

# THE ARMSTRONG X-PRESS

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## What's it like, Nils?

### Nils details the chief pilot job

By Jay Levine  
X-Press editor

David Nils Larson went to work one morning, attended a few meetings, gathered his life support gear and soon found himself 30,000 feet over the California high desert flying a NASA jet faster than the speed of sound.

At the controls of an F-15 Eagle aircraft, a high performance former military jet NASA uses for research, he climbed and dived. Nils, as he prefers to be called, flew the complex mission as part of ongoing research about what happens to a pilot's breathing while flying through maneuvers that produce roller-coaster-like stresses.

The U.S. Air Force and Navy are looking into situations where some pilots are getting sick and for which the causes remain unknown. In March 2017, the NASA Engineering and Safety Center at NASA's Langley Research Center in Virginia assembled a team to investigate pilot breathing further and Nils was flying one of those missions wearing special gear that recorded his responses.

This is not a routine day, because in the flight research business there are no routine days. For Nils, who is Armstrong's chief test pilot, once



AFRC2016-0073-16

NASA/Lauren Hughes

*Above, Armstrong chief test pilot Nils Larson checks out the NASA F-15B aircraft before he climbs into the cockpit.*



AFRC2016-0038-28

NASA/Lauren Hughes

*At left, After climbing the stairs, Armstrong chief test pilot Nils Larson prepares to enter the cockpit of a NASA F-15B aircraft and begin preflight procedures.*



AFRC2019-0066-03 NASA/Ken Ulbrich

Armstrong Center Director David McBride welcomed staff to Safety Day and reminded them to stay vigilant to avoid injuries and mishaps.



AFRC2019-0066-10 NASA/Ken Ulbrich

Former NASA astronaut Rex Walheim reviewed lessons learned on a spacewalk, where water accumulated in an astronaut's helmet.

# Safety is consistent focus

By Jay Levine  
X-Press editor

Safe by Choice was the theme for the April 3 Safety Day that featured a variety of presentations for employees in the morning and a menu of activities to choose from during the afternoon sessions.

Armstrong Director David McBride reminded center staff about the importance of safety to prevent accidents at work or at home. Additionally, he explained how a

strong safety culture encourages people to discuss potential hazards and risks before starting activities to reduce mishaps.

“Sometimes the safe choice is not obvious and in order to make informed decisions more information is needed,” McBride said. “Stay engaged and question each other. Share lessons learned at team meetings and look for best practices.”

Glenn Graham, Safety and

Mission Assurance director, presented Armstrong’s 2019 Safety snapshot.

The good news: in 2018 Armstrong had 969 flights representing 2,570 flight hours, 22 deployments and 72 projects. In addition, the center’s Aviation Safety program was recognized as a best practice by NASA Headquarters and that 498 of 516 (96%) identified hazards were closed or eliminated.

The bad news: Preventable injuries and mishaps are still happening, largely due to gaps in communication, training and operational practices. The low point of 2018 was the loss of the Prototype Technology Evaluation and Research Aircraft Sept. 25, 2018. Details and lessons learned on that incident can be found on the Code 700 Share Point site.

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AFRC2019-0066-34 NASA/Ken Ulbrich

Cynthia Jeffers received the 2019 Safety Award for civil servant of the year for her outstanding safety record in the back shop and efforts in human factors training development for her branch. Glenn Graham and McBride presented the award.



AFRC2019-0066-35 NASA/Ken Ulbrich

Tyler Long received the 2019 Safety Award for contractor of the year for proactive actions that prevented an in-flight failure of an aircraft mounted accessory drive on an F/A-18 aircraft. Graham and McBride presented the award.

# Shin tells staff ‘good work’



AFRC2019-0064-12

NASA/Ken Ulbrich

*NASA Associate Administrator for Aeronautics Jaiwon Shin visited Armstrong recently to recognize two outstanding teams (see below) and told center employees they are helping transform aviation to begin a new era of flight. Projects such as the X-57, X-59 and urban air mobility will lead to innovations in electric propulsion, supersonic flight and the ability to use new vehicles and systems to safely move people and cargo.*

*Jaiwon Shin presented an Aeronautics Research Mission Directorate Associate Administrator award to Armstrong members of the Low Boom Flight Demonstrator Project Planning and Control Team led by NASA's Langley Research Center in Virginia with members at NASA's Glenn Research Center in Cleveland, Ames Research Center in California and Armstrong. From left are Shin, Irma De Paz, Daisy Franco, Glenda Almeida, Josh Martin and Armstrong Center Director David McBride.*



