



National Aeronautics and Space Administration



LAGNIAPPE

John C. Stennis Space Center

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April 2021

Next stop: space!

See page 3



My goodness, what a month it has been. Folks here at Stennis Space Center certainly have had a full schedule. Or as Grandgator always said, “They have been as busy as a one-armed man peeling boiled shrimp.” Ark!

It was just a month ago that Stennis made history with a Green Run hot fire test of NASA’s Space Launch System (SLS) core stage on the B-2 Test Stand. On March 18, the four RS-25 engines that will help launch the maiden Artemis I mission was fired for a full-duration test. It was the most powerful test at Stennis in more than 40 years – and you know ol’ Gator had a prime viewing spot. I even wore ear plugs, though Mama Gator says I could not hear fans shouting ‘Who Dat’ in the packed Superdome. Ark!

Days after the core stage test, Stennis was at it again, firing up a single RS-25 engine on the A-1 Test Stand for another picture-perfect test.

Not so many days after that hot fire, Aerojet Rocketdyne tested its RS-68 engine on the B-1 Test Stand, a bittersweet moment for sure. It was the final scheduled test for the engine and the close of a 20-plus-year

partnership between Stennis and the company. A lot of good people deserve a great big “thank you” for the work they did on that project through the years.

All of those big tests draw a lot of attention, but what deserves just as much attention is the everyday hard work that not only makes the big moments possible but also makes Stennis a model center and one of the best places to work in the federal government. From propulsion testing to technology development to community outreach to business development to STEM engagement, Stennis folk excel on a regular basis.

It reminds me of something the famous female aviatrix Beryl Markham (the first person to fly solo, non-stop across the Atlantic, from Britain to North America, in 1936) once said. “If a (person) has any greatness (within), it comes to light, not in one flamboyant hour, but in the ledger of daily work,” she wrote in her memoir, “West with the Night.”

Stennis has its share of big tests and flamboyant moments. However, to really understand the greatness of the site, just take a little time to watch the good folk hard at work day by day, everyday, on any given day.



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NASA's MOON to MARS MISSION

Full duration! NASA conducts successful test of SLS core stage at Stennis

The largest rocket element NASA has ever built, the core stage of NASA's Space Launch System (SLS) rocket, fired its four RS-25 engines for 8 minutes and 19 seconds March 18 at Stennis Space Center.

The successful test, known as a hot fire, is a critical milestone ahead of the agency's Artemis I mission, which will send an uncrewed Orion spacecraft on a test flight around the Moon and back to Earth, paving the way for future Artemis program missions with astronauts.

Engineers designed the eight-part Green Run test campaign to gradually bring the SLS core stage to life for the first time, culminating with the hot fire on March 18. The team will use data from the tests to validate the core stage design for flight.

"The SLS is the most powerful rocket NASA has ever built, and during today's test the core stage of the rocket generated more than 1.6 million pounds of thrust within seven seconds," acting NASA Administrator Steve Jurczyk said. "The SLS is an incredible feat of engineering and the only rocket capable of powering America's next-generation missions that will place the first woman and the next man on the Moon. Today's successful hot fire test of the core stage for the SLS is an important milestone in NASA's goal to return humans to the lunar surface – and beyond."

NASA previously conducted a hot fire test of the SLS core stage Jan. 16. The four RS-25 engines fired together for the first time for about one minute before the test ended earlier than planned. Following data analysis, NASA determined a second, longer hot fire test would provide valuable data to help verify the core stage design for flight, while posing minimal risk to the Artemis I core stage.

During the second hot fire test, the stage fired the engines for a little more than eight minutes, just like it will during every Artemis launch to the Moon. The longer duration hot fire tested a variety of operational conditions, including moving the four engines in specific patterns to direct thrust and powering the engines up to 109% power, throttling down and back up, as they will during flight.

"This longer hot fire test provided the wealth

of data we needed to ensure the SLS core stage can power every SLS rocket successfully," said John Honeycutt, manager for the SLS Program at NASA's Marshall Space Flight Center in Huntsville, Alabama. "During this test, the team conducted new operations with the core stage for the first time, repeated some critical operations, and recorded test data that will help us verify the core stage is ready for the first and future SLS flights for NASA's Artemis program."

Stennis Space Center Director Rick Gilbrech (l) and Marshall Space Flight Center Director Jody Singer exchange a socially distanced high-five to celebrate the successful hot fire of the first flight core stage of NASA's Space Launch System (SLS) rocket on the B-2 Test Stand on March 18. The hot fire of more than eight minutes marked the culmination of a Green Run series of tests on the stage and its integrated systems. It came more than a year after the core stage arrived at Stennis in January 2020. Despite a year marked by COVID-19 restrictions and a record-breaking hurricane season, teams persevered in their Green Run work. Following a simulated countdown in which propellants were loaded on the stage for the first time, operators conducted an initial hot fire test of the stage's four RS-25 engines on Jan. 16, 2021. However, that test experienced an automatic shutdown after about a minute, leading NASA to schedule a second attempt. On March 18, the four RS-25 engines fired just as during an actual launch, generating more than 1.6 million pounds of combined thrust. It marked the most powerful test conducted at the south Mississippi site in more than 40 years.

The two propellant tanks in the SLS core stage collectively hold more than 733,000 gallons of supercold liquid hydrogen and liquid oxygen to help fuel the RS-25 engines at the bottom of the stage. The core stage has a complex network of flight software and avionics systems designed to

help fly, track, and steer the rocket during launch and flight. Prior tests in the Green Run test series evaluated the integrated functionality and performance of the core stage's avionics systems, propulsion systems, and hydraulic systems.

"Today is a great day for NASA, Stennis and this nation's human space exploration program," Stennis Space Center Director Rick Gilbrech said. "This final test in the Green Run series represents a major milestone for this nation's return to the Moon and eventual mission to Mars. So many people across the agency and the nation contributed to this SLS core stage, but special recognition is due to the blended team of test operators, engineers, and support personnel for an exemplary effort in conducting the test today."

Test teams at Stennis supervised a network of 114 tanker trucks and six propellant barges that provided liquid propellant through the B-2 Test Stand to the core stage. Test teams also delivered operational electrical power, supplied more than 330,000 gallons of water per minute to the stand's flame deflector, and monitored structural interfaces of both the hardware and the stand.

Testing the SLS rocket's core stage is a combined effort for NASA and its industry partners. Boeing is the prime contractor for the core stage, and Aerojet Rocketdyne is the prime contractor for the RS-25 engines.

After the core stage is refurbished, it will be shipped to NASA's Kennedy Space Center in

Florida. There, the core stage will be assembled with the solid rocket boosters and other parts of the rocket and NASA's Orion spacecraft on the mobile launcher inside the Vehicle Assembly Building at Kennedy in preparation for Artemis I.

SLS, Orion, and the ground systems at Kennedy, along with the human landing system and the Gateway in orbit around the Moon, are NASA's backbone for deep space exploration. SLS is the only rocket that can send Orion, astronauts, and supplies to the Moon on a single mission.

