

# **ACTIVE VIBRATION ISOLATION SYSTEM INSTALLATION REPORT**

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# 1. Measurement Details

- **Measurement Date**

September 5, 2017

- **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 Setup**

Bandwidth: 0 – 100 Hz

Lines: 400

Window: Hanning

Averaging: Fast Fourier Transform Spectrum Averaging

Amplitude Units: m/s<sup>2</sup>

Spectral Unit: RMS

- **Measurement Location**

1<sup>st</sup> Floor

## 2. Equipment Information

- **Manufacturer**

FEI

- **Model**

APREO

- **Floor Vibration Specification**

Disturbances due to vibrations and acoustics play a significant role. Vibration levels can be limited by proper building design in combination with vibration isolated platforms. The floor vibrations are defined by the vibration criterion (VC) curves, by Ungar and Gordon. VC levels are defined as rms speed values, integrated over one third octave bands. The VC-curves are to be used as guidelines only, the final room behavior with regard to vibrations will be determined during a site survey performed by trained FEI personnel using FEI's Site Evaluation Tool. Depending the purpose of the microscope, time constant is involved in the vibration characteristics. VC Curves Guidelines provided by the VC-curves can be interpreted as described below. The table lists applicable VC-curves for certain direction and system. In general VC-F should be achieved.

### 3. Vibration Isolation System Information

**Model: DVIA-MB1000**



Platform Dimensions	1140 x 910 x 224 mm	
Load Capacity	500 - 1700 kg	
Actuator	Electromagnetic Actuator	
Maximum Actuator Force	Vertical: 40N, Horizontal: 20 N	
Degrees of Freedom	6 degrees	
Active Isolation Range	0.5 - 100 Hz	
Vibration Isolation at 2 Hz	≥90%	
Vibration Isolation at 10 Hz	≥99%	
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)	

