

# Shake table testing FAQs

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[Click for info on what to look for in a shake table testing company.](#)

Proving seismic performance in New Zealand can be confusing. There are currently no clear processes to follow. This document answers some common questions around shake table testing.

If your question isn't here, let us know and we'll find the answer!

## What are the NZ Building Code requirements for seismic compliance?

The NZ Building Code is performance-based. The Loadings Standard<sup>1</sup> states:  
*"all parts of structures and their connections...shall be designed for the earthquake actions specified in this Section."*

The Standard for Seismic Performance of Engineering Systems<sup>2</sup> states:  
*"proprietary building services equipment shall meet specified seismic performance criteria."*

For normal buildings, this typically means making sure engineered systems are strong enough to withstand earthquake forces without failing or injuring people. Often, critical services in buildings at Importance Level 4 or higher (see next page for info on Importance Levels) must operate soon after an earthquake. Recently, owners and designers of Importance Level 3 buildings, such as schools, want the same assurance, so life can return to normal as soon as possible.

Shake table testing is one, and in some cases the only, way to prove operational continuity.

## Which products need seismic performance validation?

In buildings rated Importance Level 4 or above, any structural or non-structural elements need to be validated for seismic performance.

Some stakeholders also ask for seismic validation of non-structural elements in Importance Level 3 buildings. The best way to prove seismic performance is with shake table testing.

Example non-structural elements that might need to be tested:

- Critical services that must work during and after a seismic event
- Heating and ventilation <link>
- Fire protection
- Building services
- Communication, IT and electrical systems <link>
- Life support or evacuation systems
- Equipment that contains hazardous substances
- Storage, racking, and free-standing structures
- Systems that support valuable artefacts <link>

We've had experience testing these systems. Let us know if you have specific questions about your system.

### What is the value of shake table testing?

Shake table testing is the best way to get clear evidence of seismic performance.

Test results can help you:

- Design for seismic resilience.
- Test product performance.
- Gain compliance.
- Access new markets.
- Meet criteria for high importance level government, institutional, and commercial contracts.
- Stay ahead of changing standards.
- Increase the value of your products.

### What are Importance Levels (IL) and how do they relate to shake table testing?

A structure's Importance Level (IL) is defined by the New Zealand Building Code Clause A3. Levels range from 1 to 5.

In general, levels are split like this:

- IL1: Farm buildings, fences, etc.
- IL2: Normal buildings like offices and residential houses.
- IL3: Buildings with high occupancy like schools and rest homes.
- IL4: Buildings that are critical immediately after an earthquake or disastrous event, like hospitals.
- IL5: Structures that – if they failed – would pose catastrophic risk to a large area or many people. This includes major dams, etc.

Structures IL4 and above must prove operational continuity. This is to limit downtime so facilities can serve communities soon after a seismic event.

Operational continuity is hard to verify with engineering calculations and analysis alone as they struggle to account for the dynamic nature of earthquakes. Shake table testing is the best way to demonstrate compliance with building codes.

### What are the New Zealand Building Code requirements around shake table testing?

There are currently no NZ Standards that directly cover shake-table testing of engineering systems for seismic qualification. However, NZ Standards such as NZS 4219, cite testing as a valid approach to demonstrating seismic compliance.

Commentary C2.4 of NZS 4219 says overseas standards can be used as long as the design actions are equal to or greater than NZ Standards. We follow the shake table testing procedure from US Standard ICC-AC156, but with loads derived as per NZ Standards. We test to varying levels of earthquake accelerations to demonstrate operational continuity and ultimate/life safety performance.

### What is industry best practice for shake table testing?

Engineered systems often need to be tested to project-specific acceleration demands. These can vary with site location, structure type, proximity to active faults, and relative height of components in the building. They are often specified by the structural engineer.

To get the most value from testing, we encourage clients to test to the maximum possible accelerations required by the code. This will allow your components to be installed in a wider range of buildings without further testing.

After testing, you should do operational checks to make sure the system still performs as it should. This is also a chance to find out which parts are vulnerable so you can keep spares on hand.

A successful shake table test does not mean there is no risk of failure. In the real-world, there will be differences in assembly, adjacent plant or structure, product quality, and the nature of the earthquake. Even so, shake table testing gives a higher level of confidence than engineering calculations and simulations alone.

Testing must be done by an independent laboratory in accordance with NZS 4219 Section 4, or other suitable recognised standard<sup>3</sup>.

