Exhauster motors near the Arnold Engineering Development Complex Engine Test Facility at Arnold Air Force Base are being replaced after being in service since at least 1958.

The motors, referred to as the A and B exhauster motors, have been used to exhaust up to a combined total of 1,100 pounds of air per second during testing. In the 61-plus years that the motors have been in use, they have supported the testing of numerous aircraft engines, including those used for the B-1 Lancer, B-2 Spirit, B-52 Stratofortress, F-5, F-16 Fighting Falcons, F-35 Lightning II and U-2, a high-altitude reconnaissance aircraft, as well as cruise missiles and other projects.

“The three 38,000-horsepower motors in A Plant will greatly increase reliability, availability and maintainability to support test cells across Arnold Air Force Base,” said Maj. Michael Krauf, AEDC Acropulsion Operations Officer.

Krauf added this is a major maintenance project for AEDC.

“For the B motors, we will be replacing five motors with three, each 10,000 horsepower,” he said. “These will support three of the six compressors in B Plant.

Combined with the A motor replacement project, this is a $3.5 million project. In A Plant, four motors will be replaced with two new ones, 38,000 horsepower each.

These exhauster motors not only support engine testing for jet engine cells 3 and 3-1, but also support testing at the J-6 Large Rocket Motor Test Facility, the H2 High Temperature Lab and the Propulsion Wind Tunnel Facility.

“They’re integral to the entire base and each of the Combined Test Facilities on the base because they all utilize this exhaust plant,” Krauf said.

Jay Manton, asset manager for the Acropulsion Combined Test Force, added that the exhauster motor replacement project is also historically significant for Arnold.

“ITF II was the first plant for the Engine Test Facility, which was completed in May 1954, and a lot of the equipment came over from Germany and the newer motors are still driving those old German compressors,” he said.

By Bradley Hicks
AEDC Public Affairs

They are considered indispensable.

Those at the National Full-Scale Aerodynamics Complex at Moffett Field in Mountain View, Calif., who observed their contributions every day agree the craftsmen employed there are not only integral to the work at NFAC but play a vital role in the Arnold Engineering Development Complex mission as a whole.

“They are essential,” said NFAC Branch Manager Jeff Johnson. “We couldn’t perform this mission without them.

The craft crews at NFAC are not only responsible for maintaining all the equipment in A Plant, but they also operate and maintain the wind tunnels. (U.S. Air Force photo)

By Staff Sgt. Christine Groening
AEDC Public Affairs

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49th Wing Public Affairs

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Arnold Engineering Development Complex (AEDC) team members lower the NASA/Amy Vickers Test Rig (TTR) into the 40- by 80-foot wind tunnel in the AEDC National Full-Scale Aerodynamics Complex (NFAC) at Moffett Field in Mountain View, Calif. The TTR was used to study advanced librators and develop databases for design code validation. NFAC craftsmen not only install test articles in the facility wind tunnels, but they also operate and maintain the wind tunnels. (U.S. Air Force photo)

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746th Test Squadron celebrates diamond anniversary

HOLLOMAN AIR FORCE BASE, N.M. – The 746th Test Squadron celebrated their 60th anniversary Oct. 25.

The event was open to those with base access, and guests enjoyed various activities to include facility tours featuring test equipment and hardware, face painting, aircraft flyovers, live music and food.

“1959 was when this squadron was founded as the Central Inertial Guidance Test Facility,” said Lt. Col. Charles McNiel, 746th TS commander. “The facility existed before that, as a missile test facility.”

The squadron is known for being the Department of Defense’s go-to lead test organization, whose tests and evaluations guide GPS and integrated GPS based guidance and navigation systems.

“Just before the Apollo 11 disaster, this squadron tested the inertial navigation system that they were using to navigate to the moon,” McNiel said. “We were really a pretty serious design flaw with it. If we had not identified the flaw and fixed the system before it went on Apollo 11, they would not have been able to navigate after they had been blown off course.”

