National Aeronautics and Space Administration

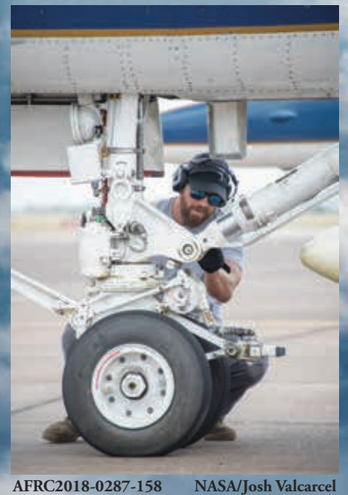
THE ARMSTRONG
X-PRESS

Volume 60 Number 11 November 2018

Taking the boom out of sonic boom

AFRC2018-0287-045 NASA/Carla Thomas

Armstrong test pilots Jim "Clue" Less (front) and Wayne "Ringo" Ringelberg (back) taxi out in a NASA F/A-18 research aircraft at Ellington Field in Houston, Texas, in preparation for a training flight for the Quiet Supersonic Flights 2018 series, or QSF18. The QSF18 flights will provide NASA with feedback necessary to validate community response techniques for future research flights for the X-59 Quiet SuperSonic Technology, or QueSST.



AFRC2018-0287-158 NASA/Josh Valcarcel

Armstrong's James Ford inspects the nose gear of an F/A-18 prior to a supersonic research flight off the coast of Galveston, Texas. Ground and maintenance crews are vital to ensure the aircraft is ready for flight.

AFRC2018-0287-655 NASA/Carla Thomas

Jasme Lee, a graduate student working in the Structural Acoustics branch at Langley Research Center in Virginia, prepares a microphone monitor station to detect the sound level of each thump produced by the F/A-18.

Cover: *Josh Valcarcel documented Less and Ringelberg (back) during preflight preparation.*

Background image: *Carla Thomas took this image on a QSF18 flight.*

Hosting QSF: Galveston assists with research

By Matt Kamlet
Armstrong Public Affairs

NASA completed a series of quiet supersonic research flights off the coast of Texas near Galveston to test ways to measure the community's response to a unique acoustic experience.

An aircraft flying at supersonic speeds (faster than Mach 1, the speed of sound) currently produces a sonic boom so loud that commercial supersonic flight is prohibited over land. However, NASA test pilots flew an F/A-18 supersonic research aircraft in a unique maneuver in November that created a quieter sound that resembles a thump. Capturing how people and sensors on the ground respond to that sound was the goal of the Quiet Supersonic Flights 2018, or QSF18, campaign.

"QSF18 was a big step in NASA's efforts to understand what is required for acceptable supersonic overland flight," said NASA's Commercial Supersonic Technology Project Manager Peter Coen. "This is the first time in decades that we have reached out to a large community as part of our supersonic research. NASA has performed similar tests at our Armstrong Flight Research Center, using similar sounds created by the same F/A-18. We've measured the noise levels and the impact on structures, as well as surveyed people for annoyance, to make certain that these tests were safe and well planned. We greatly appreciate Galveston's interest and support."

Following months of preparation including legislative engagement and environmental assessment, NASA Armstrong sent assets, resources and teams from center branches to Houston and Galveston to support the campaign. Teams from Armstrong included research, aerospace, operations engineers, pilots, project management, communication specialists, meteorologists, education specialists and aircraft maintenance crews responsible for keeping the two F/A-18 aircraft ready for multiple daily flights.

AFRC2018-0287-70 **NASA/Carla Thomas**

NASA 846 takes off from Ellington Field in route to its designated "mark" point off the coast of Galveston, Texas. Two F/A-18 aircraft from Armstrong were used for the QSF18 flight campaign, allowing flight crews to switch and fly as many as three flights in a day.

AFRC2018-0287-276 **NASA/Carla Thomas**

NASA's mission operations team of mission controllers, engineers, pilots and communications specialists, monitor the supersonic research flight from the QSF18 mission control room. The flight operations crew tracks the status of flights, maintains communications with the aircraft and communicates with the U.S. Coast Guard for sonic boom alert broadcasts to mariners.

Heather Maliska, QSF18 project manager, said the mission was a success.

