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SOFIA

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SOFIA

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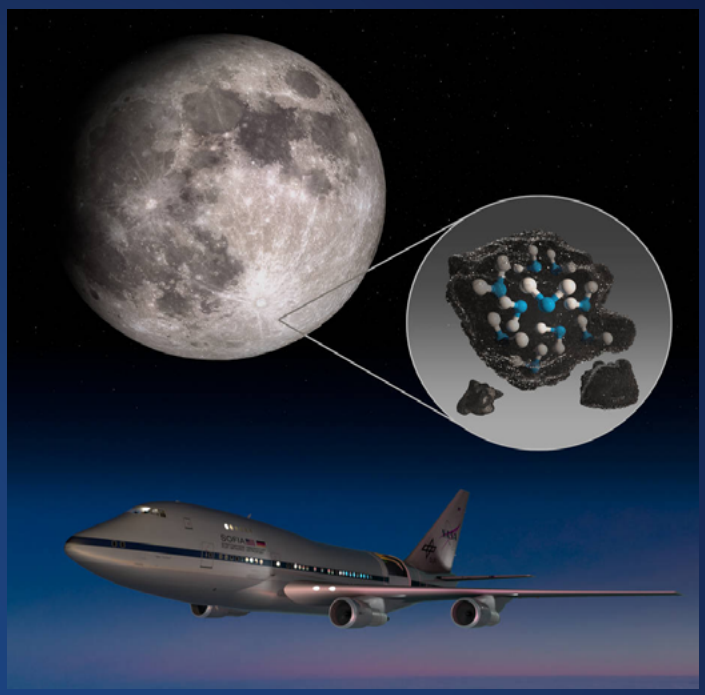
NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) has confirmed, for the first time, water on the sunlit surface of the Moon. This discovery indicates that water may be distributed across the lunar surface, and not limited to cold, shadowed places.

Data from this location reveal water in concentrations of 100 to 412 parts per million – roughly equivalent to a 12-ounce bottle of water – trapped in a cubic meter of soil spread across the lunar surface. The results are published in the latest issue of Nature Astronomy.

"We had indications that H2O – the familiar water we know – might be present on the sunlit side of the Moon," said Paul Hertz, director of the Astrophysics Division in the Science Mission Directorate at NASA Headquarters in Washington. "Now we know it is there. This discovery challenges our understanding of the lunar surface and raises intriguing questions about resources relevant for deep space exploration."

As a comparison, the Sahara desert has 100 times the amount of water than what SOFIA detected in the lunar soil. Despite the small amounts, the discovery raises new questions about how water is created and how it persists on the harsh, airless lunar surface.

Water is a precious resource in deep space and a key ingredient of life as we know it. Whether the water SOFIA found is easily accessible for use as a resource remains to be determined. Under NASA's Artemis program, the agency is eager to learn all it can about the presence of water on the Moon in advance of sending the first woman and next man to the lunar surface in 2024 and establishing a sustainable human presence there by the end of the decade.



"Prior to the SOFIA observations, we knew there was some kind of hydration," said Casey Honniball, the lead author who published the results from her graduate thesis work at the University of Hawaii at Mānoa in Honolulu. "But we didn't know how much, if any, was actually water molecules – like we drink every day – or something more like drain cleaner."

SOFIA's follow-up flights will look for water in additional sunlit locations and during different lunar phases to learn more about how the water is produced, stored, and moved across the Moon. The data will add to the work of future Moon missions, such as NASA's Volatiles Investigating Polar Exploration Rover (VIPER), to create the first water resource maps of the Moon for future human space exploration.

Read Full Story

X-59 QueSST

NASA's Supersonic X-59 Assembly Team Makes Wing Milestone

Whether you're building a house, crafting up some do-it-yourself holiday gifts, or even putting together a plastic model airplane kit, there inevitably are assembly milestones you reach that are considerably more satisfying to reach than others.

They are the kind of moments that prompt you to reflect on your work so far, bask in the glow of your accomplishment, and be inspired to continue toward the end so you can see how what you once only envisioned on paper has become reality.