AFRC2019-0064-01

NASA/Ken Ulbrich



AFRC2019-0064-02

NASA/Ken Ulbrich

*Jaiwon Shin presented an Aeronautics Research Mission Directorate Associate Administrator award to Armstrong members of the X-57 Battery Test and Redesign Team led by NASA's Glenn Research Center in Cleveland. Six people from Armstrong also were part of the team. From left are Shin, Aric Warner, John (Ivan) Maliska, Thomas Rigney, Matthew Redifer, Sean Clarke and Armstrong Center Director David McBride. Rosalio Salazar, not pictured, also was recognized.*

## News at NASA

### Mars 2020 spacecraft preparation continues

For the past few months, the clean room floor in High Bay 1 at NASA's Jet Propulsion Laboratory in Pasadena has been covered in parts, components and test equipment for the Mars 2020 spacecraft, scheduled for launch toward the Red Planet in July 2020. But over the past few weeks, some of these components have seemingly disappeared.

They are still there, tucked neatly into the entry capsule as they will be when it's time for launch. The procedure is known as vehicle stacking and involves a hyper-detailed plan for what goes where and when.

"One of our main jobs is to make sure the rover and all the hardware that is required to get the rover from here on Earth to the surface of Mars fits inside the payload fairing of an Atlas V rocket, which gives us about 15 feet [5 meters] of width to work with," said David Gruel, assembly, test and launch operations manager for Mars 2020 at JPL.

The Mars 2020 rover will conduct geological assessments of its landing site on Mars, determine the habitability of the environment, search for signs of ancient Martian life, and assess natural resources and hazards for future human explorers. Scientists will use the instruments aboard the rover to identify and collect samples of rock and soil, encase them in sealed tubes and leave them on the planet's surface for potential return to Earth on a future Mars mission.

## Test pilot... from page 1

the mission was complete, he safely landed. Shortly afterward he was completing flight paperwork in the same office once occupied by Neil Armstrong, the first man on the moon who worked at the center as a test pilot flying aircraft such as the rocket-powered X-15.

“I met him a few times and it was always such a treat, Nils recalled, “He was such an amazingly nice guy and incredibly thoughtful.”

Meeting Armstrong and sitting in the same office had symmetry for Nils, as it was Armstrong who was one of Nils’ inspirations growing up in Bethany, a small West Virginia town. He recalled always having an interest in space and NASA and using a big log in the backyard as a spaceship to play astronaut.

In addition, Nils’ physical science teacher in high school loaned him a copy of “The Right Stuff,” the Tom Wolfe book about the early days of supersonic flight, rocket planes and astronauts.

It wasn’t long before Nils found himself at the Air Force Academy, where he graduated in 1986 with an astronautical engineering degree. In the Air Force he logged more than 5,500 hours in the air flying more than 75 different types of aircraft – including the U-2 spy plane.

Retiring from the Air Force as a lieutenant colonel stationed at Edwards, he didn’t have far to go – just down the taxiway – when he joined NASA in 2007 as a test pilot. Nils continues to fly the most advanced aircraft to conduct experiments and perform research that will help NASA transform aviation for the 21st century.

### Most challenging research flights

Research varies from providing air-to-air photographic support of another aircraft flying an experiment to complex tests of new technology through flight that challenge the capabilities of the pilot and the aircraft.

For example, he recalled a particularly difficult set of missions he flew supporting the Automatic



AFRC2016-0195-196

Armstrong chief test pilot Nils Larson and research pilot Wayne Ringelberg head for a mission debrief after flying a NASA F/A-18 at Mach 1.38 to create sonic booms. The flight was part of the SonicBAT flight series at Armstrong that studied sonic boom signatures with and without the element of atmospheric turbulence.

NASA/Lauren Hughes

Ground Collision Avoidance System, or Auto GCAS. The system was designed to take over for the pilot in situations where human reflexes would be insufficient for avoiding a collision, correct for the dangerous flight condition and return control to the pilot.

“The missions were high-risk flights that were looking at pilot reaction times in avoiding hitting a mountain, so we had to fly near the mountain at high speeds,” he explained. “In other flights, airspeed, altitude and dive angles had to be executed precisely and if the aircraft was too close, or the airspeed was off, the maneuver

would get called off.”

Some of the flights produced anxious moments.

