

Jacobs

Solving the Challenges of Space Exploration

For more than 70 years, Jacobs engineers, technicians and scientists have provided integrated solutions to help solve the complex challenges of space exploration. With a global web of resources and more than 5,000 employees supporting multiple NASA centers, other government users and industry partners around the United States, the Jacobs team is able to stay steps ahead to provide advanced engineering, research and operations support.

We **invent**
by **imagining**
what is **possible.**

Innovative Solutions for Driving Launch, Flight and Mission Success

Launch Support

As prime contractor for NASA'S Exploration Ground Systems Program at Kennedy Space Center, Jacobs is responsible for the development and operations of flight vehicle components, including integration, processing, testing, launch and recovery. The Jacobs team has helped NASA to modernize and upgrade facilities and ground equipment at KSC to prepare for the launch of the Space Launch System (SLS) and Orion crew vehicle in support of the Artemis Program, which aims to put humans on the Moon by 2024. Examples of this work includes upgrades to the 6-million pound crawler transporter, the 580-foot-tall mobile launcher and launch pad 39B. The launch team is now completing development of the spaceport command and control system software, and is starting to process flight hardware for the launch of SLS and Orion. The Jacobs team also provides technical and engineering support to a variety of commercial space companies, including Lockheed Martin, Boeing, Northrop Grumman, and Sierra Nevada.



Crawler Transporter-2 Upgrades

This unique vehicle, more than 50 years old, has been restored to transport NASA's SLS and Orion spacecraft to Pad 39B.



Launch Pad 39B

This historic launch pad has been transformed with refurbished flame trenches, propellant lines, storage tanks, and communications to support a modified mobile launcher that will transport NASA's 79-metric-ton SLS rocket.



The Space Launch System (SLS)

The most powerful and complex rocket ever built, this heavy-lift vehicle will take scientific missions and humans beyond Earth orbit, launching a new era of deep space exploration.

Space Launch System

Jacobs is providing technical leadership and support to NASA's Space Launch System Program in the areas of vehicle systems engineering and integration; flight software development; avionics systems integration; lab construction and operation; vehicle structural load development; structural, propulsion and acoustic testing; and design, development and analysis. The Jacobs team also designs and oversees development and test of the Ground Support Equipment required to transport, test, and operate the massive SLS flight hardware on the ground.

Orion

Jacobs is part of the team of engineers supporting development and construction of NASA's Orion crew capsule, which is built for long-duration, human-rated missions to the moon and into deep space. Jacobs is providing critical engineering, fabrication and testing of Orion's vital systems to validate strict reliability guidelines that will ensure mission readiness on the first flight to the moon since Apollo. Multiple Jacobs contract operations work as one team to test the Environmental Control Life Support Systems, the Launch Abort System, Capsule Parachute Assembly System and Water Impact Drop and Stress Tests, as well as validating the Thermal Heat Shield withstands re-entry temperatures of more than 4,000 degrees Fahrenheit. The Jacobs team at KSC has developed and produced thousands of heat shield components for Orion.

International Space Station

Jacobs supports cargo delivery to the International Space Station (ISS) for NASA under the Commercial Resupply Services contract at Kennedy Space Center, coordinating logistics of launch payloads in concert with commercial cargo platforms such as Northrup Grumman Cygnus, and Japan Aerospace Exploration Agency HTV. The Jacobs teams at both Kennedy and Johnson Space Center have the expertise to manage the life cycle of technical and scientific payloads bound for the ISS, from concept formulation to operational systems integration. They can develop and maintain flight hardware used for experiments, coordinate with scientists to prepare and process experiments, and develop on-orbit crew procedures and plans to support the science. At the Marshall Space Flight Center, Jacobs team members develop, manufacture and test components of the ISS Environmental Control and Life Support System, as well as support materials science experiment design, development and fabrication.

The solutions we design impact human behavior and performance. **It takes as much human ingenuity as digital savvy to do all that we dream today.**



Capsule Parachute Assembly System

Performed high-altitude drop tests of a capsule mockup, slowing the vehicle from thousands of miles per hour to a gentle 25 miles per hour.



Thermal Protection System/Heat Shield

Development and production of heat shield components tested in arc jet test facilities under simulated Earth re-entry temperatures exceeding 4,000 degrees Fahrenheit.



Robonaut

Created as part of an integrated NASA team, Robonaut is a humanoid robot designed to work alongside astronauts on the ISS using existing crew tools. Jacobs procured parts, designed hardware, and assisted with assembly and certification tasks.