Currently, nearly all military equipment with navigation systems, such as aircraft, ships, submarines and vehicles, visit the test squadron to ensure proper performance.

“One of the first things that happens in a part conflict is adversaries are going to try to control GPS,” said McNiel. “Another big part of our mission that has grown considerably in the last 10 years is we jam GPS. We have the world’s most
AEDC Strategy 2020: Refocus on great power competition

By Col. Jeffery Geraghty and Chief Master Sgt. Rob Heckman

Leaders throughout the United States government recognize the need to focus the defense arsenal on great power competition. To meet this end, the U.S. House of Representatives recently created a new task force to examine how the Air Force can create a Pentagon’s technological edge against Russia and China as well as take on sacred cows along the way.” Defense News reported on Oct. 23. Likewise, leaders at the Arnold Engineering Development Complex – a major contributor to the National Defense Strategy – have a firm grasp on the compel- ing need to focus our efforts on great power competition, and better capture sacred cows that stand in the way.

Dozens of AEDC leaders met at Gossipric Island, Charleston, S.C., for an all-day strategic discussion of the National Defense Strategy – must transform more completely, thoughtfully, and deliberately into an organization that will enable us to transition our mission with maximum efficiency. Our mission – “to provide the superiority of response to meet the demands of the National Defense Strategy” – requires our full attention. A misstep in how we reason and act will enable us to apply squadron personnel to questions like: “How does the nation prove that our space warfighting technologies are second to none?” and “How does the United States prove the global superiority of our next-generation based strategic deterrence?”

As we step deliberately and thoughtfully toward a more complete integration as an Air Force Wing, focus, clarity and transpar- ency will be our guiding lights in this challenging journey.

First, we will remain mission-focused. Our proximities are to: pursue mission excellence, invest in our people, and improve and sustain the way we operate. We must therefore address our capability gap, while building and creating an organization to grow in scope, and mission alignment and supervision the past 50 years – from a single site with important but limited focus, to a nationally distributed set of test capabilities tied together which provide the underlying, systems-based framework for the nation.

Third, we will communicate with transparency the objectives and changes that we make in pur- sue of our strategy to transform AEDC and our Air Force Wing. Any changes that we enact will be deliberately and thoughtfully considered in a transparent pro- cess that determines an appropriate CONSOPs, or concept of operations for the change that is made. We will not let internal turf wars, key relationships, or “old ways” stand in the way of making the final push toward achievement of a test wing capable of meeting future threats. At the core of this strategy is vital: you must hold leaders accountable for mission focus, clarity and transparency. Each back office, each team, each boss, which Chief Staff of the U.S. Air Force, General, David Goldfein, recently requested all leaders, branch, and section levels – will take action in pursuit of this strategy immediately. If you don’t know who the leadership team is for your organization, it is your responsibility to challenge your supervisors to clarify who serves in these roles within your section, branch, or division, and how they plan to take action.

Our strategy is focused on at- tempting a future that Gen. Henry “Hap” Arnold, General of the U.S. Army Air Forces during World War II, envisioned for AEDC 70 years ago. Similarly, it is our responsibility to ask questions about our efficiency. What is your number one priority? Are you asking the big-picture questions about how we prepare for 30 years from now,” says the chairman of the new task force. The new AEDC leadership chose to renew our commitment to Hap Arnold’s legacy with a Second To None! Note: The complete text of this AEDC strategy, on which the above commentary is based, is printed on page 3 of this issue of the High Mach.

Col. Jeffery Geraghty

AEDC Commander

Chief Master Sgt. Rob Heckman

AEDC Command Chief
The 746th Test Group opened up a time capsule with McNeil, which was buried in 1963.

"Back in the day we in stalled this, I was putting it all together and something happened. I don't know what it was but I really distracts a think I put this in here," Nichoolson laughed. "Hopefully paperwork is in here! Here we are 56 years later and were going to find this out for lunch that day!"

What they found in the capsule were six handwritten pages, which read about the need for the 260 inch centrifuge, its requirements and why it was built.