Such a key milestone moment was reached Nov. 5 for the team putting together NASA's X-59 Quiet SuperSonic Technology airplane at Lockheed Martin's Skunk Works factory in Palmdale, California.

On that day technicians finished major work on the wing, closing up parts of the wing's interior that will serve as the airplane's fuel tanks and are intended to never be touched again by human hands.

"The fact this is the first time we've reached a milestone like this in which we won't see these parts or have access to this area again is why this is so important to us. It reminds us the X-59 really is coming together," said Steve Macpherson, a senior Lockheed Martin manager.

The fact the wing has hit this milestone in its assembly – the first major system of the airplane to do so – now allows other key components of the airplane including the fuselage and tail assembly to be joined together. The company is targeted to finish assembly, conduct test flights, and deliver the plane to NASA between now and sometime during 2023.

The X-59 is designed to generate supersonic sound waves that are so quiet people on the ground will hear them as sonic thumps – if they hear anything at all. Eventually, the X-59 will be flown over select communities to measure public perception of the sound.

Results will be given to regulators to use in determining new rules that could allow commercial faster-than-sound air travel over land.

The airplane's shape is the key to its low booms and a large part of that shape is reflected in the contours of the X-59's wing, especially its lower surface. Yet while the physics behind the wing's shape is complex, assembling the wing itself was more-or-less straightforward.

"The first time you build an airplane, even though it's 'just' an airplane, there's lots of challenges in getting all the parts to fit the way they should. And there's always the human element where somebody has a problem that has to be solved," he said.

Brandon noted that Lockheed Martin's Skunk Works philosophy, which keeps those who design and those who build working closely together, has worked well and kept NASA in the loop at every step – all of which made the wing-related milestone possible.

"It's not just NASA looking over a Lockheed shoulder trying to find errors. It's watching what's going on, making suggestions, and being part of the team. It's been really great, and I think it's a very successful process," Brandon said.

For now, the troubled year of 2020 is ending on a high note for everyone associated with the X-59 in the high desert of California.

"This was a significant win for the team and win for the program to see the successful close out of this wing tank portion of the wing," Macpherson said.

Read Full Story

SIO Demonstration

Urgent Medical Transport Simulated in Second SIO Demonstration

A vision of what future critical medical response could look like was simulated on NASA's second flight of the Systems Integration and Operationalization (SIO) demonstration Sept. 28 with partner Bell Textron Inc.

The SIO demonstration activity is a partnership with the FAA and industry partners to conduct demonstrations of potential commercial applications using different sizes of unmanned aircraft systems (UAS). SIO aims to accelerate the safe integration of UAS for commercial applications into the National Airspace System by tackling key challenges UAS operations face.

The Bell Autonomous Pod Transport 70 (APT 70) UAS flew for 10 minutes from Bell's facility on Floyd Carlson Field, near Fort Worth, Texas. The aircraft was operated by a remote pilot based at the ground control station.

Bell used the APT 70 to conduct a flight representing an urgent medical transport mission. It is envisioned in the future that an operational APT 70 could provide rapid medical transport for blood, organs and perishable medical supplies (payloads up to 70 pounds). The APT 70 is estimated to move three times as fast as ground transportation.

"This demonstration is a step on the path toward certification of commercial UAS operations," said Kurt Swieringa, NASA SIO technical manager. "Services such as urgent medical supply transportation can be beneficial to the public and can highlight the positive use cases commercial UAS operations provide."

The goal is to work with industry to help incentivize the creation of C2 and DAA systems based on standards informed by years of NASA research under the Unmanned Aircraft Systems (UAS) Integration in the National Airspace System (NAS) project. DAA and C2 are key systems needed to enable the safe integration of UAS into the NAS.

SIO's other industry partners are General Atomics Aeronautical Systems Inc. (GA-ASI) and American Aerospace Technologies Inc. (AATI). GA-ASI completed their demonstration activity in April and AATI is expected to follow Bell. All flight demonstrations will be at altitudes above 500 feet.

