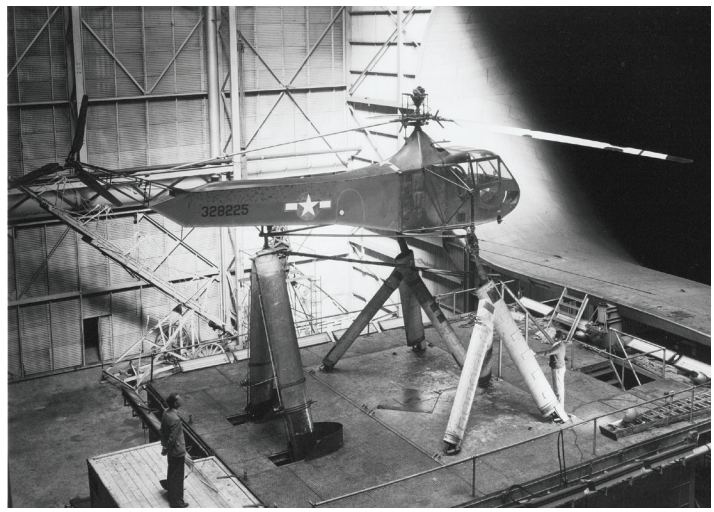
NASA Langley Research Center Dedicated as Vertical Flight Heritage Site

On Friday, May 8 (the day after Forum 71), NASA Langley Research hosted a ceremony for the recognition of the Center as an AHS International Vertical Flight Heritage Site. The ceremony featured remarks by NASA Administrator, Charles Bolden; Associate Administrator for Aeronautics, Jaiwon Shin; Acting Center Director Dave Bowles; US Congressman Scott Rigell (via video); the Honorable George Wallace, Mayor of the City of Hampton; and AHS Executive Director Mike Hirschberg.



Sikorsky YR-4B in the NACA Langley Full Scale Wind Tunnel in 1944. (All photos courtesy of NASA)

NASA debuted a historical overview video of NASA Langley's rotorcraft contributions created specifically for the event. Administrator Bolden predicted the impact that vertical flight aircraft would have on relieving ground traffic congestion in the future, citing the long travel time between Washington DC and Langley, and noted his support for rotorcraft research: "It's because of my love for rotary wing aircraft, for vertical flight, that I'm really proud to be here today," Bolden told the crowd of 100 attendees, primarily NASA employees. "I don't like catchy phrases … but I'm kind of 'Chipper for Choppers.'"

The Langley Research Center has had a distinguished history in powered lift technology development over the past 95 years. This research has been a foundation of knowledge for the worldwide vertical flight community. From aerodynamics to structures, aeromechanics, powered lift, acoustics, materials, stability & control, structural dynamics and human factors, Langley has led significant advancements in vertical lift technologies. For nearly a century, the Center has contributed to the understanding, design, analysis and flight test development of experimental and production vertical flight aircraft configurations.

Langley was the third location to be dedicated since AHS began the Vertical Flight Heritage Sites Program in 2013. The initiative is intended to recognize and help preserve sites of the most noteworthy and significant contributions made in both the theory and practice of vertical flight technology. AHS hopes to promote to the public the rich history of the worldwide vertical flight community through this program.

A mere 12 years after the Wright Brothers first flew at Kitty Hawk, legislation creating the National Advisory Committee for Aeronautics (NACA) was signed into law by President Woodrow Wilson. (2015 is thus the 100th anniversary of what is now NASA.) The NACA was formed to "supervise and direct the scientific study of the problems of flight, with a view to their practical solution." Langley Memorial Aeronautical Laboratory was established in 1917 as the first NACA research laboratory. The new Center, located in Hampton, Virginia (near Virginia Beach), was named after early American aviation pioneer Samuel Pierpont Langley.

NACA Technical Note No. 4 (TN-4) "The Problem of the Helicopter" was published in 1920 and written by NACA Chief Edward P. Warner, with an appendix by a former NACA Chairman, W. F. Durand. The paper states "The gravest charge against the helicopter is its lack of means of making a safe descent when the engine has stopped." It disproved two common misperceptions that the parachute effect of the stopped blades or the blades spinning backwards could create a safe landing. It then provided a mathematical treatment of the principle of autorotation. This principle was later to be a major feature in Juan de la Cierva's autogyro work and, eventually, in satisfactory helicopter behavior following a power failure. This 1920 technical publication even demonstrated some understanding of twist and rotor inflow considerations.

