15 Centennial Drive, Peabody, MA 01960 USA
978-532-6330 • 800-542-9725 (Toll Free)
Fax: 978-531-8682
E-mail: sales@techmfg.com
www.techmfg.com

Environmental Site Survey

Customer:	**xxxxxx**
Date of report:	**June 6, 2018**
PO Number:	**xxxxx**
Site of Survey:	**Address**
Room:	**xxxx**
Tool:	**xxxx**
Date of survey:	**March 28, 2018**
Performed by:	**Roland Erni, TMC**
Report by:	**Roland Erni, TMC**
References:	**xxxxx**
Summary:	**Vibration – Passes specification** **AC Magnetic Fields – Passes specification** **Varying DC Fields –Fails specification** **Acoustics –Fails specification**

Table of Contents

1. Background

Customer xyz requested TMC to perform an environmental site survey in room 16 at the xxx building. This site is being considered for the installation of a xxx Scanning Electron Microscope.
TMC measured the floor vibration, AC and varying DC magnetic fields and acoustics to determine site suitability per manufacturer environmental specifications. The data is included in the Appendix.

2. Instrumentation

Spectrum Analyzer
FFT Spectrum analysis performed with Data Physics Quattro DP240 with Signal Calc, 3-Channel 32 bit floating-point DSPs with up to 204.8 kHz sample rate. Inputs are coupled to dedicated 24 bit sigma-delta ADCs while both outputs have 24 bit DACs. Integral anti-aliasing filters protect the inputs and outputs.120 dB dynamic range with up to 94 kHz real-time.

Vibration Measurement
Wilcoxon Research 731A accelerometer with external Amplifier P31 (three)

EMI Measurement
Bartington 3-Axis Magnetic Field (flux-gate type) Sensor Mag-03IE70v1

Acoustic Measurement
Earthworks M30BX Microphone

3. Methodology and Data Analysis

Vibration accelerometers were placed on the floor outside of room 16 for independent X, Y, and Z measurements. Data in the room could not be captured due to carpeting in room 16. We believe that the vibration data outside of the room is very similar to the floor inside the room. Data is presented in m/s rms per 1/3 Octave for direct comparison to the specification which is a standard VC criteria.

Magnetic Field Sensors for X, Y, and Z were mounted in a machined block for orthogonal configuration, mounted to a tripod and positioned at the proposed installation location approximately four feet above the floor.

Acoustics were measured in the middle of the room at roughly 4 feet above the floor. Amplitudes are presented in 1/3 octave and narrowband.

Setup parameters are included in the Appendix with the data. All data was saved to the laptop for later analysis and reporting. Data was recorded between the hours of 11:30am to 12:30pm. All data represents a snapshot in time of the environment and can be considered as typical for this time of day, however levels can increase or decrease over time, or at different times of day, due to changes in the environment resulting from operation of neighboring equipment, facility maturity, construction, street and foot traffic, railway activity, air handling equipment, and other factors and activity.

4. Conclusions

The vibration data indicates the measurement location passing specification in all directions and frequencies.

Magnetic Field measurements indicate the AC fields passing specification in all directions and frequencies.

DC Magnetic field fluctuation measurements indicate the site is failing specification in all directions due to the proximity to 2 elevators (approx. 50 ft)

Room Acoustics failed specification below 1000 Hz.

5. Recommendations

Due to DC fields failing specification, TMC's Mag-NetX is recommended. Mag-NetX is a 3 axis magnetic field cancellation system, using three coil pairs arranged in a Helmholtz configuration. By laws of physics and due to geometry of coils the compensation field is generally not uniform. TMC's coil pair arrangement gives better uniformity of compensation fields than three individual coils. See link to Mag-NetX for more information, or contact TMC.

Because the acoustic noise levels exceed the tool specification, sound reducing measures should be considered. Wall mounted sound attenuating panels are primarily effective at high frequencies but can make overall improvement to tool performance. Point-of-use acoustic enclosures are more effective for mitigating acoustics at low frequencies. TMC's SEM-Closure is effective down to approximately 20Hz, over a wide range of frequencies and is available with various configurations. See link to SEM-Closure for more information, or contact TMC.