NASA plans to document best practices and lessons learned from the SIO activity and provide it to the UAS community to increase industrywide progress toward routine commercial unmanned aircraft operations.

Read Full Story

FOSS Rocket Boxes

Readied for Environmental Testing

A system originally developed to collect strain and other measurements on aircraft has been advanced and its durability enhanced for potential use in space.

Researchers at NASA's Armstrong Flight Research Center in Edwards, California, hope to validate the new version of their Fiber Optic Sensing System (FOSS) with four research boxes recently sent to NASA's Langley Research Center in Hampton, Virginia.

Environmental testing will determine if the systems can withstand heat, cold, vibration, pressure and other severe conditions encountered during a rocket flight and if there is potential signal interference. Shock testing, the only part of the work that will not be completed at Langley, will happen at the MGA Research Corp. in Manassas, Virginia, about 160 miles north of the NASA center.

"It will take about four to five months to complete the testing that will start with some functional checkouts of the boxes once they arrive at Langley," said Eric Miller, Armstrong's FOSS project manager.

If it is successful, this enhanced system called the Compact Fiber Optic Sensing System (cFOSS), or the FOSS rocket box, offers the ability to take thousands of measurements along a fiber optic wire about the thickness of a human hair.

Jonathan Lopez, an Armstrong research engineer, completed the final prep of the systems heading to Langley. He installed the box lids, cut foam for each unit to cradle the system and placed the FOSS boxes in separate protective cases for transport. Equipment to facilitate the testing also was sent.

"The FOSS team has spent the last few years designing these systems to ensure they meet and exceed the strenuous requirements performing

in a rocket launch environment," Lopez said. "To help ensure this an engineering design unit was integrated and put through pre-environmental testing here last year. It is a great feeling to finish the integration process of the FOSS space flight units."

Because launch vehicles have a number of different thermal and mechanical subsystems, Parker explained, the team envisions a FOSS system that will provide a number of measurements on the cryogenic tanks, not just on the outside of the tank but possibly also on the inside to measure fuel level.

Armstrong researchers are working on the effort with a team at NASA's Glenn Research Center in Cleveland.

"We just completed a sync review and the plan is for the testing to be next summer," Miller said. "The prototype testing will be at Glenn. We will fabricate some cryogenic sensors and complete some initial checkouts at Armstrong and then we will integrate those sensors into their test set up this spring for testing in the summer."

Much of the technology effort to advance FOSS for use on rockets was funded by the Space Technology Mission Directorate's Center Innovation Fund. In addition, LSP and LOFTID also have provided funding in support of the FOSS rocket box development.

Read Full Story

Precision Lunar Landing

NASA Tipping Point Partnership with Blue Origin to Test Precision Lunar Landing Technologies

From the rim of Shackleton crater to permanently shadowed regions on the Moon, a NASA-developed sensor suite could allow robotic and crewed missions to land precisely on the lunar surface within half the distance of a football field.

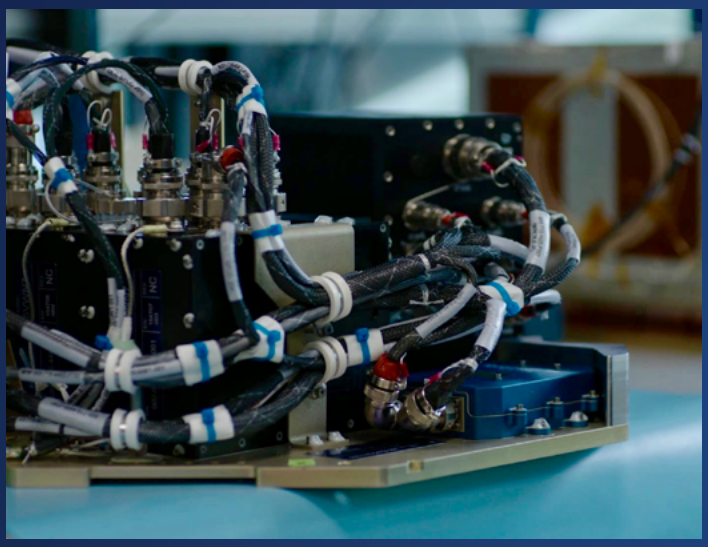
Technologies to enable exact and soft landings on the Moon and other worlds will fly on Blue Origin's next New Shepard suborbital rocket launch, targeted for 12:40 p.m. EDT Thursday, Sept. 24.

