



THE ARMSTRONG X-**PRESS**

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New X-plane

Distributed electric aircraft named X-57

By **Matt Kamlet**

Armstrong Public Affairs

With 14 electric motors turning propellers and all of them integrated into a uniquely designed wing, NASA will test new propulsion technology using an experimental airplane now designated the X-57 and nicknamed “Maxwell.”

NASA Administrator Charles Bolden highlighted the agency’s first X-plane designation in a decade during his keynote speech June 17 in Washington at the American Institute of Aeronautics and Astronautics (AIAA) annual Aviation and Aeronautics Forum and Exposition, commonly called Aviation 2016.

“With the return of piloted X-planes to NASA’s research capabilities – which is a key part of our 10-year-long New Aviation Horizons initiative – the general aviation-sized X-57 will take the first step in opening a new era of aviation,” Bolden said.

As many as five larger transport-scale X-planes also are planned as part of the initiative. Its goals – like the X-57 – include demonstrating advanced technologies to reduce



NASA Langley/Advanced Concepts Lab, AMA Inc.

This artist’s concept of NASA’s X-57 Maxwell aircraft shows the plane’s specially designed wing and 14 electric motors. NASA aeronautics researchers will use the Maxwell to demonstrate that electric propulsion can make planes quieter, more efficient and more environmentally friendly.

X-57, page 8

Airvolt tests electric motors

Test stand will help prepare for X-planes

By Jay Levine

X-Press editor

Before the first electric propulsion X-planes fly, such as the X-57, researchers at NASA Armstrong are using a unique test stand to understand the intricacies of how electric motor systems work.

Made of steel and aluminum, the 13.5-foot tall Airvolt test stand is one of the newest tools in NASA's multi-center approach to explore the use of electric propulsion on future aircraft. The goal of using this technology is to burn less fuel, while reducing emissions and noise.

Airvolt was designed and fabricated at Armstrong and can help researchers anticipate system integration challenges and verify and validate electric propulsion components, said Yohan Lin, Airvolt integration lead.

"The test stand will help us to understand electric propulsion and the nuances of different systems," he said. "A lot of claims are made about the efficiency of electric motors and we want to verify that and gain experience with commercial off-the-shelf, or custom-designed systems."

Airvolt also permits researchers to evaluate early-stage technology and build confidence in its use for future systems.

One of the key items researchers need to know is if integrated electric propulsion can be used like traditional aircraft propulsion, Lin explained. If there are distinctions in how the systems work, researchers will find methods of managing the differences.

For example, Airvolt research has already confirmed a challenge – electro-magnetic interference, or EMI, he explained. EMI is when an electric circuit is interrupted by an internal or external force or



AFRC2016-0100-1

NASA/Lauren Hughes

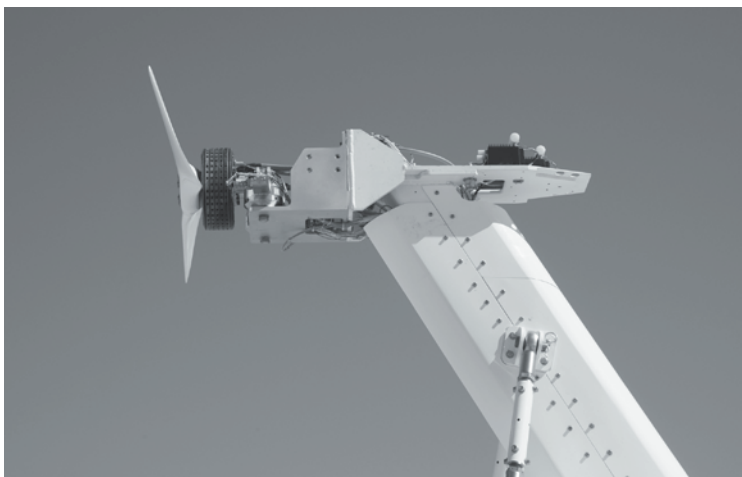
Yohan Lin, Airvolt integration lead, prepares the electric propulsion test stand.



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NASA/Lauren Hughes

The equipment required for an electric propulsion test is ready for research.



