National Aeronautics and Space Administration

facility opportunity

A safe, advanced, adaptable isolation system that eliminates the need for critical lifts

Starr Soft Support for State-of-the-Art Aircraft Ground Vibration Testing


NASA photo by Tony Landis


NASA photo by Tom Tschida


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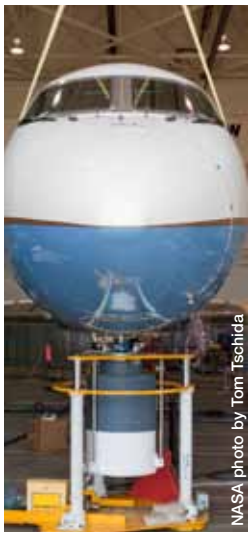
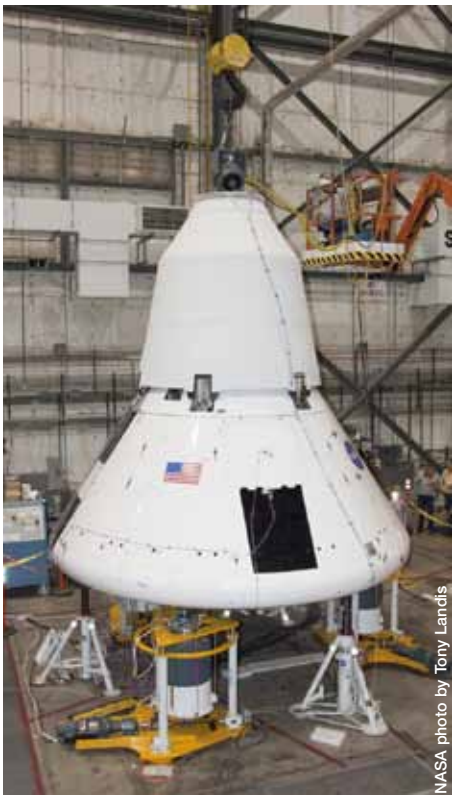
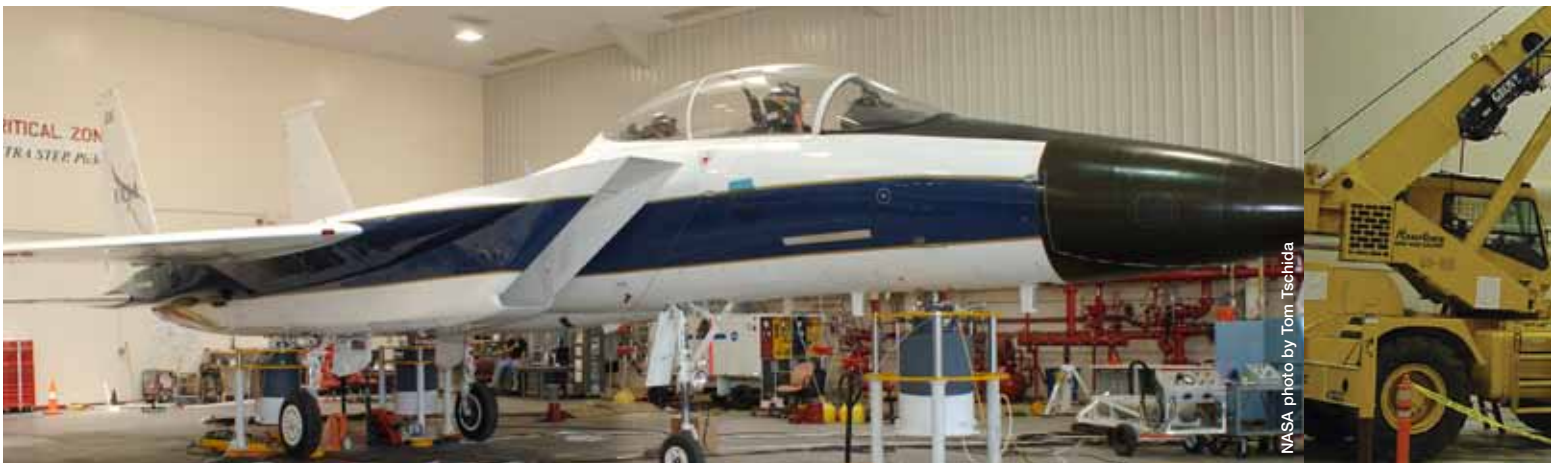