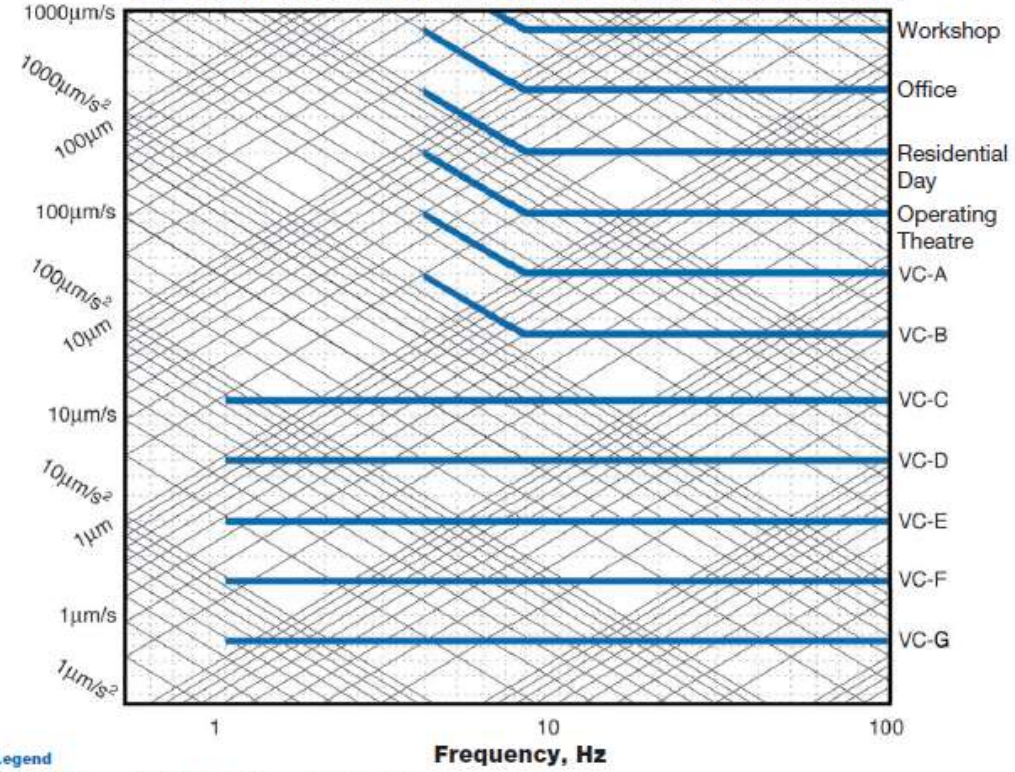
6. Appendix – the Measurement Data

a. Vibration Measurements

Instrument Specification

Figure 1

Velocity, Position, and Acceleration for Different Environments:



Legend

Criterion Curve	Amplitude[1] µm/s (µin/s)	Detail Size[2] µm	Description of use
Workshop (ISO)	800 (32,000)	N/A	Distinctly perceptible vibration. Appropriate to workshops and nonsensitive areas.
Office (ISO)	400 (16,000)	N/A	Perceptible vibration. Appropriate to offices and nonsensitive areas.
Residential day (ISO)	200 (8,000)	75	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 400X.
Operating theatre (ISO)	100 (4,000)	25	Vibration not perceptible. Suitable in most instances for surgical suites, microscopes to 100X and for other equipment of low sensitivity.
VC-A	50 (2,000)	8	Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	25 (1,000)	3	Appropriate for inspection and lithography equipment (including steppers) to 3µm linewidths.
VC-C	12.5 (500)	1 - 3	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.
VC-D	6.25 (250)	0.1 - 0.3	Suitable in most instances for demanding equipment, including many electron microscopes (SEMs and TEMs) and E-Beam systems.
VC-E	3.12 (125)	< 0.1	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.
VC-F	1.56 (62.5)	N/A	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.
VC-G	0.78 (31.3)	N/A	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] As measured in one-third octave bands of frequency over the frequency range 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.

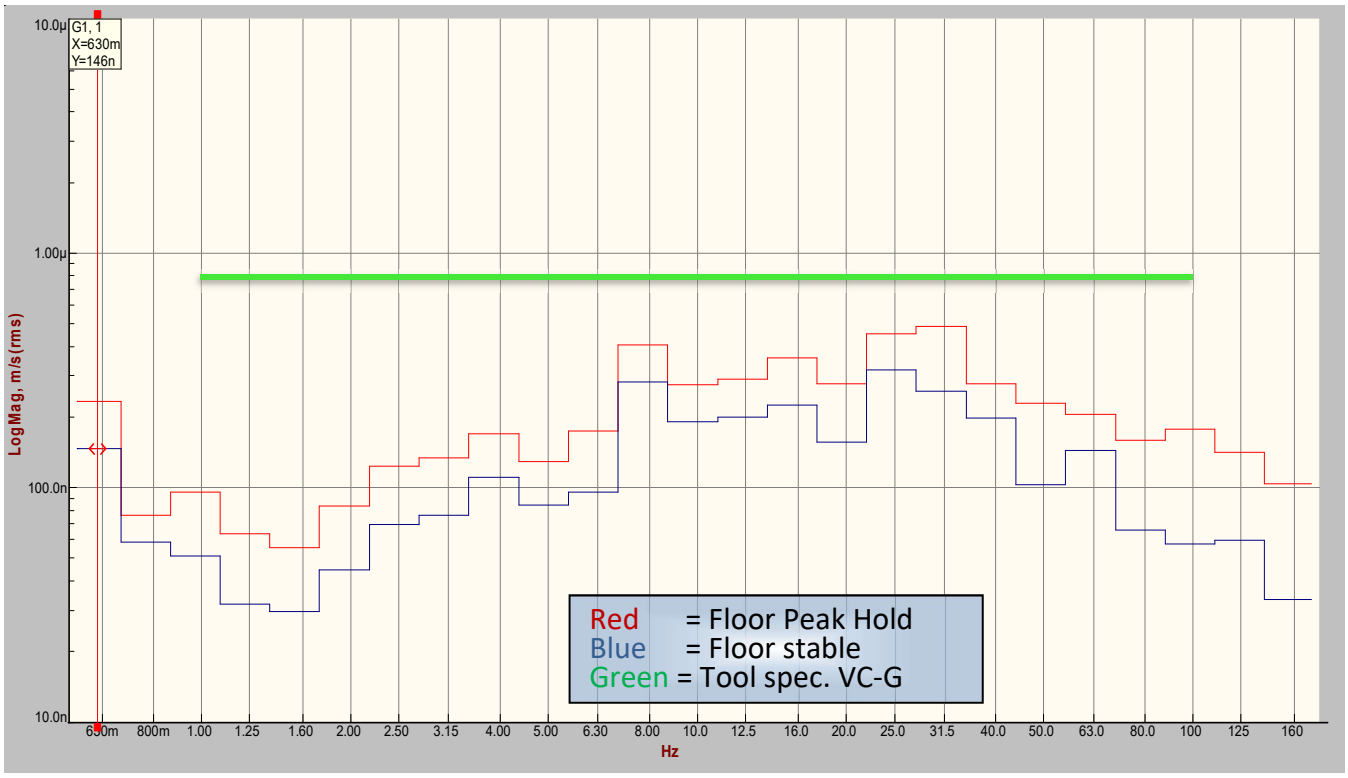
The information given in this table is for guidance only. In most instances, it is recommended that the advice of someone knowledgeable about applications and vibration requirements of the equipment and processes be sought.