AFRC2016-0100-5

NASA/Lauren Hughes

The electric propulsion system to be tested is secured at the top of the Airvolt test stand and instrumented to collect data.

condition, which results in noise interference.

"EMI issues impacted data collection and real-time displays and gave us false indicators in the control room," he explained. "It was caused by the propulsion system's noise."

The solution was to install a combination of hardware filters on the test instrumentation and use digital filters on the acquired data. With the challenges eliminated, researchers in the control room were able to safely monitor key parameters.

Test operations begin with the installation of an electric motor with a propeller attached and the system affixed to the test stand. A number of high-fidelity sensors on the test stand provide critical measurements to a data acquisition unit that processes, records and filters the data and sends it to the control room for monitoring.

During an electric motor test on Airvolt, a 50-foot area is cleared and most of the staff is in the control room monitoring the research results, Lin said. A safety operations representative and a quality inspector observe the test from a safe distance.

As the motor starts the sound is similar to that of a large, square window fan, only slightly louder and with the propeller blade turning much faster. It is much quieter than a typical conventional combustion piston engine of the same size.

The first tests on Airvolt in late 2015 focused on the energy efficient Pipistrel Electro Taurus electric propulsion system, which is typically used for motor gliders, Lin explained.

The Pipistrel motor is powered by lithium polymer batteries and produces 40 kilowatts of power, which are monitored by the Airvolt that is capable of accommodating systems that use up to 100 kilowatts of power. The test stand can also withstand 500 pounds of thrust.

Researchers using Airvolt are interested in determining voltage,

Sherrard selected as center's chief of staff

By Leslie Williams

Armstrong news chief

Armstrong Director David McBride appointed Roberta Sherrard to become the center's chief of staff. Sherrard will report to the center director's office providing expert advice and guidance on organization and management issues across the center.

In coordination with NASA Headquarters and Armstrong's organizational directors, Sherrard will assist with the integration of center-wide and institutional strategies as well as support center activities including programmatic, research, mission support and technical support functions.

She will also be responsible for coordinating center responses to agency boards and councils where she will represent the center director's office. As chief of staff, Sherrard will maintain awareness of center capabilities and related activities.

Prior to assuming her current



Roberta Sherrard

position, Sherrard was the deputy director for the Mission Information and Test Systems Directorate from 2008 to 2016. She was responsible for oversight and direction of the center's mission operations technology infrastructure and services. In addition, she

played a key role in the creation of Armstrong's Strategic Plan, which sets the center's course for the future.

Her deputy director responsibilities included flight-test range engineering and operations services, aircraft engineering simulations and all information technology services. She was responsible for the strategic direction and operational functions of the Dryden Aeronautical Test Range (DATR), Flight Simulation, and Information Technology Services in support of Armstrong's missions.

Sherrard transferred from the Air Force Flight Test Center (AFFTC) to NASA in 1999. She supported the X-34, X-43A and F/A-18 Active

Aeroelastic Wing projects while developing a working knowledge of real-time data acquisition systems, data processing, graphical displays, and software development. She also participated in the requirements specification, development and acceptance testing for the DATR Integrated Next Generation System, which advanced the capabilities to support future test programs.

Sherrard began her federal career in 1989 at the Air Force Flight Test Center at Edwards Air Force Base, California. During her time at the AFFTC, she worked as a program analyst on flight test projects that included the YA-7F, AC-130, F-16, C-17 and F-22 aircraft for the Ridley Mission Control Center.

Sherrard holds a Bachelor of Science degree in computer science from Arkansas State University, Jonesboro, Arkansas. She is the recipient of a NASA Outstanding Leadership Medal, the NASA Group Achievement Award for her work with the Columbia Accident Investigation Board Support Team and she was selected as a Women@NASA honoree in 2013.

News at NASA

Exoplanets discovered

An international team of astronomers has discovered and confirmed a treasure trove of new worlds using NASA's Kepler spacecraft on its K2 mission. Among the findings tallying 197 initial planet candidates, scientists have confirmed 104 planets outside our solar system. Among the confirmed is a planetary system comprising four promising planets that could be rocky.