The exploration of the Moon with NASA's Artemis program includes preparations to send astronauts to Mars as part of America's Moon to Mars exploration approach.



NASA's MOON to MARS MISSION

(Top left photo) NASA acting Administrator Steve Jurczyk speaks to guests prior to the Green Run hot fire test of the Space Launch System core stage on the B-2 Test Stand at Stennis Space Center on March 18.



(Bottom left photo) Astronaut Jessica Meir speaks with media prior to the Green Run hot fire test of the Space Launch System core stage March 18.

(Far right photo) Astronauts Jessica Meir (l) and Zena Cardman view the Green Run hot fire test of the Space Launch System (SLS) core stage on the B-2 Test Stand at Stennis Space Center on March 18. NASA is building SLS to power deep space missions, including a return to the Moon as part of the Artemis program.



NASA's MOON to MARS MISSION



(Top left photo) Stennis Space Center Director Rick Gilbrech speaks to guests prior to the Green Run hot fire test of the Space Launch System core stage on the B-2 Test Stand (top center and right photos) at Stennis Space Center on March 18. The hot fire culminated a yearlong series of tests on the stage and its integrated systems.

(Bottom photos) NASA acting Administrator Steve Jurczyk (l to r), Stennis Space Center Director Rick Gilbrech, Stennis Deputy Director John Bailey, and Stennis Associate Director Mary Byrd all give a "thumbs-up" to a successful Green Run hot fire test of the Space Launch System core stage on the B-2 Test Stand on March 18.



NASA's MOON to MARS MISSION



(Top left photo) An on-stand camera offers a close-up view of the four RS-25 engines, which produce a combined 1.6 million pounds of thrust, during the Green Run hot fire test of NASA's Space Launch System (SLS) core stage on the B-2 Test Stand at Stennis Space Center on March 18.



(Top right photo) A drone photo provides a bird's-eye view of the Green Run hot fire test of the Space Launch System core stage on March 18.

(Bottom photo) Four NASA leaders participate in a virtual press briefing following the March 18 Space Launch System hot fire test at Stennis Space Center. Participants included (l to r): NASA acting Administrator Steve Jurczyk; Tom Whitmeyer, NASA deputy associate administrator for Exploration Systems Development; John Honeycutt, SLS Program manager at Marshall Space Flight Center; and Julie Bassler, SLS Stages Office manager at Marshall Space Flight Center.



NASA's MOON to MARS MISSION



(Above photo) A telephoto view offers a look at the four RS-25 engines firing during the Space Launch System core stage hot fire March 18.

(Below photo) NASA acting Administrator Steve Jurczyk (l) and Stennis Space Center Director Rick Gilbrech celebrate a successful hot fire March 18.



NASA's MOON to MARS MISSION



SPACE LAUNCH SYSTEM
ARTEMIS TESTING:
GREEN RUN CHECKLIST

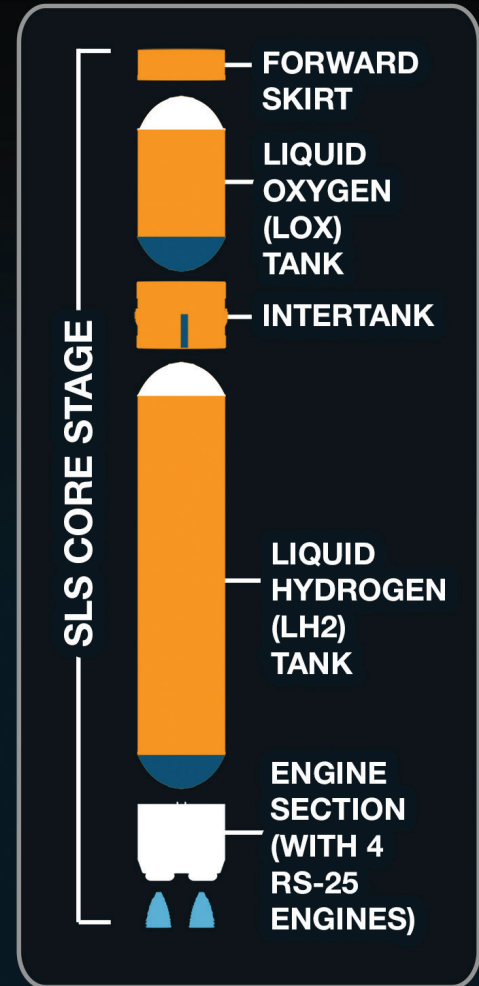
National Aeronautics and
 Space Administration



TESTING THE WORLD'S LARGEST ROCKET STAGE

A total of eight Green Run tests minimize risk to the **ARTEMIS I** core stage and ensure the flight hardware satisfies design objectives and validates design models:

- TEST 1** Apply forces simulating launch to the unpowered, suspended core stage. ✓
- TEST 2** Turn on and check out core stage avionics. ✓
- TEST 3** Simulate potential issues to test systems that shut down other systems if there's a problem. ✓
- TEST 4** Test main propulsion system components that connect to the engines. ✓
- TEST 5** Test thrust vector controls and check out all the related hydraulic systems. ✓
- TEST 6** Simulate launch countdown to validate timeline and sequence of events. ✓
- TEST 7** Load and drain more than 700,000 gallons of cryogenic propellants. ✓
- TEST 8** Fire all four RS-25 engines for up to 8 minutes. ✓



#ARTEMIS

NASA's MOON to MARS MISSION

NASA recognizes Stennis Space Center HErOes

To mark progress in NASA's Artemis program that will return humans, including the first woman and person of color, to the Moon, the space agency's Human Exploration and Operations (HEO) Mission Directorate has been recognizing HErOes performing necessary and critical work.

Overall, 15 Stennis Space Center employees have been cited by the NASA directorate for their Artemis-related efforts. These individuals are listed below, along with accompanying photos and brief information about their Artemis program role.

Dawn Davis



Davis, chief of the Stennis Electrical Engineering Branch, was cited for exceptional leadership and support to the SLS Green Run test project and for embodying the "I Made It Happen" motto.

Michael Holmes



Holmes, Stennis A-1 Test Stand facility manager, was cited for his tireless work to ensure the test stand and A-1 control center maintained operational readiness to flight certify RS-25 engines.

Todd Mannion



Mannion, lead of the Stennis Facility Services Branch, was cited for his work to ensure the SLS core stage was properly lifted and installed on the B-2 Test Stand for Green Run testing.

Nick Nugent



Nugent, a member of the Engineering Division team in the Stennis Engineering and Test Directorate, was cited for his role and work on the NASA Pathfinder, SLS core stage and Exploration Upper Stage projects.

Stephen O'Neill



O'Neill, a member of the Stennis Environmental and Health Services team, was cited for exemplary industrial hygiene and occupational health support to the SLS Green Run test project during the COVID-19 pandemic.