“I was going Mach 1.2 straight down from 30,000 feet and activated the system,” Nils said. “In those seconds, it is difficult to imagine how close I was to planet Earth. There was some adrenaline there. Even when I could tell the airplane was not going to hit the ground, I still had the ground rushing toward me and I was experiencing sensory overload. I said to mission control, ‘I hope the data was good because I really don’t want to have to go and do it again.’”

Nils remembers being somber on the day he flew that mission. The area in which he was flying was the same place where a friend, Lockheed Martin pilot David Cooley, perished flying an F-22A in 2009. Nils believes Cooley could have been saved if an Auto GCAS was available then.

The reality of the hazards of flying high-performance jets is not lost on Nils, or his wife Kirsten, who was close with Cooley’s spouse.

Kirsten doesn’t like it when her husband flies dangerous missions, Nils said, and prefers he just not tell her about them. However, years later when the Auto GCAS he

helped test led to saving a pilot, it was a moment he was happy to share with his wife.

“When I opened my email and read about the save, I printed it out and handed it to Kirsten,” he said. “She had chills. I told her ‘I know you hated it when I worked on it, but here is a guy coming home to his family now because of that work.’”

A system based on what Nils proved in flight is currently used on a number of military aircraft and is credited with saving eight pilots and seven aircraft since 2014. In fact, Armstrong work was included as part of the winning



ED10-0236-27

NASA/Carla Thomas

The U.S. Air Force F-16D Automatic Collision Avoidance Technology aircraft flew at low levels above the Sierra Nevada Mountains to test the ACAT Fighter Risk Reduction project. The goal was to develop collision avoidance technologies for aircraft to reduce the risk of ground collisions. Such systems on U.S. Air Force aircraft have resulted in saving eight lives and seven aircraft.

2018 Collier Trophy submission for F-35 Auto GCAS testing. There also are discussions about incorporating such a system on additional military aircraft, as well as commercial aircraft.

### Complex and varied missions

Sometimes Nils’ work includes flying aircraft at different locations to meet research goals.

For example, a recent series of Quiet Supersonic Flights in Galveston, Texas, sought to measure community response to less intense sonic booms, the noise generated by supersonic flight.

The data collection is part of a larger effort involving the X-59 Quiet Supersonic Technology (QueSST) aircraft intended to

eventually allow commercial supersonic flight over land – currently prohibited – and greatly reduce coast-to-coast travel times.

To put that in perspective, it takes about 3.5 hours to get to Las Vegas by car from Edwards Air Force Base. For Nils in a high-performance jet, it takes about 25 minutes from takeoff to Las Vegas flying subsonic, but 10 minutes to get back at supersonic speed.

Nils also flies science aircraft like the DC-8 flying laboratory. He flew the first half of the NASA DC-8 26-day mission around the world in April 2018 for the Atmospheric Tomography (ATom) mission. Scientists were studying the atmosphere in the remotest parts

of the planet to better understand the processes that determine how greenhouse gases cycle around the world.

Aside from multiple mission locations and time zones, the team had additional challenges. For example, diplomacy and coordination were required with flights over different countries and work days can stretch to 14 hours or more on particularly busy days.

Maintenance challenges with the aircraft also can occur, but Armstrong crews were on location and prepared with key parts and worked to avoid trouble and quickly resolved problems when they arose, Nils explained.

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## Nils... from page 5

### The job

Helping to manage all of the logistics required before Nils steps into the cockpit underscores that it isn't always glamorous being a test pilot. Training, instrument refresher courses, simulations and check rides are part of the work. Another requirement is annual physical examinations until pilots reach the age of 55, after which NASA requires a physical examination every six months. At 54, he will soon need to add that to his to do list.

Also not particularly glamorous, but required to assure mission success before every flight, Nils has attended a number of meetings and briefings on the flight, practiced in the simulator if the flight is complicated, checked the weather, reviewed runway and airspace notices, looked over mission requirements and filed a flight plan.

Flexibility is a key character trait in a test pilot. Weather, experiment complications, or technical challenges with the aircraft or the chase plane are just a few of the common problems that can lead to multiple cancellations or postponements.

"Once you have been involved with flight research long enough, everybody knows when something doesn't go as planned that it's the nature of flight test," Nils said. "When you are researching new things, they don't always work perfectly. However, we have great teams of engineers and mechanics and if they don't like it, they won't let you go."

One of the perks of being the chief test pilot is the ability to influence the design and operations of a new experimental aircraft. For example, on the X-57 Maxwell distributed electric propulsion aircraft, Nils participated in early concept discussions.