Reprinted with permission from Colin Gordon Associates. VCA–VCG refer to accepted standards for vibration sensitive tools and instruments. The levels displayed are RMS values measured in 1/3 octave band center frequencies. 1/3 octave plots are discussed in section 1.2.3.

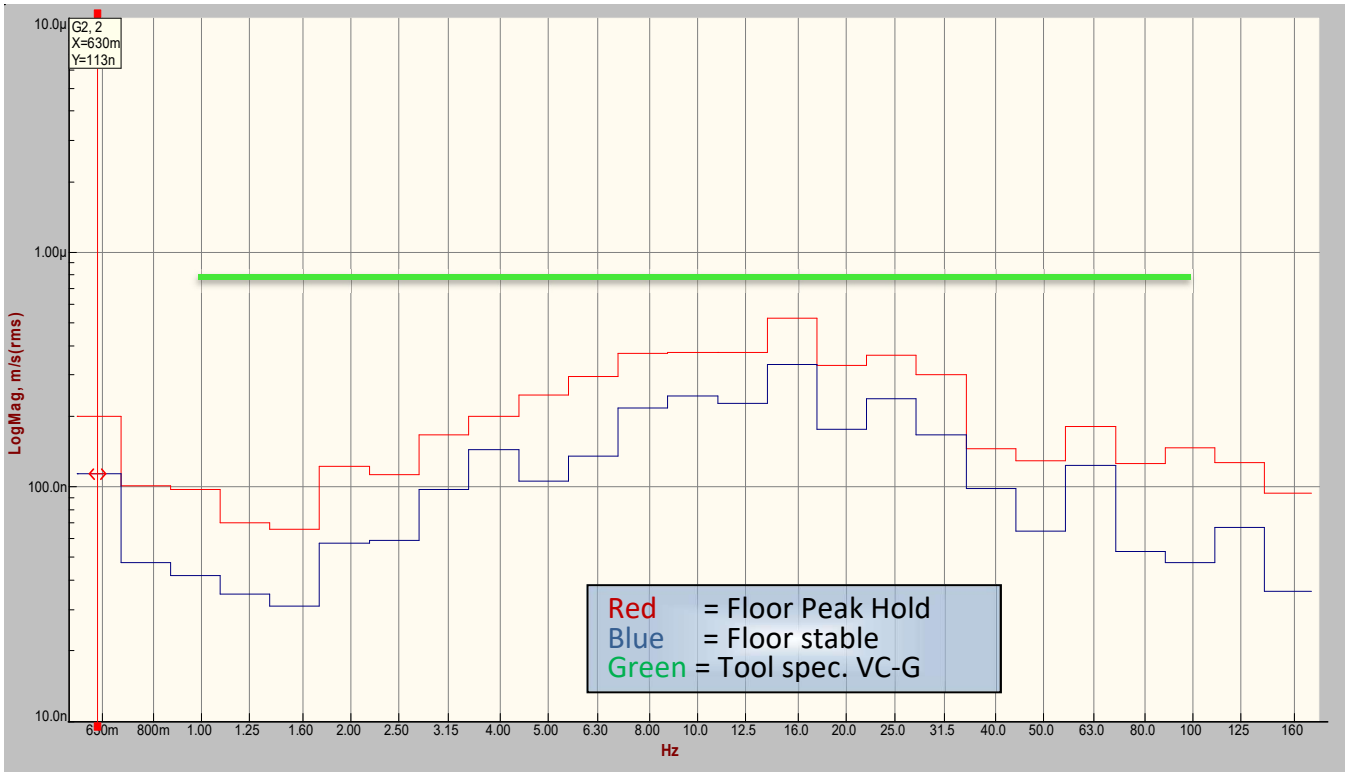
Setup parameters

Frequency span: 0-200Hz
Number of lines in analysis bandwidth: 3200
Number of Averages: 30, Stable
Window: Hanning
Trigger: Free Run