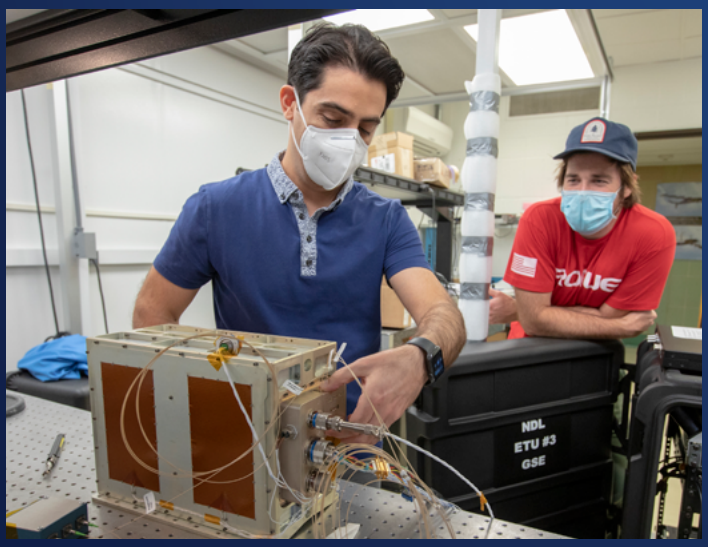
The rocket's flight path is relevant to lunar landings, providing a unique opportunity to mature sensors and algorithms for potential use on Artemis missions.

"This public-private partnership is a great example of NASA and industry working together on common goals – to explore more of the Moon and eventually land humans on Mars," said Jim Reuter, associate administrator for NASA's Space Technology Mission Directorate (STMD). STMD selected Blue Origin for a Tipping Point award in 2018 to help increase access to planetary surfaces.

Sensors and specialized software are fundamental to NASA's Safe and Precise Landing – Integrated Capabilities Evolution (SPLICE) technology suite. This flight test, the first of two under the Tipping Point partnership, will demonstrate the performance of two NASA-developed precision landing sensor systems, advanced algorithms, and a new computer.

The rocket launch won't be the first for some SPLICE components – NASA's Flight Opportunities program based at the agency's Armstrong Flight Research Center in Edwards, California, enabled tests on other commercial platforms. But this is the first integrated test for the computer with two





Read Full Story

of the three SPLICE sensor systems. So, before the technologies make their way to the Moon or elsewhere in the solar system, NASA is taking advantage of another proven testing platform.

Leading up to the New Shepard launch (NS-13), Blue Origin installed the sensors onto the upper portion of the reusable rocket booster and integrated the custom SPLICE descent and landing computer and remaining hardware into the booster. During the approximately 12-minute venture from Earth to space and back to Earth, SPLICE will collect data on the range of operations for each component to help the team better understand how the elements work together and on the same timetable during a lunar-relevant descent and landing.

“The sensor data is all processed via the descent and landing computer,” explained Carson. “Lots of other software runs in the background, integrating the different systems, figuring out what needs to run next, and, for this test, synchronizing timing with the Blue Origin flight computer. It’s all crucial so the system can run autonomously and provide us with data that we can analyze post-flight.”

“Precision landing is critical for a sustainable lunar future that builds a lunar base with successive missions,” said Brent Sherwood, vice president of Advanced Development Programs, Blue Origin. “On New Shepard together with NASA, we are demonstrating in flight the capabilities America can use to conduct lunar exploration.”

NASA designed the elements to work together or separately. One or all of the capabilities could be integrated into a spacecraft, depending on the destination and mission requirements.