The 746th TS plans to take a copy of the same document they buried in 1963 and create another time capsule for the new individuals who open it in 60 years.
Arnold AFB welcomes service members for a day of food, comradery

An afternoon of food, fun and fellowship was on the menu as veterans and active-duty service members from Arnold Air Force Base for the Military Appreciation Day: Past, Present and Future event at the Arnold Lakeside Center. The event was held each year at Arnold AFB as a way to say “thank you” to past and present service members and their families.

This year’s Military Appreciation Day was Oct. 18 at the Arnold Lakeside Center. The event was held each year at Arnold AFB as a way to say “thank you” to past and present service members and their families. A free lunch buffet that included hamburgers, hot dogs and a smorgasbord of sides, event activities included boat rides, horse-drawn buggy rides, cornhole, dart and free music.

The event was presented by Arnold AFB Services, the Arnold AFB Personnel office and the Arnold Community Council. It was sponsored by the Arnold AFB Senior Association, BlueCross/BlueShield of Tennessee Compuscare Hospice and Palliative Care, and Magnolia Health Plan.

This marked the third year the Military Appreciation Day event was held under the “Past and Future” banner, and it was again open to all military and their families.

More than two decades ago, the AFSAs began hosting a yearly gathering at the ALC for veterans and patients from the Veterans Affairs Medical Center in Murfreesboro.

As overall military enrollment began to decline, the AFSAs was finding it more and more difficult to prepare for the event.

To keep the event going, the Arnold AFB Services and Personnel offices teamed up and began discussing ways to make it bigger and more attractive.

Arnold Engineering Development Complex team members from these offices came up with the idea of inviting veterans to represent the past, active-duty military to represent the present, and the families of both of these groups to represent the future.

Some of the veterans in attendance this year were brought from the Tennessee State Veterans’ Home in the Alvin C. York Veterans’ Administration Medical Center to the Arnold AFB by the Arnold Air Force Base employee and event volunteers.

One of the B Plant motors operates at the Baierische Motoren Werke, or BMW, plant in Munich, Germany, and according to Maniscalco there are no other places in the world where the motors are used. “I recently took a trip to inspect them from the motors before they were brought here,” he said. “There are two notable features. First, they are very versatile, specifically for use here at Arnold.”

In addition to the motors, the equipment used to get the motors up and running is also highly involved. “All the electrical and control components from the switchgear are being repositioned,” Maniscalco said. “We have to rewire significantly and control interfaces and with all the systems all over the facility. So the project is really a large undertaking.”

Johnson is spearheading the project, but Maniscalco’s input has been a combined effort, with the Test Operations and Maintenance team also helping。“It is the responsibility of all employees to help the work of the team successful. This is an effort that requires a lot of people. We are working together to get this done,” he said.

The remainder of the ex-

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Motorists urged to make driving safely a priority

By Chris Wolfe

AEDC Safety

The Tennessee Highway Patrol and the Arnold Air Force Base Safety Office are urging all motorists to drive cautiously, both day and night, and not to drink and drive this Halloween season.

According to statistics, seven people were killed and 53 were injured in vehicle crashes in Tennessee during the Halloween period last year between Oct. 31 and Nov. 1. Of those seven, six were involved in deer-vehicle collisions, which occurred at night.

The Tennessee Highway Patrol and other law enforcement agencies across the state are reporting a strong increase in the number of deer-vehicle collisions this year due to the higher visibility of deer along roadsides as temperatures cool and trees lose their leaves.

By Deidre Moon

Motorists driving through areas of higher collision risk should:

- Be alert and attentive at all times,
- Avoid distracted driving,
- Turn on the vehicle headlights,
- Slow down when you approach an animal,
- Don’t attempt to remove a deer from the roadway unless you’re certain it’s dead. A dead deer can be a distraction for other drivers,
- Pull off the roadway,
- Drive safely,
- Contact local police for assistance.