NASA photo by Tom Tschida


NASA photo by Tony Landis

Invented by Starr Ginn, Deputy Chief of the Engineering Directorate's Aerostructures Branch at NASA Dryden Flight Research Center, the Starr Soft Support isolation system incorporates an automatically reconfigurable aircraft jack into NASA's existing isolators. This enables an aircraft to float in mid-air without the need for a critical lift during ground vibration testing (GVT), significantly reducing testing risk, time, and costs. Currently incorporating the most advanced technology available, the 60,000-pound capacity isolation system is used for weight and measurement tests, control surface free-play tests, and structural mode interaction tests without the need for any major reconfiguration, often saving days of time and significantly reducing labor costs. The Starr Soft Support technology adds the most advanced aircraft testing isolation method available to the state-of-the-art ground testing capabilities at Dryden — a world leader in aircraft ground and flight testing.



Benefits

- **Safe:**
  Eliminates the need for critical lifts during GVT and other aircraft tests, drastically reducing risks to personnel, testing equipment, and the aircraft itself
- **Accurate:**
  Enables aircraft to float in mid-air, enabling highly accurate and relevant test results
- **Adaptable:**
  Reconfigures automatically to meet changes in aircraft height and hardware configurations, significantly reducing testing time and costs
- **Streamlined:**
  Requires only one simple set-up for all phases of GVT, helping ease data analyses

Technology Details

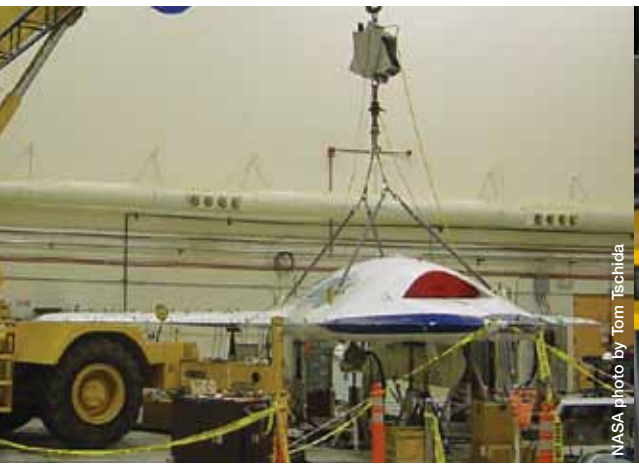
How It Works

The Starr Soft Support isolation system consists of an aircraft jacking device with three jacking points, each of which has individual motors and accommodates up to 20,000 pounds for a total 60,000-pound capacity. The system can be transported to the aircraft by forklift and placed at its jacking points using a pallet jack. Electric actuators power the jacking point motors, raising the aircraft above the ground until the landing gear can retract. Inflatable isolators then deploy, enabling the aircraft to float in mid-air, simulating a free-free testing environment.

Why It Is Better

Inflatable isolators have been in use at NASA for years, enabling aircraft to literally float, unsupported, for highly accurate GVT. These isolators must be placed underneath the aircraft for this to occur. Traditionally, this is achieved by a "critical lift"—a very dangerous procedure in which a crane and flexible cord system are used to lift the aircraft. The aircraft then dangles in the air while personnel place the isolators underneath the plane and prepare the aircraft for testing. This situation is dangerous, expensive, and time consuming. Most GVT requires measurements be taken with at least four configurations of the aircraft (e.g., landing gear in, landing gear out, etc.), requiring at least four lifts. Each time the aircraft is reconfigured, the crane/cord system must be reconfigured as well, and the height of the isolators underneath the aircraft must also be adjusted. This adds a tremendous amount of time, cost, and risk to the testing.

In contrast, the Starr Soft Support isolation system eliminates the need for critical lift by integrating the inflatable isolators into an aircraft jacking system. The system maintains vertical and horizontal isolating capabilities. The aircraft can be rolled onto the system, jacked up, and then the isolators can be inflated and positioned without any personnel needing to work underneath the aircraft. Also, the system accommodates changes in aircraft configuration, automatically adapting to changes in mass, and it can adjust the height of the isolators in one basic set-up.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Real-World Testing and Use

Real-World engineers completed a successful proof test on the Starr Soft Support system in December 2005, with no anomalies noted. The system has been used for aircraft testing for NASA missions as well as for client aircraft since 2006.