Michael Pannell



Pannell, a member of the Stennis Environmental and Health Services team, was cited for providing occupational health support and implementing COVID-19 protective measures for Stennis test team members.

Jason Peterson



Peterson, Stennis range manager, was cited for his outstanding and crucial support in directing restricted airspace operations during the Space Launch System propulsion testing activities.

Ryan Roberts



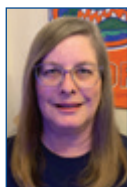
Roberts, B-2 Test Stand director, Roberts was cited for his energy, dedication and perseverance as his test stand team prepared for the arrival and installation of the SLS core stage.

Barry Robinson



Robinson, B-2 Test Stand SLS Green Run manager, and his team were cited for completing all B-2 Test Stand work for Green Run testing and for enhancing capabilities of five other support facilities in the process.

Debra Rushing



Rushing, a member of the Stennis Infrastructure Services Branch team, was cited for her work to ensure SLS teams had a secure and robust network infrastructure on which to implement the Green Run hot fire test.

Brennan Sanders



Sanders, a member of the Stennis Test Complex Support Branch team, was cited for leadership of construction refurbishment work on the B-2 Test Stand, ensuring smooth arrival of the SLS core stage.

Kevin Stiede



Stiede, project manager with the Stennis Facility Services Design team, was cited for his support of SLS Green Run hot fire events by managing the test day viewing site logistics and setup.

Melissa Wagner



Wagner, a contract specialist in the Stennis Office of Procurement, was cited for coordinating delivery of propellants to Stennis, ensuring enough was on hand for various Artemis program needs.

Casey Wheeler



Wheeler, a project manager with the Stennis Design and Construction team, was cited for his work on various projects in support of the refurbishment of the B-2 Test Stand for SLS Green Run testing,

Christina Zeringue



Zeringue, a member of the Stennis Safety and Mission Assurance team, was cited for her work to oversee the safety and quality aspects of the SLS Green Run test project, and to identify and address emerging issues.

NASA's MOON to MARS MISSION

NASA conducts 2nd hot fire in new RS-25 single-engine test series for SLS

NASA conducted a second RS-25 single engine hot fire test April 6 as part of a new series to support the development and production of engines for the agency's Space Launch System (SLS) rocket on future missions to the Moon. The full-duration hot fire of more than eight minutes (500 seconds) was conducted on the A-1 Test Stand at Stennis Space Center. It is part of a scheduled seven-test series designed to provide valuable data for Aerojet Rocketdyne, lead contractor for the SLS engines, as it begins production of new RS-25 engines for use after the first four SLS flights. Four RS-25 engines help power SLS at launch, firing simultaneously to generate a combined 1.6 million pounds of thrust at launch and 2 million pounds of thrust during ascent. The RS-25 engines for the first four SLS flights are upgraded space shuttle main engines and have completed certification testing. During the new test series, operators will focus on evaluating new engine components and reducing risk in engine operation. They will fire the engine through a range of operating conditions to demonstrate and verify its capabilities and to provide data to enhance production of new engines being manufactured with cutting-edge and cost-saving technologies. The initial test of the new series was conducted Jan. 28 for 500 seconds as well, the same amount of time the engines must fire during a launch to power the SLS rocket to orbit. During the subsequent full-duration hot fire April 6, operators also gimballed the RS-25 engine, using a new NASA-designed vector control system for the first time since it was installed. "Gimbaling" refers to how the engine must move on a tight circular axis in order to ensure proper flight trajectory. NASA is building SLS as the world's most powerful rocket. SLS will fly to the Moon as part of NASA's Artemis program, including the Artemis I uncrewed test flight this year that will pave the way for future flights with astronauts to explore the lunar surface and prepare for missions to Mars. RS-25 tests at Stennis are conducted by a combined team of NASA, Aerojet Rocketdyne and Syncom Space Services operators. Syncom Space Services is the prime contractor for Stennis facilities and operations.





RS-68 undergoes final acceptance test at Stennis

The world's most powerful hydrogen-fueled rocket engine built by Aerojet Rocketdyne, the RS-68A, completed its final hot-fire acceptance test April 12 (above) on the B-1 Test Stand at Stennis Space Center.

The hot fire concluded an RS-68 test partnership of more than 20 years between Stennis Space Center and Aerojet Rocketdyne.

United Launch Alliance's Delta IV Heavy rocket uses three Aerojet Rocketdyne RS-68A engines; one on each of its three Common Booster Cores to launch the nation's most critical spacecraft into orbit. The three RS-68A engines combine to generate more than 2 million pounds of thrust for the Delta IV Heavy.

"The throttleable RS-68A engine has been the centerpiece of the Delta IV Heavy rocket for more than fifteen years," said Eileen P. Drake, Aerojet Rocketdyne CEO and president. "We are very proud of the 65 engines flown to date and their flawless performance record."

Conceived using a simplified design approach to lower cost while maintaining its overall reliability, the RS-68, was first tested at Edwards Air Force Base in California; testing later moved to Stennis in 2000. The RS-68 powered Delta IV made its inaugural flight in 2002.

"We've continued to improve the RS-68 engine, which today remains the most powerful hydrogen-fueled rocket engine in the world," said Jim Maser, Aerojet Rocketdyne Senior Vice President of Space. "This engine was developed entirely with company funds to be a very cost

competitive and extremely reliable booster engine."

The upgraded RS-68A, which generates 705,000 pounds of thrust at sea level, completed its first test firing in September 2008, was certified in April 2011 and made its inaugural flight in June 2012.

"Our RS-68 test partnership with Aerojet Rocketdyne spans more than 20 years and the final RS-68 hot-fire test closes out a historic chapter in propulsion testing at Stennis Space Center," Stennis Space Center Director Richard Gilbrech said. "The RS-68 was the first engine to be both assembled and tested at Stennis. While this particular test project is ending, we look forward to continued work with Aerojet Rocketdyne on future endeavors."

In addition to launching numerous payloads supporting the U.S. Air Force Space Command and the National Reconnaissance Office, the Delta IV Heavy carried NASA's Orion Space Capsule on the EFT-1 Mission in December 2014 and launched the Parker Solar Probe on its mission to unlock the mysteries of the Sun in August 2018. The Delta IV Heavy powered by the RS-68A engine continues to be the primary heavy-lift launch vehicle for the nation.

The Delta IV Heavy has four launches remaining, with its final mission planned for late 2023.

Aerojet Rocketdyne's work at Stennis continues with final assembly and test of the RS-25 engine that powers the core stage of America's next super heavy-lift rocket, the Space Launch System (SLS). The most powerful rocket ever built, SLS will send humans to explore the Moon as part of the NASA's Artemis program.



