commercialcrew

NASA Image Archive - Commercial Crew Program
https://images.nasa.gov/search-results?q=commercial%20crew&page=1&media=image,video,audio&yearStart=1920&yearEnd=2018

STEM Engagement

The NextGen STEM Commercial Crew Program brings the accomplishments of NASA and our commercial partners, Boeing and SpaceX, to audiences through a variety of educational resources and opportunities. These hands-on, authentic STEM activities and classroom resources, including apps like “Rocket Science: Ride to Station,” engage students and educators in the mission while helping build a strong and growing U.S. space industry in low Earth orbit by providing meaningful STEM experiences to the future generation of explorers.

To learn more, click here:
https://www.nasa.gov/stem/nextgenstem/commercial_crew/index.html

To access the app, click here:
https://www.nasa.gov/stem-ed-resources/rocket-science-ride-to-station.html

#LaunchAmerica STEM Toolkit
Calling all teachers, parents, and students of the Artemis Generation! Celebrate the Boeing Orbital Flight Test-2 (OFT-2) by using these classroom and at-home educational resources. Join NASA to #LaunchAmerica and participate online for NASA’s Boeing OFT-2 by signing up for the virtual guest experience.

To access the STEM Toolkit, click here:
https://www.nasa.gov/stem/nextgenstem/commercial_crew/launchamerica-stem-mission-toolkit

NASA's Virtual Guest Program
Over 545,000 virtual guests have followed NASA launches and milestones since 2020. The program offers a registration opportunity for each launch. After registration, guests have access to curated resources, email updates, and a passport stamp for their virtual guest passport following a successful launch. Guests also have the opportunity to send a message to the crew through their registration for crewed missions. Providing the virtual guest program allows for guests to be notified of any schedule changes, interactive opportunities, and updated information. To learn or join the virtual guest program: https://www.nasa.gov/specials/virtualguest/

For the virtual guest passport, click here: https://nasa-external-ocomm.box.com/s/mhdv60p0g3xowte635a27peqibwgcezh

360 Virtual Reality Tour
Through 360-degree video and virtual reality technology, students can get a behind-the- scenes look at NASA and commercial partner facilities, where next-generation human- rated spacecraft and rockets are being developed and tested for flight, without leaving the classroom. These provide an experience second only to being there.

To access the virtual reality 360 tour video playlist, click here: https://www.nasa.gov/stem/nextgenstem/commercial_crew/virtual-reality.html