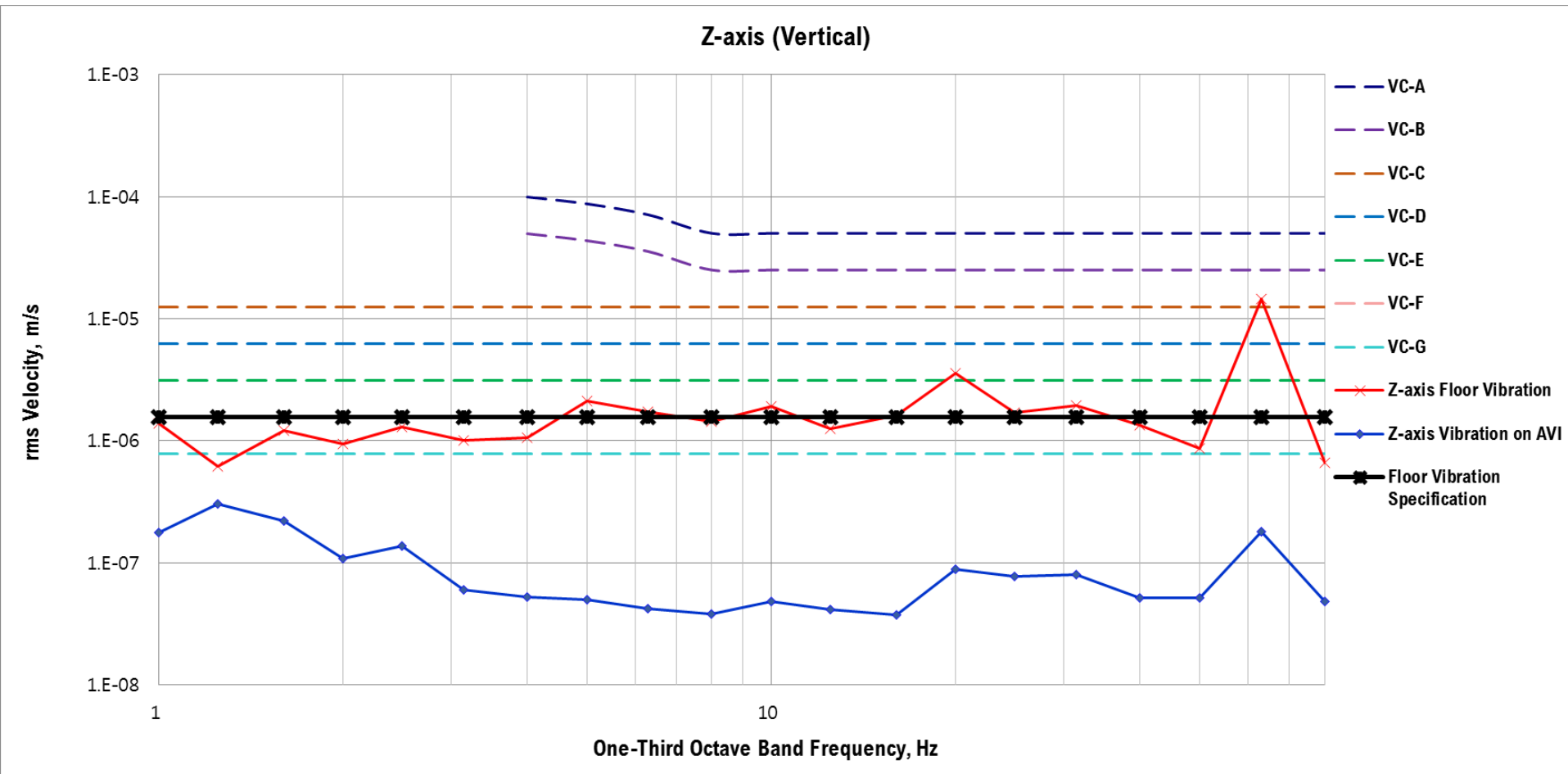
## 4. Installation Photos



## 5. Summary

Floor Vibration Specification			
Frequency Range	1 - 80 Hz		
