ACTIVE VIBRATION ISOLATION SYSTEM
CASE STUDY

Delivered by Sungkuk Kim

Work Completed, Feb 14, 2019

Contents

1. Measurement Details

- **Measurement Date**

February 11, 2019

- **Measurement Devices**

1. LAN-XI Data Acquisition Hardware
    - Brüel & Kjær 3050-A-040 (Serial Number: 3050-111438)
2. Data Analysis Software
    - Brüel & Kjær PULSE LAB SHOP 22
3. Sensors
    - PCB Accelerometer
    - Model: 393B05 (Serial Number: 48995, 40626)

- **Measurement Location**

4th Floor

- **Measurement Setup**

Bandwidth: 0 – 100 Hz

Lines: 400

Window: Hanning

Averaging: Fast Fourier Transform Spectrum Averaging

Amplitude Units: m/s2

Spectral Unit: RMS

2. Equipment Information

- **Manufacturer**

  FEI

- **Model**

  SEM INSPECT S50

- **Floor Vibration Specification**

  VC-E in Vertical and Horizontal Axis

3. Vibration Isolation System Information

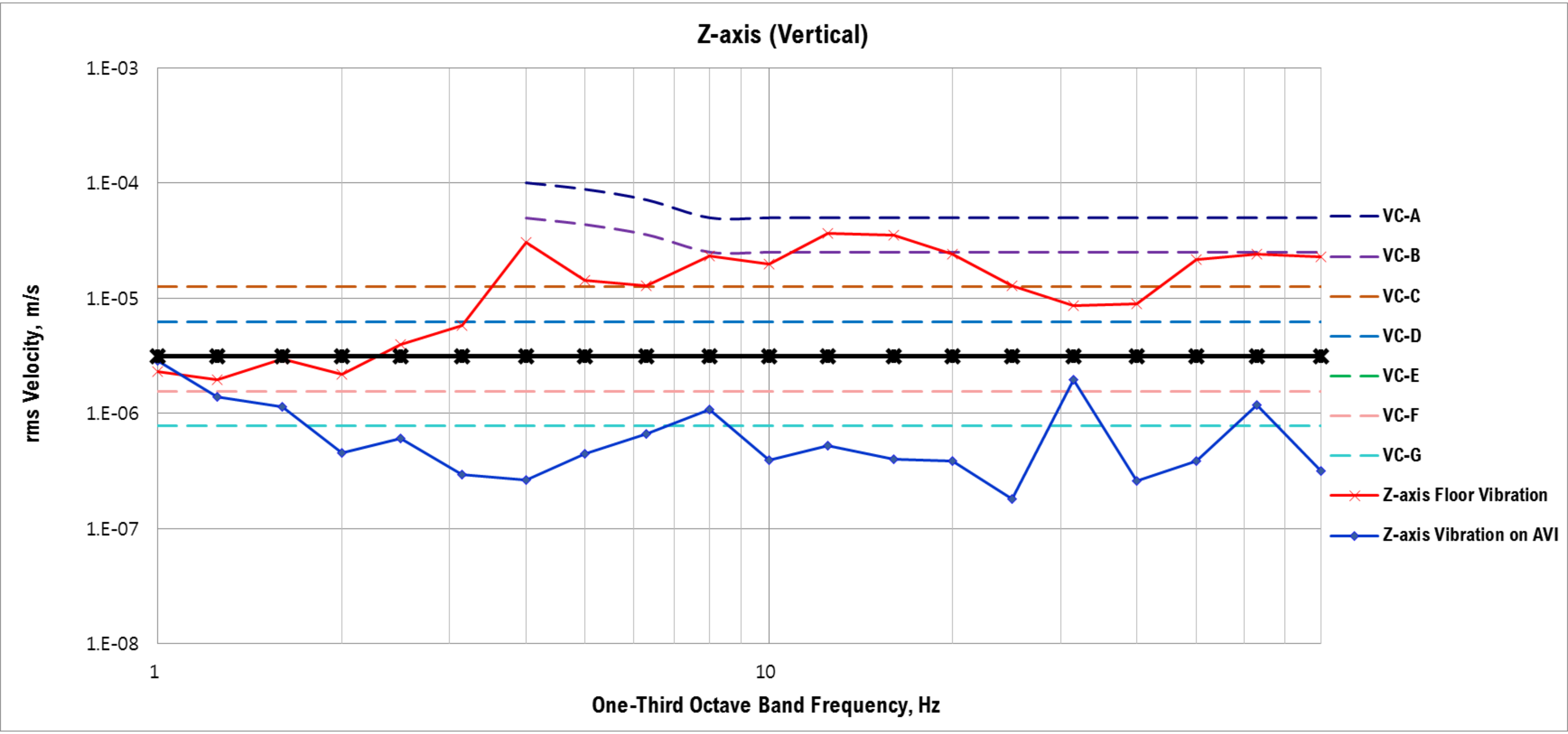
Model: DVIA-MB1000

Model		DVIA-MB1000	DVIA-MB3000	DVIA-MB6000