The planets, all between 20 and 50 percent larger than Earth by diameter, are orbiting the M dwarf star K2-72, found 181 light years away in the direction of the Aquarius constellation. The host star is less than half the size of the sun and less bright. The planets' orbital periods range from five and a half to 24 days, and two of them may experience irradiation levels from their star comparable to those on Earth. Despite their tight orbits – closer than Mercury's orbit around the sun – the possibility that life could arise on a planet around such a star cannot be ruled out, according to lead author Ian Crossfield, a Sagan Fellow at the University of Arizona's Lunar and Planetary Laboratory.

The researchers achieved this "roundup" of exoplanets by combining data with follow-up observations by earth-based telescopes including the North Gemini telescope and the W. M. Keck Observatory in Hawaii, the Automated Planet Finder of the University of California Observatories and the Large Binocular Telescope operated by the University of Arizona. The discoveries are published online in the *Astrophysical Journal Supplement Series*.



AFRC2016-0169-1

NASA/Ken Ulbrich

Safety award

Brett Pauer was recognized as Armstrong Safety Representative of the Year for his contributions to safety awareness within his organization and the center. Pauer provided guidance and input into creating a Mishap Response Book for Aeronautics project managers. He also was a Safety Day 2016 guest speaker about when his car was washed away during a flash flood. He received the award from Jim Smolka, left and Patrick Stoliker.

By Jay Levine

X-Press editor

Izadel "Izzy" Rosas sits in the cockpit of the F/A-18, grabs a hold of the control stick and smiles.

While 4-year-old Izzy is a little young for the rigors of flying a high performance jet, she is not too young to be inspired by the science, technology, engineering and mathematics that enable flight research.

During a Sons and Daughters to Work Day recently at NASA Armstrong, children were invited to fly simulators and learn about life support pressure suits for high-altitude flight. They also engaged in educational activities like an exhibit that enabled attendees to see what it was like repowering the International Space Station.

A robotics demonstration by the Gryffingear award-winning robot built and operated by students of the Palmdale Aerospace Academy also attracted attention. Other exhibits including watching room-temperature water boil to demonstrate high-altitude challenges and an opportunity to learn more about what mom and dad do at work.

"The kids hear us talk about what we do at work, but this gives them an opportunity to see the hardware and have hands-on experiences that will help them make connections to what they see here with science, technology, engineering and mathematics," said Nils Larson, an Armstrong parent and lead pilot.

Cooper Larson, a fourth grader, gravitated to a robotics display.

"I liked controlling and trying to get the balls in the tube," he said. He is also a For Inspiration and Recognition of Science and Technology (FIRST) Lego League Junior Challenge participant.

Nils Larson explained to his son the science and engineering as the water pushed on a piston using hydraulics to make the arm move to meet the goal of dropping the balls into a tube.

Gabi Joffe, a 10th grader, said she liked seeing all the different

Sons and Daughters

Children learn what mom and dad do at work



AFRC2016-0175-12

NASA/Lauren Hughes

Izadel "Izzy" Rosas sits in the cockpit of an F/A-18 research jet during a day designed for children to see what mom and dad do at work at NASA Armstrong. About 240 children attended the event.



AFRC2016-0175-37

NASA/Lauren Hughes

NASA Armstrong intern Ethan Czuppa explains elements of the Prandtl-D aircraft to Howard Joffe and his daughter Gabi Joffe. The aircraft is the first of its kind that features a new method for determining the shape of the wing with a twist that could lead to a revolution in aircraft design and efficiency.



AFRC2016-0175-80

NASA/Lauren Hughes

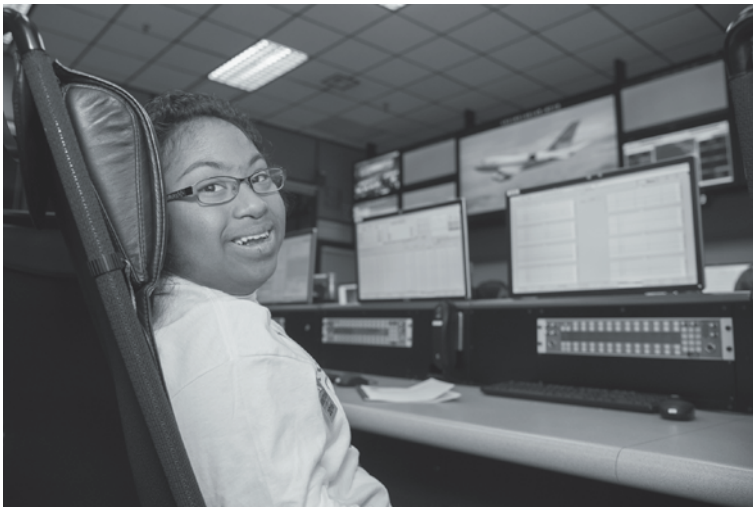
Part of the Sons and Daughters to Work Day was an opportunity to “fly” in an aircraft simulator.