"Being there at the beginning of experimental aircraft study is awesome because test pilots are geeky engineers too," he said.

However, he also goes to a lot



AFRC2018-0040-07

NASA/Lauren Hughes

*NASA chief test pilot Nils Larson evaluates software in the X-59 simulator that could predict where sonic booms would be felt on the ground and the intensity.*

**"A full afterburner takeoff in the F-15 Eagle, when I pull back on the stick and I am hauling to 25,000 feet straight up in a few seconds and flip it on its back – it doesn't get much better than that."**

### David Nils Larson, Armstrong chief test pilot

of meetings about developing experimental aircraft that never become actual experimental airplanes, which he refers to as vapor projects.

### Exhilaration of flight

Before Nils steps into the cockpit, he shakes hands with the crew chief and talks to the crew. After the flight he thanks them for letting him borrow their aircraft, as the crew takes care of the aircraft like it is a family member. He values all of the people who make it possible for him to fly.

But it isn't until all the checklists

are complete and he is waiting to take off that he has time to reflect while looking at the blue sky and wispy clouds above.

"I've got a smile on my face and I'm thinking this is what I always wanted to do and I can't believe I get to do this," Nils said.

When the wheels come off the runway, "I take a breath and say 'ahhhhhhhh,'" Nils said. "Everything else – the paperwork, the meetings, the hassles – all fall away and there is just the mission. I come back with a smile on my face."

Like many seasoned pilots,

whichever aircraft he is flying is his favorite, but that's especially true of a high-performance aircraft.

"When I am flying a fighter and light the afterburner that acceleration pushes you back in the seat a bit," Nils explained. "A full afterburner takeoff in the F-15 Eagle, when I pull back on the stick and I am hauling to 25,000 feet straight up in a few seconds and flip it on its back – it doesn't get much better than that. That's just good fun right there."

When the wheels hit the ground, he's not disappointed it's over – he is euphoric and smiling.

"Sometimes when I am walking away from the airplane with my helmet bag, still wearing my gear, I look back at the lakebed and the airplane," Nils said. "In that moment, it is just as I envisioned when I read the book 'The Right Stuff' all those years ago. I think, 'How cool is this?' Then I say a little prayer. I look up and say 'thanks.'"



AFRC2019-0066-07 NASA/Ken Ulbrich

Glenn Graham, Armstrong Safety and Mission Assurance director, said the center is doing well on safety, but there is room for improvement.



AFRC2019-0066-23 NASA/Ken Ulbrich

Jeb Orr, Space Launch System flight control technical specialist at NASA's Marshall Space Flight Center in Alabama, discussed X-15 lessons learned.

### Safety... from page 2

"Think about ways to make your work areas better and safer," Graham said. "I think we are doing well, but there are opportunities for us where we can improve. Safety relies on all of us. Choose to be safe and as Captain Marvel said 'be the best version of yourself.'"

Rex Walheim, Safety and Mission Assurance director at NASA's Johnson Space Center in Houston and a former astronaut, explained that a sequence of events can unfold slowly in a situation that at first

doesn't look as dangerous as it is. Astronaut Luca Parmitano was tethered to the International Space Station July 16, 2013, by 85 feet of retractable cord. The spacewalk is always conducted in pairs, but sometimes the two astronauts are not within sight of each other. Parmitano reported water inside his helmet, which was an incident he encountered on a spacewalk a week earlier, and which was dismissed as a leak from a drink bag that was later replaced.

As more water gathered in the helmet, water was in his eyes and encroached on his face. The spacewalk was terminated. It was getting dark as it does every 45 minutes in orbit above the Earth as he slowly worked his way back to the airlock. He had to feel his way back using the tether and feeling for the handrails. The situation deteriorated and his voice and demeanor changed as he said "There's a lot of water." Inside the airlock, other astronauts saw the

urgency and helped remove his space suit.

Water in Parmitano's communication system prevented him from telling anyone what was happening. Walheim said the astronaut's calm demeanor probably saved his life as more than 1.4 liters of water had entered his helmet. It was discovered that a blockage had caused the water to spill into the helmet.

Some root causes included the

### Safety Day, page 8



AFRC2019-0066-36 NASA/Ken Ulbrich

Kate McMurtry was named 2019 Safety Representative of the Year for her exceptional work for the Flight Operations Branch and the Aviation Safety Working Group. Glenn Graham and McBride presented the award.