Platform Dimensions (L x W x H)		Custom-made		
Load Capacity		500 - 1700 kg	1500 - 3500 kg	3000 - 6000 kg
Actuator		Electromagnetic Actuator		
Maximum Actuator Force		Vertical: 40 N, Horizontal: 20 N		Vertical: 80 N, Horizontal: 40 N
Degrees of Freedom		6 degrees		
Active Isolation Range		0.5 - 100 Hz		
Vibration Isolation at 1 Hz		≥90%		
Input Voltage (V)		AC100 - 240V / 50 - 60 Hz / 1A		
Power Consumption (W)		Maximum 110W, <50 W in normal operation		
Operating Range	Temperature (°C)	5 - 50 °C		
	Humidity (%)	20 - 90%		
Required Air Pressure		≥ 0.5 MPa (≥ 5 bar)		

4. Summary

Floor Vibration Specification			
Frequency Range	1 - 80 Hz		
Floor Vibration Specification	VC-E	VC-E	VC-E
Measurement Direction	Z-axis (Vertical)	X-axis (Left to Right)	Y-axis (Front to Back)
Floor Vibration	Fail	Fail	Fail
Vibration On Active Vibration Isolation System	Pass	Pass	Pass

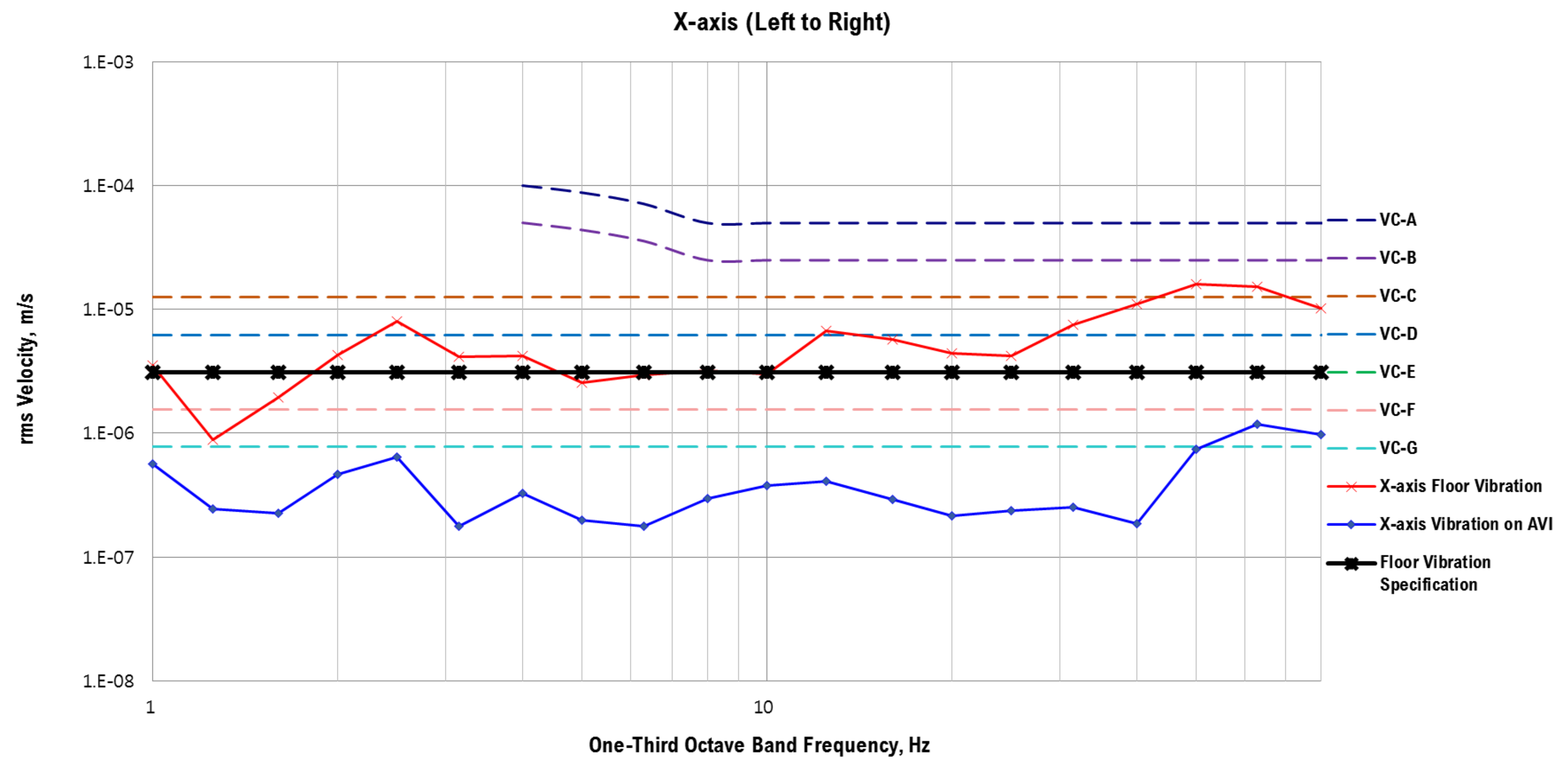
5. Results – VC Curves, Z-axis (Vertical)