"The QSF18 flight test campaign met all of our objectives and was fully successful. We are extremely happy with the outcome. We completed 52 sonic thumps over the course of 22 mission flights and survey participant response was high, with their reactions aligning with our researchers' expectations. The community engagement, sonic boom measurements, operational deployment, basing procedures and social survey development performed throughout the course of planning, implementation and execution of QSF18 will apply directly to identifying and minimizing risks for the

QSF, page 6

X-Press November 2018

The horizon is seen from high altitude in the cockpit of a NASA F/A-18 research aircraft while performing the quiet supersonic dive maneuver over the Gulf of Mexico. In order to create a quieter thump in place of a louder sonic boom, the aircraft climbed to about 49,000 feet where it inverted and briefly went supersonic during a dive and finished with a subsonic pull-up. It created a sonic boom where the shockwaves traveled in such a way that when they reached a designated area – in this case Galveston – they were perceived more as a thump compared to a traditional sonic boom.

AFRC2018-0287-193
NASA/Carla Thomas

community testing that will be completed with the X-59 QueSST."

The F/A-18 is a typical supersonic aircraft and in order to shush the boom it was positioned into a quiet supersonic dive maneuver. Starting out over the water at about 50,000 feet the aircraft began a special dive that created a regular sonic boom that was generally perceived to be a quieter thump.

QSF18 was unique for another reason. NASA's Johnson Space Center, located just north of Galveston, provided critical support for the mission, which was focused on aeronautics support instead of space. The center's flight operations staff were part of the team supporting the QSF18 aircraft, pilots and additional crew based at nearby Ellington Field.

"NASA's role as a leader into new frontiers paves the way forward toward new technologies, opportunities and milestones across multiple endeavors, as we have always done throughout our history," said Mark Geyer, director of NASA's Johnson Space Center. "As our efforts also continue to expand our boundaries and capabilities in space, Johnson Space Center is proud to be working with our colleagues at NASA's research centers at Langley and Armstrong, and to take part in the agency's aeronautics research efforts to lead aviation into a new era as 'One NASA.'"

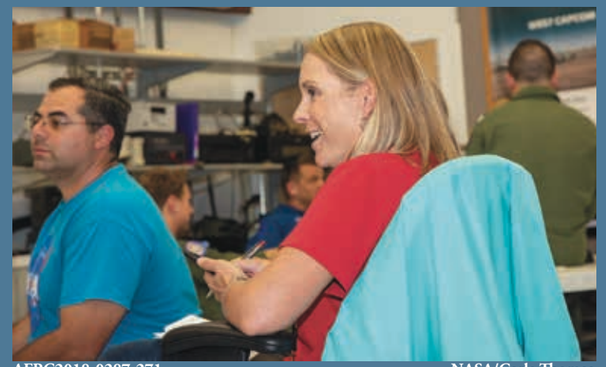
The research for QSF18 also included a number of contractors. In addition to the prime contractor, Applied Physical Sciences Corp., NASA worked with Penn State University, Applied Research Lab, Volpe National Transportation System Research Center, Gulfstream Aerospace Corporation, Eagle Aeronautics, KBRwyle and Gaugler Consulting.

In Galveston, community feedback data were gathered through the use of a survey in which 500 residents were recruited to volunteer. If they heard the thumps, they were asked to define the level at which they were able to perceive the sound. QSF18 data will be used to help NASA better understand successful data collection methods for future flights using an experimental aircraft called the X-59 Quiet Supersonic Technology, or QueSST. Starting in the early 2020s the X-59 will directly fly over yet-to-be-selected communities to collect data using lessons learned from QSF18.

"Galveston is both honored and excited to be part of this project," said Galveston Mayor James Yarbrough. "This is the type of project that motivates engineers and innovators. In Galveston, we have a long and proud history of being involved in advances in science and technology, whether that's in medicine, rail or shipping. In this case, our residents had an opportunity to participate in a study to advance aviation and the design of commercial planes that can break the sound barrier quietly. We're excited we were a small part of it, supported NASA and helped ensure the success of this study. Thanks to NASA for choosing Galveston as the location for testing this idea."

NASA provided resources to residents who were interested in learning more about supersonic flight research and how it may help lead to an exceptional reduction in commercial flight times.

NASA also engaged teachers and youth of the Galveston area through STEM learning activities. Those activities featured two web-based opportunities, including a "Seeing Sound" learning module with classroom activities for students, and a citizen scientist activity for anyone in the Galveston area to submit data on the sounds they heard. The second activity was separate from the process of collecting official data responses from pre-selected community volunteers.



AFRC2018-0287-271 **NASA/Carla Thomas**

QSF18 operations engineer Oscar Mejia maintains communications with the pilot, while project manager Heather Maliska oversees operations at the QSF18 mission control room at Ellington Field following a supersonic research flight.

AFRC2018-0287-314 **NASA/Carla Thomas**

While NASA's F/A-18 goes supersonic off the coast, a team of researchers, such as Ed Haering above, monitor the flight and operate multiple sound monitor stations around Galveston and its surrounding area.

