# Vibration Isolation for the Aerospace Industry

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# Vibration Isolation for Vacuum Chamber Applications

It's a momentous occasion when a spacecraft is launched above Earth's atmosphere and into orbit. From the first steps on the moon to the creation of advanced telescopes, the mystery of outer space continues to compel us to want to learn more about the unknown. That's why the engineers at Fabreeka International work closely with the aerospace industry during the testing process of a spacecraft or its hardware.

Before an aerospace object can be launched into orbit, it's necessary to conduct testing in a space-simulated environment. For this environment to be achieved, a vacuum chamber or thermal vacuum chamber is used to simulate the pressure and thermal effects of launch and space travel.

Tests are run in the chambers to ensure survivability and validate the performance of a spacecraft under the conditions it will experience post-launch. These tests are necessary during every stage of spacecraft development to avoid any costly errors. The effects of vibration are tested in addition to temperature, pressure, humidity, and sound. Then, the components are checked to ensure there are no defects such as a leak, break, or short circuit.

# What is Fabreeka's Vibration Isolation System?

Engineers at Fabreeka can isolate payloads in a variety of ways. One way is to isolate the payload externally to support the chamber itself. Another way is to support the payload externally by using feed-throughs under the chamber or supporting the payload inside of the chamber.

When the chamber and payload need to be isolated together, the isolation system is installed to support and lift the chamber externally. The chamber may also be anchored to the ground and a dynamically rigid platform or structure can be isolated beneath it. The platform may be connected to the vacuum chamber using feed-throughs or support points that penetrate the chamber using vacuum-compatible seals. The payload/object that undergoes testing inside of the chamber is supported on these feed-throughs, which provides vibration isolation for the payload.

In cases where the size and weight of the chamber are not practical to isolate the entire chamber externally, the vibration isolation system is designed and fabricated to be installed inside the chamber. To achieve this, Fabreeka's engineers ensure that the vacuum-compatible isolation system meets strict material specifications to limit out-gassing (the release of a gas that was dissolved, trapped, frozen, or absorbed in a material) and fulfill cleanliness requirements. Additionally, in thermo-vacuum applications, the isolators may be required to function in temperature extremes where heater blankets are necessary to keep them at an operable temperature.

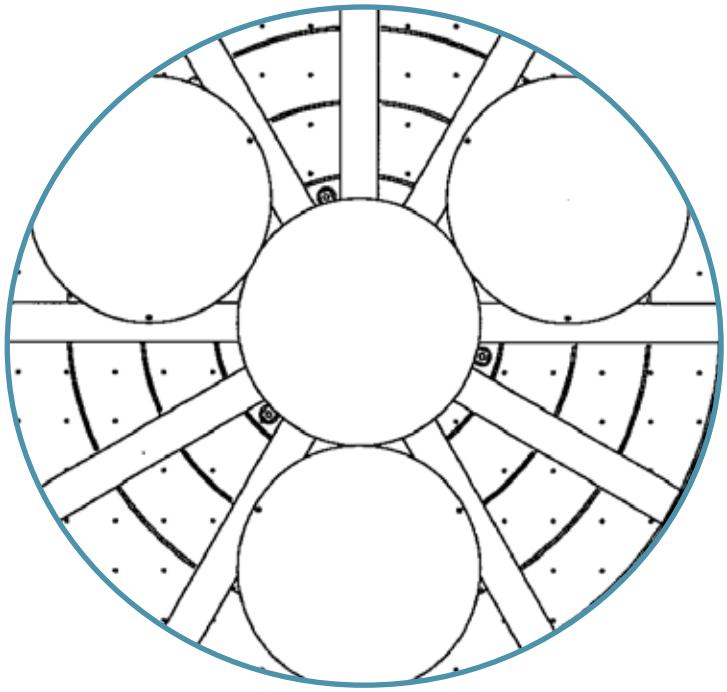
The vibration isolation system includes Fabreeka's Precision Aire™ Leveling PAL Isolators. The isolators are self-leveling, use servo valves to maintain the vacuum chamber's position, and float the payload at its jacking joints. Oftentimes, the servo valves and gas connections are plumbed to exhaust outside the room to prevent contamination. The system also includes a pneumatic control panel, height indicator panel, leveling valves, and several standard safety features to not only make the system reliable but also safe to use during testing. Also, installed sensors provide the height and position of the mass via an electric display.

# Fabreeka's Vibration Isolation System in Use

Fabreeka developed an isolation system to support the development of instruments for NASA's Hubble Space Telescope (shown right) and the Next Generation Space Telescope at the Goddard Space Flight Center.

Due to the size and weight of the thermal vacuum chamber used to test the instruments, it was impossible to isolate the entire chamber externally. Therefore, Fabreeka designed and installed a vibration isolation system inside of the chamber. The vibration isolation system consisted of three isolators (shown left) – each designed to minimize leakage under a vacuum environment.

Another major component of the system was its payload table (sketch shown right) made of stainless steel that could support a maximum weight of 29 thousand pounds. In addition, a counterweight system was used to ensure the stability of the system. Next time you see Hubble's breathtaking photographs of distant stars, galaxies, and planets, maybe you will think of Fabreeka!



Fabreeka designed a vibration isolation system to assist in satellite assembly and testing at the Korean Aerospace Research Institute's Satellite Integration and Test Center.

The purpose of the project was to construct a vibration isolation system that would isolate the optical table inside the Thermal Vacuum Chamber from the environmental vibration. Fabreeka had to meet a vacuum level requirement of less than $10^{-7}$ Torr inside the chamber at ambient temperature.


Before the isolation system was installed, engineers at Fabreeka conducted a prestudy to test the dynamic values of the isolation system such as natural frequencies, damping, and vibration values. In addition to the installation of the isolators on the designated hardpoints (shown middle right) a control panel (shown bottom left) was installed which controls the pressure gage.

# How is Fabreeka's Vibration Isolation System Shaping the Aerospace Industry?

At Fabreeka, we provide customers with the isolation systems they need for the most accurate testing of spacecraft and varying hardware. We have worked with some of the top aerospace manufacturers around, including NASA, in the design of custom isolation systems.

Experts cooperate with Fabreeka and use customized stainless steel PAL isolators for vacuum chamber isolation with a special design to keep air permeation to a minimum so the vacuum chamber can achieve deep vacuum levels. The assembly can be done in a clean-room environment, and isolator components can be baked out to minimize out-gassing.

Prior to installing the vibration isolation system, the isolators are designed and tested in-house by engineers at Fabreeka with an intent to design each isolator to minimize leakage under hard vacuum and high-temperature environments.

Essentially, Fabreeka's isolators create a more stable platform for applications that often include nano-type measurements. This is critical as it ensures external vibrations will not interfere with sensitive measurements.

Engineers at Fabreeka take the time to work with aerospace testing groups on the design of the vibration isolation system based on the required project specifications. From the design review, supervision of installation, and on-site training of the system, Fabreeka will ensure the system is ready for testing.

"Fabreeka has many solutions for isolating test fixtures in vacuum chambers from external vibration. We can isolate the entire vacuum chamber from the floor, or we can isolate the test fixture inside the vacuum chamber with our custom vacuum-compatible isolators. Reach out to learn more about our pneumatic isolation system."

- Luis De Jesus, Engineering Manager/Head of Operations at Fabreeka International

## Fabreeka provides customers with:

An isolation system designed for accurate testing of spacecraft and varying hardware.

A system tailored to required project specifications.

A design review, supervision of installation, and on-site training of the system if requested.

A system that can be trusted. At Fabreeka, our commitment is to do it right the first time, every time.

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