AFRC2016-0175-55

NASA/Lauren Hughes

Jeremy Clay and his daughter Breanna pose with a new friend at the high-altitude flight suit exhibit.



AFRC2016-0175-90

NASA/Lauren Hughes

Yasmeen Sandhu learns about the mission control room at NASA Armstrong during Sons and Daughters to Work Day.



AFRC2016-0175-08

NASA/Lauren Hughes

Christi Yapching shows her nephew Anthony Cantalupo and her son Elijah Cantalupo some elements where she works in Armstrong Television.



AFRC2016-0175-49

NASA/Lauren Hughes

Evan Soukup, Brian Soukup, Jackson Soukup, Austin Miller and Travis Evans take time out for a photo.



AFRC2016-0175-14

NASA/Lauren Hughes

Meleana Miles tries on a pilot's helmet. Kids learned good skills in science, technology, engineering and math could lead to internships and jobs at NASA.

Sons and Daughters... from page 4

exhibits and learning about them. She was particularly impressed that the Prandtl-D remotely piloted glider is so lightweight. The aircraft is the first of its kind that features a new method for determining the shape of the wing with a twist that could lead to a revolution in aircraft design and efficiency.

Howard Joffe, her father and Armstrong employee, said he appreciated the opportunity to show his daughter about the Armstrong work and “maybe do this kind of work. She is interested in what we do here.”

Alexis Jensen, an eighth grader, took pride in helping her father Red Jensen set up the display of remotely piloted aircraft with her siblings Cate, Jack and Ryan.

“I helped put the wing on,” she said pointing to a large, red Super Cub aircraft.

“They always ask what I do,” said Red Jensen, who is the Small Unmanned Aircraft Systems chief pilot and master technician for the Dale Reed Subscale Flight Research Lab. “I work with airplanes, but they had a chance to see for themselves in greater depth. It now is more tangible for them what I do.”

Robert Brenizer, a recent high school graduate who aspires to be a future intern at Armstrong, was most impressed with the Prototype-Technology Evaluation and Research Aircraft (PTERA). PTERA is a versatile remotely piloted flying laboratory aircraft that is bridging the gap between wind-tunnel experiments and full-scale flight testing.

“It is really cool that the PTERA is constructed from carbon fiber,” he said. “Carbon fiber makes sense because it is strong and light weight. I was really intrigued by the PTERA because I am interested in all things aviation from designing to building and flying.”

Children experienced jobs with focuses on science, technology, engineering and mathematics and perhaps one day some of them will follow in mom or dad’s footsteps.



AFRC2016-0175-35

NASA/Lauren Hughes

Mera Burton, left, and Maria Caballero help inspire young minds with an interactive education hydraulic arm exhibit that attracted many children.



AFRC2016-0175-48

NASA/Lauren Hughes

Learning what dad does brought Robert “Red” Jensen’s family to the Dale Reed Subscale Flight Research Lab. They helped him set up the display that includes the PTERA on the left and the Super Cub on the right. From left are Alexis, Cate, Jack, Ryan and Red.

Smolka completes 30-year career

By Jay Levine

X-Press editor

Jim Smolka's career at NASA Armstrong spanned more than three decades before his retirement June 30. He flew high-performance aircraft and served in a number of managerial posts.

The best part of working at Armstrong was the people, he said.

"I will miss our world-class engineers, the good group of pilots and the former pilots who were heroes of mine," Smolka said.

He also loved the research flights. "Whenever you have a precise data point you're trying to get for the engineers, that's a challenge," he explained.