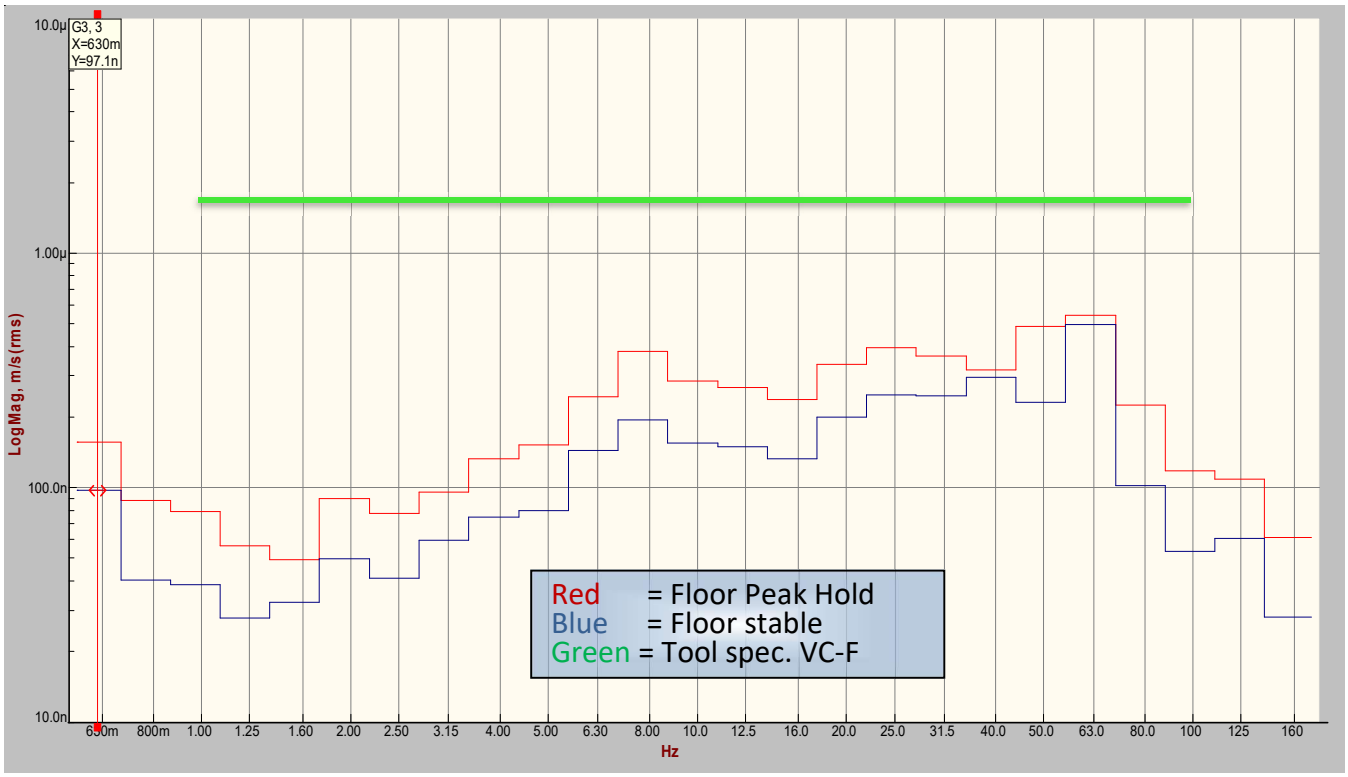
Horizontal side-to- side, (Run 2 and Run 3)



Horizontal front-to-back, (Run 2 and Run 3)



Vertical floor vibration, (Run 2 and Run 3)