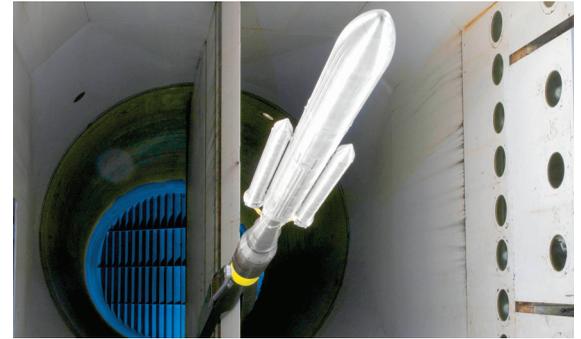


International Space Station

As an integrated solution provider, multiple Jacobs contract operations work as one team to provide crucial engineering and testing support to the ISS, a test bed for deep space technologies and systems critical to human exploration beyond low-Earth orbit.

Research, Test and Facility Support

As NASA's largest professional and technical services provider, Jacobs brings subject matter experts with proven experience in their technical fields, delivering innovative solutions to exploration and research programs across the country. This work includes the operation and maintenance of a variety of unique research and development facilities, including NASA arc jet facilities and wind tunnels, with a long history of supporting similar Department of Defense facilities as well.



Wind Tunnels

Jacobs is the world's premier provider for all wind tunnel related services, delivering highly technical, innovative solutions across the entire life cycle including wind tunnel design, fabrication, commissioning, operations, maintenance, condition assessment and capital investment. Our wind tunnel services support a range of wind tunnel customers and users from automotive, freight trucking, aerospace and government. Jacobs provides operations service for all of NASA's wind tunnels contributing to flight and propulsion research and access to space for Commercial Resupply, Commercial Crew and the agency's Space Launch System.



Full-Range Testing Services and Capabilities

Jacobs provides an extensive range of reliability testing and prototyping solutions for any aerospace hardware or software application, including: Mechanical & Electronics Manufacturing, Structural Load Testing, Environmental Testing (Thermal/Vacuum, Electromagnetic Interference, Vibration), Antenna Performance, Battery Performance & Failure Testing, Pyrotechnics Testing, and Hypervelocity Impact Testing. To add more fidelity to testing data, unique analysis tools, techniques and computational models are applied to ensure accurate results.

Marshall Space Flight Center, Huntsville, AL

A campus of world-class facilities for propulsion system and launch vehicle development, advanced materials and manufacturing processes development, flight software development and test, and systems engineering and integration of the SLS rocket. Jacobs support includes construction and operation of the SLS flight software/hardware integration and test facility, the Systems Integration Lab (SIL).

Johnson Space Center, Houston, TX

Jacobs provides space exploration integration systems engineering, astro-materials science and hardware reliability testing services here at NASA's primary center for design, and development for human spaceflight. Jacobs engineers also design and test, robotic systems, life support systems, communications, and astronaut safety systems along with image analysis of space systems hardware.

Langley Research Center, Hampton, VA

Jacobs provides Maintenance, Operations, and Engineering support at NASA's Langley Research Center, home to 270 Research and Institutional Facilities, 220 of which are classified as critical. Efforts here include support to subsonic-to-hypersonic wind

tunnels, laboratories, test stands and instrumentation. NASA's focus is on revolutionary improvements to aviation and expanding the understanding of Earth's atmosphere and technology development for space exploration.

White Sands Test Facility, Las Cruces, NM

A resource for testing and evaluating spacecraft materials, components and rocket propulsion systems that enable safe human exploration and utilization of space. NASA's hypergolic experts, most of whom are Jacobs' employees, reside at this facility, and play a critical role in ensuring the health of future hypergolic propulsion system development.

Ames Research Center, Moffett Field, CA

Jacobs provides Aerospace Testing and Facilities Operations and Maintenance and additional facility support services here at NASA's lead conductor of innovative research and development.

Kennedy Space Center, Cape Canaveral, FL

Jacobs provides overall management and implementation of Kennedy's ground systems capabilities, flight hardware processing and launch operations. This includes operation and

maintenance of the Vehicle Assembly Building, Launch Pad 39B, the Multi-Payload Processing Facility, Launch Equipment Testing Facility, International Space Station science payload support laboratories, and the Thermal Protection System research and production facility.

Glenn Research Center, Cleveland, OH

At NASA's center for designing and developing innovative technology in aeronautics and space exploration, Jacobs' technical services support subsonic and supersonic wind tunnels, engine altitude chambers and component, space propulsion, zero gravity and space simulation facilities.