One of the more interesting flights for Smolka was during his tenure on the F/A-18 High Alpha Research Vehicle, or HARV. The nine-year program used research hardware and software to examine aircraft control in previously hazardous areas of the post stall regime.

"We did some spins to look at the basic aircraft characteristics, and we also did some spins at military power, which were designed to collect engine stall data," he said. "Anytime you have an aircraft out of control, it gets your attention! It was exciting and fun, and we had a lot of preparation in the simulators to fly it safely."

Another part of the program involved Smolka and former Armstrong test pilot Ed Schneider learning how to aerially refuel the highly modified research aircraft.

"It was the hardest airplane to refuel," he recalled. "We were both experienced pilots in F/A-18 aircraft. Because of the mass



AFRC2016-0186-75

NASA/Ken Ulbrich

Ed Mathieson helps with the traditional greeting for a pilot who has flown his last flight. The tradition honored Jim Smolka's final flight for NASA Armstrong June 28 in an F-15 aircraft.

characteristics of this particular airplane that made it extremely sensitive to control, it was very difficult to capture the basket and stay in position through the refueling. That was the first flight. By the end it had looked like we did it our whole lives."

His next adventures will be knocking off items from his bucket list, starting with four-wheel drive exploits, travel to France in the spring and trips to Africa to photograph a safari and a return to see the sights he missed during a previous visit to Japan.

Smolka retired as the director for Safety and Mission Assurance. In that role he was responsible for flight and range safety, aviation and institutional safety at Armstrong. Smolka also served on Armstrong's

Airworthiness and Flight Safety Review Board, which provides independent assessment of each flight project's readiness to proceed to flight.

Smolka was the director of Flight Operations at Armstrong from 2012 to 2015. In that post he was responsible for the center's fleet of highly modified manned and unmanned aircraft that are flown on worldwide science, astronomy and aeronautical flight research missions and the flight and ground crews that fly and maintain them.

He previously served as the center's chief engineer, where he provided independent technical guidance and oversight to Armstrong flight projects and chaired Armstrong's Airworthiness and Flight Safety Review Board.

Smolka started his Armstrong career in 1985 as a research pilot and flew a number of research and support aircraft. He was project pilot on the Advanced Control Technology for Integrated Vehicles and Intelligent Flight Control Systems research projects flown on NASA's now-retired NF-15B research aircraft and the Gulfstream/NASA F-15 Quiet Spike sonic boom reduction project.

He was co-project pilot on the F-16XL Supersonic Laminar Flow Control aircraft and participated in the F-15 Highly Integrated Digital Electronic Control flight and engine control system projects. He also had roles in the Advanced Fighter Technology Integration, or AFTI, F-16 and the AFTI F-111 Mission Adaptive Wing, F-104 and F-15 Aeronautical Research Aircraft experiments and projects flown on the NB-52B.

Before joining NASA, Smolka was an F-16 experimental test pilot with General Dynamics Corp. for two years at Edwards, including work as a project pilot with the Air Force and NASA Advanced Fighter Technology Integration F-16 Joint Test Force located at Armstrong, then called Dryden Flight Research Center.

Named a Fellow of the Society of Experimental Test Pilots in 2012 for distinction in experimental flight test, Smolka has authored several technical publications and has taught a number of graduate and undergraduate courses in aerospace for California universities. He has accumulated more than 9,000 hours of flight time during his 40-year flying career.

Gordon, hero and former mechanic, dies at 94

John Allen "Catfish" Gordon, 94, who was a member of the team that rescued an X-15 pilot, died May 3. He was 94.

Gordon was part of the rescue team at Mud Lake, Nevada, on Nov. 9, 1962, when NASA veteran pilot

John B. "Jack" McKay was forced to make an emergency landing following an engine failure.

The X-15 canopy was ejected, the nose gear broke and the research vehicle flipped onto its back. As a result of Gordon's actions with

other crew members to cut McKay free of the straps keeping him in his seat and extracting him from the aircraft, he received the NASA Exemplary Bravery Medal. He also received an Apollo Achievement Award during his career.

He was a mechanic for two decades in the 1950s and 1960s, retiring in 1972. Some of the iconic aircraft on which he worked in addition to the X-15 rocket plane included the X-24A and X-24B.