“We develop and test new technologies so that NASA and industry can use variations of them based on the mission need,” said Game Changing Development Program Executive Niki Werkheiser. The program manages SPLICE’s technology development. “Since a one-size-fits-all solution for landing on other worlds isn’t feasible, we are bringing about flexible, next-generation capabilities that NASA and our partners can apply to a variety of missions.”

California Fires

NASA Pilot Flies California Fire Missions

NASA pilot Scott Howe is flying a remotely piloted MQ-9 with infrared cameras that can see through smoke and ash. The live images are overlaid with maps and satellite imagery of California wildfires to give commanders a more complete picture of what they face.

Howe is not flying the Ikhana, a civilian variant of the MQ-9 that was based at NASA's Armstrong Flight Research Center in California. This fire season he has often been flying a MQ-9 for the California Air National Guard as they assist with some of the most devastating wildfires in the state's history.

To date the fires have consumed more than 3 million acres and six of the largest 20 fires in California were this year, said Sagar Fowler, a Cal Fire battalion chief. Cal Fire is California's arm of the U.S. Department of Forestry and Fire Protection.

At the height of operations, there were about 18,700 firefighters battling 27 wildfires, nearly 2,400 fire engines are deployed, 129 aircraft were assigned and more than 360 bulldozers plowed fire lines critical to stopping the fire's movement, Fowler said.

The aircraft flies between 20,000-26,000 feet altitude as part of the conditions of a certificate of authorization (COA) with the Federal Aviation Administration granted to fly the missions. That process and early fire mission demonstrations were assisted by NASA Armstrong and the now retired remotely piloted Ikhana during the 2006 Western States Fire Mission.

His most intense experience this summer was supporting the Bobcat fire in the San Gabriel Mountains.

"The fire looked like a claw, or a tiger paw stretching south out of the mountains right up to a neighborhood in the Azusa area. "It literally was right in the backyard of these homes. It seemed like there was a firetruck parked in everyone's driveway, every single home, ready to do whatever it took to defend each house. I really felt the urgency of what we were doing."

Howe and his unit give fire commanders vital information about the fire's hot spots and provide maps of the fires to strategically protect people, firefighters and property. His unit has another important job.

"There's also the side benefit of noticing if a floating ember started a new spot fire way off that nobody has caught," he explained.

"The big work for the pilot is not just putting the aircraft in a good position looking at a particular fire with the way the terrain can mask things, which is what you are doing when you are on station, when they need you to move, you have to build a whole flight plan and clearance to move that aircraft to a new location."

Multiple target areas are slated for the two to three hour block. The shifts are nine hours and have a day, mid shift and swing shift. He reports for his shift an hour before he is scheduled to complete paperwork to fly, monitor feeds from the aircraft and attend the mission briefing including fires updates and statewide weather.

The pilots are assigned to a ground cockpit and given the mission assignment. Once seated in

the ground cockpit, Howe usually can remove his mask required when people can't socially distance. A plexiglass barrier between him and the sensor operator he is paired with in the other seat, receive an update briefing and the pilots switch seats when it is their opportunity to fly.

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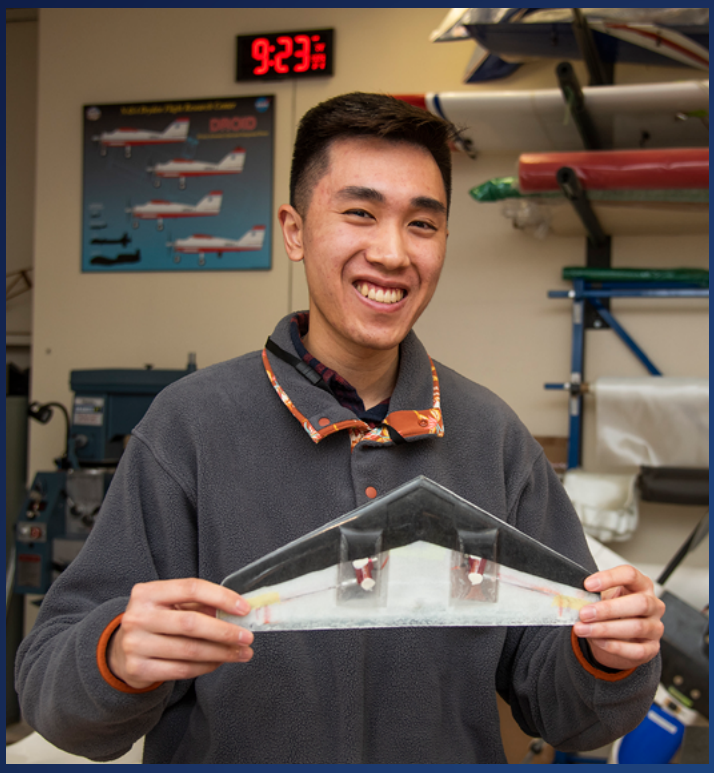
Armstrong Internship