Throughout the years, Langley researchers continued exploring the complex problem of vertical flight. Beginning with autogyros and then helicopters, and continuing with studies of vertical and/or short takeoff and landing (V/STOL) configurations, the Center has made significant contributions to the understanding, analysis, and practical application of physics for vertical flight. Aerodynamic, dynamic, structures, handling qualities, flight characteristics and acoustic theories have been explored and documented, often leading the way for development and improvement of operational configurations.

In addition to TN-4, Langley played a key role during the 1920s in disseminating European rotary wing research in the form of Technical Notes. As Langley began to assemble the world's best aeronautical facilities, it became a center of aeronautical development in the US. In the 1930s, the Center led the important development of the NACA airfoils, which facilitated efficient rotor blade designs.

With the development of the first successful rotary wing aircraft,

Vertical Flight Heritage Site ceremony dignitaries (L to R): Shin, Bolden, Gorton, Hirschberg, Bowles and Wallace.

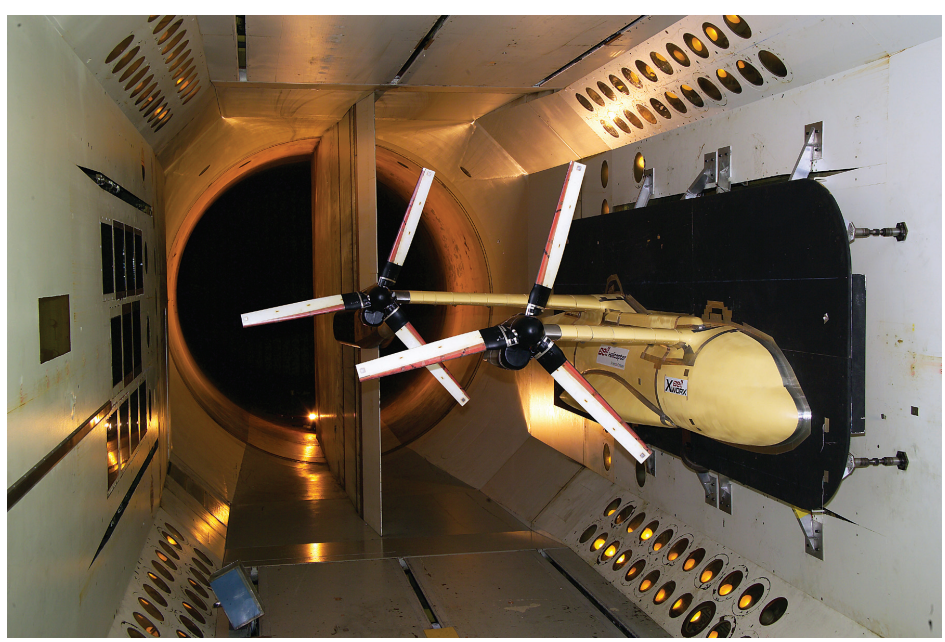
the autogyro, the Center began to undertake rotorcraft flight test programs and became an important intermediary between the military and industry. Principal flight test and aerodynamic evaluation of Army autogyros occurred at Langley between 1935 and 1938 featuring intensive studies into the problems of ground resonance. By this time, the NACA had published 11 technical reports, 10 technical notes, 14 technical memorandums and four aircraft circulars dealing directly with rotating-wing aircraft.

During World War II, Langley supported the Army's fundamental aerodynamic and structural studies of the first generation of military helicopters. In fact, Langley was the War Department's and Navy Department's sole aerodynamic investigator in rotary wing aircraft between 1935 and 1945. The Army Air Forces conducted flight testing, but they relied entirely on Langley for both wind tunnel testing and flight evaluation during the autogiro era: Langley was the only US government organization undertaking fundamental aerodynamic investigation on military rotorcraft during the war years.

Flight research at Langley from the early 1930s in autogyros, continuing into the war years in the 1940s and through the 1950s, was invaluable in advancing the understanding of flight dynamics, handling qualities and ground resonance. Research for powered lift configurations in the 1960s and 1970s showed the benefits and challenges for these nonconventional vehicles. Research in flight acoustics in the 1980s to today has resulted in reduced community noise and had an impact on the development of civil and military configurations.

