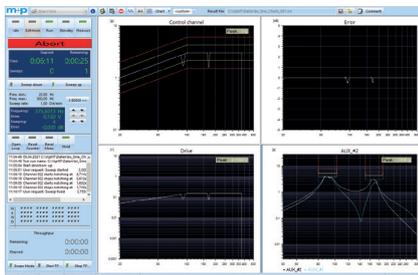
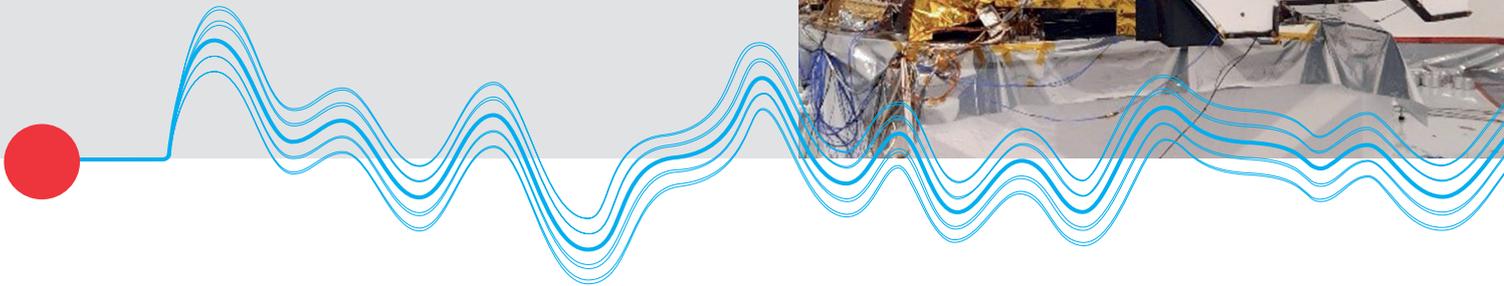


Force Limited Vibration Testing



The importance of vibration testing in qualifying and accepting hardware cannot be overstated. However, and especially with sophisticated aerospace and other high-tech equipment, it is important to implement techniques that prevent vibration over-testing and ensure item safety during qualification.

Vibration over-testing occurs when an object under test is subjected to unrealistically severe and potentially damaging forces at its resonances. To reduce cost by avoiding over-dimensioning and ensure short development times, the most effective solution to mitigate over-testing is force limited vibration testing.



The Challenges

The outputs from force transducers, installed at the fixing points of the unit under test, are used to reduce (notch) the vibration excitation at resonances of the test item/fixture to more closely simulate the real-life environment of the combined system in the flight mounting configuration. Tri-axial force transducers are usually employed and accommodate cross-axis directions of the vibration excitation without the need to change the transducer. The combined output of each transducer is also used to measure the overturning moment.

m+p VibControl software
for efficient force limited vibration control

Force limited vibration testing demands a large number of measurement channels: there may be 4-48 fixing points per component, and each will require three measurement channels for the x, y, z outputs from the force transducers, with additional inputs from accelerometers, etc. Traditionally, the total force per axis is derived by adding the forces on that axis from each force transducer using summing amplifiers.

However, this method is incapable of detecting failed transducers, so the applied force may be under-estimated and the force limit exceeded. In addition, when testing large structures, monitoring the overturning moment requires a measurement of the force vector at each fixing point, which is not possible when directional outputs are combined via external summing amplifiers.

m+p international Solution

These issues have been overcome by m+p international's solution using m+p VibRunner hardware and m+p VibControl software, which have proved highly successful for force limiting vibration control. m+p VibRunner units are designed specifically for noise and vibration engineering applications; self-contained, low-profile units can be combined for high-channel counts with synchronization across all channels.

All communications are via Gigabit Ethernet so that m+p VibRunner units can be located close to the measurement point to minimize transducer cabling. This unique hardware design enables both frequency and time domain data to be displayed simultaneously in real time, even while controlling the vibration system with over 500 channels, any of which can control or 'notch' to the test spectrum.

m+p VibControl software products can be configured to tackle a full range of excitation modes, test control and safeguarding, including notching for sine and random vibration testing, time domain displays, time domain data storage, and support for multiple monitors and remote workstations. The time domain can even be recorded at a higher sample rate from the control, for higher resolution data reduction. Further analysis of the time domain recording can be achieved in the m+p Analyzer software package, which provides the user complete data reduction, processing, and reporting capabilities.



Powerful multi-channel m+p VibRunner acquisition hardware

Instrumentation

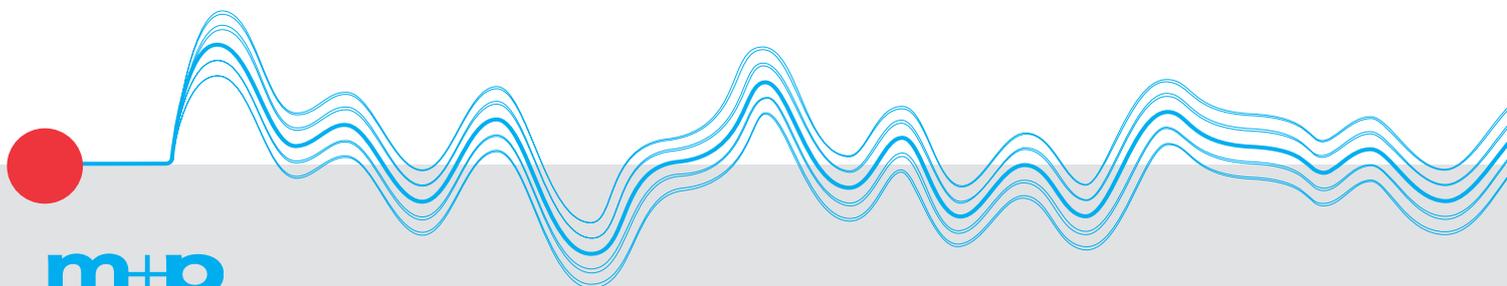
For force limited vibration testing, tri-axial force washers are inserted at the fixture and the correct preload is applied by tightening the fixing bolt. To convert from charge to voltage, the individual outputs are connected to a charge amp, which is fully integrated and configurable from the control software, and then physically connected to a channel on the m+p VibRunner unit.

When connected this way, measurement channels can be displayed in the time or frequency domain to verify that each force washer is working correctly. Each channel has alarm and abort limits set to detect faults or adjust the output to protect the system from over-test. If the m+p VibControl software detects an open force channel, it immediately aborts the test.

The response of every force channel is individually measured and stored while the force sums and moments are calculated by the software and displayed in real time as pseudo-channels. To calculate the overturning moment, measurements of the physical geometry of each transducer from a datum are entered into the software, providing an advantage over traditional systems thanks to its ability to reveal off-axis values. m+p VibControl also allows the facility to import notch profiles from MATLAB or a similar program and fine-tune notch specifications based on prior test runs at lower test levels in order to avoid overshoot of the defined notch limit.

During tests, the system applies a predetermined sine or random vibration excitation to the assembly while the resulting force sum and overturning moment pseudo-channels are compared to a set of user-defined test limits. The output is then limited if the sum of individual forces in the excitation axis, the root sum square of the acceleration vector at each point, or the overturning moment exceed their set limits. Adjusting the output via calculated channels provides a comprehensive method of protecting both the test article and the shaker system from costly repairs in the event of an over-test.

Please contact us to learn more about our force limited vibration testing solutions.



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