Floor Vibration Specification	VC-F		
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

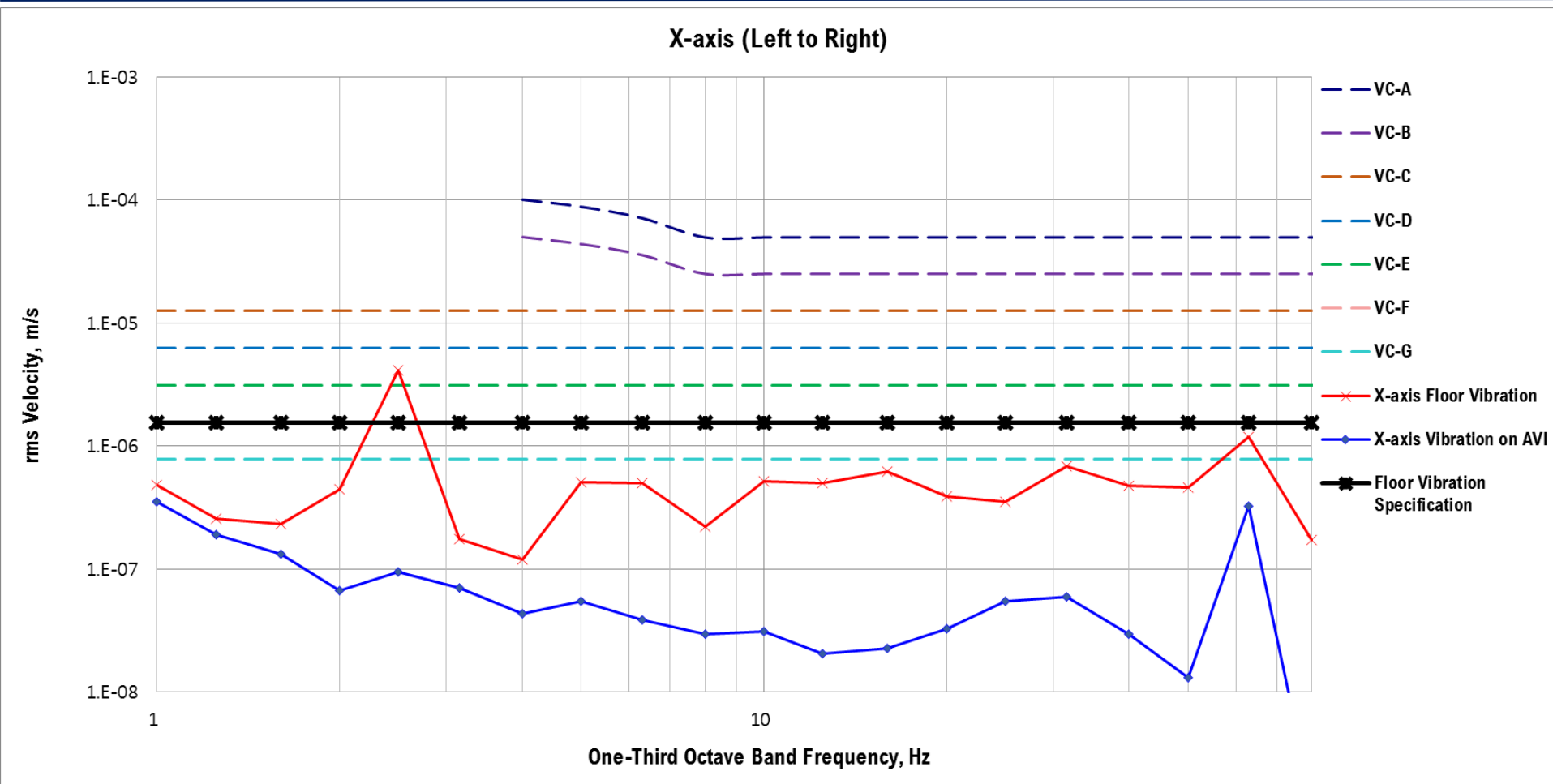
## 6. Results – Z-axis (Vertical)