AVI = Active Vibration Isolation

The measured vertical floor vibration did not meet the vibration specification VC-E.
The active vibration isolation system reduced the vertical floor vibration from VC-A to VC-E.

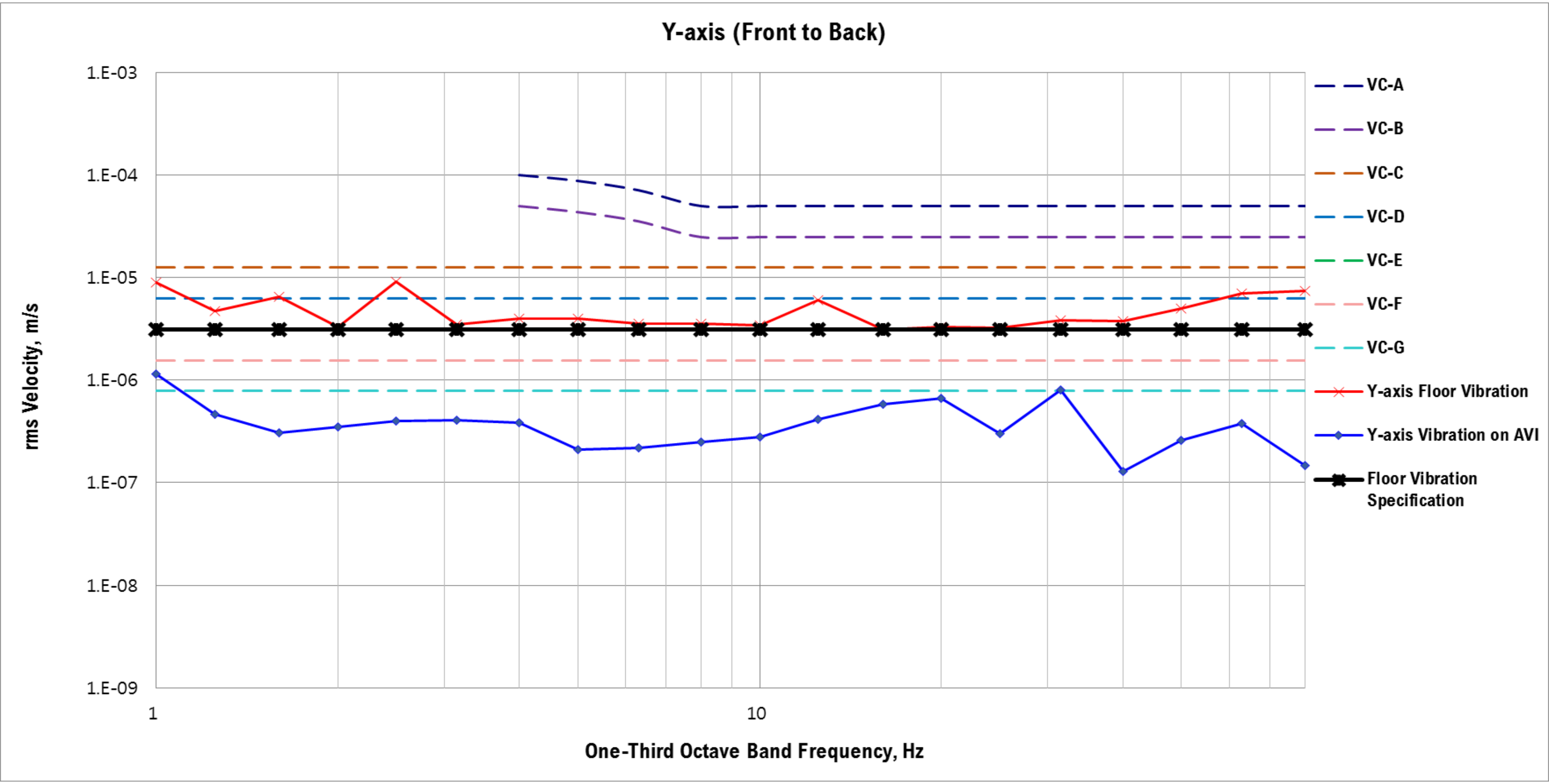
5. Results – VC Curves, X-axis (Left to Right)