Sam Maximizes NASA Armstrong Internship



When Nathan Sam accepted an internship at NASA's Armstrong Flight Research Center in California he didn't know what to expect, but he knew he would be working on an aircraft prototype that could one day fly on Mars.

Sam, a mechanical engineering student from California State Polytechnic University, Pomona, modified computer-aided drawings that had been developed by previous interns to make molds. From those molds the Preliminary Research Aerodynamic Design to Land on Mars, or Prandtl-M, version 6.0 would be fabricated.

"As a mechanical engineering student, the electrical aspects of the project are unfamiliar," Sam explained. "I watched and kept notes on the electrical installation, but I was unable to work on those systems because we began working from home. However, when we fabricate the next Prandtl-M, I will begin working on the electrical tasks independently."

"Dave (mentor Dave Berger) asked to perform aerodynamic analysis on the Prandtl-M 6.0 version we flew and that really helped me with the transition as I have never done anything like it and I am learning a lot," Sam said. "Coming into the project I didn't get much say into the design of Prandtl-M, but now doing analysis on the vehicle I am able to be a part of the process. I knew I wanted to work in the aerospace industry once I graduate and performing these type of tasks really confirmed to me what I want to do."

Sam will be challenged again when his summer internship begins and he will be the leader of the intern Prandtl-M team refining the 6.0 aircraft he advanced that is the second of the three potential Mars airplane versions. He and his team will begin work on the third 18-inch wingspan prototype 7.0 Prandtl-M. The first of the series had a 24-inch wingspan and was called the 5.0 Prandtl-M.

"I am excited to continue to have first-hand experience, getting back to flight testing the Mars airplane and building skills that will give me a boost in seeking the kind of work I want to do after college."

Read Full Story

Launch America

NASA Test Pilots and Astronaut for Launch America Share Common Bond

In 1998 when NASA Armstrong Flight Research Center's research pilots Troy Asher, Jim Less and Tim Williams attended the U.S. Air Force Test Pilot School (TPS) in Edwards, California, with classmate and now astronaut Robert Behnken, they did not know he would make this big of a mark on spaceflight.

Behnken, or as they fondly call him "Dr. Bob," was one of two astronauts on the Crew Dragon Demo-2 mission to launch American astronauts from U.S. soil for the first time in nearly a decade May 30. Behnken flew in two NASA space shuttle missions in the early 2000s, but this mission was his signature on history.

"Bob is a very humble guy, but in TPS he had a solution to every problem and always knew the answer," Williams said. "We thought early on, wow, this guy is impressive."

It is rare for a young engineer to come to TPS with a doctorate and Behnken did just that

after graduating with honors from the California Institute of Technology.

“Flying is never routine and manned spaceflight is a lot like flight test,” Less said. “It is all about safety review and risk mitigation. This was the first manned mission of this spacecraft and they were conducting a flight test.”

Asher added that flying a first flight scenario is one of the most sought-after career milestones a test pilot can complete. Asher as Armstrong’s director for flight operations, and with a military background, has only flown a few from conception to flight in his career.

“Bob and Doug flew in some of the very last space shuttle missions, so they chose the two most qualified pilots you can find to kick off the next generation of spaceflight,” Asher said. “Who better to fly it than the two who have been intimately involved in the design from the beginning?”