The measured vertical floor vibration exceeded the floor vibration specification at 5 Hz, 10 Hz, 20 Hz to 80 Hz. The active vibration isolation system reduced the vertical floor vibration from VC-C to VC-G.

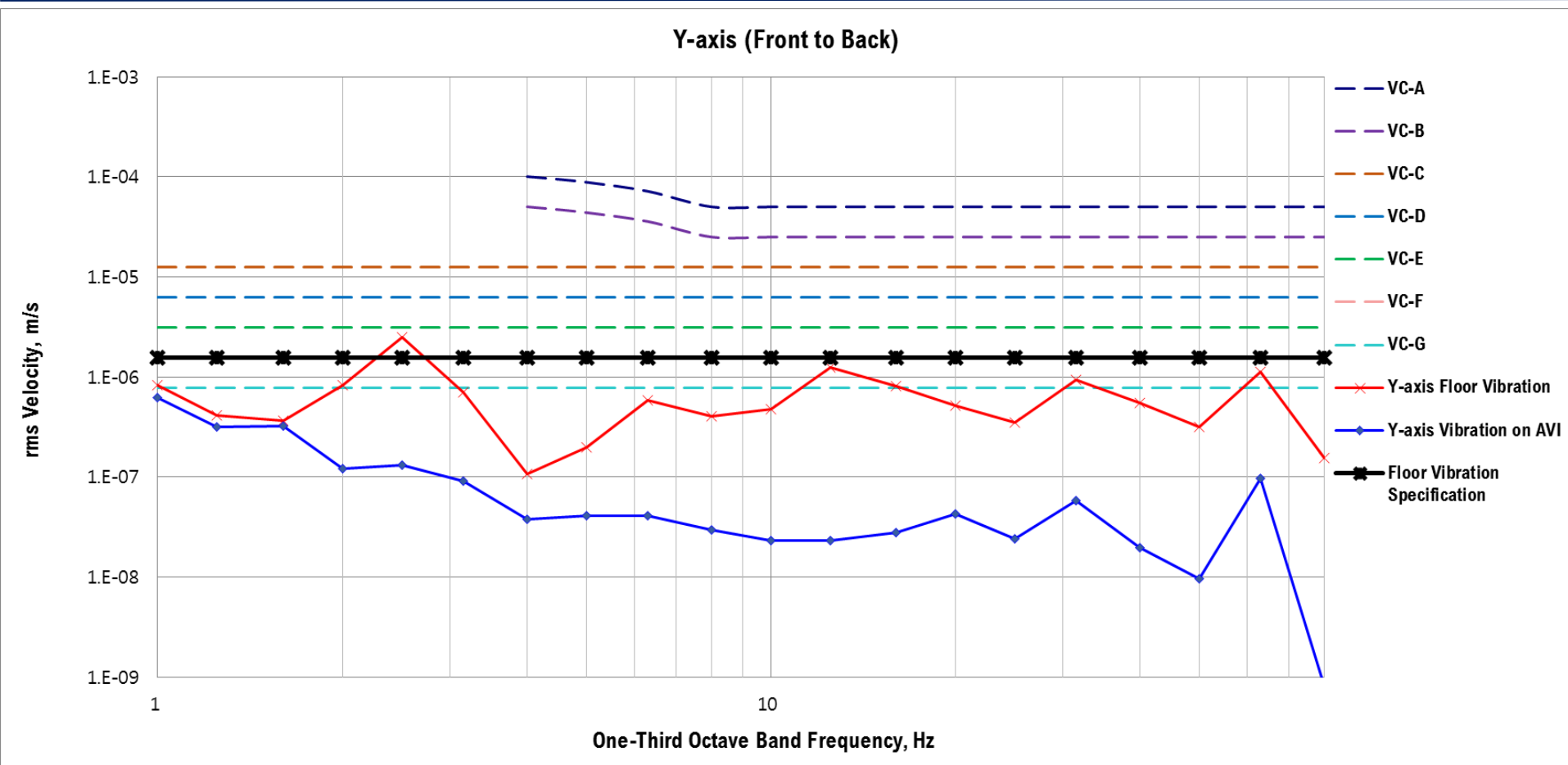