AVI = Active Vibration Isolation

The measured X-axis floor vibration did not meet the floor vibration specification VC-B.
The active vibration isolation system reduced the X-axis floor vibration from VC-B to VC-F.

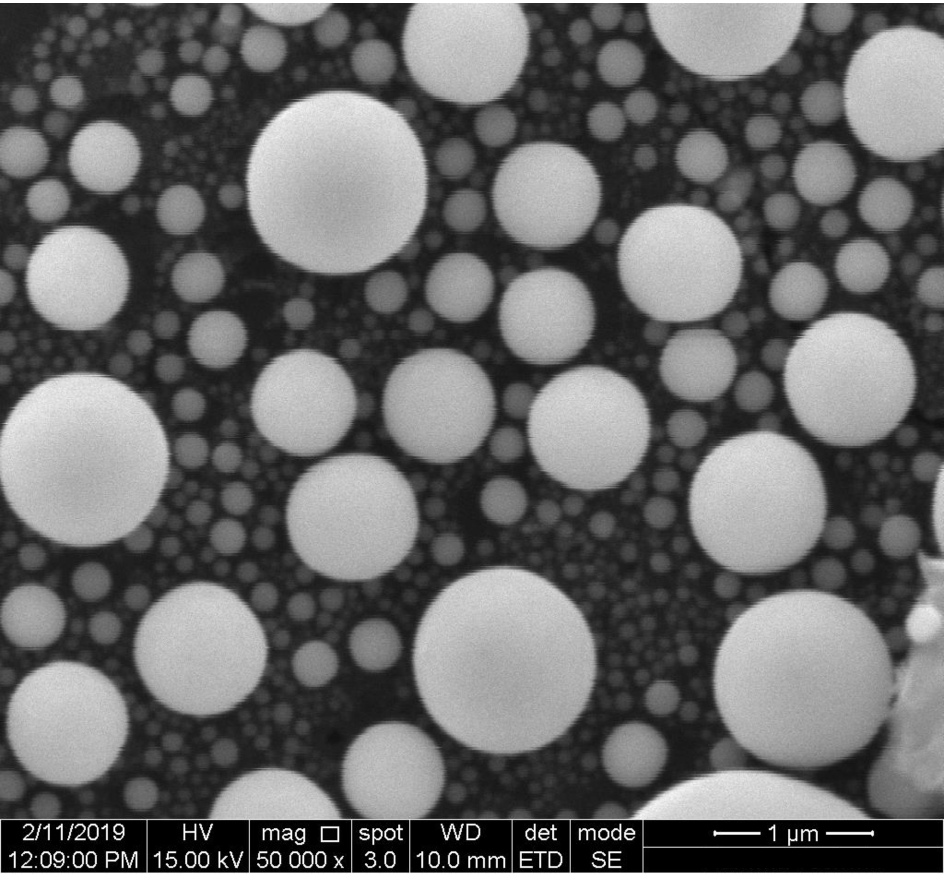
5. Results – VC Curves, Y-axis (Front to Back)