NASA's Perseverance Mars rover took a selfie with the Ingenuity helicopter, seen about 13 feet away in this image from April 6, 2021, the 46th Martian day, or sol, of the mission. Perseverance captured the image using a camera called WATSON (Wide Angle Topographic Sensor for Operations and eNginering), located at the end of the rover's robotic arm. Perseverance's selfie with Ingenuity was stitched together from 62 images taken while the rover was looking at the helicopter, then again while it was looking at the WATSON camera. Videos explaining how NASA's rovers take their selfies can be found [here](#). The Mars 2020 Perseverance mission is part of NASA's Moon to Mars exploration approach, which includes Artemis missions to the Moon that will help prepare for human exploration of the Red Planet. For more about Perseverance, visit [here](#). For more about Ingenuity, visit [here](#).

NASA in the News

Former senator nominated for NASA post

Acting NASA Administrator Steve Jurczyk released the following statement after the May 19 nomination by President Joe Biden of Bill Nelson to serve as the 14th NASA administrator: "I'm pleased President Biden has nominated former U.S. Senator Bill Nelson to lead our agency. Bill has a proven history of supporting our work here at NASA, and has helped advance America's position in human exploration, science, aeronautics, and technology. While the Senate must confirm the nomination, I look forward to continuing to work with Bill and the Biden-Harris administration to carry out NASA's many critical missions in the years to come. ... As we look to the future – and with Bill at the helm – we will continue to take on and find solutions to problems once thought unsolvable, and educate and inspire the next generation of American scientists, engineers, and workers." Nelson represented Florida in both the U.S. House (1979-91) and the U.S. Senate (2001-1). While chair of the House space subcommittee, Nelson flew aboard the space shuttle Columbia on the STS-61C mission in 1986.

Mars Odyssey marks 20-year milestone

NASA's 2001 Mars Odyssey spacecraft has marked an anniversary in its exploration of Mars. Odyssey launched 20 years ago on April 7, making it the oldest spacecraft still working at the Red Planet. The orbiter, which takes its name from Arthur C. Clarke's classic sci-fi novel "2001: A Space Odyssey" (Clarke blessed its use before launch), was sent to map the composition of the Martian surface, providing a window to the past so scientists could piece together how the planet evolved. It has done far more than that, uncovering troves of water ice, serving as a crucial communications link for other spacecraft, and helping to pave the way not just for safer landings but also future astronauts. Odyssey's two decades of data have been a boon for researchers working to determine where water ice is locked up on the planet. It has provided invaluable data on the composition of Mars and also provided 1 million images that have helped NASA determine where to send landers and rovers to land on the planet. To learn more regarding Odyssey and its Martian mission, visit [here](#) and [here](#).

NASA releases statement on discretionary request

The Biden-Harris Administration submitted to Congress on April 9 the president's priorities for fiscal year 2022 discretionary spending. The following is a statement from acting NASA Administrator Steve Jurczyk on the funding request:

"This \$24.7 billion funding request demonstrates the Biden Administration's commitment to NASA and its partners who have worked so hard this past year under difficult circumstances and achieved unprecedented success.

"The president's discretionary request increases NASA's ability to better understand Earth and further monitor and predict the impacts of climate change. It also gives us the necessary resources to continue advancing America's bipartisan Moon to Mars space exploration plan, including landing the first woman and first person of color on the Moon under the Artemis program.

"We know this funding increase comes at a time of constrained resources, and we owe it to the president and the American people to be good and responsible stewards of every tax dollar invested in NASA. The NASA workforce and the American people should be encouraged by what they see in this funding request. It is an investment in our future, and it shows confidence in what this agency has to offer."

The president's FY 2022 discretionary funding request:

- Keeps NASA on the path to landing the first woman and the first person of color on the Moon under the

Artemis program. This goal aligns with President Biden's commitment to pursue a comprehensive approach to advancing equity for all. With NASA's [Space Launch System](#) rocket and [Orion](#) spacecraft, as well as U.S. commercial partnerships with the human landing system and [Gateway lunar outpost](#), we will send astronauts to the Moon and provide learning opportunities for future missions.

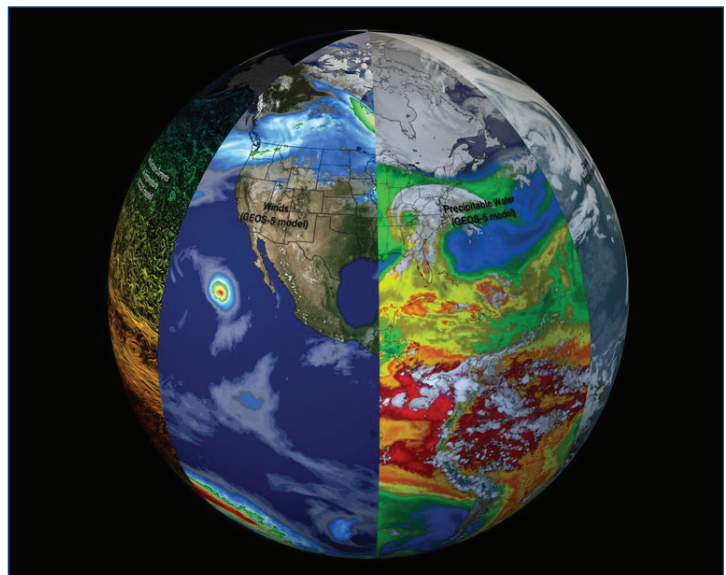
- Strengthens NASA's ability to better understand Earth and how it works as an integrated system, from our oceans to our atmosphere, how it all impacts our daily lives, and how it all is impacted by climate change.
- Furthers robotic exploration of the solar system and the universe.
- Invests in aviation to make our skies safer, our fuels cleaner, and to get you to your destination faster than ever before.
- Includes new funding for NASA's STEM engagement efforts to inspire underserved and underrepresented students to become the next generation of scientists, engineers, mathematicians, and explorers.

These discretionary investments reflect only one element of the president's broader agenda. In the coming months, the administration will release the president's budget, which will present a unified, comprehensive plan to address the overlapping crises we face in a fiscally and economically responsible way.

For more information on NASA's fiscal year 2022 discretionary request, visit [here](#).

NASA invites individuals to be #ConnectedByEarth

NASA is asking people around the world to observe Earth Day 2021 on April 22 by sharing their pieces of the planetary masterpiece to celebrate how everyone is #ConnectedByEarth. The agency is inviting people to post an image on social media of themselves (if they wish) and the bit of Earth that connects them to the planet. Images should be tagged with #ConnectedByEarth. If people want to share their general location (state, province, country), it will enable the agency to explore the world's wider connections. NASA Earth science shows how natural systems – land, water, air, ice – connect to, and affect, individuals and climate. While people are all connected to each other as Earthlings, sharing a tiny, blue ecosystem in space, they are also connected to the planet itself, as it is likewise connected to them. On Earth Day, via #ConnectedByEarth, the collective images of so many different parts of the planet and the humans (and other creatures) who share it will create a stunning picture of the connected pieces of the world. Another way individuals can celebrate the 51st observance of Earth Day is by starting their own garden – be it in a plot of Earth or a pot full of Earth – using seeds similar to the ones taken to the International Space Station for the astronauts' garden. For more, check out the [Growing Beyond Earth](#).