Dryden used the technology to successfully suspend a G-III airplane and, in June 2009, suspended the crew module for the Orion Project's Crew Exploration Vehicle (CEV). The technology was used to test all parts of the vehicle that are associated with the abort test project. These included the CEV and its adapter cone. Initial rocket testing for Orion revealed that the external load environments were much higher than the models had been designed to withstand. In order to make the models more realistic in terms of what the hardware would actually produce, the Orion team needed to obtain highly accurate damping margins via GVT. The Starr Soft Support isolation system provided the required accuracy while saving the mission significant testing time.

Dryden personnel also used the Starr Soft Support system to successfully perform a GVT on an F-15 being structurally modified by Gulfstream.

"Creating a free-free boundary for light articles is relatively easy. But for heavy vehicles, there are very few systems that are available. I found Dryden's soft support relatively easy to use and it stayed consistent over the entire 5-day test."
— Ken Fiorelli, Orion Crew Module testing, Quartus Engineering, Inc.

"The Starr Soft Support system provided the isolation from the ground that we needed. At other companies, we had used other isolation systems (air bag suspension systems, bungees, and EVAC air bags). Getting acceptable lateral isolation with the airbag systems can be difficult. Your system provided very good lateral isolation due to the sway bars, and the adjustability of the axial isolation appear to work very well also. Overall, I was impressed."
— Bob Pinkham, Project Orion - Loads and Dynamics, Lockheed Martin Space Systems

Applications

- Aircraft ground vibration tests
- Weight and balance measurements
- Complete inertia tensor measurements
- Control surface free-play tests
- Structural mode interaction tests

Aircraft Testing Opportunities at Dryden

Engineers at Dryden perform flight research and technology integration to revolutionize aviation and pioneer aerospace technology. Dryden provides research and project support in six disciplines: aerodynamics and propulsion, aerostructures, dynamics and controls, flight instrumentation, flight systems, and systems engineering and integration. In each of these areas, Dryden's expertise covers software, hardware, analysis, modeling, planning and execution of flight, and development of flight or ground test techniques.

Located at Edwards, California, in the western Mojave Desert, Dryden is uniquely situated to take advantage of excellent year-round flying weather, the remote area, access to the Edwards Air Force Base's restricted air space, and visibility to test some of the nation's most exciting air vehicles. Partnership with Dryden provides access to a world-class workforce and flight environment plus unrivaled research facilities.

And now, with the addition of the Starr Soft Support technology, the Flight Loads Laboratory is the premier aircraft testing facility in the United States, offering the most advanced aircraft isolation system available by the engineers who invented it.

Dryden's Flight Loads Laboratory offers customers:

- Thermal, structural, ground vibration, and structural mode interaction testing of aircraft and aircraft structural components
- All testing under one roof for convenience and efficiency
- A large data acquisition and thermal control system
- Up to 84 channels of hydraulic load control
- Systems for applying advanced instrumentation
- A unique virtual laboratory system for remote, real-time monitoring of tests through a secure Internet connection
- A highly skilled and experienced workforce of engineers and technicians
- State-of-the-art tools to design and analyze test set-ups for testing one-of-a-kind items

"En route to obtaining flight clearance for the Quiet Spike™ sonic boom mitigator installed on NASA Dryden's F-15, a GVT was required to ensure that the installed Quiet Spike frequencies were in agreement with predictions. To eliminate the uncertainty associated with supporting the aircraft on soft tires or jacks, the soft support system was utilized to simulate a free-free configuration. The GVT results using soft supports and free-free predictions were in close agreement (4% maximum deviation), therefore confirming the structural modeling of the Quiet Spike mitigator and interface to the F-15." — Donald Freund, Ph.D., Principal Engineer, Preliminary Design, Gulfstream Aerospace Corporation

For More Information

If you would like more information about the Starr Soft Support isolation system or about Dryden's aircraft testing capabilities and facilities, please contact:

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