AVI = Active Vibration Isolation

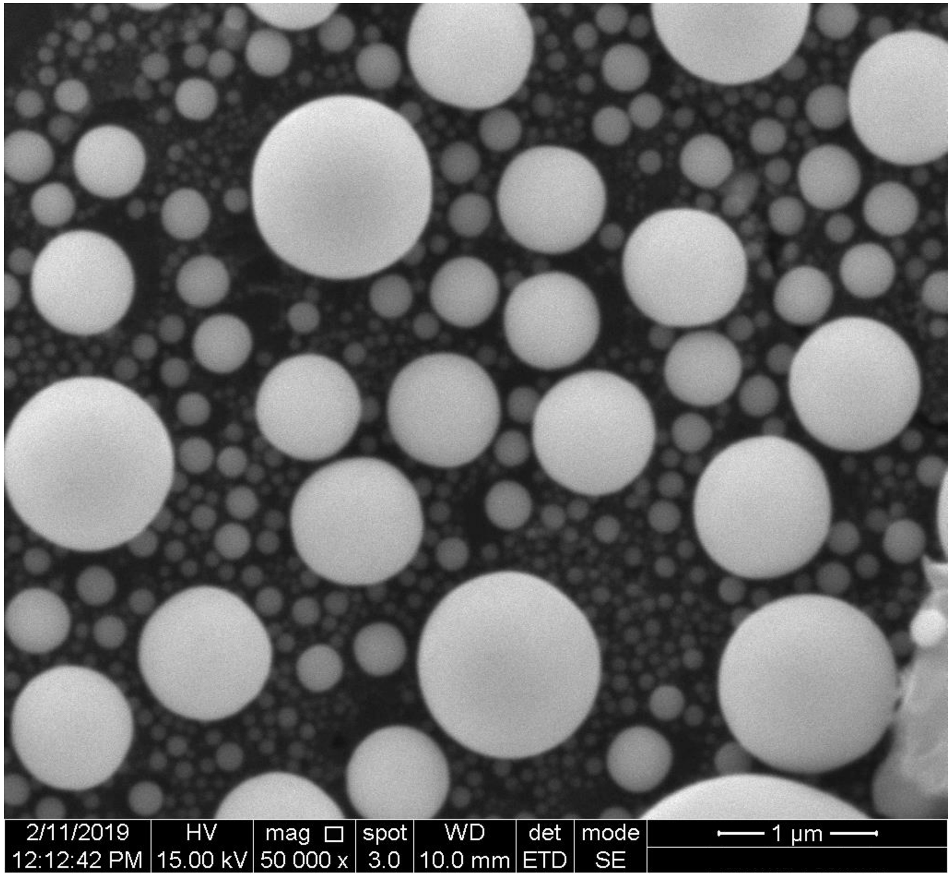
The measured Y-axis floor vibration did not meet the floor vibration specification VC-C.
The active vibration isolation system reduced the Y-axis floor vibration from VC-C to VC-G.