b. Magnetic Field Measurements

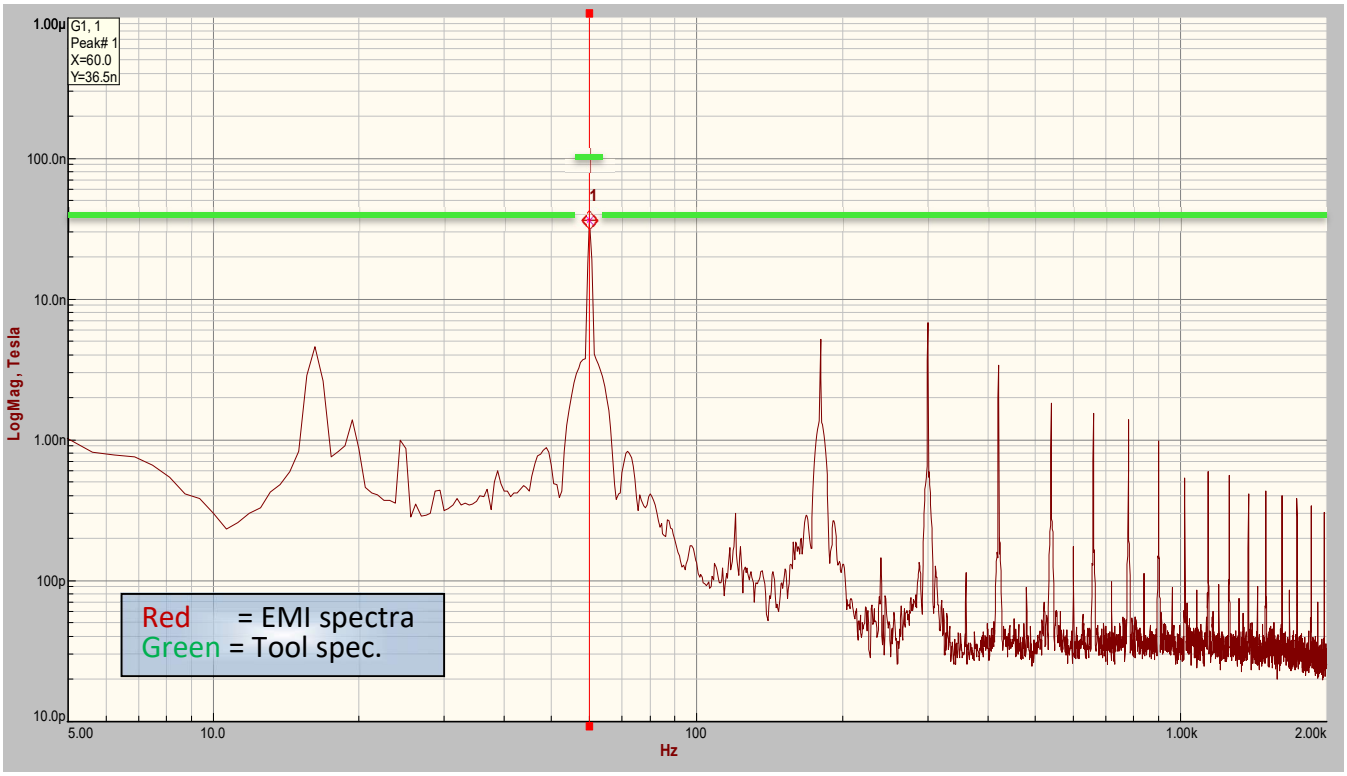
i. AC Field

Instrument Specification:

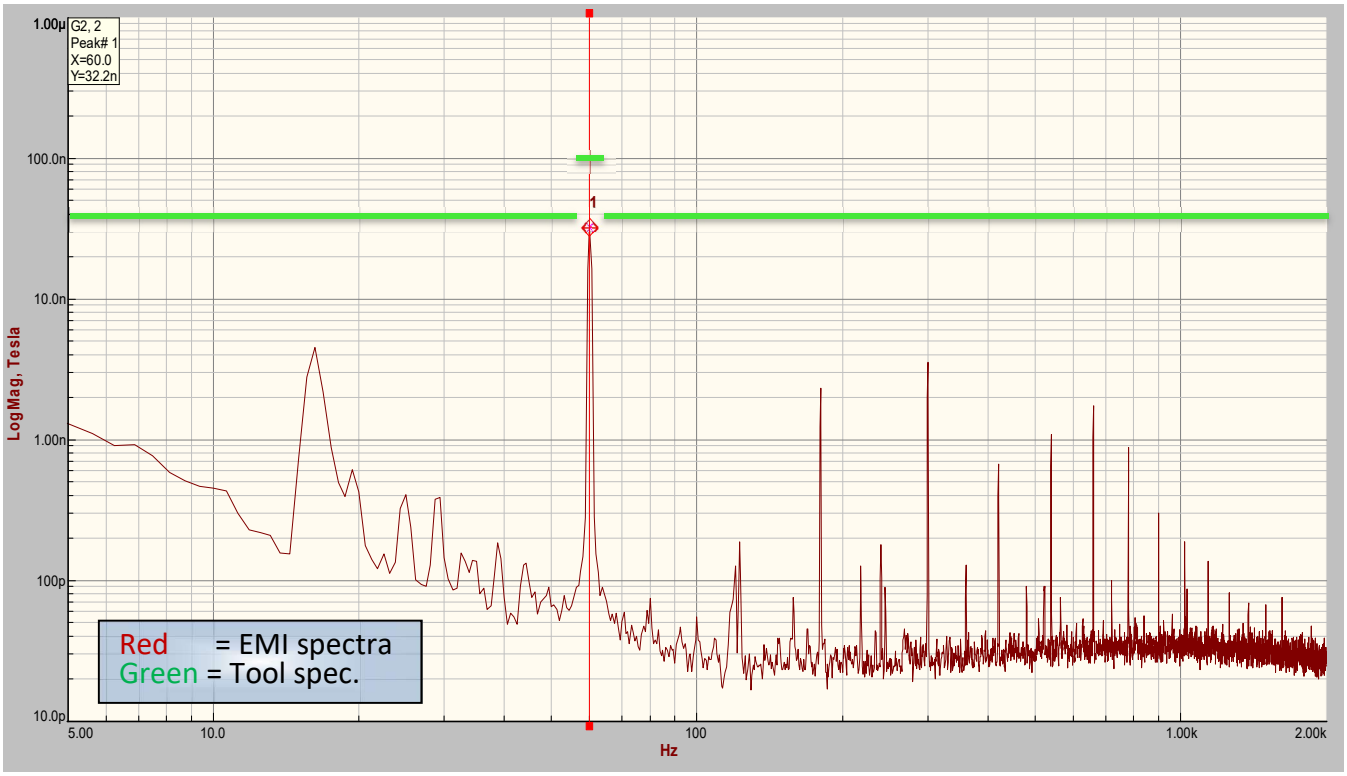
Setup Parameters:

Frequency span: AC 10Hz to 2000 Hz
Number of lines in analysis bandwidth: 3200
Number of Averages: 100, Peak Hold
Window: Hanning
Trigger: Free Run

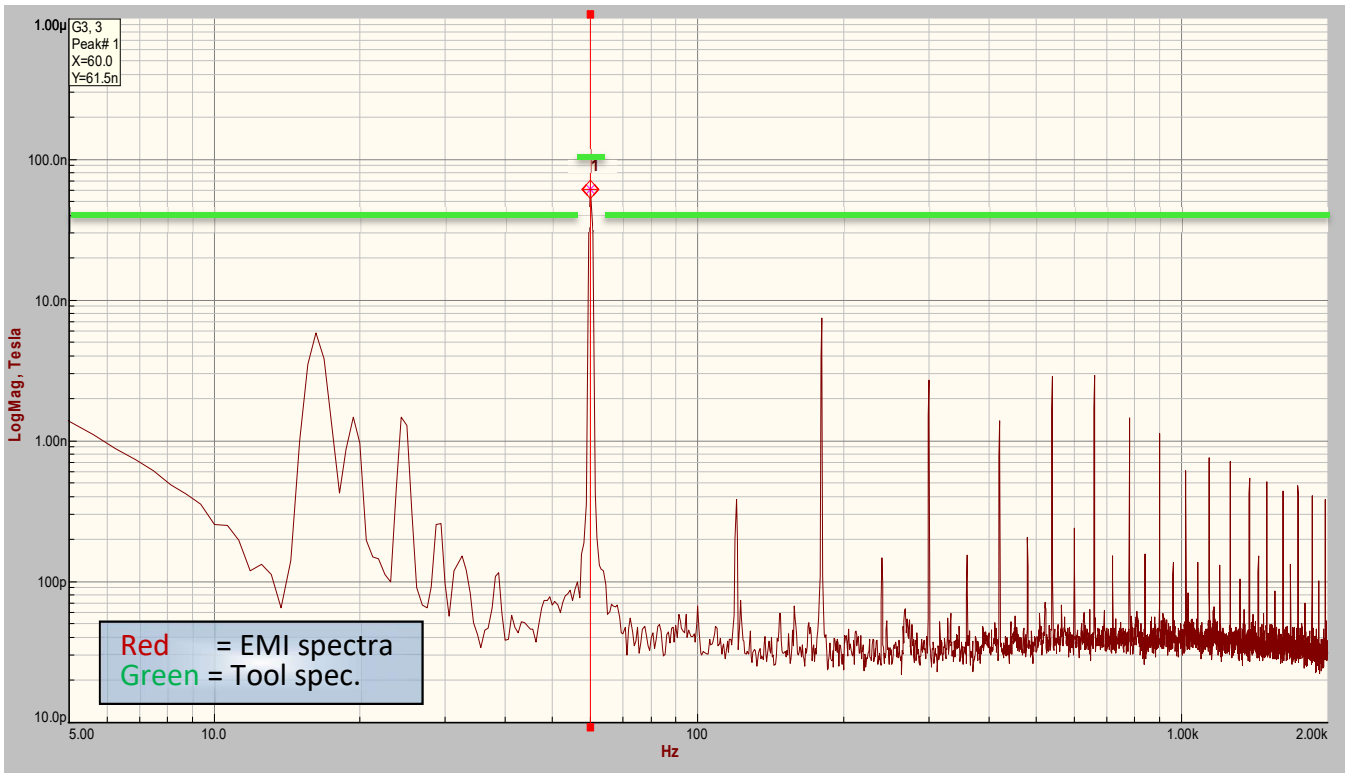
Horizontal X (side-to-side) AC Field, (Run 4)



Horizontal Y (front to back) AC Field, (Run 4)



Vertical Z AC Field, (Run 4)