The three remarked about what an honor it was to see their classmate kickoff a new era of spaceflight, and the sense of national pride it brought to see NASA astronauts launch from U.S. soil again.

“He has been involved with this program for many years, and now we got to see the first flight,” Williams said. “When I saw the video of him getting strapped in, it raised goosebumps. It is such a privilege and very personal to see someone you know up there.”

Read Full Story

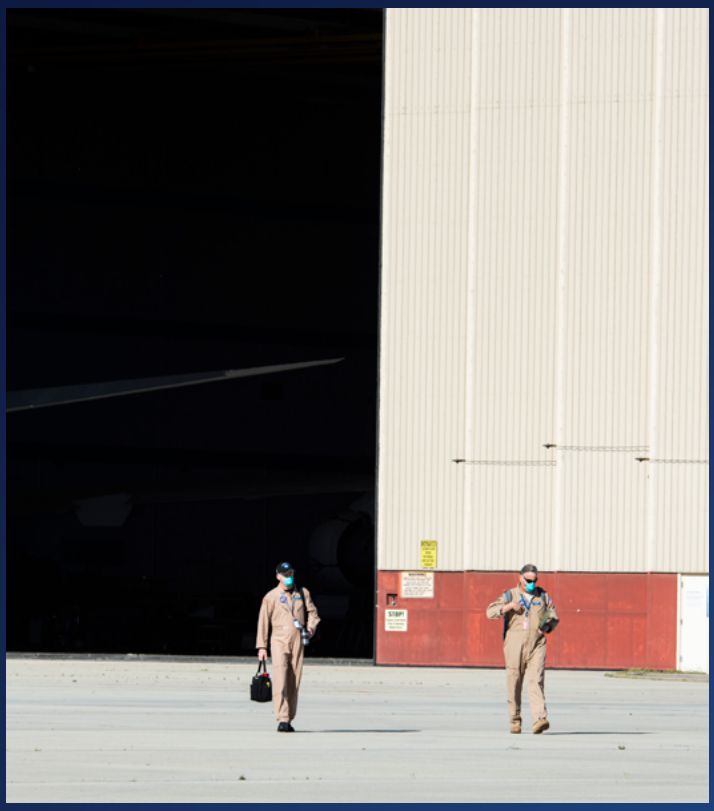
Mars Perseverance

Armstrong Provides Mars Perseverance Rover Support

When the COVID-19 pandemic delayed NASA Earth science missions, the agency's airborne science aircraft such as the C-20 and G-III Gulfstream had a new mission – get the Mars Perseverance 2020 team from California to NASA's Kennedy Space Center (KSC) in Florida to prepare the rover for launch.

The mission is timed for when Earth and Mars are closest to each other and ideal for the rover and the Integrity Mars Helicopter to travel and land on Mars. That is, it takes less power to travel to Mars now, compared to other times when Earth and Mars are in different positions in their orbits. NASA's Mars 2020 mission launched June 30, 2020 which avoided the need to wait more than two years for the planets to align again.

The first support flight used the C-20. The aircraft had special scientific equipment removed from the interior and additional seats were installed for NASA's Jet Propulsion Laboratory (JPL) in Southern California crewmembers. The aircraft



delivered the first group of Perseverance team members to KSC on March 23 and several similar flights followed.

“Getting the Perseverance team and gear safely where they need to go is just the latest in Armstrong’s affiliation with Mars exploration,” said Wayne Ringelberg, chief research pilot at NASA’s Armstrong Flight Research Center in California. “We hosted Mars Exploration Rover evaluations at Roger’s Lake in 2003, and in 2011 we tested the descent radar used on Curiosity’s landing in 2012.”

Trips began at sunrise, with Armstrong’s flight surgeon Dr. Dwight Peake, performing health screenings and protective equipment fittings. In addition to properly fitting M-95 masks and trainings on their use, JPL staff received aircraft egress training, ensuring they knew how to be safe to fly. By sundown in Southern California, the aircraft crew would return home with the mission team members.

“One of the best demonstrations of One NASA I’ve seen in a while is playing out right now with our Perseverance rover.” said Thomas Zurbuchen, associate administrator of the Science Mission Directorate. “Together we are persevering.”