6. Results – Active Off vs Active On



Active Vibration Isolation Off

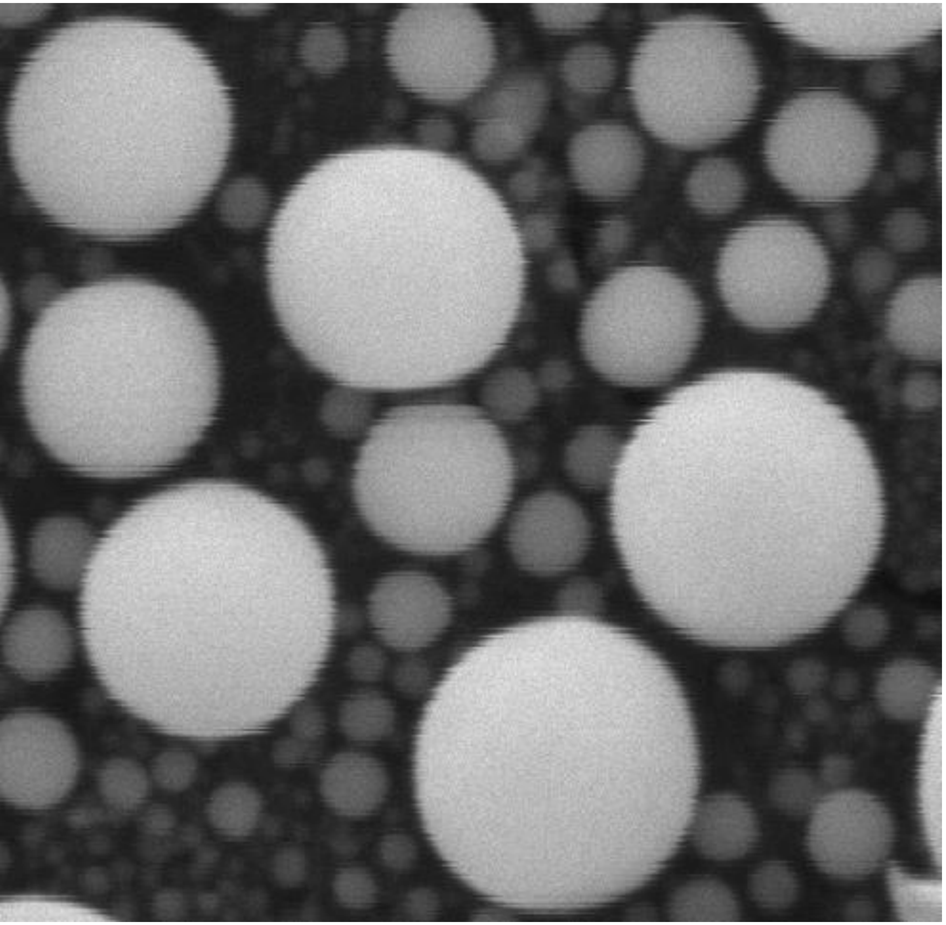
HV:15.00 kV
Mag: 50 000 x
Linewidth: 1 µm



Active Vibration Isolation On

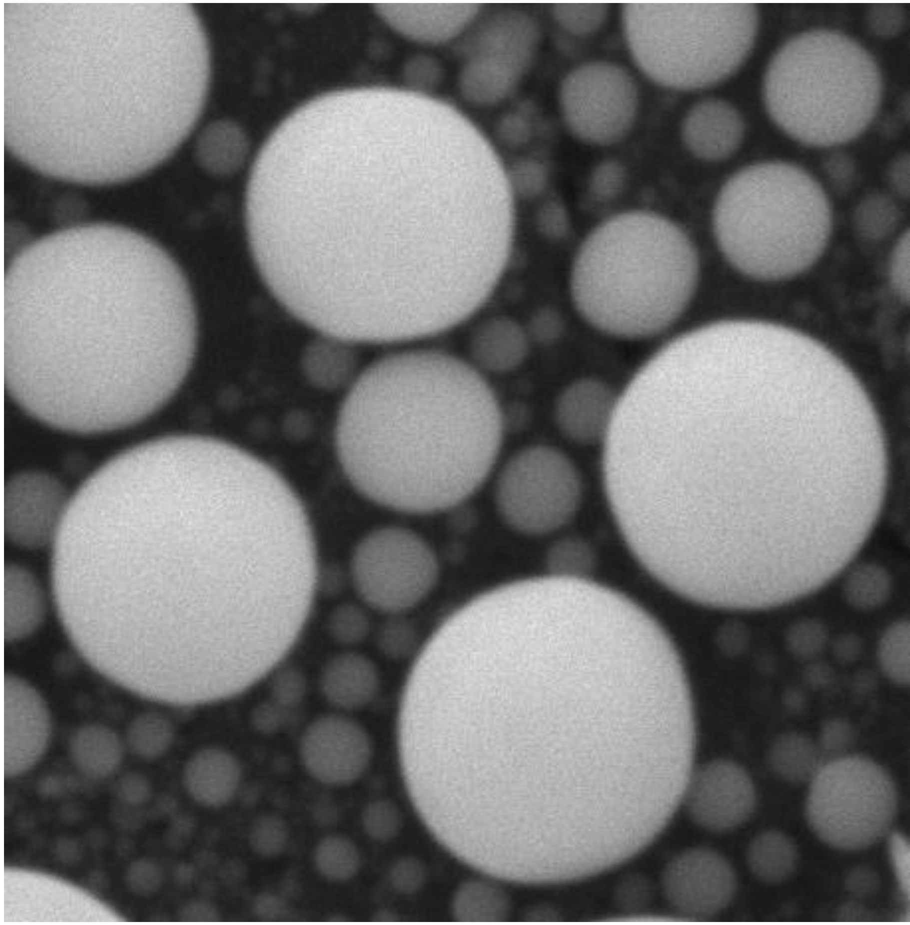
HV:15.00 kV
Mag: 50 000 x
Linewidth: 1 µm