INFINITY Science Center to reopen May 29



INFINITY Science Center, the official visitors center for NASA's Stennis Space Center, has announced plans to reopen to the public with a special Sci-Fi Saturday event May 29.

The center has been closed for much of the past year due to the COVID-19 pandemic and related restrictions. Following the May 29 grand reopening event, the facility will resume normal operating hours, beginning June 3.

Hours of operation will be Thursday through Sunday, 10 a.m. to 6 p.m.

The center also has announced plans for upcoming events, including STEM (science, technology, engineering, and mathematics) events and several camps in June and July. For information about activities, persons may visit www.visitinfinity.com.

INFINITY Science Center features 72,000 square feet of exhibits and activities, allowing guests to explore Earth and space through artifacts, tours, memorable experiences, educational programs, and citizen science opportunities.

Stennis receives accolades for cutting-edge study

An international conference of aerospace experts recently recognized Stennis Space Center for cutting-edge research in predictive maintenance and integrated systems health management (ISHM).

A collaborative paper by the Stennis Autonomous Systems Lab on how to implement health management capabilities into an existing high-pressure pump-based system was awarded top honors last month in the Predictive Maintenance/ISHM track by the international Institute of Electrical and Electronics Engineers (IEEE) Aerospace Conference. The paper focused on how to use system monitoring capabilities on the liquid nitrogen pump system at Stennis.

“This is a major recognition of the innovative work being done by a dedicated team of people at Stennis, working with research partners,” said Duane Armstrong, chief of the Test Technology Branch in the Stennis Engineering and Test Directorate. “This team is focused on helping to improve the performance and reliability of Stennis systems and to increase their cost efficiency. It is a challenging but vital area of work.”

Systems management and maintenance is a critical need, particularly for a site such as Stennis that uses decades-old facilities to conduct large rocket stage and engine tests. For instance, the Stennis High-Pressure Gas Facility, which houses the liquid nitrogen pump system, has remained in constant operation since it was built in the 1960s. All maintenance and repair work on systems must be completing while the facility remains in operation.

There are several operating risks associated with high-pressure systems, such as the liquid nitrogen network at Stennis. Cavitation is one of the most common and damaging. It occurs when liquid in a system forms vapor cavities or bubbles that can cause serious damage to equipment when they implode. Pumps in such systems also suffer from lower output due to wear in valves and seals. Pumps used with super-low temperature cryogenic liquids develop leaks on the cold end of the assembly as well, requiring replacement of assembly components.

Predictive maintenance and ISHM capabilities would help in monitoring such a system and allowing issues to be addressed automatically or in more timely fashion. For instance, if a monitoring system could detect cavitation, it could automatically take steps to protect the pumps and equipment. Likewise, if the operational life of a pump’s cold end assembly could be determined, replacement parts could be ordered in a timely fashion.

However, installing such capabilities within a heritage system such as the High Pressure Gas Facility poses particular challenges due to the age of the equipment and the lack of existing instrumentation and data that is needed.

This (award) is a major recognition of the innovative work being done by a dedicated team of people at Stennis, working with research partners.

**Duane Armstrong
Stennis Test Technology Branch Lead**

In the recognized study, the Stennis Autonomous Systems Lab teamed with D2K Technologies to study whether – and how – such capabilities could be introduced in the Stennis liquid nitrogen system. The results are captured in the award-winning paper – “A Case Study on the Challenges and Opportunities for the Deployment of Prognostics and Health Management Capabilities in Existing Engineering Systems.”

The paper suggests innovative approaches, including the use of condition-based algorithms, to address concerns in a way that allows cavitation issues to be detected in real-time, as well as wear problems related to pump seals and components. Implementation of the suggested approaches would both protect equipment from damage and maximize the efficiency of the system.

The next step for Stennis is to implement the suggested capabilities into the liquid nitrogen system, whenever funding is available “If the approach can be proven at the Stennis High Pressure Gas Facility, it could serve as a prototype for similar systems,” Armstrong said. “It also could serve as a starting point to use the same sort of algorithmic approach to solve other system issues.”

Authors of the case study paper include Fernando Figueroa and Lauren Underwood with Stennis Space Center, joined by Federico Piatti and Mark Walker with D2K Technologies in Oceanside, California.

NASA small business awards include Stennis projects

Small businesses are vital to NASA's mission, helping expand humanity's presence in space and improve life on Earth. NASA has selected 365 U.S. small business proposals for initial funding from the agency's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) program, a total investment of more than \$45 million.

The research and development selections include eight projects managed by Stennis Space Center and its Test Technology Branch.

NASA selected 289 small businesses and 47 research institutions to receive Phase I funding this year. More than 30% of the awards will go to first-time NASA SBIR/STTR recipients. NASA selected proposals to receive funding based on their technical merit and commercial potential. The selections span the breadth of NASA missions to empower the agency's work in human exploration, space technology, science, and aeronautics.

The six selected SBIR projects selected for Phase I awards to be managed by Stennis Space Center are:

- "High Speed Emission Tomography for Ground Test Facilities," developed by En'Urga Inc in West Lafayette, Indiana. The project seeks to evaluate the feasibility of using mid-infrared hyperspectral imaging as a diagnostic tool for ground test facilities that have high-temperature turbulent flows, such as exhaust plumes from rockets and advanced propulsion systems.
- "Distributed High-Temperature Fiber-Optic Temperature Sensing System for Nuclear Thermal Propulsion," developed by Intelligent Fiber Optics Systems Corp. in San Jose, California. The project seeks to develop a rugged, miniaturized, multi-function high-temperature sapphire optical fibers-based Distributed Temperature Sensing system for use in extreme operating environments.
- "Wireless Field-ready Transducer Acquisition Device," developed by Parabilis Space Technologies Inc. in San Marcos, California. The project seeks to de-

velop a device to provide remote, wireless reading of existing transducers with Bluetooth enabled devices.

- "Hybrid Additive Manufacturing of Integrated Sensing (HAMIS) System," developed by RC Integrated Systems, LLC, in Torrance, California. The project seeks to develop a unique system to provide high-resolution simultaneous measurement of pressure, temperature, and strain in high temperature and/or radiation environments.
- "Thin Film Tungsten for High Temperature Hydrogen Embrittlement Mitigation," by Summit Information Solutions Inc. in Richmond, Virginia. The project seeks to use a deposition technique used primarily in the microelectronics industry to address the problem of hydrogen embrittlement, a particular problem with propulsion test piping systems.
- "Processing of Refractory Metals for Extreme Temperature Testing," developed by Transition45 Technologies Inc. of San Juan Capistrano, California. The project seeks to develop a unique manufacturing process to form refractory metals and alloys at much lower temperatures that currently possible, resulting in a safer, less expensive process.