Armstrong has also worked closely with a flight crew from NASA’s Wallops Flight Facility in Virginia for use of their C-130 cargo plane to transport hardware for the Perseverance rover mission. On May 10, nearly 5,000 pounds (2,270 kilograms) of mission flight hardware, test gear and equipment for the rover were loaded onto the C-130 aircraft and delivered to KSC.

Multiple NASA centers and several different industry organizations have all worked closely together to follow through with critical activities pertinent to meeting the tight launch window. To keep mission costs and risks as low as possible, the Mars 2020 design is based on NASA’s successful Mars Science Laboratory mission architecture, including its Curiosity rover and proven landing system.

The Perseverance rover’s astrobiology mission will search for signs of ancient microbial life. It will also characterize the planet’s climate and geology, collect samples for future return to Earth and pave the way for human exploration of the Red Planet. The mission is part of a larger program that includes missions to the Moon as a way to prepare for human exploration of the Red Planet. Charged with returning astronauts to the Moon by 2024, NASA will establish a sustained human presence on and around the Moon by 2028 through NASA’s Artemis lunar exploration plans.

Read Full Story

Moon Landing

Wheelock Readies Astronauts for Moon Landing

Astronaut Doug “Wheels” Wheelock spent his NASA career expanding knowledge of living and working in space. His new mission is working to determine the best way to train astronauts to return to the surface of the Moon.

Wheelock is a veteran test pilot and retired U.S. Army colonel who has accumulated 178 days in space and was a guest speaker at NASA’s Armstrong Flight Research Center in California during a recent virtual Safety Day. During his NASA career he conducted six spacewalks, flew in Space Shuttle Discovery and the Russian Soyuz and served as International Space Station Expedition 25 commander.

He was recently selected by the NASA Flight Operations directorate at NASA’s Johnson Space Center in Houston to lead the human lander system joint testing. He also is co-chairman of the joint test panel for the lunar landing project that is part of NASA’s Artemis mission to return astronauts for sustainable human exploration of the Moon.

“We have these companies that are building landers, but we need to be able to train our

crews," Wheelock said. " I am managing the test development and eventual testing and selection of platforms we will use for fixed base mockups, motion simulation and inflight trainers."

It wasn't always space missions and lunar landers for Wheelock. From an early age he said he learned from Neil Armstrong, as he watched as the first man on the Moon showcase qualities he believed leaders should have, such as humility and authenticity.

"I had a chance to ask him a question (when I was a kid), and I wanted to know how he felt as an extraordinary superhero," he said. Armstrong did not view himself in that way, which had an even bigger influence on Wheelock.

"How does an ordinary boy end up standing on the Moon?" he thought. "I later learned that ordinary kids from ordinary places do intersect with the extraordinary.

It wasn't until years later after he had been an astronaut that he recalled what a first grade teacher told him, "You could land on the Moon one day, too." As an astronaut, he remembered that and knows, "Children of all ages look to NASA for redefining what's possible for them."

On Aug. 24, 1998, he was selected as an astronaut and learned how to tackle complex challenges.

"It's like when we have pieces to a 1,000 piece puzzle and all pieces in front of us, but the box was taken away," he said. "We don't know what it looks like, but we look for the corners. Corners are the existence of our hearts, minds, bodies and souls."

The approach applies to a number of challenges.

"What we do in the simulators, or flying test plans, we know what the picture is supposed to look like," Wheelock said. "However, we may be doing something we have never done before, or trying to gain knowledge on a piece of equipment for the first time and that also is a puzzle. If we don't approach it by looking for the corners and connective parts, then we're not going to solve it."

Wheelock said being an astronaut isn't easy and he had to overcome several fears if he was to conquer the skies and space. He had an intense fear of falling and loud noises. Through strength, courage and a commitment to teamwork, he overcame it all and was rewarded for his hard work.

"When I went to space I wanted to rush to the window," he recalled. I wanted to look at the thin blue line of the atmosphere and see from space the small town I came from."

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