6. Results – Active Off vs Active On



Active Vibration Isolation Off

HV:15.00 kV
Mag: 50 000 x
Linewidth: 1 µm



Active Vibration Isolation On

HV:15.00 kV
Mag: 50 000 x
Linewidth: 1 µm

7. Reference

Generic Vibration Criteria

Criterion Curve	Description	Amplitude1) µm/s (in/s)	Detail Size2) µm
Workshop (ISO)	Distinctly perceptible vibration. Appropriate to workshops and non–sensitive areas.	800 (32,000)	N/A
Office (ISO)	Perceptible vibration. Appropriate to offices and non–sensitive areas.	400 (16,000)	N/A
Residential Area (ISO)	Barely perceptible vibration. Appropriate to sleep areas in most instances. Usually adequate for computer equipment, hospital recovery rooms, semiconductor probe test equipment, and microscopes less than 40x.	200 (8,000)	75
Operating Theatre (ISO)	Vibration not perceptible. Suitable in most instances for surgical suites, microscopes to 100x and for other equipment of low sensitivity.	100 (4,000)	25
VC–A	Adequate in most instances for optical microscopes to 400x, microbalances, optical balances, proximity and projection aligners, etc.	50 (2,000)	8
VC–B	Appropriate for inspection and lithography equipment (including steppers) to 3µm line widths.	25 (1,000)	3
VC–C	Appropriate standard for optical microscopes to 1000x, lithography and inspection equipment (including moderately sensitive electron microscopes) to 1µm detail size, TFT–LCD stepper/scanner processes.	12.5 (500)	1 – 3
VC–D	Suitable in most instances for demanding equipment, including many electron microscopes (SEMs and TEMs) and E–Beam systems.	6.25 (250)	0.1 – 0.3
VC–E	A challenging criterion to achieve. Assumed to be adequate for the most demanding of sensitive systems including long path, laser–based, small target systems, E–Beam lithography systems working at nanometer scales, and other systems requiring extraordinary dynamic stability.	3.12 (125)	<0.1
VC–F	Appropriate for extremely quite research spaces; generally difficult to achieve in most instances, especially cleanrooms. Not recommended for use as a design criterion, only for evaluation.	1.56 (62.5)	N/A
VC–G	Appropriate for extremely quite research spaces; generally difficult to achieve in most instances, especially cleanrooms. Not recommended for use as a design criterion, only for evaluation.	0.78 (31.3)	N/A

1. As measured in one–third octave bands of frequency over the frequency 8 to 80 Hz (VC–A and VC–B) or 1 to 80 Hz (VC–C through VC–G).
2. The detail size refers to line width in the case of microelectronics fabrication, the particle (cell) size in the case of medical and pharmaceutical research, etc. It is not relevant to imaging associated with probe technologies, AFMs, and nanotechnology.

The information given in this table is for guidance only. In most instances, it is recommended that the advice of someone knowledgeable about applications and vibration requirements of the equipment and processes be sought.