AFRC2019-0066-37 NASA/Ken Ulbrich

Nicholas Baird and Jesus Garcia of the Kay & Associates AGE Fleet Team accepted the team award for their selfless and quick action, which prevented potential injuries and damage. Graham and McBride presented the award.

## Safety Day... from page 7

perception that drink bags leaked, a time consuming reporting process, and the perception that minor amounts of water in the helmet was normalized. A temporary process allowed spacewalks to resume, but Walheim questioned whether there should be a time limit on interim solutions. Armstrong project teams should ask similar questions when facing an anomaly, Graham said.

Walheim also discussed root causes of the loss of the space shuttles Challenger and Columbia in an afternoon session.

Jeb Orr, Space Launch System flight control technical specialist at NASA's Marshall Space Flight Center in Alabama, recalled lessons learned from the X-15 that flew 199 missions from Edwards Air Force Base and what is now known as Armstrong.

Orr focused on the vehicle and the Michael Adams 1967 crash, which remains the only fatality from a piloted hypersonic vehicle. The rocket planes still hold records for high altitude and high speed flight. The X-15 proved flight control techniques, advanced propulsion methods and it flew experiments during flights that reached 367,000 feet and speeds of Mach 6.7.

The causes of Adams' crash are complex. The initial investigation determined there were controls issues and the aircraft became uncontrollable as Adams became disoriented. The NASA Engineering and Safety Center recently took a fresh look. The complexity of systems, display design, human factors and flight controls were

contributing factors, although disorientation might not be as big a factor as originally thought. The NESC concluded that Adams found himself in a situation in which there was little he could do.

In one of the afternoon sessions, Orr went into more detail on the X-15 systems and the crash.

Linda Jensen, chief of the Human Capital Strategy Division of the California Human Resources Office, discussed from a first-hand experience the human side of safety. For her, 2013 was a rough year that began with a serious car accident in January that left her fighting for her life.

"I owe my life to some first responders and doctors and nurses," she said. "I was hit by a motorcyclist so hard that my seat moved 13 inches to right and I had bruises, a broken hip and a ruptured spleen. The motorcyclist didn't make it."

Five days passed in the intensive care unit at the hospital, as the condition of her spleen was a concern. She used nature music and breathing techniques to relax and block out some of the pain. After release from the hospital, her spleen ruptured again and it had to be removed in what became a month-long ordeal. She then progressed to a walker, then crutches and finally walked on her own. Now she shares what she learned.

"I consider every moment to be precious," Jensen said.

Director of Safety for Mitsubishi, Antonio Cortés, revealed why April



AFRC2019-0066-68

NASA/Ken Ulbrich

3 has been his personal safety day for 23 years. In 1996 six of his colleagues were lost when a 737 they were traveling in hit a mountain. He pledged to become a safety professional and currently works for Mitsubishi Aircraft Corporation overseeing the safety management system for flight testing and certification of two concept aircraft.

"The biggest challenge in safety is asking the right questions and defining your actions," Cortés said. "Can you prove you are safe? That question keeps me up at night. It is an extraordinarily difficult question to answer."

Safety cannot be determined simply through a flight operations view, although that is how engineers tend to approach safety, Cortés said. In addition to obvious technical and mechanical focus, there also needs to be a look at other factors such as human resources, performance, human integration and thinking twice.

"How can you make sure? Cortés asked. "Traditionally, measure close

*Abbigail Waddell works at sharpening her fire extinguishing skills during a Safety Day training. A number of trainings and exhibits were offered following the main activities at the base theater.*

calls and accidents. If there is no data to measure from, make data. Past performance is not an indicator of future performance."

Also at the event:

- Troy Asher, Flight Operations deputy director, reviewed the results of the 2018 Federal Employee Viewpoint survey that led to center improvements. The survey was detailed in the February X-Press.

- Training options included fire extinguisher training, Conex box tours, spill prevention and countermeasures training and hazardous symbols recognition.

- An ISF exhibit included the ombudsman, the Employee Assistance Program, the Government – Industry Data Exchange Program, the Office of Diversity and Equal Opportunity, the NASA Safety Reporting System, tire safety, hearing conservation, diet, ergonomics, desert wildlife safety, the Community Response Emergency Team, disaster preparedness, the California Highway Patrol driving safety and a distracted driving simulator. For more information, call ext. 2837.

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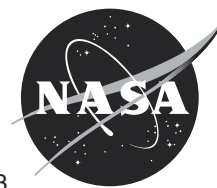
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