X-57... from page 1

fuel use, emissions and noise, and thus accelerate their introduction to the marketplace.

The X-57 number designation was assigned by the U.S. Air Force, which manages the history-making process, following a request from NASA. The first X-plane was the X-1, which in 1947 became the first airplane to fly faster than the speed of sound.

“Dozens of X-planes of all shapes, sizes and purposes have since followed – all of them contributing to our stature as the world’s leader in aviation and space technology,” said Jaiwon Shin, associate administrator for NASA’s Aeronautics Research Mission Directorate. “Planes like the X-57, and the others to come, will help us maintain that role.”

NASA researchers working directly with the hybrid electric airplane

also chose to name the aircraft “Maxwell” to honor James Clerk Maxwell, the 19th century Scottish physicist who did groundbreaking work in electromagnetism. His importance in contributing to the understanding of physics is rivaled only by Albert Einstein and Isaac Newton.

As part of a four-year flight demonstrator plan, NASA’s Scalable Convergent Electric Propulsion Operations Research project will build the X-57 by modifying a recently procured Italian-designed Tecnam P2006T twin-engine light aircraft.

Its original wing and two gas-fueled piston engines will be replaced with a long, skinny wing embedded with 14 electric motors – 12 on the leading edge for take offs and landings, and one larger

motor on each wing tip for use while at cruise altitude.

NASA’s aeronautical innovators hope to validate the idea that distributing electric power across a number of motors integrated with an aircraft in this way will result in a five-time reduction in the energy required for a private plane to cruise at 175 mph.

Several other benefits would result as well. Batteries will solely power “Maxwell,” eliminating carbon emissions and demonstrating how demand would shrink for lead-based aviation fuel still in use by general aviation.

Energy efficiency at cruise altitude using X-57 technology could benefit travelers by reducing flight times, fuel usage, as well as reducing overall operational costs for small aircraft by as much as

40 percent. Typically, to get the best fuel efficiency an airplane has to fly slower than it is able. Electric propulsion essentially eliminates the penalty for cruising at higher speeds.

Finally, as most drivers of hybrid electric cars know, electric motors are quieter than conventional piston engines. The X-57’s electric propulsion technology is expected to significantly decrease aircraft noise, making it less annoying to the public.

The X-57 research started as part of the NASA Aeronautics Research Mission Directorate’s Transformative Aeronautics Program’s Convergent Aeronautics Solutions project, with the flight demonstrations being performed as part of the Flight Demonstration Concepts project in the Integrated Aviation Systems Program.

Airvolt... from page 2

current, power, torque and thrust performance of the commercial off-the-shelf components and learning about the characteristics of such a system, Lin explained. In addition, researchers are looking to build competencies in electric propulsion system verification and validation.

“Preparatory work for developing in-house skills and knowledge can’t wait until an X-plane comes,” he said. “We want lessons learned early on so that we can apply them to upcoming designs and establish best practices for operating those systems.”

Next up for the Airvolt are tests

during late summer on the Joby Aviation JM-1 motor that will provide information for modeling simulations of the electric propulsion elements.

The data collected from the tests will include torque and thrust measurements, high-fidelity voltage analysis, power efficiency, and details on how the system behaves. A simulation model will be developed from that information to study flight controls, power management and transition issues of a distributed electric aircraft.

To prepare for the possibility of

distributed electrical propulsion, where multiple motors are used, “you want to understand the characteristics of one motor system first so variables can be reduced when trouble shooting the multi-motor configuration,” Lin explained.

“Overall, we are getting excellent data,” Lin said. “What we are learning will help us to understand this new technology, and be a starting point for complex challenges. Each system is different, but we will be ready.”

Tools such as Airvolt support

a key NASA Aeronautics Research Mission Directorate’s goal to transition the aviation community to low-carbon propulsion – an effort that is part of the agency’s multi-center electric propulsion plan.

The NASA ARMD Advanced Air Transportation Technologies hybrid gas electric propulsion subproject funds the current Airvolt work. The AATT subproject aims to explore and develop technologies and concepts for improved energy efficiency and environmental compatibility for future fixed wing subsonic transports.

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