## 6. Results – X-axis (Left to Right)



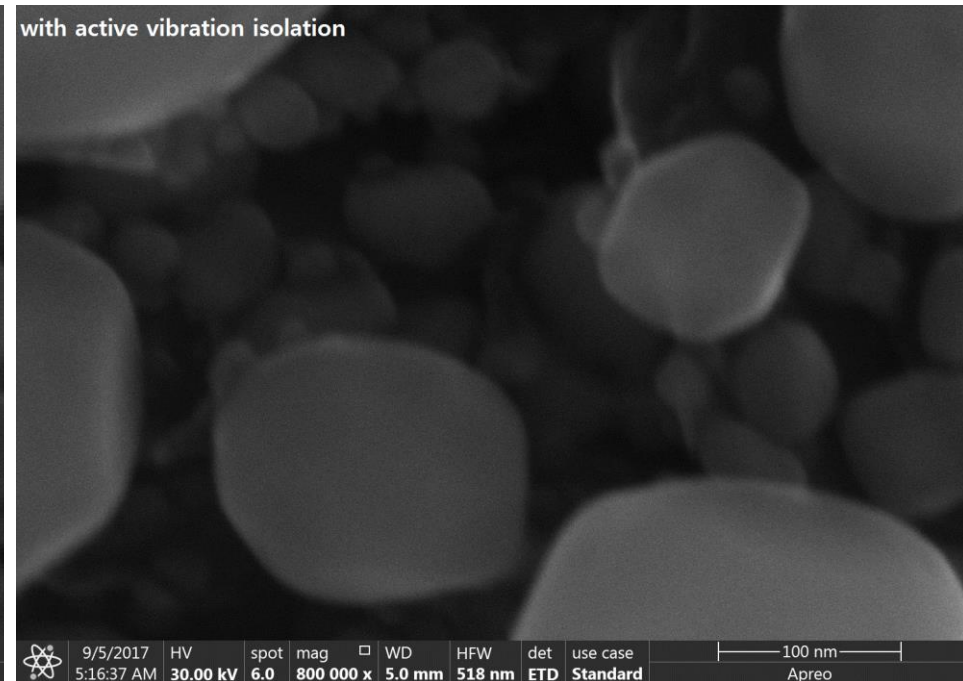
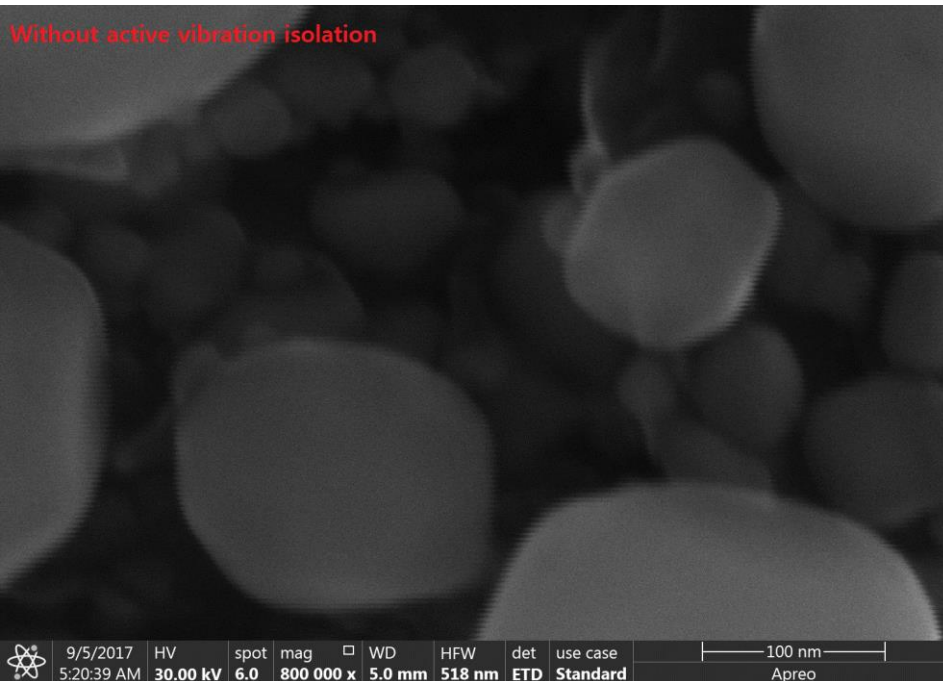
The measured X-axis floor vibration exceeded the floor vibration specification at 2.5 Hz.  
 The active vibration isolation system reduced the X-axis floor vibration from VC-D to VC-G.