The two selected STTR projects selected for Phase I awards to be managed by Stennis Space Center are:

- "Intelligent Photonic Micro-Sensor Network for Rocket Propulsion Ground Testing," developed by Intelligent Fiber Optics Systems Corp. in San Jose, California, and Stanford University in Stanford, California. The project seeks to develop a scalable, wirelessly networked, photonic instrumentation solution for measuring strain and temperature, as well as derived acoustics, pressure, and heat flux.
- "Wireless Networked, High Temperature, Wide Bandwidth Pressure Sensors for Propulsion System Monitoring," developed by Nanosonic Inc. in Pembroke, Virginia, and Virginia Tech in Blacksburg, Virginia. The project seeks to develop wireless networked, high temperature, wide bandwidth pressure sensors for use in propulsion systems during ground test and launch operations.

Hail & Farewell

NASA welcomes the following:

Calvin Thompson

Public Affairs Specialist

Office of Communications

NASA bids farewell to the following:

Darryl Gaines

AST, Technical Resources Management

Office of the Director

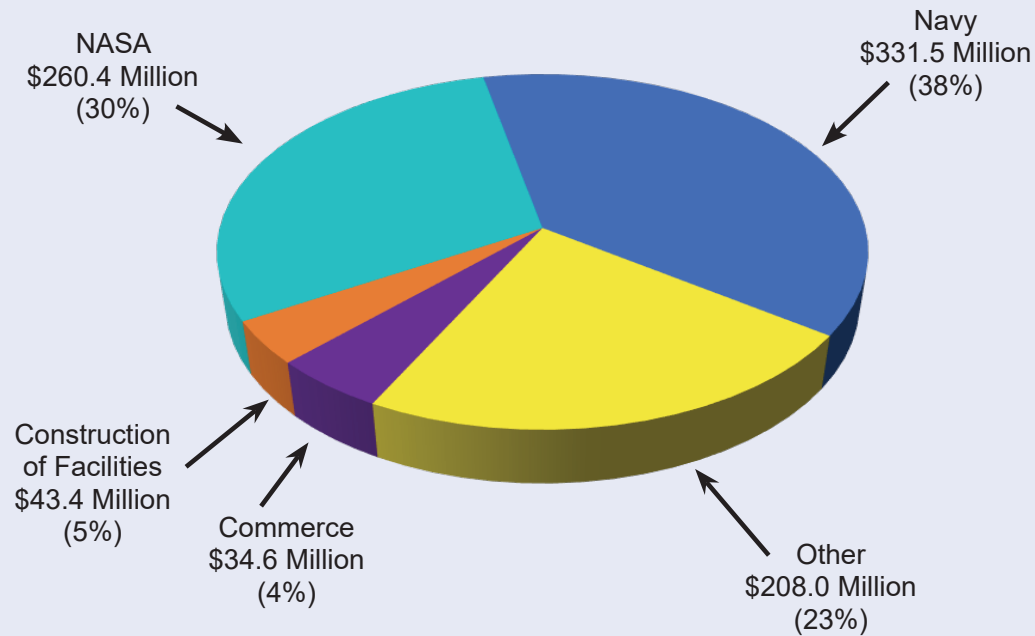
Charles Liberto

Supervisory AST, Engineer Project Management

Engineering and Test Directorate

Study shows Stennis has significant economic impact on Gulf Coast region

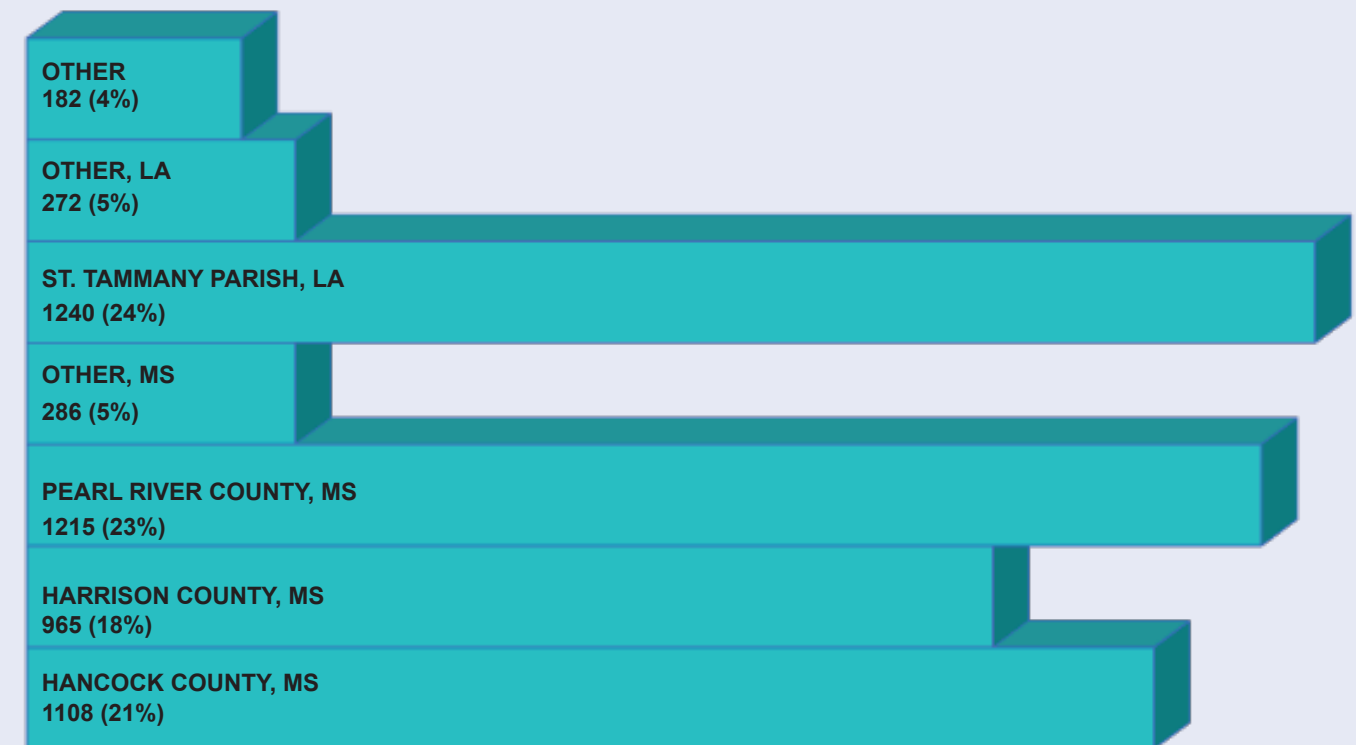
Direct Global Economic Impact \$877.9 Million



Workforce*

- NASA and contractors – 1856
(Stennis federal civil servants, 451; contractors and other, 1405)
 - Department of Navy and contractors – 2098
 - Department of Commerce and contractors – 209
 - Other Resident Agencies – 1105
- *Totals as of Sept. 30, 2020

