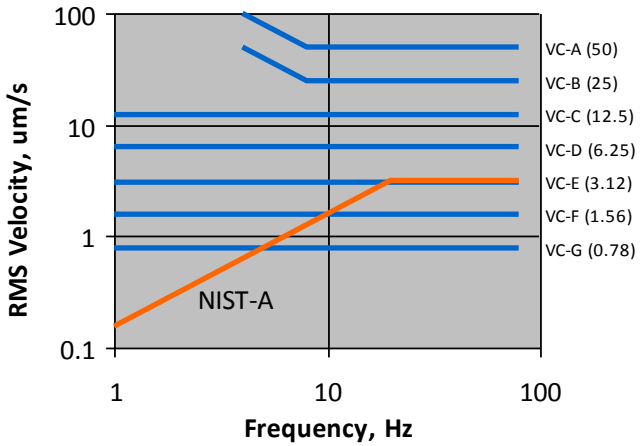
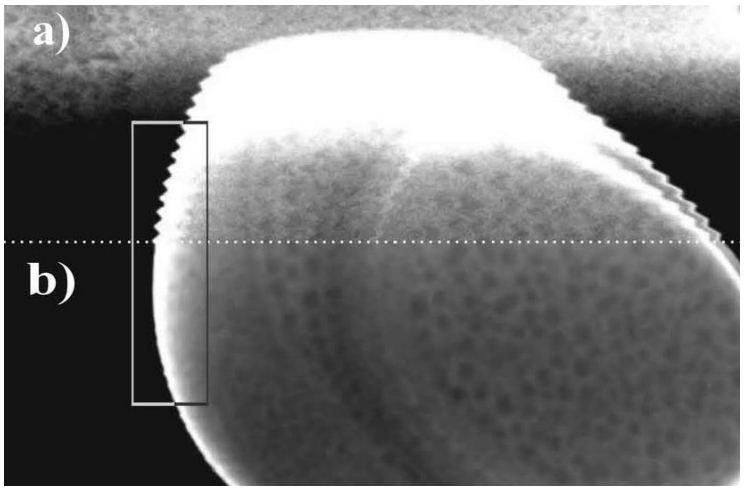


Traditionally, the VC-E curve at 3.12µm/s (125 µin/s) was considered to be the lower limit of achievable criteria. However, R&D environments at ground level can be much "quieter" than industrial production spaces. Two new curves called VC-F (60 µin/s) and VC-G (30 µin/s) were adopted by IEST in 2007 specifically to address R&D environments, especially for nanoscale research. Additionally, the NIST-A and NIST-A1 criteria are being used in nanotech labs at universities and government research centers.

High-quality vibration and noise environments are necessary for nanoscale imaging and manipulation tools. Figure (b) shows a pristine SEM image, while (a) shows the same image degraded by vibration. Off-the-shelf tools requiring VC-F/G environments include electron microscopes from FEI, JEOL, and Philips, while one-of-a-kind tools, such as hand-built STMs, require even tighter vibration standards. Cutting edge research requires the next generation of precision, and in general, all imaging instruments perform *better* in quieter settings.



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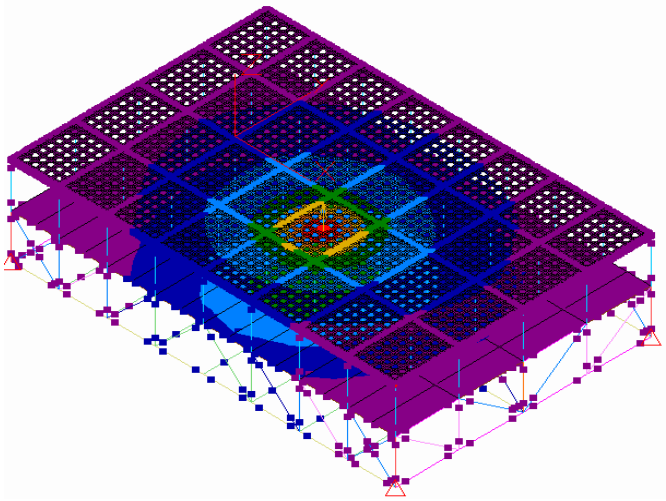
Some processes are only modestly sensitive to vibration and can be accommodated on specially-designed upper floors; however, the most demanding criteria in nanotech labs are relevant only at grade-level floors. In some cases a floating structure might be considered, but this creates significant additional expense. The existing site ambient condition, structural design, and mechanical systems all contribute to the vibration environment. In the best-case, the ambient condition limits performance.

The ambient condition and structural dynamic parameters can be tested directly in existing structures. Supplemental modeling can reveal the possibilities of an existing structure, or can be used to validate new structures or retrofits. One non-obvious difference between typical constructions and nanotech labs is the intense scrutiny required of rotating mechanical systems. These generate significant vibration and noise and must be balanced and isolated to a higher standard.



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Recent Projects : Industrial, university, and institutional nanotechnology labs with vibration & noise design by VACC.

- **Los Alamos National Lab** – *Center for Integrated Nanotechnologies*, CINT (2006): "Gateway Facility" for nanomaterials research, including microscopy suites.
- **Micron Technologies** – *Nanofab, Boise* (2007): Lithography mask house, with suites for industrial production-level e-beam lithography.
- **Pacific Northwest National Lab** – *Physical Sciences Complex* (2008): Five-building materials characterization laboratory, including cleanrooms and SEM/TEM suites.
- **Northwestern University** – *Tech Building Infills* (2008): Multiple infill spaces for multidisciplinary nanotech labs with FIB, SEM, NMR, & e-Beam Litho.
- **University of Washington** – *Molecular Engineering Building* (2009): New $78M building to consolidate interdepartmental nanotech lab facilities.
- **University of South Florida** – *Interdisciplinary Science Building* (2009): New $68M nanotech / life sciences research facility, including teaching labs and auditoria.