AFRC2018-0287-317 **NASA/Carla Thomas**

Langley research engineer Jonathan Rathsam, along with field team researchers including Armstrong's Paul Dees, Langley's Matt Hayes and Gulfstream Aerospace's Matt Collmar, communicate with teams of researchers in and around Galveston, and monitor data during the QSF18 flight series.

Supersonic study could lead to faster travel times

By Matt Kamlet
Armstrong Public Affairs

NASA supersonic flight research is leading to the development of tools, technologies and knowledge to help tear down technical barriers to practical commercial supersonic flight. The results could one day enable the reduction of coast-to-coast travel times by as much as half.

Supersonic commercial flight impediments include sonic booms, the noise resulting from piercing the sound barrier, airport community impacts, fuel efficiency and high-altitude emissions. In addition, NASA research also seeks to meet the challenges of structural weight and flexibility, airspace operations and the ability to design future vehicles in an integrated, multidisciplinary manner.

The Commercial Supersonic Technology (CST) Project focuses on sonic boom reduction methods and approaches. The project's scope includes design tools for vehicles with low sonic boom, and defines the necessary approaches and techniques for objectively assessing the levels of sonic boom acceptable to communities living in the vicinity of future commercial supersonic flight paths.

Knowledge and data collected from supersonic flight research has resulted in the design and recently-begun construction of NASA's newest X-plane, the X-59 Quiet SuperSonic Technology, or QueSST. X-59's Low-Boom Flight Demonstration mission will provide information to the efforts of national and international regulatory organizations in the development of sound standards for future supersonic commercial aircraft.

In addition to this focus, CST research lays the groundwork for overcoming other challenges facing commercial supersonic flight including energy efficiency, reduced pollutants emitted into the atmosphere and acceptable noise levels in areas near the airport.

Armstrong's role in support of CST often includes supersonic flight operations for research. This role in 2018 included the Quiet Supersonic Flights 2018 campaign, or QSF18, which tested techniques and methods for community data collection, as well as the fourth phase of Air-to-Air Background-Oriented Schlieren flights, known as AirBOS, which is testing updated imagery hardware to visualize supersonic shockwaves.

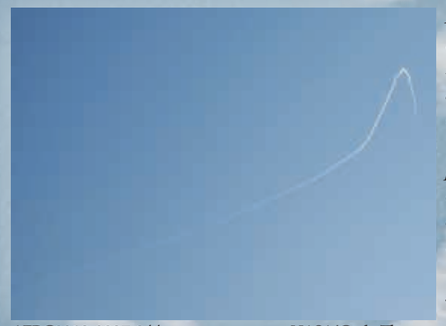
NASA Illustration

AFRC2018-0287-165 NASA/Josh Valcarcel

NASA ground and maintenance crews prepare the F/A-18 research aircraft for a supersonic research flight off the coast of Galveston, Texas in support of the QSF18 flight campaign. These crews are vital to ensuring the aircraft is ready to operate safely and efficiently for NASA's research.

AFRC2018-0287-683 NASA/Carla Thomas

In order to accurately match community response data to the various levels of sonic thumps, a number of microphone monitor stations were positioned and operated to detect exactly how loud or quiet was each thump produced by the F/A-18.



AFRC2018-0287-344 NASA/Carla Thomas

A contrail of the NASA F/A-18 research aircraft is seen off the coast of Galveston, Texas, performing the quiet supersonic dive maneuver in support of the QSF18 flight series.

AFRC2018-0287-145 NASA/Josh Valcarcel

Life support technician Phil Wellner helps prepare NASA test pilot Wayne "Ringo" Ringelberg (and photographer Carla Thomas in the back seat)prepare to take off for a supersonic research flight. NASA photographers and videographers take part in operations to support mission documentation.

Karen Rugg, strategic communications lead for NASA's ARMD, talks to students at Austin Middle School in Galveston. Students asked questions and learned from QSF18 project leads as NASA promoted interest in STEM careers.

AFRC2018-0287-387 NASA/Andrew Carson

AFRC2018-0287-423 NASA/Andrew Carson

Public affairs officers Jimi Russel and Kate Squires discuss commercial supersonic technology with Galveston residents. A primary element of the QSF18 campaign was engagement with, and accommodation of, Galveston community members.

X-Press
Address: P.O. Box 273, MS 1422
Edwards, CA 93523-0273
Phone: 661-276-3449
FAX: 661-276-3167

Editor: Jay Levine
Logical Innovations, 661-276-3459

Managing Editor:
Steve Lighthill, NASA

NASA Chief,
Strategic Communications:
Kevin Rohrer