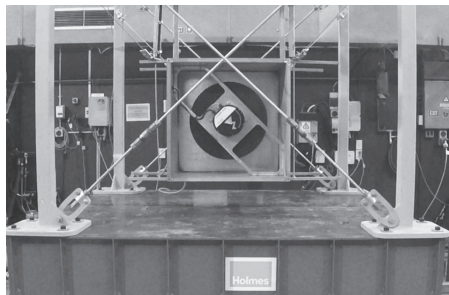
### What happens if a product fails shake table testing?

To reduce the chance of failure, we can work with you to identify possible structural weaknesses prior to testing.

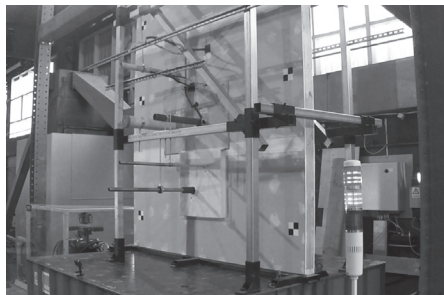
If a product does fail, our team of engineers can work with you to discover why and find a solution.

## What is a shake table and how does it work?

A shake table is a test apparatus designed to simulate the demands of an earthquake event on to a test specimen (product or components). It is hydraulically powered with specialised controls and instruments to closely observe the acceleration demands being created.



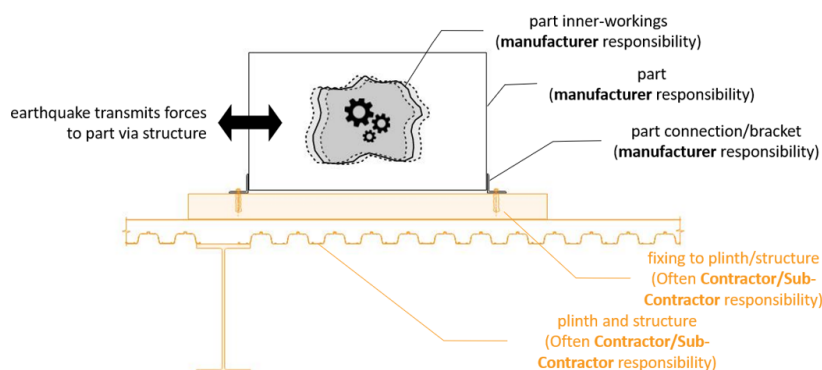
Air unit suspended on shake table



Passive fire protection devices in plasterboard on shake table

A series of universal rigid fixtures are adapted to the products and components for testing. Testing can be undertaken on wall, floor and ceiling mounted details.

Specimens are fixed to the table using anchors, either as specified in their design/ installation instructions, or specifically designed by a seismic restraint engineer.



At Holmes Solutions, we have two shake tables – horizontal and vertical. They are both 2.5m x 2.5m square, and can handle samples up to 5m long and 3000kg in mass. Depending on the mass and centre of gravity, the shake tables can achieve the maximum required accelerations as specified in AS/NZS1170.5 part 8 of 3.6G (horizontal), and 2.5G (vertical).

## Why does it matter how the equipment is supported or fixed?

For a shake table test, it is important that anchors match as close as possible to the installation design. This helps replicate the actual stressed areas and load paths. For example, if the sample on the shake table had six floor fixings and the final install only four, test results may not be valid.

Because use-cases vary, you'll need installation specific design to confirm bolt/ anchor specifications for each project.

## What does the client provide?

All we need from you is:

- the product to test.
- details of how the product should be fixed to the shake table. We can help with this.
- details of operational checks you need during/after testing.
- the acceleration and performance demands you are targeting.

If you're unsure what your performance demands are, we can give you questions to ask your project partners. We can also interpret the answers.

## How many shake table tests are in a programme?

If your product is one-off (not part of a product line), you only need to test that product. One test on each axis (X,Y, Z) to the performance demands you are targeting.

If your product is part of a product line (with similar structural configurations and internal components), you may need to test a range of different configurations and different components to ensure coverage across your range. Interpolation of results within product ranges is commonly accepted.

We can work with you to find the best way to do this.

## How do I apply the results?

Test results are summarised in a report that can be used to demonstrate that your product meets specifications and the Building Code. Results and footage can also be used in marketing material.

## We'd love to help!

For more info about shake table testing, please get in touch.  
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