AEDC SAFETY

Caution urged as peak deer-vehicle collision season returns

By John W. Lamb

AEDC Public Affairs

Insurance statistics report that about 1 million deer-vehicle collisions occur each year in the United States resulting in approximately $1 billion in vehicle damage.
Translate the idea of trust


By Lauren Russell
66th Air Base Group
Public Affairs

HANSCOM AIR FORCE BASE, Mass. — Uncertainty waits outside the wire. Incoming fire, attacks and ambushes are a moment away.

To survive in a war zone, U.S. troops must rely on their teams, putting their trust in their equipment, their wingmen and their interpreters.

In 2009, now Airman 1st Class Aws Hussein, 66th Comptroller Squadron financial management technician, was working as a translator for the U.S. military in Iraq. Hussein served as an interpreter for U.S. forces in Iraq before immigrating to the U.S. in 2013. (U.S. Air Force photo)

By the time Lombardo arrived, Hussein was a Theology major at Baghdad University when he first learned English. “My mother always told me and my brothers that if we ever left Iraq, we would need another language to communicate with the world,” he said. “We picked English, but never expected to use it as much as we did.”

Hussein wasn’t looking for a job while he finished school, but his younger brother convinced him to use his language skills to translate for the Americans. Before long, all four of the Hussein brothers were interpreting for the troops.

In September 2019, Lombardo was preparing for his tenth deployment. Days before he was set to leave, he walked into the Hanscom Finance Office to finalize his travel plans and spoke to the young Airman at the service desk.

“The Airman came up to me and asked me if I was in Iraq in 2009, and I said ‘yes,’” said Lombardo. “And I had just named him 007.”

At the time, local nationals who served as interpreters could apply for U.S. citizenship through the Special Immigration Visa Program. The process was long and complicated, but Lombardo initiated 007’s application with the State Department and sent letters in vouch for the young man.

About a month later, Hussein was dubbed 007. “It was always in the back of my mind,” he said. “Finally, I just said to him, ‘I want to tell you my story. I have had a lot of ups and downs. I have never given up and I want to tell you my story.’”

In September 2019, now Airman 1st Class Aws Hussein, 66th Comptroller Squadron financial management technician, was working as a translator for the U.S. military in Iraq. Hussein served as an interpreter for U.S. forces in Iraq before immigrating to the U.S. in 2013. (U.S. Air Force photo)

“Sgt. Lombardo was a great Airman,” said Hussein. “He is the piece of the puzzle to make our job work.”

Still, Hussein couldn’t shake the idea of enlistment.

“It was always in the back of my mind,” he said. “I have to do it. I have kept waiting. I would have missed my chance.”

To see his dear friend after ten years, not only living the American dream but serving as an Airman, Lombardo said he could not be prouder. “He is the piece of the puzzle to make our Air Force better,” said Lombardo. “I’ve seen where he’s come from. What he comes to realize, 007 is the success story.”

Hussein hopes to stay in the comptroller career field and retire from the Air Force.

“If I could give my younger self a piece of advice, I would say, ‘keep going, you’ll make it,’” he said.
WWII Army Air Force veteran shares the Nobel Prize in Chemistry

By Erin Crawley
Air Force Research Laboratory

ABINGTON, Va. – The Air Force Office of Scientific Research congratulates John B. Goodenough, professor in the Cockrell School of Engineering at The University of Texas at Austin, for recently being awarded the Nobel Prize in Chemistry 2019. The eldest recipient of a Nobel Prize at age 97, Goodenough shares the award with M. Stanley Whittingham of Long Island University and Akira Yoshino of Meijo University, for the development of lithium-ion batteries. To-day these rechargeable batteries are part of our everyday lives and used in a variety of electronics from smartphones to electric vehicles.

Since his early beginnings as a college student and throughout his distinguished career, Goodenough’s research has positively impacted the progress of Air Force science and technology, especially in basic research.