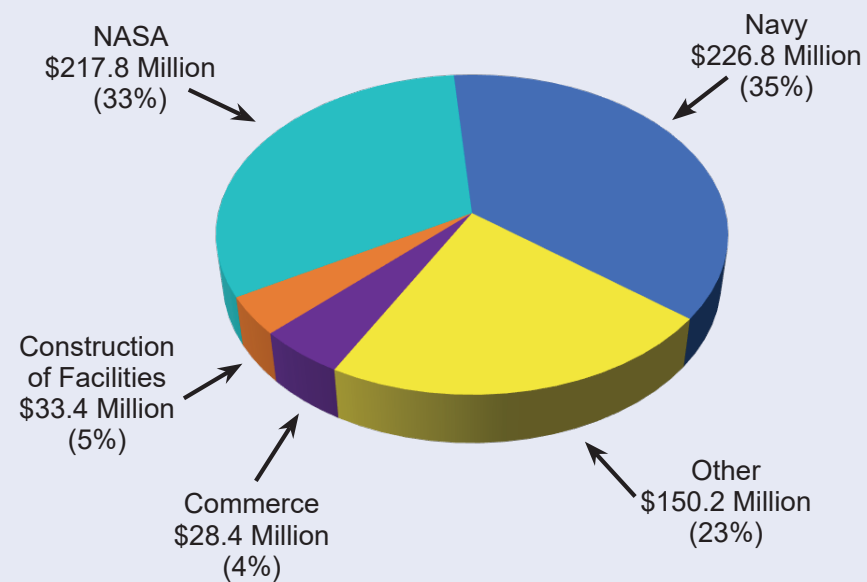
Residential Distribution of Stennis Personnel



Stennis Space Center is a major contributor to the Gulf Coast economies of Louisiana and Mississippi. It spends almost 74 cents of every dollar within a four-county/parish, 50-mile-radius area. It is responsible for contributing just more than \$1 billion million to the economies of Hancock, Harrison and Pearl River counties in Mississippi, and St. Tammany Parish in Louisiana in the fiscal year 2020 alone. Eighty-six percent of Stennis employees reside in the four-county/parish area.

*Study by Alan Barefield of Mississippi State University, March 2021.

Direct Economic Impact 50-mile Radius \$656.6 Million



Employee Skills Summary

- Scientific/Engineering – 31%
- Business/Professional – 23%
- Technical/Crafts/Production – 25%
- Clerical – 6%
- Other – 15%

Education Levels (All Employees)

- Doctorate – 4%
- Masters – 14%
- Bachelors – 34%
- Associates – 11%
- Some College – 13%
- High School Diploma – 23%
- Other – 1%

Total workforce – approx. 5,200

Average salary with benefits – \$100,000

Small business specialist finds joy in Stennis journey

Kay Doane loves everything about her job as the small business specialist for **Stennis Space Center**, not only the journey that brought her to the position but the journey alongside members of the Stennis family and the journey that lies ahead for both NASA and the south Mississippi site.

“I am proud to be the face of Stennis at small business events, telling companies how they can be part of something bigger as a NASA small business contractor,” said Doane, who has a 30-plus-year career of federal service, including the past four years in the Stennis Office of Procurement. “Small businesses keep our economy and neighborhoods strong. They play a large part in helping us succeed in our NASA missions.”

The journey to Stennis was a circuitous one for Doane, who grew up in nearby Terrytown, Louisiana, before moving to Carriere, Mississippi, in 2000. Like many of her era, her most vivid earliest space-related memory was of the space shuttle Challenger tragedy in 1986. However, she also recalls the plaque in her brother’s room that depicted Neil Armstrong placing the American flag on the surface of the Moon during his historic Apollo 11 mission. “I remember going in his room to look at it, thinking it was just amazing,” Doane said.

Doane eventually found her way to the front lines of the equally amazing space exploration work of the post-Apollo years. First, however, she followed in the footsteps of her civil servant father, joining the U.S. Air Force Reserves in 1989 and retiring with 20 years of service. She started her civil service career in 1993 in finance positions with the U.S. Navy and Defense Information Systems Agency before moving to a position with the NASA Shared Services Center at Stennis in 2005. In 2013, Doane worked a detail assignment in the Stennis Office of Procurement before fully joining that team in 2017 as the small business specialist.

She has excelled in the role, evidenced by the number of NASA group achievement awards already received during the short tenure. Most recently, Doane was recognized

for her “tireless advocacy” by the NASA Office of Small Business Programs. The agency office highlighted Doane during Women’s History Month as one who “reminds us of all the incredible achievements of women all around the world.”

Stennis Office of Procurement Director Gerald Norris has praised Doane for leading an “innovative and sustainable” program that has had a direct impact on NASA’s human space exploration efforts by helping



Kay Doane is “the face of Stennis Space Center” for small businesses, thanks to her work in the Office of Procurement. She loves everything about her job, as well as the journey that led her to the south Mississippi site.

Stennis achieve it related missions. This includes the **Green Run** testing activities for NASA’s Space Launch System rocket.

Last month, Stennis completed a yearlong series of integrated systems tests on the rocket, which is being built to carry the first woman and first person of color to the Moon as part of the **Artemis program** and to enable future missions to Mars. The Green Run series at Stennis culminated with a full-duration hot fire of the core stage’s four **RS-25 engines** on March 18. The 500-second test generated a combined 1.6 million pounds of thrust and represented the most powerful test conducted at the site in more than 40 years.

Like many of her colleagues, Doane has been forced by the COVID-19 pandemic to fulfill her important role while working remotely. The shift to telework status precluded her ability to host on-site Small Business Showcase events that allow local vendors to display their capabilities that might contribute to the Stennis missions.

Doane has responded to the new conditions by planning and hosting virtual showcase events each quarter. She also has worked to maintain contact with small businesses and Stennis resident tenants throughout the year, ensuring the site continued to nurture the vital relationships needed to support ongoing missions. The effort is aided by a Stennis Small business video created by Doane, which won a 2019 Silver Telly Award for outstanding production.

Due to such efforts and despite COVID-19 restrictions, Stennis significantly surpassed a number of key goals in contract awards during the fiscal year 2020, including those set for contract awards to HUBZone; woman-owned; and service-disabled, veteran-owned businesses. Overall, the site surpassed its total small business goal for the year by 11.1 percent.

The credit rests with members of the Stennis family, Doane said. “Working from home the past year due to COVID-19 has really given me a greater respect for my fellow coworkers at Stennis,” she said. “Not only am I impressed

everyday by the work that is accomplished but also by the general kindness each employee shows to one another to stay connected during these difficult times. I truly miss being in the office and being able to have the day-to-day interactions in person with my fellow friends.”

The awareness is no real surprise for Doane, who characterizes Stennis as the most diverse organization she has even known. “This is why I believe we perform better,” she said. “When people are respected for who they are, they want to be at work and do their best.”