The historical investment of the NACA – and now NASA – in facilities for experimental and computational research has provided a substantial benefit to vertical flight research. The Langley Full Scale Tunnel, later known as the 30-by-60-Foot Tunnel, was a workhorse for the exploration of helicopter and autogyro configurations. The Langley Low Turbulence Pressure Tunnel and the 6-by-28-Inch Transonic Tunnel were used to develop rotorcraft airfoil series. Research with the Helicopter Test Tower explored rotor stall. The Langley Transonic Dynamics Tunnel has provided understanding of aeroelasticity and vibratory loads. Work in the Langley V/STOL Tunnel, now the 14- by-22-Foot Subsonic Tunnel, has demonstrated the importance of interactional aerodynamics and configuration studies. Impact testing at the Landing and Impact Research (LandIR) facility is unique in the world for assessing the combined vertical and horizontal loads experienced by many vertical flight vehicles. And Langley's computational research, conducted on clusters and supercomputers, is leading the way to a future of integrated modeling and simulation.

In 1970, NASA's Fred Gustafson published his landmark "History of NACA/NASA Rotating-Wing Aircraft Research, 1915–1970" series in *Vertiflite*. In it he wrote, "NACA/NASA's most effective past contributions in rotating-wing aircraft research have involved the providing of an understanding of fundamentals." Gustafson also noted that "An illustration of the depth and



Langley's Transonic Dynamics Tunnel conducted essential aeroelasticity testing for the V-22 Osprey development, and was later used for Quad TiltRotor tests.

breadth of the helicopter research by the Langley group is that its published work — plus some otherwise unpublished work — forms the primary basis for the book, *Aerodynamics of the Helicopter* by Gessow & Myers, which was originally published in 1952" and is still considered "the classic textbook on the subject" today.

Langley Research Center has had a long and distinguished history in vertical and powered-lift technology development. Langley research is embedded in the current fleet of helicopters and tiltrotors around the world and today's ongoing research will provide new technology for future generations of vertical flight.

Got to **www.vtol.org/nasa-langley** for videos, speeches, links and other materials from the ceremony.

Special thanks to W. Todd Hodges, Robert J. Huston, Robert Tapscott and Susan Gorton for their contributions to the nomination package, the ceremony and this article.

Citation: AHS Vertical Flight Heritage Site NASA Langley Research Center

Since its establishment in 1917 as the Langley Memorial Aeronautical Laboratory, the Langley Research Center has performed groundbreaking research to advance the state of the art in vertical flight. The Center's research has contributed significantly to understanding vertical flight aerodynamic and dynamic principles, design requirements, and handling qualities through analysis, wind tunnel testing and experimental flight research.

Research at Langley has been key to the development and maturation of many novel configurations and has paved the way for the growth of today's global vertical flight industry.

Forum 71 Attendees Tour Langley and Ft. Eustis

Forum 71 Tour Participants at the Langley LandIR test site with the Transport Rotorcraft Airframe Crash Testbed (TRACT 2)

Dozens of Forum 71 attendees received a unique opportunity to participate in tours of NASA Langley Research Center and Ft. Eustis, with an overview of US Army's Aviation Development Directorate – Aviation Advanced Technology Directorate (AATD) as well as a closed visit to the US Army Transportation Museum.

On the Langley tour, participants toured the 14- by 22-Foot Subsonic Tunnel and Rotor Test Cell, the LandIR facility, the Exterior Effects Room for acoustics research, and other research facilities. The tour was led by Susan Gorton, NASA Revolutionary Vertical Lift Technologies Project Manager.

At Ft. Eustis, COL Steven Braddom, the AATD Commander, provided an overview briefing of Ft. Eustis and its history, as well as the research being conducted at AATD. Attendees then toured the US Army Transportation Museum, with nearly 100 vehicles ranging from planes, helicopters, tugboats and landing craft to trucks, jeeps, hovercraft and trains. The museum has more than a dozen historical vertical flight aircraft on display, including the Bell UH-1B Huey, Boeing YCH-47A Chinook prototype No. 2, Piasecki CH-21C Shawnee and Sikorsky YCH-54A Tarhe Skycrane.