Goodenough’s first introduction to the Air Force was during World War II. In 1943, while studying mathematics at Yale University, Goodenough was called to duty and served as a meteorologist in the Army Air Force. According to a 2014 interview he had with Bea Perks for Chemistry World, “On one occasion he cleared a flight from an Air Force base in Stephenson, Newfoundland, for General Eisenhower (then Allies Supreme Commander) who had a 15 minute ETA of D-Day,” which landed him a battle in the last six minutes of his ETA (estimated time of arrival).”

Goodenough went on to receive an undergraduate degree in mathematics from Yale and later a doctorate in Physics from the University of Chicago in 1952.

The next part of Goodenough’s career was spent at the Massachusetts Institute of Technology as an experimental researcher, where he specialized in solid state chemistry and concentrated on the basic and fundamental research leading to the development of from dom-access memory (RAM).

In 1976, Goodenough took a position at the University of Oxford as a professor and headed up the Inorganic Chemistry Laboratory. He was there until 1986 when he moved to the University of Texas at Austin, where he continues his research today. It was during his time at the University of Oxford that Goodenough made the lithium-ion battery discovery. During his time at the University of Oxford, Goodenough had received a basic research grant from AFOSR to study “New Materials for Electrochemical Cells” between 1975 and 1981. The purpose of the research was to design, prepare and categorize new materials for electrochemical cells with a special emphasis placed on solid-solution cathodes for secondary batteries of high specific energy and power.

In 1980, Goodenough was AFOSR Program Officer who oversaw the grant. In a 1982 summary of the 27th AFOSR Chemical & Atmospheric Sciences Program Review, of which Goodenough’s work was a part, he wrote, “Professor Goodenough and his group have come up with an invention that relates to an electrical device which includes a conductor of hydrogen cations.” He went on, “This invention is covered under U.S. Patent Application 12108.”

This was an important invention which originated from the Oxford group’s research is concerned with a method of preparing a high surface area form of LiCoO2. This is covered under U.S. Patent Application 135222. It relates to ion conductors. Such ion conductors have potential application as solid-solution in electrochemical cells. The high surface area lithium compounds were key in demonstrating how a rechargeable lithium ion battery could be fabricated.

In 1986, Goodenough published a paper in the Materials Research Bulletin, Vol. 15, pages 783-789, on his original work in developing lithium cobalt oxide cathodes that led to modern lithium-ion batteries. He acknowledges both AFOSR and the European Energy Commission for supporting his work.

“This is a wonderful example of how the AFOSR basic research mission works. In this particular instance, it shows that research funded by AFOSR has directly contributed to enabling modern cell phones, portable computers, electric cars, and modern mobile military technologies. AFOSR is proud to have Goodenough join an illustrious cadre of scientists who contributed much of their careers exploring the fundamental science that lead to their amazing discoveries. AFOSR has contributed basic research funding to 52 Nobel laureates over the past 68 years. On average, these laureates receive AFOSR funding 17 years prior to winning their Nobel awards.

As a vital component of the Air Force Research Laboratory, the AFSOR mission is to support the Air Force goals of control and maximum utilization of air, space, and cyberspace by investing in basic research efforts for the Air Force in relevant scientific areas.
EDWARDS AIR FORCE BASE, Calif. – The Air Force Research Laboratory has successfully tested a state-of-the-art rocket engine preburner to elevate the United States technology base for high performance oxygen-rich staged combustion, or ORSC.

The preburner was designed, developed, and tested under the AFRL Hydrocarbon Boost program with prime contractor Aerojet Rocketdyne, and supported by the Air Force Space and Missile Systems Center. Testing was conducted at NASA Stennis Space Center facilities.

The HCB preburner success was a culmination of two decades of AFRL research into ORSC to advance high performance, robust, and reusable domestic rocket engine technologies.

The preburner harnesses energy to power other engine systems, and is subject to extreme oxygen environments that conventional metals cannot survive. The HCB preburner to power other engine systems, and is subject to extreme oxygen environments that conventional metals cannot survive. The HCB preburner success was a culmination of two decades of AFRL research into ORSC to advance high performance, robust, and reusable domestic rocket engine technologies.

