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Vibration Isolator Steadies Optics for Telescopes

Isolators used to control semiconductor manufacturing keep the James Webb Space Telescope steady.

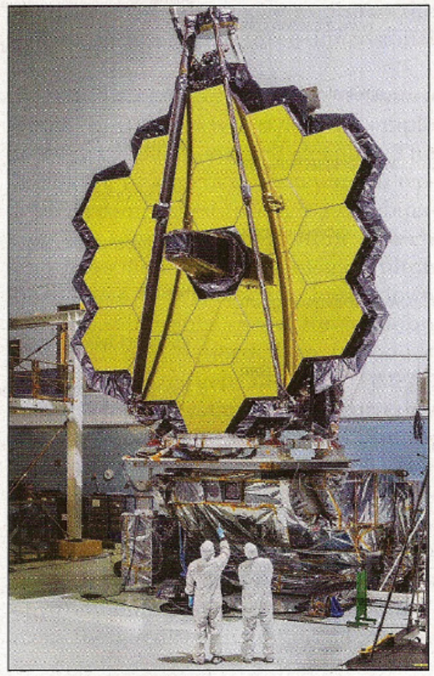
If you've ever tried to hold a camera steady for a long exposure in low light, you know exactly what happens: the camera shakes and the image blurs. The same can happen with images from telescopes or any other long-range image. In fact, for some very sensitive optics, even ordinary ground vibrations can be enough to throw off the results.

That's why NASA often needs a tool called a vibration isolator, according to Serge Dubovitsky, instrument system engineer at Jet Propulsion Laboratory (JPL). These work in a few different ways but essentially create a more stable platform where external vibrations won't interfere with sensitive measurements.

Dubovitsky often works on optics including systems of mirrors for observational missions like telescopes. The mirrors reflect light in different wavelengths, concentrating it into an image that can be analyzed by other instruments. But before these optics are installed, they have to be tested to ensure they perform as intended. "For optics that operate in roughly visible wavelengths," said Dubovitsky, "any motion on the scale of one micron or even much less than that disturbs the image quality."

Optics testing is also often done in a vacuum, with ramifications for vibration isolators. "Vacuum is important in verifying optics because air interferes with light. If you are aiming at space applications, on the ground you need vacuum," Dubovitsky explained. Even when working with optics that will remain on the ground, a vacuum can be helpful for testing.

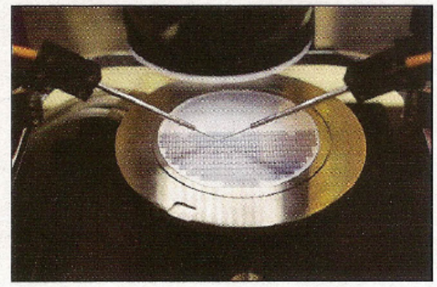
Vacuum creates its own challenges, especially for vibration isolators, which often use air to make the platform "float" and tend to include hoses and bladders made of rubber that can outgas or leak, releasing lightweight molecules that could interfere with the vacuum. Air systems also have to be able to vent exhaust gases without compromising the vacuum. Other systems that use electricity risk overheating because there is no



To ensure the James Webb Space Telescope's instruments get crisp images out in space, Webb has undergone months of tests, some of which required a vibration isolator to hold it extremely steady.

airflow to help dissipate heat. Faced with a project that required an isolator for testing space-ready optics — which requires a fairly high degree of vacuum compared to typical industry standards — JPL turned to Minus K Technology.

NASA had bought several vibration isolators from Minus K over the years including a system for the James Webb Space Telescope of six isolators, specially built to hold up to 10,000 pounds each. That's a larger capacity than Minus K had ever built before and the company believes it is the largest-capacity vibration isolator anywhere for this type of application. "Six of our isolators are now on top of a chamber at Johnson Space Center supporting that project," said engineering director Erik Runge, adding that "now that we have the design, we could adapt it for other customers, too."



For a project with the Jet Propulsion Laboratory, Minus K Technology built a vibration isolator that worked well in a hard vacuum. The company now sells similar models to other customers including to run quality control testing on silicon chips.

The company had to test special greases and parts to find what would work best in a hard vacuum and not outgas. "As a result of some of the things we've learned, we can make all of our vacuum-compatible isolators to work at a higher level of vacuum when needed," Runge said.

Minus K's isolators work so well in vacuums because they are designed differently than many other devices, using no air and no electricity. The isolators work through negative stiffness mechanisms, mounting the platform on springs or flexures to control the net stiffness of an entire system. That enables direct control of the resonant frequency of the system, which is what determines the isolation performance. Minus K's isolators maintain vertical isolation with springs and flexures and they achieve isolation horizontally through a set of columns.

Minus K isolators are used to steady electron microscopes, optical microscopes, and other scientific instruments but the vacuum-compatible isolators are also used to assist quality control in manufacturing semiconductors. Companies have bought the vacuum-compatible isolators for optics and others have not specified the final purpose, in part because many of the applications are related to defense work.

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