For Doane, it is all part of what makes the journey so meaningful and enjoyable.

Online Resources

Listen to Stennis Technology Transition Lead Tom Stanley on the SuperTalk Mississippi (Good Things, 4-6-21, <https://www.supertalk.fm/shows/goodthings/#s1efGe80X11>)

Read profile of Stennis Associate Director Mary Byrd on LSU College of Engineering website at: <https://www.lsu.edu/eng/news/2021/04/admarybyrd.php>

Stennis Emergency Management

NASA Coronavirus Response

Stennis Virtual Tour



Stennis Fact Sheets

NASA E-Book Downloads

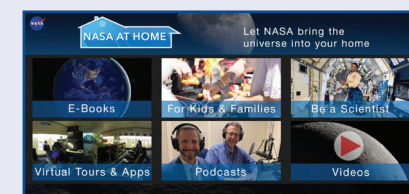


Stennis Artemis Resources Page

NASA STEM@Home

NASA at Home

NASA STEM Toolkit



NASA Image of the Day

1978 – NASA tests shuttle propulsion system

Note: NASA's John C. Stennis Space Center has played a pivotal role in the nation's space program. The following offers a glimpse into the history of the space program and the rocket engine test center. As the center celebrates its 60th anniversary later this fall, Lagniappe is looking back at the history of the site.

In the 1970s, the Apollo Era was coming to a close. Saturn rocket testing had ended at the Mississippi Test Facility, but a new engine roar was soon to be heard, the space shuttle main engine.

In 1971, the testing of the space shuttle main engines was assigned to the Mississippi Test Facility, and work began on modifying the test stands for this new endeavor.

The space shuttle main engine test project at Stennis officially began on May 19, 1975. The so-called “burp” test did not include full ignition of the engine. The first full ignition space shuttle main engine test occurred on June 12, 1975. Twelve days later, on June 24, 1975, Stennis conducted the first full-duration space shuttle main engine test.

With single-engine testing under way, attention at the newly-renamed National Space Technologies Laboratory squarely turned to testing the shuttle's main propulsion test article (MPTA). For that project, the site brought in the best test conductors in the country.

The shuttle MPTA consisted of three main engines, an external propellant tank, associated systems and a

simulated orbiter aft section. All of the components were installed on the B-2 Test Stand and the engines test fired simultaneously, just as during an actual launch, to prove the propulsion system would operate as needed to power shuttle flights.

The MPTA testing was critical due to the unique nature of the shuttle design. Every previous rocket system was tested with uncrewed flights prior to launching human missions. That was not the case with the space shuttle.

The first time it launched, it carried two astronauts, who were relying on the work that had been done at Stennis to carry them safely to space.

Harry Johnstone first headed up the program, and through the years the MPTA test team, consisted of Tom Baggette, John Plowden, Tom Lyddon, Marv Carpenter, Lou Nelson, Boyce Mix, Doug Howard and Bill Lindsey, just to name a few members of the team.

In March 1978, the MPTA test team went through a Firing Readiness

Review that was done by NASA's Review Board. Each element and part of the operation was reviewed, and at the end of the extensive two-day session, the operation received the “thumbs up” for test firing.

So, on April 21, 1978, 40 years ago, the first shuttle MPTA test was conducted on the B-2 stand at 11:34 a.m. The hot fire was only 1.90 seconds and signaled by just a small puff of smoke, but it was an important chapter in testing history at what is now [Stennis Space Center](#).



A trio of space shuttle main engines fire simultaneously during a test of the vehicle main propulsion test article on the B-2 Test Stand at Stennis. The series of tests to certify the design and operation of the shuttle propulsion system was a critical milestone leading up to the maiden launch of the vehicle and is considered by many to represent one of Stennis' finest hours.

Office of Diversity and Equal Opportunity

Workplaces benefit from religious tolerance

Business is generally thought of as a secular activity, with workplaces seen as inappropriate settings for religious faith expression or observance. However, given the growing popularity of bringing one's whole self to work and the fact that more than 80% of the world claims some religious affiliation, business leaders are increasingly concerned about how best to handle expressions of faith by their employees.

For many religious people, their faith is associated with deeply held values that inform their actions and behaviors at work and in their personal lives. With the workforce's diversification, the matter of religious diversity is a topic that many employers have either broached or will need to broach.

At one time, religious diversity reflected various traditional organized religions. But today, it encompasses a multiplicity of religious traditions and an increasing variety of noninstitutional belief systems.

Although religious behavior and viewpoints may result in conflict at work, religion can also inspire positive virtues in the workplace. For example, religion can positively influence a worker's loyalty, morale, and communication.

However, expressions of belief may also conflict with the business's requirements, causing employers to walk a fine line between non-discrimination on religious grounds, service to the customer, and fair treatment of all employees.

Certain religious beliefs may dictate that employees dress a certain way, avoid eating certain foods, or not work on holy days. Pitting these tenets against the demands of business may create tension in the organization, often with negative ramifications. Conflicts over religious dress have resulted in lawsuits, causing people to leave jobs or be fired, damage to the organization's reputation, and difficulty in attracting or retaining staff and customers. However, actively accommodating highly diverse beliefs and practices within an organization also is possible.

With the workforce becoming more diverse, understanding how to approach employees' religious rights is imperative for employers. While managing religious diversity in the workplace is a topic that each

employer should address individually, having some general guidelines can help.

According to Title VII of the Civil Rights Act of 1964, employers cannot discriminate or treat employees less favorably because of their religious beliefs. The Equal Employment Opportunity Commission (EEOC) recognizes both harassment for religious beliefs and denial of a religious accommodation as forms of disparate treatment.

Protections under Title VII apply whether the religious beliefs or practices in question are common or non-traditional, and regardless of whether they are recognized by any organized religion. The non-discrimination provisions of the statute also protect employees who do not possess religious beliefs or engage in religious practices. All governmental entities must carry out their missions neutrally and without any hostility to any religion or related observances, practices, and beliefs, or lack thereof.

It is the responsibility of employers to accommodate an employee's religious beliefs and practices, if the accommodation does not cause undue hardship. A religious accommodation could be as simple as approving a day off to observe a religious holiday, a flexible work schedule, or accommodation for one's dress. Employers should always focus on an employee's productivity and ability to complete the job regardless of which accommodation, religious or otherwise, is being requested.

Employers cannot raise the subject of religion on a job application or during an interview. For instance, an employer cannot ask applicants if their religion will prevent them from working certain days. Alternately, it is the employee's responsibility to communicate with an employer regarding any religious accommodations needed. Accommodating an employee's religious practices can go a long way in showcasing the employer's tolerance for diversity and respect for the workforce.

Employers who encourage their workforce to be tolerant of diversity, including respecting individual religious beliefs, will ultimately make stronger teams and a happier workplace.

Information in this article came from: the following sources: Harvard Business Review; Circa Works; and EEOC.