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The HCB preburner was highly instrumented to understand the technology trade space, rather than development of a point design for operational use. This approach allowed AFRL researchers to study fundamental technical issues during engine development efforts today, such as combustion stability and thermal management.

Air Force ownership of the HCB preburner design, hardware, and test data enables this foundational knowledge base to be directly applied to new engine design tools, academic research, and translated across U.S. industry for future engine development efforts or block upgrades.

AFRL’s Rocket Propulsion Division at Edwards Air Force Base, California has played a key role in advancing rocket engine technologies for the nation, since 1952. Nearly every liquid rocket engine developed in the United States traces its roots to these AFRL technologies and experimental demonstrations.
U.S. Air Force Research Laboratory Developing Space Solar Power Beaming

By Kirtland Public Affairs

KIRTLAND AIR FORCE BASE, N.M. — The Air Force Research Laboratory is developing space-based solar power transmission capability using high-efficiency solar cells to collect the sun’s energy, convert it to radio frequency, and beam it to earth.

Energy is a strategic enabling and potential vulnerability for our nation and our Department of Defense,” said U.S. Air Force Col. Eric Felt, director of the AFRL Space Vehicles Directorate. “To ensure DOD mission success, we must have the energy we need at the right place at the right time.”

Providing uninterrupted, assured and agile power to expeditionary forces operating in unimproved areas such as forward operating bases would provide an advantage to U.S. and allied forces.

“The Space Solar Power Experimental Demonstrations and Research Project is a very interesting concept that will enable us to capture solar energy in space and precisely beam it to where it is needed,” Felt said. “SSPIDR is part of AFRL’s ‘big idea pipeline’ to ensure we continue to develop game-changing technologies for our Air Force, DOD, nation, and world.”

AFRL researchers are focused on developing and demonstrating some of the key technologies necessary to integrate into a conceptual space-based power beaming system. Northrop Grumman will partner with AFRL and has been awarded a contract valued at more than $100 million to develop and deliver the critical hardware elements to support space-based experiments into this leading-edge technology.

Pitch to develop tech for colorblind pilots wins first place at innovation competition

By Jennifer Spradlin
U.S. Air Force Academy Public Affairs

The U.S. Air Force Academy hosts its first Falcon Tank, a competition to encourage cadet innovation, Oct. 18. Cadet 2nd Class Bailey Hopkins won first place for an idea to incorporate existing technology to correct colorblindness into pilot visors issued by the Air Force.

“His idea earned him first place in the competition and the opportunity to work with USAFA Spark, which hosted the event, and other Academy leaders for further development and funding. Spark cells are part of an initiative led by AFWERX to create an innovation network at Air Force bases around the world to foster local improvement ideas. The Academy stood up its first cell in 2019, joining more than 40 other cells.

“I think it’s important to teach cadets about innovation principles and design thinking to help them be successful in an era of rapidly changing technology,” said Cadet 1st Class Yann Wollman, USAFA Spark director.

The cell is run and operated by cadets, although Wollman said he would like to expand the program to include enlisted Airmen and officers. Each cadet squadron has a representative in the cell where Wollman said the focus is split between innovation education and application sessions with problem and solution workshopping.

“We have to adopt a culture where we learn to fail quickly, and that it’s okay to fail so that we can push through to find solutions to complex problems,” Wollman said.

The Academy also hosted an innovation panel for cadets and faculty with representatives from the Department of Defense and cutting-edge industry projects, Oct. 22. Lauren Kraussneger, Air Force chief transformation officer, outlined some key Air Force initiatives, including Hack the Air Force, Spark Tank and Digital Air Force. She encouraged all cadets to take courses in coding or rapid prototyping while gaining awareness of key technologies like machine learning and artificial intelligence.

“We need (future leaders) to understand what possibilities there are in emerging technical fields so that they are prepared to shape the future, rather than feel limited by it,” she said.