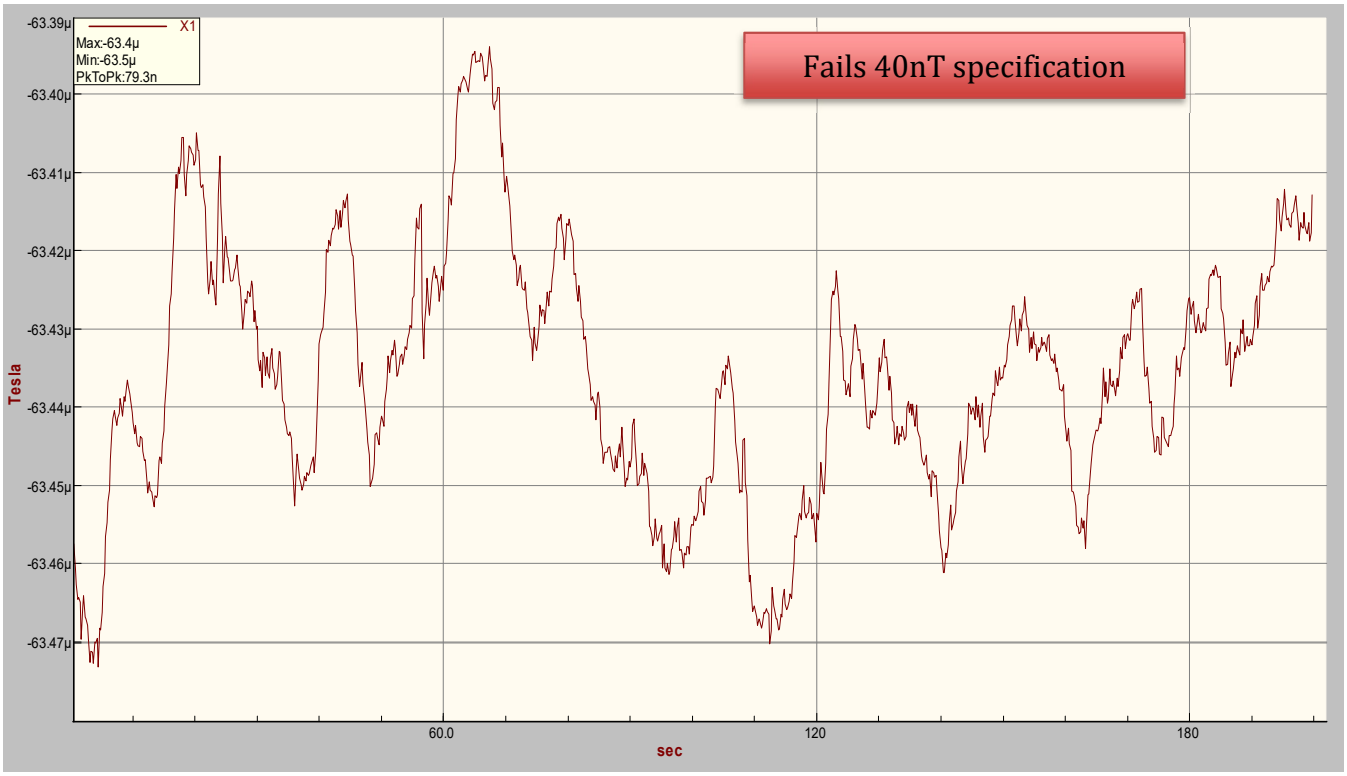
ii. DC Magnetic Fields measurements

Instrument Specification

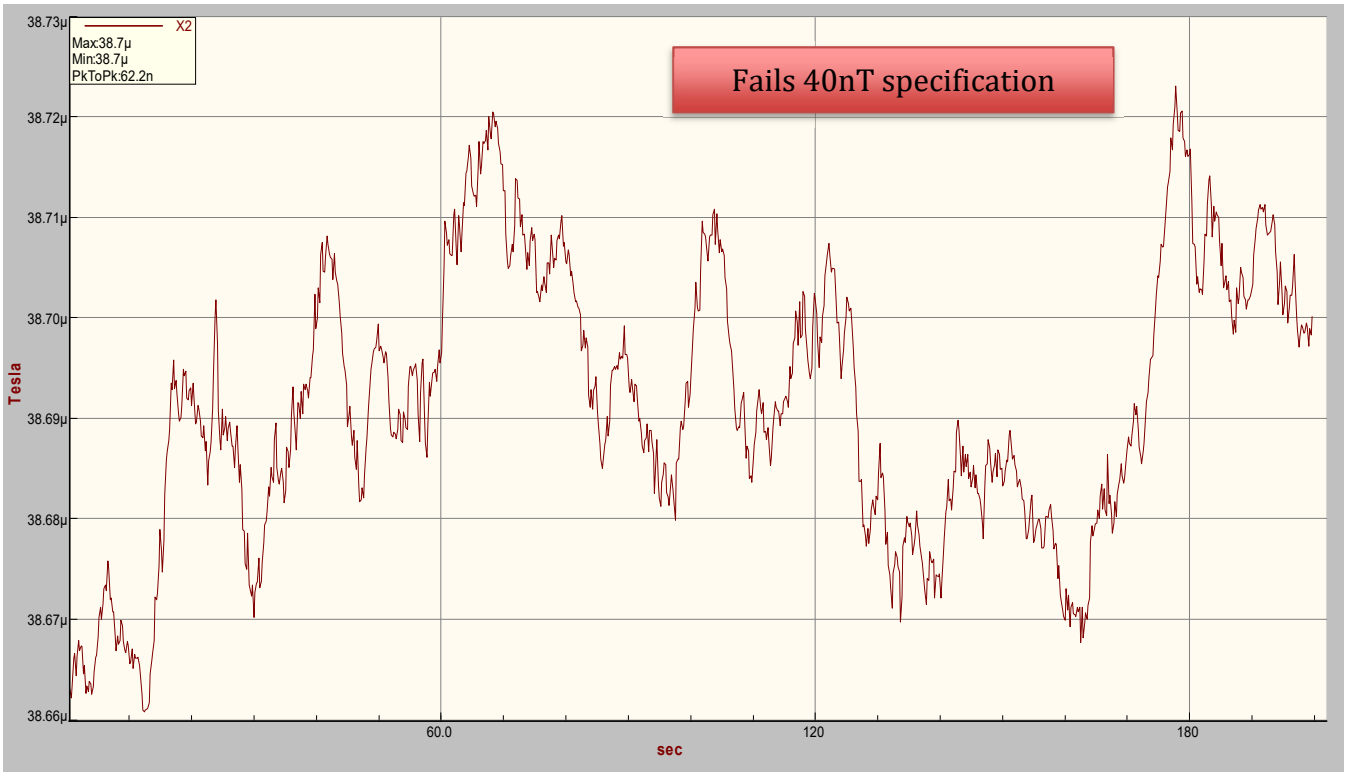
Setup Parameters:

Time span: 200 seconds (0 to 2 Hz, 400 lines)
Number of Averages: 1, Peak Hold

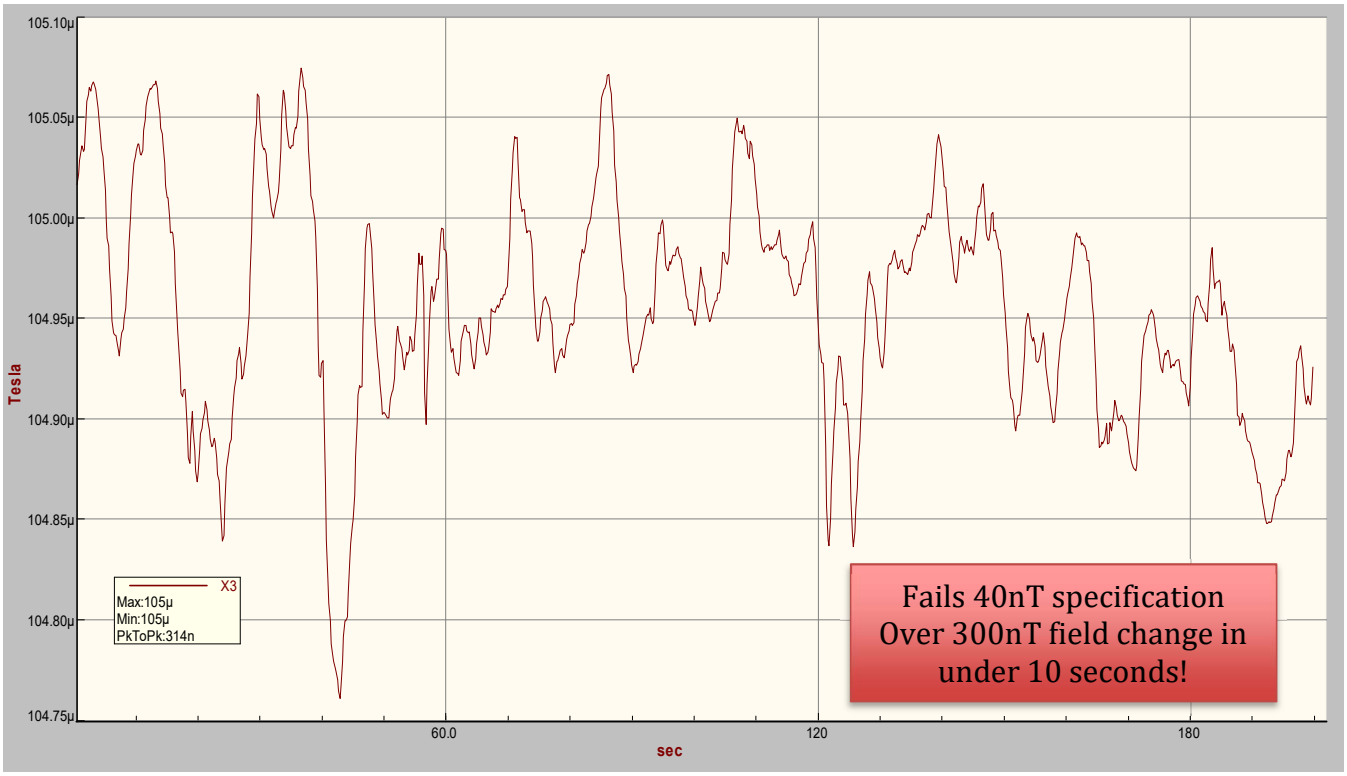
Horizontal X (side-to-side) DC field (Run 1)



Horizontal Y (front to back) DC field (Run 1)



Vertical plot DC field (Run 1)



c. Acoustic Noise Measurement (SPL in dB)

Instrument Specification

Allowable acoustic noise:

Setup Parameters

Frequency span: 0 to 2000Hz
Number of lines in analysis bandwidth: 3200
Number of Averages: 100, Stable and Peak
Window: Hanning
Trigger: Free Run

Acoustics in 1/3 octave (Run 5 and 6)