## 6. Results – Y-axis (Front to Back)



The measured Y-axis floor vibration exceeded the floor vibration specification at 2.5 Hz.  
 The active vibration isolation system reduced the Y-axis floor vibration from VC-E to VC-G.

## 7. Results – Vibration Isolation Effects on Imaging



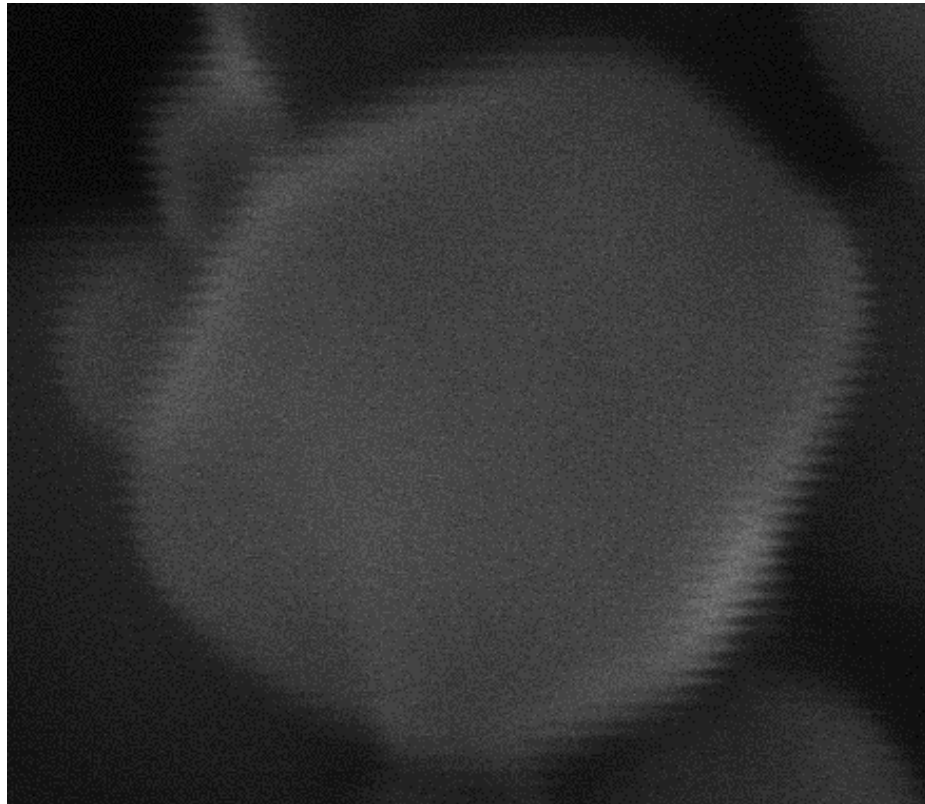
**Active Vibration Isolation Off**

**HV:30.00 kV  
Mag: 800 000 x  
Linewidth: 100 nm**

**Active Vibration Isolation On**

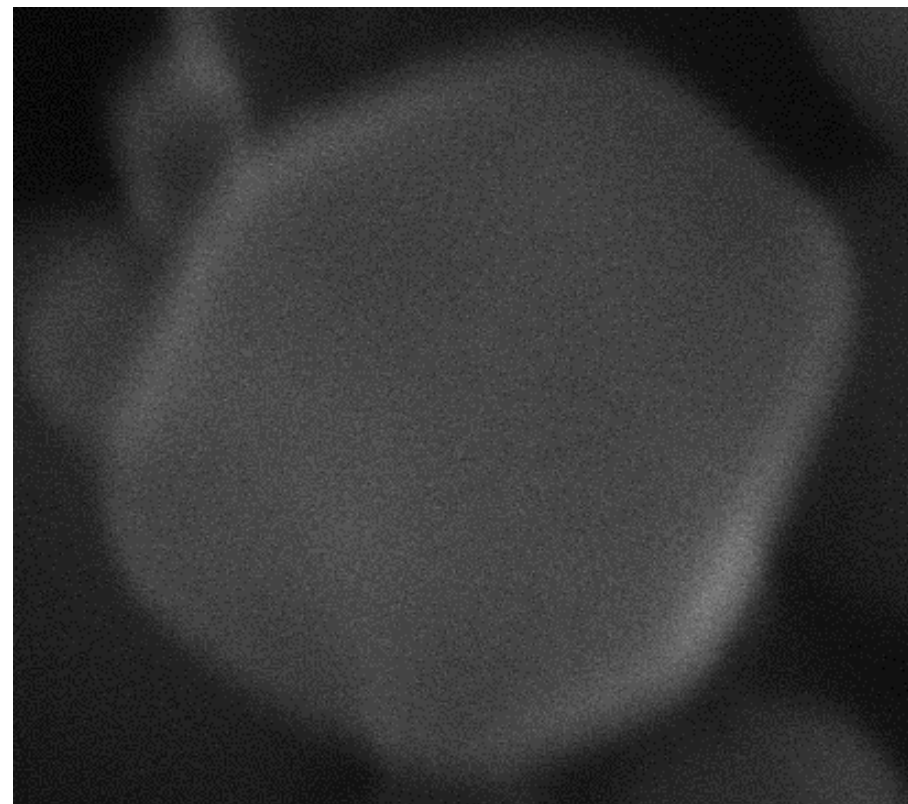
**HV:30.00 kV  
Mag: 800 000 x  
Linewidth: 100 nm**

## 7. Results – Vibration Isolation Effects on Imaging



Active Vibration Isolation **Off**

HV:30.00 kV  
Mag: 800 000 x  
Linewidth: 100 nm



Active Vibration Isolation **On**

HV:30.00 kV  
Mag: 800 000 x  
Linewidth: 100 nm

## 8. Reference

### Generic Vibration Criteria

Criterion Curve	Description	Amplitude <sup>1)</sup> μm/s ( in/s)	Detail Size <sup>2)</sup> 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 quiet 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 quiet 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.