Goddard Space Flight Center, Greenbelt, MD

In addition to developing and validating new technologies for future mission support, Jacobs provides electrical/electronic engineering support services to include the study, design, development, fabrication, integration, testing, verification and operations of space flight, airborne, and ground system hardware and software.

For more than 70 years...

we've built a **worldwide reputation** for providing **innovative solutions** to government, private companies and industries.

Cybersecurity Solutions

Securing and Defending Our Nation's Most Critical Networks

Jacobs is a premier provider of national security-grade cybersecurity solutions that ensure the confidentiality, integrity, and availability of the world's most sensitive networks, systems, and data. As a foundational component of our suite of capabilities, we offer integrated cybersecurity solutions that span the cybersecurity lifecycle, as well as standalone capabilities that address specific security challenges. Our engineers and systems administrators are currently delivering cybersecurity solutions to the Intelligence Community, USSOCOM, and the Missile Defense Agency.

Client Success Stories

Cybersecurity Situational Awareness

A classified customer desired consolidation and sharing of cyber threat situational awareness across multiple networks and information sharing domains while ensuring protection of data. Jacobs developed a Cybersecurity Information Sharing Portal with integrated Public Key Infrastructure (PKI)-enabled authentication services coupled with corporate authorization services, which enabled the consolidation and dissemination of real-time cybersecurity situational awareness information across the global enterprise. We also integrated key cyber data feeds and implemented data fusion techniques to enhance cyber situational awareness. Our solution now represents the primary mechanism through which cyber event related information is shared among critical stakeholders in support of the client's cyber defense mission.





Incident Response and Remediation

In response to a Heartbleed security vulnerability that impacted all HTTPS web browser sessions and remote login capabilities, which could have compromised legitimate DOD system administrators credentials. Jacobs developed security testing scripts and assisted our DOD customer in the development and implementation of a remediation program to patch vulnerable systems.

This solution was developed within 48 hours of the discovery of the vulnerability, a full week before any form of testing was commercially available, ultimately avoiding thousands of hours of IT security labor and ensuring the continued integrity of our customer's enterprise network.

Industrial Control Systems and SCADA

Cyber attacks in the Middle East prompted the initiation of security requirements for all Physical Security Information Systems and Industrial Control Systems for one of our oil and gas clients. As a central aspect of the client's \$20B refinery expansion project, our engineers performed an in depth risk assessment, audited plant and control networks, and assessed proposed architectures to secure more than 1,000 endpoints covering seven major units across Plant, Process, and Business networks. Our engineers designed and developed requirements that incorporated Security Information and Event Management solutions optimized for an ICS/SCADA environment, and Intrusion Detection Systems, Network Monitoring, and Industrial Firewall solutions. This raised the overall security posture of the customer through the deployment of security management and monitoring technologies optimized for the customer's environment. We also increased the overall ICS security awareness of client staff, influencing the security and safety consciousness of the organization.

Intelligent asset management **protects tomorrow's** space technologies **today.**

Intelligent Asset Management Solutions



Maximizing Our Clients Return on Investment

Jacobs addresses every aspect of asset management, from concept to asset retirement. Regardless of the asset's lifecycle phase – from strategic planning, concept, design, construction, operation, maintenance, or asset extension/retirement – Jacobs deploys our Asset Management Delivery Framework to improve asset effectiveness and reduce the total cost of ownership.

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Jacobs Asset Management Deployment Strategies for NASA Langley Research Center:

- Deployed technologies to enable real-time monitoring and analytics of critical assets, improving efficiency, reliability, and availability
- Instrumented ~665 assets using ~60,000 discrete points to measure vibration data through a wireless network
- Introduced Building Automation and combined 11 disparate systems (primarily HVAC) into a single integrated system, now monitoring more than 110,000 points
- Designed and implemented the hardware and software to enable real-time-asset monitoring and data capture in the Integrated Operations Center

- Leveraged our cybersecurity experts to ensure the safety and integrity of data transfer and capture
- Linked floor plans using Geographic Information Systems (GIS) and attached control drawings to facilitate troubleshooting and quickly identify problem areas

Benefits to NASA Langley Research Center since rollout of our Asset Management Delivery Framework in October 2015:

- No failures or unplanned outages of instrumented assets
- Validated client cost avoidance of ~\$5M equating to a 4-year return on investment
- Recognition by Uptime Magazine as the Reliability Program of the Year for 2017

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